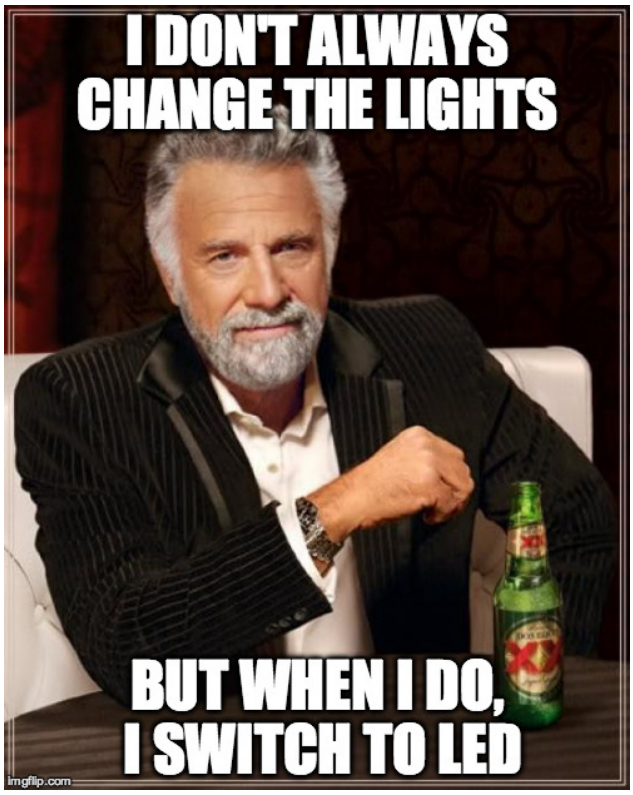

LIGHTING AUDIT

Agriculture and Bioresources Building

PRODUCED FOR

University of Saskatchewan Office of Sustainability and Environment and Sustainability 401

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Overview

Across the University of Saskatchewan there are thousands of light bulbs, each drawing power, releasing CO_2 into the environment, and costing the University money even though more energy efficient and sustainable lighting systems are available. In the Agriculture and Bioresources (AgBio) building it is unknown how much of current energy use is for lighting, making it difficult to lobby for change around the issue. By performing a lighting energy audit for the AgBio building at the University of Saskatchewan it can then be determined how much energy and money is going towards our current lighting system. Comparisons to other forms of lighting are then possible and improvements can be made. The audit will focus on lights found in laboratories, offices, classrooms, lounges, conference rooms, and any other rooms that are not part of experiments. Therefore fume hoods, walk in coolers, and growth chambers that are used for experiments were not included in our calculations. These rooms were left out because it may not be possible to use different lighting options. Once this information is gathered we will be able to demonstrate how converting our current lighting system to an LED system will save on electrical, replacement, and waste disposal costs as well as promote a more sustainable and environmentally option.

Introduction

Across the University of Saskatchewan there are thousands of lightbulbs, each of which are drawing power, costing money, and releasing harmful greenhouse gas (GHG) emissions into the environment. To assess this, a lighting audit was performed of the AgBio building to determine how many lights the building has and what type of lights they are. It should be noted that this audit only includes lights used for lighting purposes and does not include lights that are involved in scientific experiments (fume hoods, growth chambers, walk-in coolers). With the results from this audit it is possible to perform a comparison of the current lighting system to other systems that are available. In this report, we compare the current system to that of an LED system. This comparison involved examining the differences in power, money, and GHG emissions between the two systems. The reason LEDs were chosen as the lighting comparison is because they are more environmentally friendly. They do not contain glass or produce excess heat making them safer to handle, they have increased efficiency, have a longer lifespan compared to fluorescent tubes and contain no harmful mercury making them easier to dispose of (Tronix, 2016).

Material and Methods

In order to obtain accurate results, we went out and performed a count of all the lights in the AgBio building; taking note of their specific type and location. With this data then recorded we were able to do the calculations that would be necessary to form the best comparison between the current lighting system and there LED replacements. We obtained the specifications on the current lighting system from the Facilities Management Division (FMD) and compared them to LED replacements we found on 1000bulbs.com (an online retail outlet). This website was beneficial as it provided not just the specifications on LED's, but also for the existing lights used in the AgBio building. This ensured that the price comparisons would be fair, with no bias towards either product.

For our calculations we needed to know how many hours in a day the lights would be on and the cost of energy per kW*h for the University. Margret Asmuss and Kathryn Theede from the Office of Sustainability were able to provide us with these values. The cost for energy is discounted for the University compared to off campus costs and is $0.05525 per kW*h. The number of hours per day the lights were on was estimated to be 13 hours between September and April weekdays, 12 hours between May and August weekdays, and 6 hours a day on weekends year round. Take into account however that these hours are general estimations for the basis of demonstrating the energy cost differences between the current system and the lower wattage LED's and that the actual cost difference will be slightly different. With this information we were able to do a simple cost comparison calculation between our chosen lights as well as determining the equivalent GHG emission savings from reduced electricity consumption.

