Savings in Consolidating Machines

Reducing Redundancy by Switching to Multi-Functional Devices on Smith Campus

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Abstract

As conservation and sustainability have become higher priority issues, new topics have been introduced as potential solutions for making the planet a healthier place. Whereas recycling and rainforest preservation were previously the major options when one imagines how to be sustainable, reductions in energy consumption are now being considered as valuable contributions to sustainability. This project addressed a specific avenue of energy consumption at Smith College: the excessive use of IT devices and possible ways to consolidate machines as well as bringing awareness to campus employees.

Two different evaluations were conducted. The first determined how the consolidation of a particular subset of machines into multi-functional devices (MFD's) would change overall energy use. The second surveyed locations on campus to establish in which circumstances excessive energy use was occurring and if there was potential for reduction. The methodology for each evaluation involved a survey of machines and research into the energy consumed by devices at the particular locations, either via direction measurement or published materials.

A total of 75 Canon copiers currently exist at Smith College. The number of Xerox MFD's to replace them and the number of devices each MFD will replace has yet to be determined. One floor in two separate buildings was surveyed for the second component. The administrative building showed a remarkably higher amount of IT devices (and also energy consumption) than did the academic building. The biggest contributor to this difference resides in the fact that the majority of offices in academic settings have personal IT devices in each office, as opposed to sharing by floor. The simplest solution is to decrease inefficient older machines and excessive use in private offices and switch to password protected community-shared devices and MFD's.

Introduction

Recent climate concerns have spurred conservation and sustainability to reenter the public eye from a somewhat dormant resting place. While some may view this reappearance as a first time focus on the environment, this is not actually the case. Environmental concerns have existed and will exist as long as the impetuses for them are in practice. For example, recycling became popular in the 1970's (RRSI 2004), bans on chemicals for environmental use (such as DDT) in the late 1960s (Environmental Defense Fund 2009), and attempts to reduce air pollution as far back as the 1950's (ARIC 2002). With the recent trends of climate change, efforts have increased to readdress environmental issues and develop sustainable technology, beginning with monitoring greenhouse gas emissions in the 1990's (U.S. EPA 2009). Energy use is a concern that was not heavily emphasized in the past, but as evidenced by increasing commercials for 'energy smart products' (such as compact fluorescent light bulbs) and signs requesting one to "please turn off the lights when leaving, it is now receiving more attention. Furthermore, ENERGY STAR, which began in 1992, is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy which aims to help us save money and protect the environment through energy efficient products and practices (ENERGY STAR 2009).

Colleges are hubs of electronics and are therefore good targets for evaluating energy use. If the 5-Colleges are a representative example, colleges typically receive a lot of internal effort from student groups to improve conservation and sustainability. However, some issues exist undetected beneath under the radar and require serious effort to be addressed. Oberlin College, for example, works to address all facets of sustainability, even challenging issues that are above the power of student-led organizations. Oberlin has initiated energy efficiency measures that are somewhat common, such as purchasing energy efficient light bulbs and encouraging the

unplugging of electronics when not in use, but they have also gone up and beyond the standard approach. A few of their projects include: dorm monitoring, production of solar energy, chiller replacement, and the well known Adam Joseph Lewis Center for Environmental Studies, which helped launch the green building movement of the mid 1990's (Oberlin College 2009). However, because not all colleges are as organized as Oberlin, other means have been created to assist in evaluating and developing sustainability on campus.

"The Sustainable Endowments Institute is a nonprofit organization engaged in research and education to advance sustainability in campus operations and endowment practices." The SEI conducts surveys to produce the College Sustainability Report Card, which compares colleges based on different aspects of sustainability, including energy efficiency (The College Sustainability Report Card 2008). After receiving a report card showing exactly what is lacking, a college can then work to make improvements for the next year.

