Cañada College Library and Learning Center Computer Audit

Introduction

Cañada College has a great deal of computing and related technology. In the future, as the school grows and technology advances, there will likely be even more. Unfortunately, much of this technology is used only occasionally or is even unused. This report covers one way to optimize energy technology-related energy consumption.

Background

Cañada College is a community college located in the heart of the Bay Area peninsula. It serves almost 7000 students from many different backgrounds. Sitting atop rolling hills surrounded by nature preserves, Cañada is a beacon for sustainability in the community. While fifty-percent of our energy comes from its own solar fields, the school is constantly looking to be more sustainable. One way they hope to improve efficiency is by limiting electricity usage, particularly of computers.

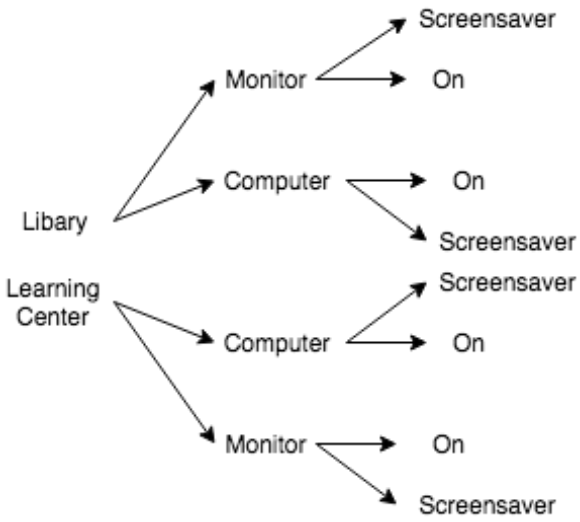
The largest and most frequently used public computer facilities on campus are the Library and the Learning Center, located on the third and second floor of Building 9 respectively. The library serves as a silent study space with computers and books. The Learning Center houses a number of student support services and organizations and serves as a collaborative study space with tutors. In both facilities, computers stay on from 6:00am to 10:30pm. When computers remain unused during this time, rotating advertisements are displayed on their monitors in both buildings.

In the Learning Center there are about 115 computers. The particular area this study focuses on is an open area in the center of the building comprised of four long islands housing 29 desktop computers. This is a popular place for students to study between classes and access the internet.

In the Library there are over 100 computers. This study focuses on the library's instructional lab, which contains 36 HP z2110 SFF workstation computers. The room is primarily used for library classes and workshops, but is otherwise open to public use.

Method

The sustainability interns started the audit by touring the schools computers to find the most optimal place to audit. They decided on Library and Learning Center.
Measurements were taken on April 27th, 2017 at 11:00am on Monday May 1st, 2017 at 9:30am in the Learning Center and Library lab. The energy usage of the computer and the monitor of each "computer set" were measured separately. As well, the energy usage was measured at both the Library and Learning Center, as each building holds different computer models. Finally, the energy usage of each model and part (computer or monitor) was measured in both "sleep mode," displaying screensavers, and while they were on and being used.



Measurements were taken using a kilowatt-measuring device named “Kill-a-watts” in order to gauge how much energy the computers were using. Kill-a-watts plug in between an outlet and the device’s cable, measuring the energy sent between them. The data was recorded in the form of kilowatt-hours. The data is displayed in Figure 1.

The number of students using the computers as well as the number of students who were in the area not using the computers were recorded throughout Thursday and Friday at approximately one-hour intervals. This information was used along with the kWh each device uses in an hour, to calculate the total amount of energy used each hour at the Learning Center and Library lab separately. Finally, by calculating the total amount of energy used in each place on a given day, the amount of money that the school spends, and therefore the amount of money the school could save on computer energy usage was calculated.

Results

To review calculations for figures below, refer to Appendix A.

Figure 1.
The figure below displays the kWh each device uses per hour in each mode on each model.