For our main assessment we focused primarily on four-foot tube lights as they make up 97% of the lights in the Ag-Bio building. The current tube light used is the Sylvania 21781 - F032/841/Eco T8 fluorescent and we compared it to the Euri 2100 Lumens - LED 4ft. T8/T12 replacement. First, we determined a yearly replacement cost for each light type over a year in the AgBio building. This was done by dividing the cost of the bulb by its operating lifespan to find the cost of the individual bulb per year. Operating lifespan was found by dividing manufacturers lifespan by the operating hours, using the average number of hours all the lights are on over the course of one year. Multiplying this number by the number of bulbs in the building results in a replacement costs for the all the lights yearly. Next, we calculated the energy consumption for the two lights. This was done by multiplying the number of hours the light is on by its wattage in kilowatts. Lastly, we calculated the GHG emission differences

between the two systems. This was done assuming that .49 kg of CO_2 equivalents are produced per kW*h of energy produced at a natural gas fired electricity plant. The Queen Elizabeth power plant is also fuelled with natural gas and because it is the closest power plant to Saskatoon, it was assumed to supply the power to the University (Working Group III, 2014; SaskPower, 2016). This CO_2 equivalent value was multiplied by the difference in kW*h used between the current fluorescents and the LED replacement to find the amount GHG emissions saved.

Results

The results of the lighting audit were complied in an Excel workbook to be utilized by the Office of Sustainability and by any other group who wishes to further pursue a related project to demonstrate the power, monetary, and GHG saving by switching to LEDs. Table 1 represents the room types and bulb types that were determined by performing the lighting audit. The lights labeled large lights around the atrium, pot lights, and halogens, displayed in figures 1-3, as well as the large CFL, short tubes, and parkade lights were not included in the calculations for energy savings as they make up a small percentage of total amount of lights in the AgBio Building. Table 2 displays the breakdown of all the lights in the AgBio building by light type; while table 3 displays the breakdown of lights by the rooms they are found in. Using these values it was possible to calculate the energy, monetary and GHG savings, which are summarized in table 4.

Room Legend		Light Legend	
Lab	L	Large Lights Around Atrium	U
Class Room	C		
Office	O		
Chamber	CH	Flourecent Tube	F
Bathroom	B	Large CFL	LCFL
Maintanence	M	Short Tube	ST
Hallway	H	Pot Light	P
Computer Lab	CL	Hallogen	HA
Storage	STO	Parkade Lights	LED SQ
Gallery	G		

Table 1: Rooms and Lights included in the audit.

Figure 1: Large lights around atrium.

Figure 2: Pot lights

Figure 3: Halogen

Table 2: Lighting breakdown by light type.

Type of Light	Number of Lights
F	9476
P	195
HA	51
U	52
ST	26
LCFL	9

Table 3: Lighting breakdown by room type.

Room Type	Type of Light	Number of Lights
L	F	1006
	LCFL	9
ICH	F	274
O	F	764
	HA	10
oCH	F	32
H	F	1280
	U	44
	HA	41
	P	2
	ST	16
G	P	185
	F	68
B	F	168
C	F	594
cCH	F	16
Elevator	F	5
	ST	10
Stairwells	F	130

Table 4: Summary of energy, monetary, and GHG savings.

Light Type	kW/hr Totals	Replacement Cost	Opperating Cost	Kilograms of Carbon Dioxide Equivalent Emissions
Fluorescent	1,014,454	$3,711.75	$56,048.56	497,082
LED Tube	645,561	$8,158.42	$35,667.27	316,325
Difference	368,892	-$4,446.68	$20,381.30	180,757

Conclusion and Recommendations

The results demonstrate that there is clear savings both monetarily and environmentally to be found by converting over to LED lights throughout the AgBio building today. We found that LED's do cost more per year to replace however the savings found with decreased energy consumption far offset this cost (figure 7). It is this decreased energy consumption and cost, therefore decreasing the university's carbon footprint where LED's truly shine above the rest. These are also not all the savings that LEDs have to offer. Their higher lifespan means they are changed less resulting in a reduction of labor costs

because less time is spent replacing burnt out lights. The technology of LED's is also improving rapidly meaning longer life spans and higher efficiency at a decreased cost is reasonable to expect in the not too distant future.

Although this report indicates that an LED lighting system is a feasible switch for the University of Saskatchewan to begin to implement, more work remains to be done. To begin it is recommended that further studies be done to gain a better estimate of how long the lights are on in a day. By gaining a better understanding of how long lights are on, more accurate cost and savings will be able to be calculated. A simple study could also be performed where two rooms, one with LED and one with fluorescent, are compared in terms of lighting outputs and public opinion. It is also recommended that future groups work towards getting LED lights (fluorescent replacement and pot lights) in the FMD ordering system as a way to getting these lights implemented campus wide.

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