One aspect of this report card is climate change and energy. Aside from the previously mentioned energy-related concerns, excessive energy consumption by IT devices is now being realized as a significant portion of a college's electricity pie. In today's age of technology, it is not abnormal for a person's office to be equipped with a computer, printer, and maybe even a fax machine. Place this setting in an office complex or an academic institution, multiply by the number of employees, and the result is a lot of electronics plugged in. Computers are understandable as they are often used regularly and are required in order for each person to function in their position, but other devices are not used with the same frequency. On a college campus, not only do students bring multiple personal IT devices, but each department and office has their own IT devices. Reductions for students are a different issue than those for offices. For example, sharing a printer, on a dormitory floor, which may contain fifty individuals with

various schedules, is not really realistic. Departments and offices, on the other hand, pose simpler solutions because there have fewer people and IT device use is more regular and fairly predictable (business hours).

Smith College received an overall B+ on its report card for the year 2009. The climate change and energy category only received a B. As result, new projects have been implemented in order to improve the grade for next year's evaluation. A cogeneration system has already been initiated, new energy efficient freezer monitors are in the process of being installed, and now, research has been invested into how IT devices contribute to total energy consumption.

A recent calculation of the number of IT devices on the Smith College campus estimated 800 printers and scanners. The college employees approximately 1400 faculty and staff, which includes custodians, house keepers, grounds, dining and trades people. Most of these positions do not require the daily use of any IT devices; yet, the machine to staff ratio is approximately 1:2. It is clear this is a bit excessive. Thus, to update the campus, some of the numerous IT devices will soon be replaced by multi-functional devices (MFD's). These devices will replace fax machines, scanners, printers, and copiers; acting as all four at once. That is three fewer machines plugged in, zapping energy, and three fewer machines requiring maintenance and materials. However, because the MFD's will only replace a particular subset of devices, further research is needed to evaluate where on campus the biggest energy consumers are as well as how their IT device total can be reduced. Twenty-nine percent of Smith's carbon footprint is from electricity (Weisbord 2009). This study evaluated how taking a close look at IT devices on campus can help reduce this figure.

Methods

Survey and Condense

The first portion of this study involved inventorying different locations on campus to determine if the number of machines present in selected buildings corresponded to the number of machines on the college's master list as well as analyzing opportunities for reduction. This was done separately for the fleet and for the rest of the machines. The fleet survey was conducted by the vendor and a Smith College representative. This survey involved looking at each office containing a canon copier, analyzing how frequently the machine was used, and determining what size of MFD would replace it. If more than one copier was located in an office, the vendor also analyzed whether condensing to fewer MFD's than canon copiers was a possibility.

In order to sample the rest of the machines on campus, both an academic and an administrative building were randomly selected to survey. In order to randomly select locations to choose for each category, all of the appropriate buildings were assigned numbers and then a random numbers table was used to select the sample. Within each building, a walk-through was conducted, checking for accuracy on the current list of IT devices, adding non-ITS purchased machines, and otherwise making necessary corrections. In some cases, this also included speaking with operators of the devices to verify if the machine was currently in use. The completion of the survey provided a rough idea of how accurate the old inventory lists were as well as provided new accurate lists for the selected buildings.

Energy Consumption Analysis

The energy consumption was determined using the same methods for the two different groups of IT devices (the campus vs. the fleet copiers), but was applied differently; direct

measurement versus published numbers. The fleet devices were randomly selected, one of each model number, and measured directly using a 'Kill a Watt' measuring device. The 'Kill a Watt' was plugged into the wall (and the IT device plugged into the 'Kill a Watt') for approximately 48 hours during a business week. The values recorded were KWH (kilowatt hours) and time (hours devices plugged in).

In order to determine energy consumption for the machines in the two different types of buildings, the energy consumption was researched using online resources and operation manuals. Because these values were found as a high 'operation' number and a low 'standby' number, the energy consumption total was not directly comparable to that calculated for the fleet. Instead, the energy consumption by building was used to determine roughly the areas on campus where energy consumption was highest and where the most high-consuming machines were. In order to do this, a theoretical energy total was projected, using one hour of high 'operation' time and seven hours of low 'standby' time to represent a business day.

Results

There were a total of 75 Canon copiers on campus (Table 1). Out of the eight models represented, the models 2300 and 6000 had the highest energy consumption (Fig. 1). However, because both of these models are only found in one location on campus, they do not contribute significantly to the total energy use by Canon copiers. Instead, the models 5000 and 2200 take up a much larger portion of the pie, since there exists 13 and 18, respectively (Fig. 2). A new Xerox MFD uses approximately 763.08 KWH and costs the college about $122.09 per year. As of today, the total MFD's expected to be installed on campus is still in flux, so a new device total and energy total can not yet be projected.