Screensaver Library Monitor	Screensaver Library computer	On Library Monitor	On Library Computer	On Learning Center Monitor	On Learning Center Computer	Screensaver Learning Center Monitor	Screensaver Learning Center Computer
0.0324 kWh per hour	0.01558 kWh per hour	0.01818 kWh per hour	0.02803 kWh per hour	0.00645 kWh per hour	0.013636 kWh per hour	0.01558 kWh per hour	0.01558 kWh per hour

Figure 2.
The graph below provides a visual representation comparing energy usage of each device for each mode for the Library's computers.

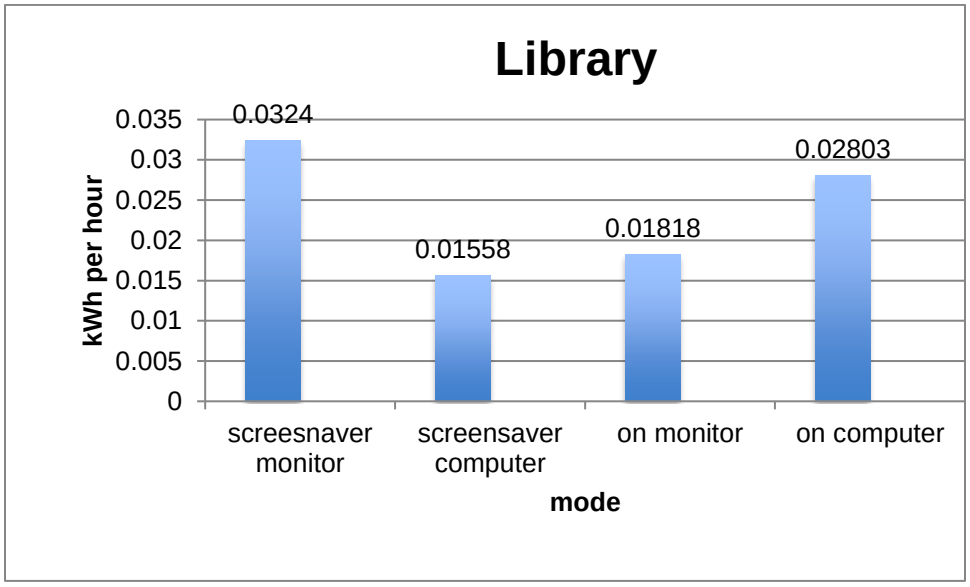
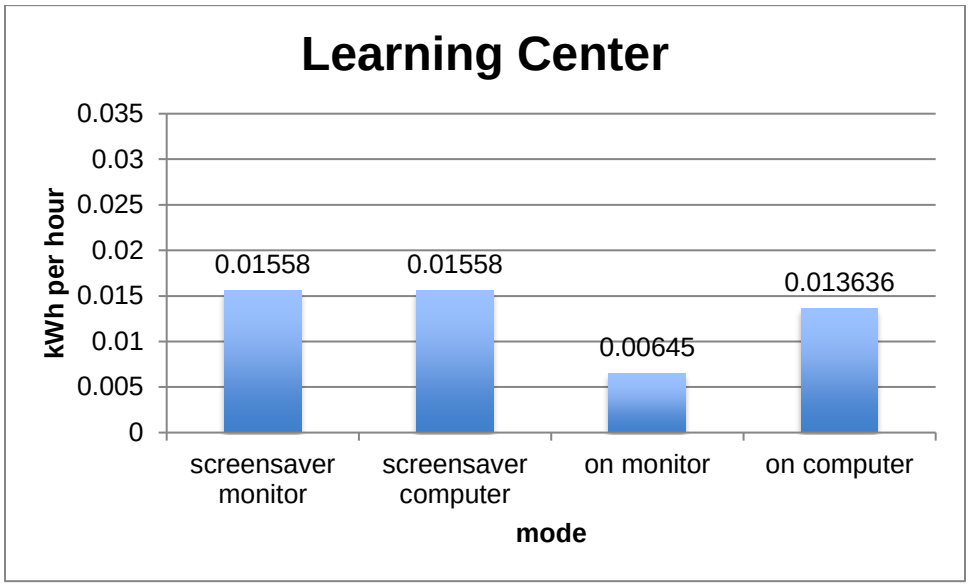


Figure 3.
The graph below provides a visual representation comparing energy usage of each device for each mode for the Learning Center's computers.



