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Campus Energy Audit: An Analysis of Inappropriate Indoor Lighting

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BACKGROUND

• One benefit of an energy audit is saving money. "The aim of an energy audit: Identify viable and cost effective measures, which will reduce operating costs" (Beggs 2002). In order to succeed in an energy audit "You must first diagnose the problem then prescribe treatment, which will result in energy cost reductions" (Beggs 2002). It is known that one of the main ways energy is used in buildings is lighting, therefore it can be expensive (M. Santomouris 1994). The same basic approach is used in various energy projects to save money. A goal must be set for energy conservation and the plan must be made to satisfy the goal. Energy audits are a relevant issue in today's world. Many projects have been conducted in the sustainability field and many colleges have taken part in it. Daemen College completed an energy audit of two buildings and prepared recommendations for energy conservation (Young 2006). The college now uses lighting that is efficient in all classrooms. The New College of California organized project "Save a Watt" (McKaughan 2003). The goal of their energy audit was to create a roadmap for how they could achieve a 20% reduction in electricity used on campus (McKaughan 2003). Other colleges that have played a part in sustainability are Michigan State, University of Idaho, University of South Maine, Valley Forge Christian College, Williams College and our own Southern Illinois University. "Nearly the entire SIUC campus has been retrofitted with the latest, most efficient lighting thanks to Plant and Service Operations" (www.siu.edu/~sustainability). The audit I performed contributed to SIUC's already successful sustainability project.

PURPOSE

This project is significant because it benefits the environment and society. Identified during this project were ways to save money and reduce greenhouse gas emissions. The potential electricity that can be conserved could save the university money, particularly in the long term. Because the environment is becoming a greater concern there may be a time when fees will be charged for emitting too much carbon dioxide. This project will continue to benefit the school into the future. This project benefits the environment because it could reduce the amount of carbon dioxide, and mercury put into the atmosphere. Carbon dioxide emissions contribute to global warming. Mercury has a very negative effect on humans. It can cause problems such as central nervous system damage, and neurological damage. This project supports the reduction of mercury emissions, therefore promoting health.

RESEARCH QUESTIONS

Where within Faner Hall is electricity being wasted through inappropriate lighting?

Can we identify strategies to reduce wasted electricity?

How can the completion of this project benefit the environment and SIUC?

MATERIALS AND METHODS

First I identified places in Faner Hall where there is inappropriate lighting (places in Faner Hall such as hallways and stairwells that are well lit with daylight, but still contain artificial lighting; Figure 1). Blueprints were used to accurately identify each improper light structure: location and wattage (Figure 2). The total number of watts wasted came to 12,075w for indoor lighting and 3,056w for outdoor lighting . The time frame of outdoor lighting was not in sync with the indoor lighting therefore further calculations were made with indoor lighting only. With the consideration of school holidays and weekends inside lights were estimated to be on at 100% for 252 days a year and 60% for 113 days a year. An estimation of 8 hours/day wasted was used in the following calculations: (8hrs) (113x0.6)+ (252days) = 2,558.4 hrs/year. In order to calculate KWh: 2,558.4 x 12,075w = 30,892.68KWh. As we are charged $0.08/KWh the dollar amount of waste was calculated: 30,892.68KWh x $0.08 = $2,471.41/Year. The net usable space of Faner Hall is 213,895 square feet, so to identify the KWh/Square foot wasted (in Faner) 30,892.68KWh/213,895square feet =0.14KWh/square foot wasted in Faner. Net usable space for the entire main SIUC campus is 6.8 million square feet, so if the waste in Faner is representative of campus: (6,800,000square feet x 0.14 = 952,00 KWh x $0.08) that would equal = $76,160/Year.
Sample readings were taken (both cloudy and clear days) in the places identified as having "improper lighting". All sample readings taken were measured in foot candles (FC), using an EXTEC EA 31 light meter, and were well above the lighting standards set by the Illuminating Engineering Society of North America of 5FC. The lowest sample reading on a cloudy day was 11FC and the highest sample reading on a sunny day was 210FC.