Of the two types of buildings surveyed, the administrative building (College Hall, Floor 1) showed a much larger number of IT devices than did the academic building (Sabin Reed, Floor 2), both before and after the list was updated (Table 2). Offices with more staff (Student Financial Services, SFS) and the Class Dean's understandably had more devices than the smaller offices, which contributes to higher KWH and cost (Fig. 3). The changes in updating the list were largely due to removing devices which were originally included but not actually being used and adding faxers and copiers, which ITS chose to exclude during their first walk-through.

The updated energy consumption values show theoretical increases in all offices except for SFS, which actually had a decrease in total IT devices, and Disability Services, which remained the same.

Table 1: Distribution of Canon Copier Fleet by Model Number.

Model	Quantity
IR5000	13
IR1310	12
IR2270	4
IR2200	18
IR3300	17
IR1670	8
IR2230	1
IR6000	1
Total	74

Note: One model, the IR8500, was found in one location on campus. However, because of incompatibilities between the copier cord end and available measuring devices, the copier could not be measured. It was omitted from the survey.

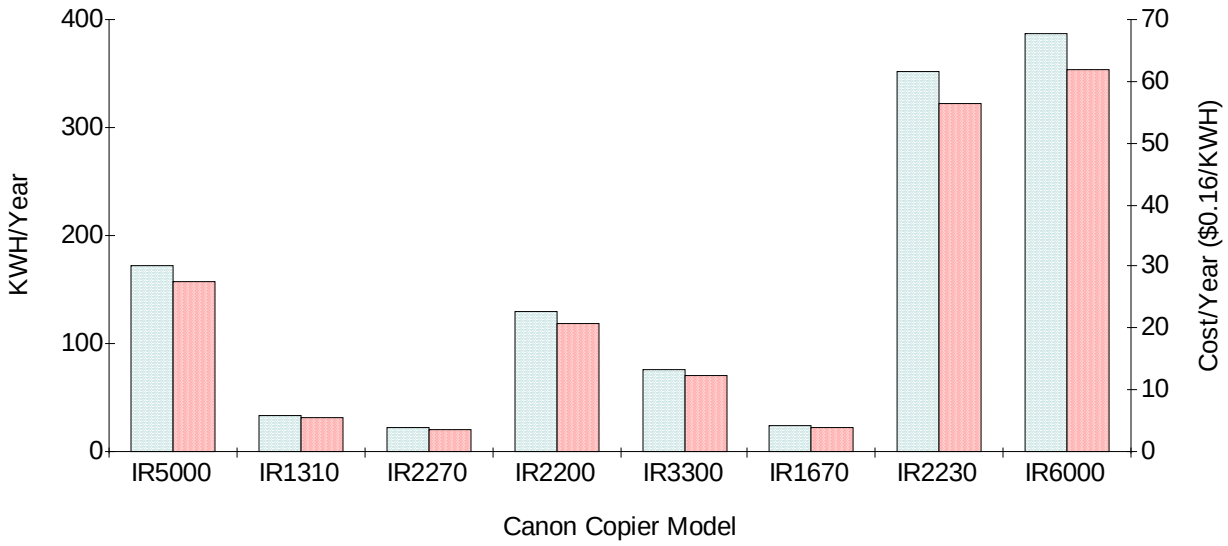

Figure 1: Energy Consumption and cost by model number for the sample of the Canon copier fleet. Each bar represents the data for one machine of that model.