As displayed in figures 2 and 3, both the computer and monitor in screensaver mode use more energy than when on. Additionally, Library computers use more energy than Learning Center computers. This might be because the monitor was unresponsive when the energy use of computers on in the Learning Center was being measured. Additionally, inconsistencies and discrepancies between energy usages of devices may be a result of interns only using some of the computers while measuring, with others kept on but not used.

Figure 4.
The graph below compares the number of computers used and unused in the Library Lab at each time interval.

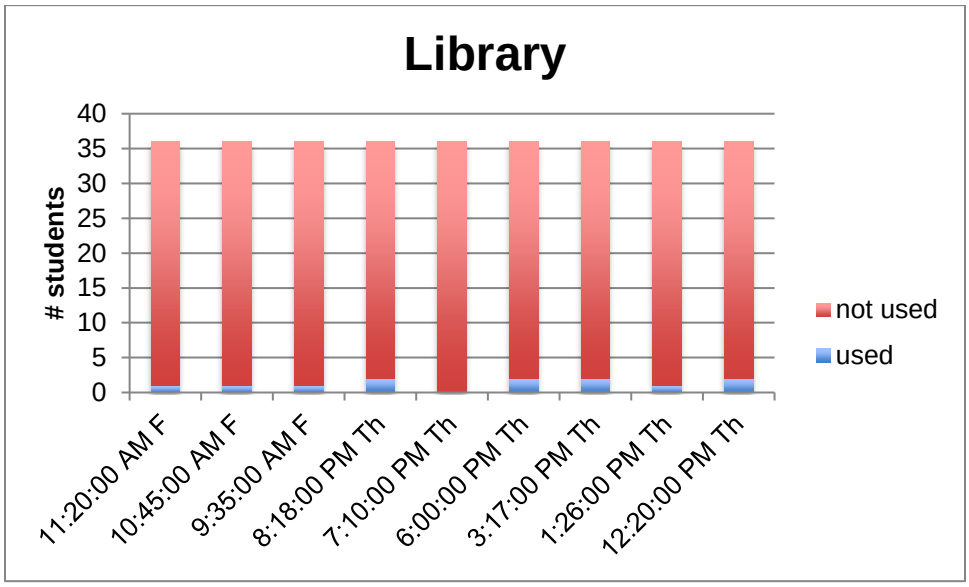
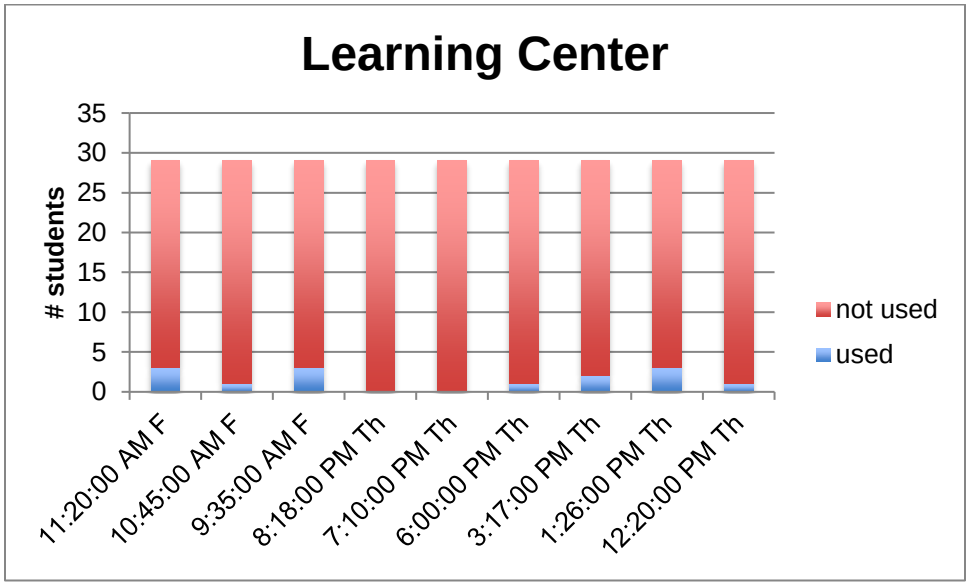


Figure 5.
The graph below compares the number of computers used and unused in the Learning Center at each time interval.