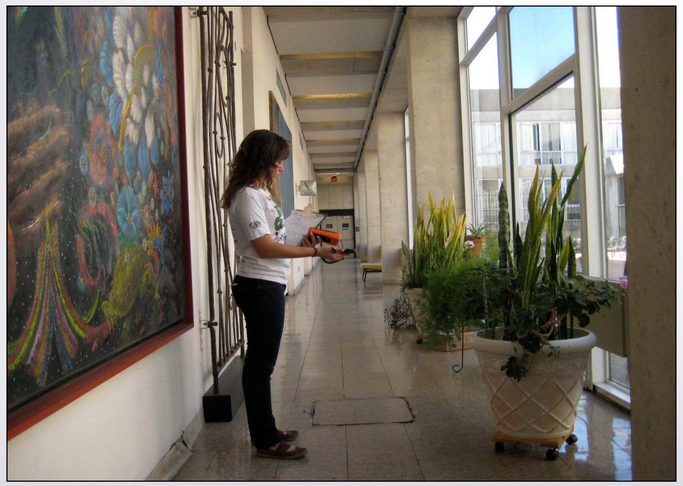

Figure 1. Sample readings being taken on a sunny day, second floor, C wing of Faner Hall.

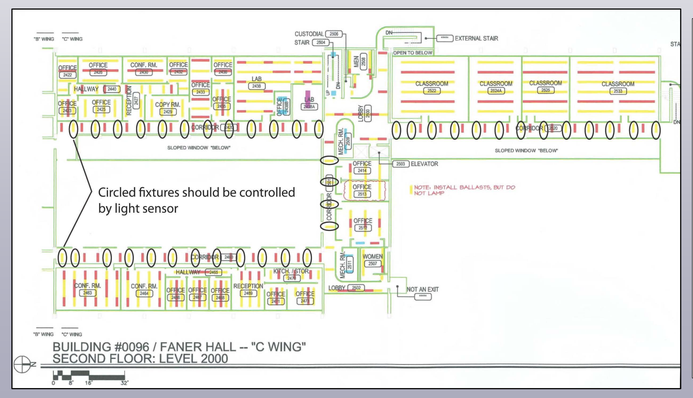

Figure 2. Floor plans for Faner Hall showing overhead lighting fixtures. Red bars are fixtures that have been 'de-lamped'. Black ovals indicate lighting fixtures that are not needed during daylight hours and could be controlled by a light sensor. Almost 300 light fixtures in Faner Hall were identified that are not needed during daylight hours.

RESULTS

I calculated that 30,892.68 KWh are wasted annually due to this "improper lighting". At $0.08/KWh this energy waste costs Southern Illinois University Carbondale $2,471.41 each year. The amount of CO2 being emitted is 22.2 metric tons. According to the EPA this electricity waste is equal to the electricity use of 2 homes/year, 2,518 gallons of gasoline, 51.6 barrels of oil (Figure 3), or the annual greenhouse gas emissions from 4.1 passenger vehicles. This audit included stairwells, hallways, corridors and lounges within Faner Hall. Classrooms, and offices were not included but would add a significant amount of electricity waste. Faner is unique in its design with open hallways and corridors, and may not be a good comparison to other buildings on campus. However the main campus is 6.8 million feet sq. and if the electricity waste of Faner is applied to this number there could be up to 952,000KWh of electricity waste/square foot of campus.

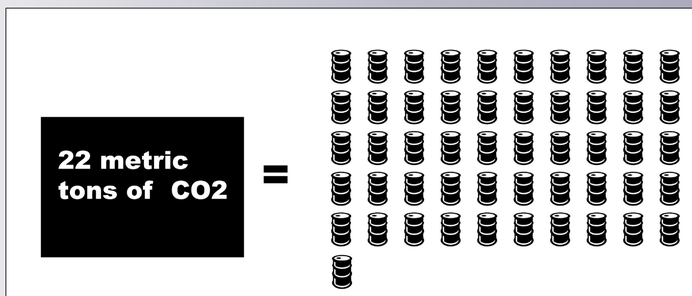

Figure 3. 22 metric tons of CO2 is equivalent to the annual greenhouse gas emissions from burning 51.6 barrels of oil (Source: EPA)

REFERENCES

1. Beggs, Clive Energy Management Supply and Conservation Oxford: Martins the printers Ltd, 2002.
2. McKaughan, Laura. "Energy Waste Reduction" Michigan State University. 2003.
3. Santomouris, M. "Energy consumption and the Potential for Energy Conservation in School Buildings in Hellas" Energy 19 (1994): 653-660.
4. Young , Brenda. "Energy Usage" Daemen College. 2006.
5. www.epa.gov/cleanenergy/energy-resources/calculator.html

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