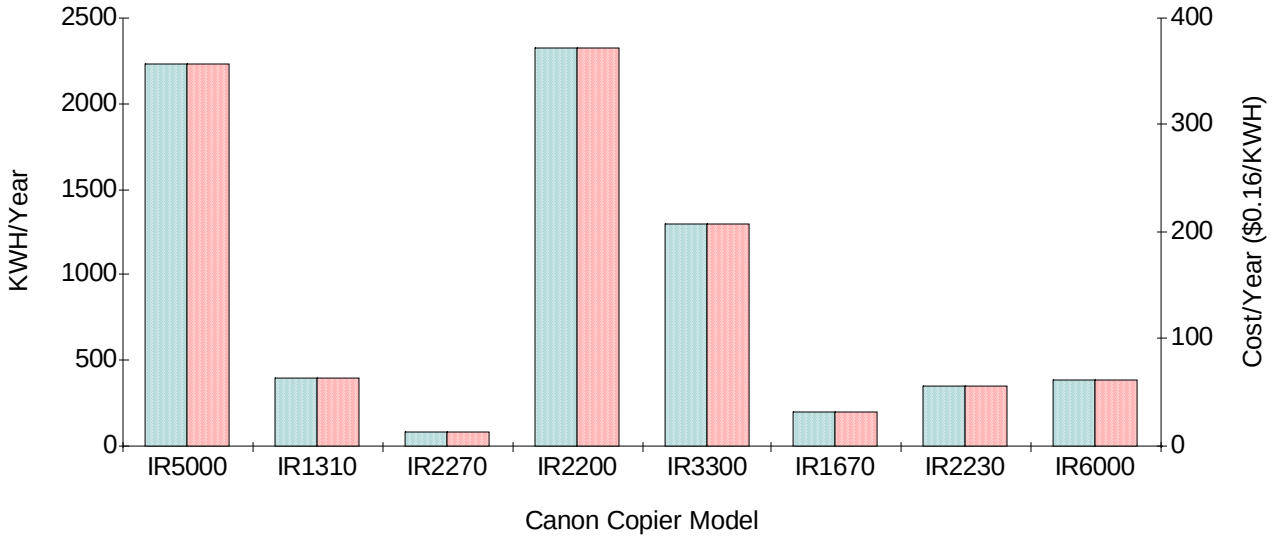

Figure 2: Projected energy consumption and cost for the Canon copier fleet, calculated by multiplying each individual model's consumption by the quantity of that model.

Table 2: Change in number of IT devices by location on campus. The first five locations are located in College Hall, the administrative building. Sabin Reed is in an academic building.

Department	Original	Added	Removed	Difference	Updated
Class Deans	10	5	4	1	11
Disability Services	3	0	0	0	3
Institutional Diversity	3	3	2	1	4
Registrar's Office	4	2	0	2	6
Student Financial Services	14	4	4	0	14
Sabin Reed	4	5	1	4	8

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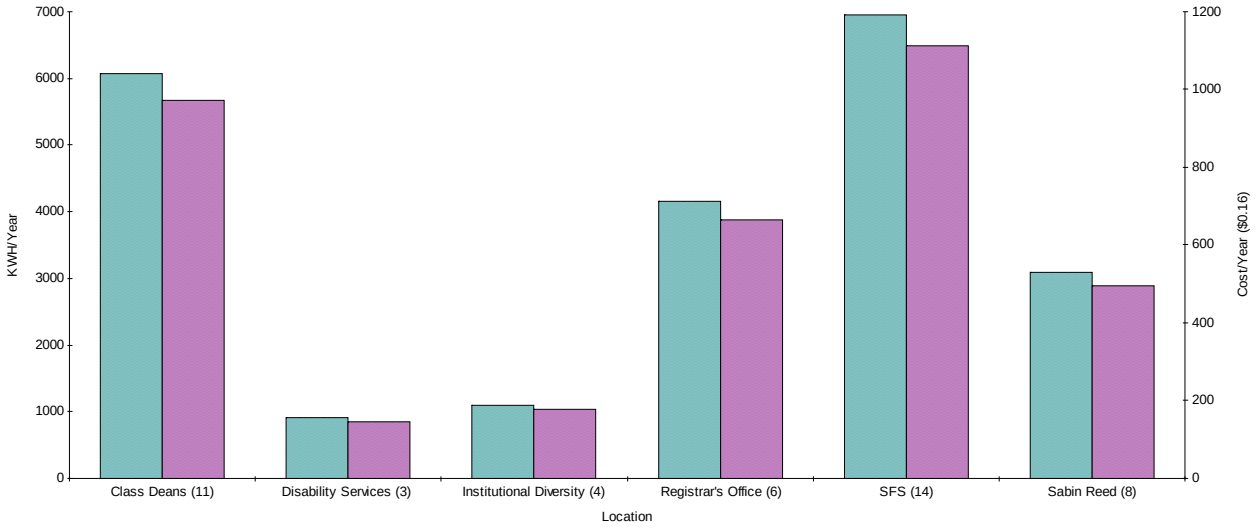

Figure 3: Distribution of energy use and associated cost for College Hall (first 5 locations) and Sabin Reed. Numbers in parentheses show quantity of machines represented for each location.