Figures 4 and 5 show that the number of students using computers essentially remains the same throughout the day. However, according to staff at the Learning Center, who record the number of people in the center each day, activity is greatest between 9:00am and 12:00pm. Activity dies down at 9:30am, 11:00am, and around 1:45pm until 5:00pm, when activity picks up again before night classes. Given that measurements were taken at odd intervals during class-times, the number of students recorded in the Learning Center and Library are unusually low, an assumption further corroborated by the Learning Center's data. According to their data, between classes there area at least few more students present.

Figure 6.
The figure below shows the total amount of energy used at the Library Lab approximately every hour, including the energy use of both sleeping and used computers.

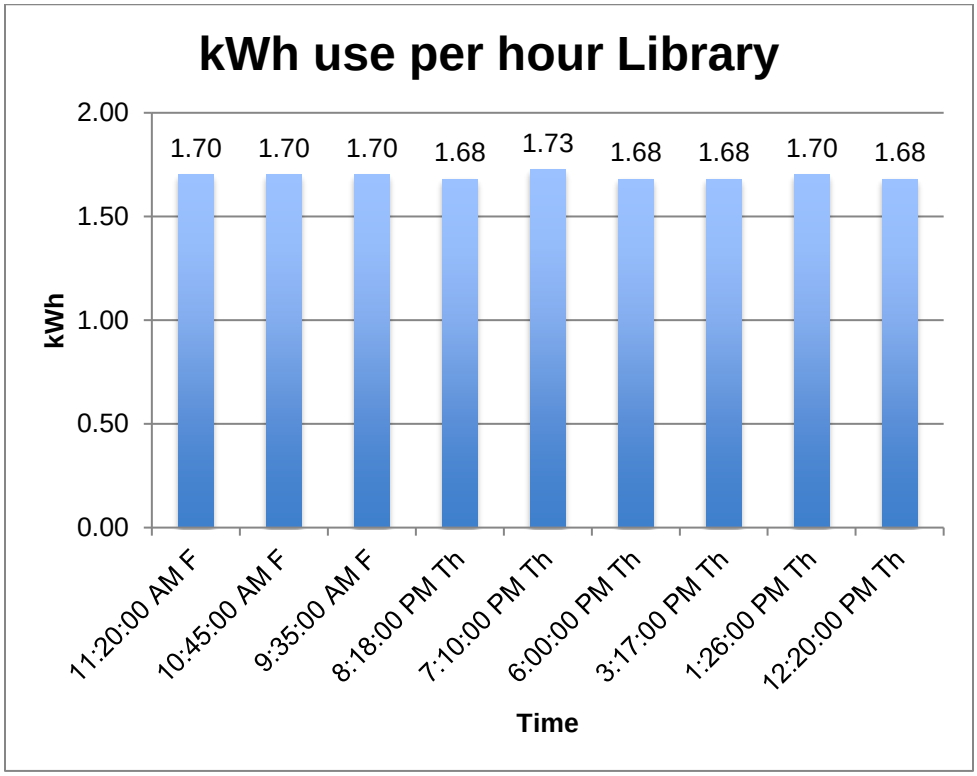
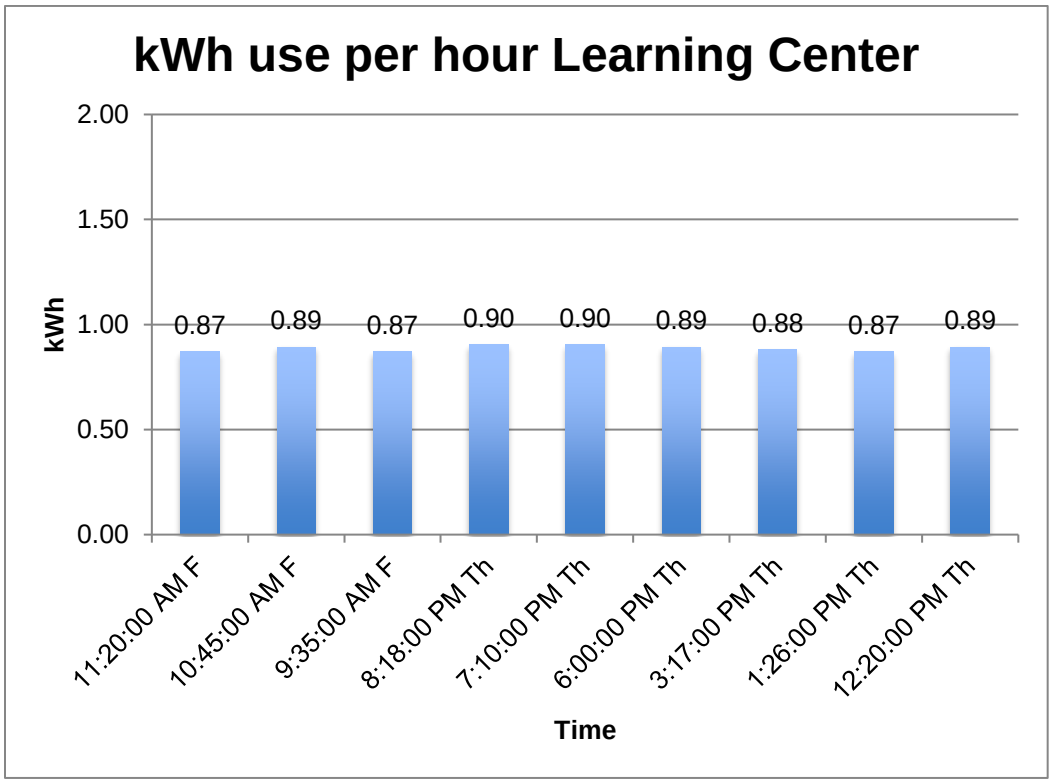