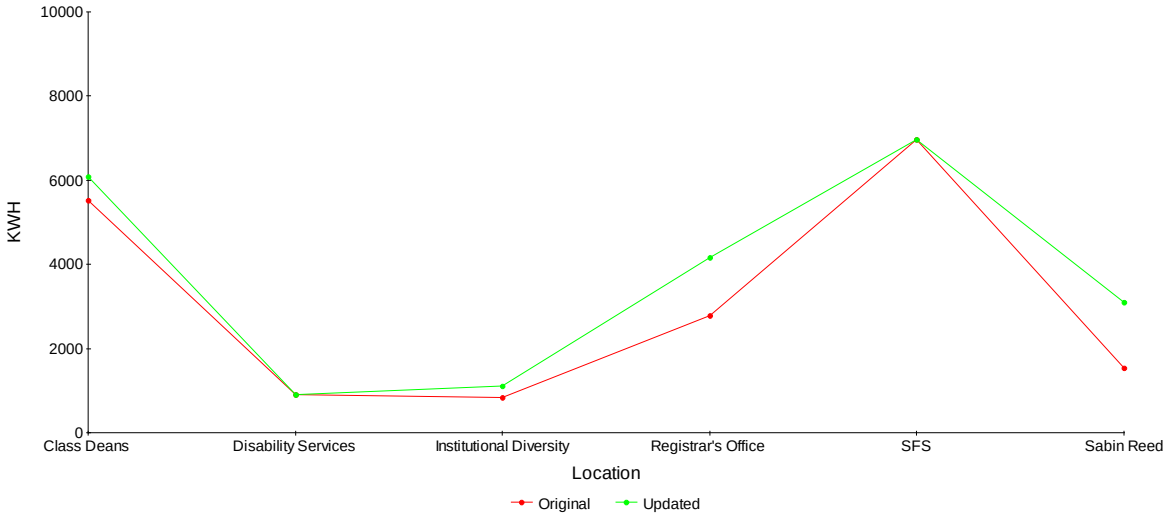

Figure 4: Change in energy use by location. The KWH values were calculated by obtaining an average energy consumption per machine for each office and then multiplying by the original and the updated number of machines.

Discussion

Measurement of the MFD shows relatively high figures (763.08 KWH and $122.09 per year) when compared to the energy and cost of the Canon fleet values (Fig. 1), and would appear to be a poor change. However, the MFD reduces the number of machines plugged into outlets and using energy. Older devices, which exist in many locations on campus, do not have very efficient sleep modes, and they continue to pull out a substantial amount of energy, even when not being used. Therefore, by unplugging four inefficient devices and plugging in one efficient MFD, less energy will be consumed. The total number of new MFD's and the amount of devices they will replace is still to be determined. The offices in which the current fleet resides have the option to adopt the new machine or to not replace the leaving old copier. Only once this decision is made will estimates for change as a result of consolidation be produced. They will also remove devices that the MFD can replace at their own discretion.

The survey of College Hall and Sabin Reed altered the list for different reasons. For College Hall, the list was inaccurate due to machines being listed that were not is use and the absence of copiers and faxers. Sabin Reed, on the other hand, had relatively few machines to start with, so the alternation to the total was only due to the addition of copiers and faxers (Table 2). Additionally, in both instances, identification numbers sometimes did not match up for a listed office. In those cases, the overall total was not altered. The incorrect machine was simply 'removed' from the list and the new machine was 'added'.

In terms of the energy consumption by devices in College Hall versus Sabin Reed, the quantity is the leading factor. In all cases except for the registrar's office, there was a correlation between number of machines present and energy consumption (Figure 3). However, the registrar's office shows a higher energy consumption than Sabin Reed, even though Sabin Reed

had more devices. This is due to the composition of devices. The majority of devices in any location was comprised of printers, usually HP laserjets, so the printers are most likely not the cause for the discrepancy. The published material for some of the other devices reported very low operational wattage. This applied to three devices in College Hall (one in Disability Services, one in Institutional Diversity, and one in the Registrar's office) and three devices in Sabin Reed. From an overall perspective, both locations have an equal number of low consuming devices. However, when looking at the proportion of low consuming devices to total devices, Sabin Reed reports a better percentage. College Hall has 7.9% (3:38 low consuming to total) of their devices in this category and Sabin Reed has 37.5% (3:8 low consuming to total). Therefore, when comparing the Registrar's office and Sabin Reed, two areas with a similar number of total devices, Sabin Reed reports a lower energy consumption because of a higher proportion of low energy consuming devices.

Additionally, College Hall contained four faxers, all of which were reported to have medium to high KWH (400 ~ 900 KWH). Sabin Reed had none. This may be due to the role of the type of building. College Hall, as an administrative building, may have more faxing needs than Sabin Reed, an academic building.

There was not a huge jump in energy consumption from the original to the updated count of machines. This is most likely due to the totals of machines not always changing drastically. The removal of three from the master list and the addition of four to the list will only increase the theoretical total energy consumption by the amount of one machine. Also, because the energy consumption values were taken from published materials and not gathered empirically, this study did not take into account how often machines in each location were used. If the data had been directly measured for all devices, a much more accurate idea of the expected change would have

resulted. Therefore, the possibility exists that although the office of Student Financial Services has a total of 14 machines, their energy consumption may not be very high if the frequency of use is low.

Several recommendations exist for how to improve this study as well as use these findings to implement change. The components which are still pending need to be completed. For the MFD's, this includes collecting the responses from the various offices on campus which currently contain a canon copier and recording whether or not they will adopt a MFD. Furthermore, a later study will need to be conducted to see which machines they decided to eliminate, if any. Laurie Petrie, the Operations Supervisor for Smith, estimates that this will take approximately one year. Machines will probably not be replaced until it is time to replace ink or toner. Then, instead of purchasing new printer supplies, the print jobs may then be directed to the MFD (Petrie 2009). As for the other devices on campus, directly measuring the current devices would help determine which machines are the most frequently used and therefore which are the highest priority for updating to more efficient devices.

Additionally, there are some very simple solutions for improvements on campus. Aside from behavioral changes, such as not using devices to excess, printing double-sided, and turning off electronics when not in use, offices can reorganize to reduce individual devices in private offices. Printers for example can be reduced to one per floor or community space. Password protected access can solve issues resulting from confidentiality, thus allowing all members in an office/department to make use of the machine. Also, the purchasing department could take a more regulatory approach and monitor purchases to check for energy efficiency. This would eliminate the need to change machines at a later time.

If these changes can be implemented, Smith will join the colleges and universities leading the way in sustainability. Stanford University recently reported results after conducting a campus wide study on energy use. From the results, the director of Sustainability and Energy Management, Joyce Dickerson, has started reporting monthly energy consumption data for offices across the campus. This has caused friendly competition to try and get the lowest energy value. The estimated savings from this are projected to be around $200,000 a year. Dickerson also addressed "phantom" power reduction in IT devices, which is the power used when devices are plugged in, using energy, but not actually in use (Dickerson 2009). These are solutions which Smith can also easily adopt.

One problem reported by Dickerson was that Stanford is large and decentralized, which makes cooperation and organization between offices and departments very difficult. This is not an issue for Smith College. As a fairly small college, the various components of Smith should be able to work together to bring down energy use by IT devices. The major IT related issue is identifiable and solvable: machines in general are overabundant, but more specifically, inefficient, old, and single-use devices are plugged in and drawing "phantom" energy. Campus faculty and staff need to be made aware of this fact, encouraged to change their IT device behavior and reorganize to make a more efficient use of the plethora of devices surrounding them.

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