Figure 7.
The figure below shows the total amount of energy used at the Learning Center area approximately every hour, including the energy use of both sleeping and used computers.



In both figures 6 and 7, there is an obvious lack of variation in energy usage across different time intervals. As the data represented in these graphs comes from multiplying the kWh per hour of devices by the amount of computers used and unused, the error in recording the number of students using computers discussed earlier may have misrepresented the total amount of energy used per hour in both the Learning Center and Library Lab.

Given the opportunity of energy saving in the Library and Learning Center during classes, the next section introduces a few recommendations for increasing the efficiency of the Library and Learning Center's energy usage.

Recommendations

Behavioral

Recommendation I: Change Computer Etiquette
According to, the idea that turning a computer on and off uses more energy than sleep mode is a myth. In fact, a computer running on screensaver mode uses just as much energy if not more than turning a computer on. Therefore, it would make sense for

students to turn on computers when they need them, and turn them off when they are done. In order to encourage students into the habit of turning the computers on and off themselves, Cañada College can use posters to remind students to turn computers off when they are finished using them. Posters can be placed at individual computers or larger posters can be displayed within the Library and Learning Center and other computer facilities.

Infrastructure

Recommendation II: Laptop as Replacement for Desktops
There are already laptop carts on campus available for classes to use but no such program for individual students exists. Rather than use clunky desktop computers that require a permanent facility to house them, laptops could be available for checkout at the Library and Learning Center. Students can study wherever they need rather than looking for a desktop in the right study space. When the usage of computers exists as an "on-demand" service, there will be no idle computers waiting for users, saving the school energy and money.

Operational

Recommendation III: Change auto-timing
As mentioned previously, computers in the Library and Learning Center are on an auto-timer, turning on at 6:00am and turning off at 10:30pm. The Library and Learning Center open at 8:00am and close at 9:00pm. The computers are on for 2.5 extra hours a day. Considering the time needed to prepare and boot up computers as well as shut them down, the auto-timer hours could be restricted to 7:00am and 10:00pm.

Recommendation IV: Reduce Usable Area During Low Periods
During classes, the usage of computers in the Library and Learning Center are particularly low. In order to reduce the number of idle computers, both the Library and Learning Center could condense usage to single area during those times. With more than 100 computers in each facility, only a small fraction of those computers will be used. Rather than keeping most of the computers idle, the Library and Learning Center could pick a particular area where computers will be kept on for use during low usage periods.

Recommendation V: Terminate Screensaver Advertisements
According to the study, the screensaver mode uses more energy than computers being used. Additionally, in secluded spaces like the Library Lab, there are often 35 unused computers rotating advertisements for only one person in the room to see. Advertising in unused spaces in ineffective and an unnecessary use of energy. Therefore, the school could save energy by either turning computers completely off or have them go into true sleep mode without screensavers when not in use.

Communication

Conflicting practices only create friction and reduce efficiency. In order to streamline computer usage, ITS, instructional aids, professors and students all must to communicate with each other. The report covers many recommendations, however, they can only be implemented with collaboration and cooperation. ITS and instructional aids must clearly define job roles and identify optimal processes for turning on and turning off computers. Additionally, ITS and professors must collaborate so ITS understands professors needs and ITS's capabilities. ITS and professors must create clear practices for computer usage and turning off and turning on computers for class-time. Finally, professors must remind students of computer etiquette and responsibilities, upholding them to the standards that they, the instructional aids, and ITS have agreed on. Additional materials such as informational posters, or presentations during orientation can be implemented to reinforce computer etiquette in students.

In addition to all suggestions, further audits should be conducted in the future to hone data and narrow solutions to computer energy usage efficiency.

Conclusion

Assuming that computers are on 200 days a year, Cañada College spends approximately 1,000 dollars a year on energy for the computers in the Library Lab and main area of the Learning Center alone. Given that in this study, these facilities do not rise above 10% occupancy, and computers on screensaver mode account for 98% of computer energy usage in these areas, Cañada College could save 882 dollars by shutting off computers not being used. This does not include savings on improved efficiency of computers are being used. This is not a significant amount of money, however, this is only a small fraction of the computers at Cañada College.

Appendix

Appendix A.

	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1			Library		36					Learning Center		29				
2			used	not used						used	not used					
3	Friday	11:20:00 AM F	1	35	2.78%	97.22%	0.02	1.68	1.70	3	26	10.34%	89.66%	0.06	0.81	0.87
4	Friday	10:45:00 AM F	1	35	2.78%	97.22%	0.02	1.68	1.70	1	28	3.45%	96.55%	0.02	0.87	0.89
5	Friday	9:35:00 AM F	1	35	2.78%	97.22%	0.02	1.68	1.70	3	26	10.34%	89.66%	0.06	0.81	0.87
6	Thursday	8:18:00 PM Th	2	34	5.56%	94.44%	0.05	1.63	1.68	0	29	0.00%	100.00%	0.00	0.90	0.90
7	Thursday	7:10:00 PM Th	0	36	0.00%	100.00%	0.00	1.73	1.73	0	29	0.00%	100.00%	0.00	0.90	0.90
8	Thursday	6:00:00 PM Th	2	34	5.56%	94.44%	0.05	1.63	1.68	1	28	3.45%	96.55%	0.02	0.87	0.89
9	Thursday	3:17:00 PM Th	2	34	5.56%	94.44%	0.05	1.63	1.68	2	27	6.90%	93.10%	0.04	0.84	0.88
10	Thursday	1:26:00 PM Th	1	35	2.78%	97.22%	0.02	1.68	1.70	3	26	10.34%	89.66%	0.06	0.81	0.87
11	Thursday	12:20:00 PM Th	2	34	5.56%	94.44%	0.05	1.63	1.68	1	28	3.45%	96.55%	0.02	0.87	0.89
12			0.01818	0.0324			0.33	16.63	16.96	0.00645	0.01558			0.31	8.55	8.86
13			0.00645	0.01558			65.68	3326.61	3392.29	0.013636	0.01558			62.49	1710.34	1772.83
14			0.02463	0.04798					678.458667	0.020086	0.03116					354.565511