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Killing Watts: Ghost Loads at the University of Colorado Colorado Springs

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Ghost loads (also known as phantom loads, vampire loads, standby power or leaking electricity) needlessly consume electricity when electronic devices are not in use, costing institutions money and needlessly sending tons of CO_2 into the atmosphere. An analysis of computer and other ghost loads at the University of Colorado Colorado Springs (UCCS) was conducted in the Spring of 2009 with the results showing that computers annually cost the school $37,505.96-$45,017.56. The environmental impact of idle computers was calculated as 521.73-626.07 tons of CO_2 emitted into the atmosphere. These estimates are likely low since data was neither gathered on weekends, nor during the summer. Other potential sources of ghost loads are identified and strategies that could lead to lower costs and carbon emissions are presented.

Introduction

Ghost loads (also known as Phantom loads, vampire loads, standby power or leaking electricity) are currently gaining attention in the nation and the world as major consumers of electricity needlessly cost companies and individuals surprisingly large sums of money (Null, 2009). In times like the present, when money is in short supply and institutions such as the University of Colorado Colorado Springs (UCCS) look to cut costs, it logically follows that finding out how much electricity consumed as a ghost load would enable the University to save money by implementing strategies to reduce needless energy consumption and more effectively use its limited funding.

Not only is reducing electricity consumption financially responsible, it is beneficial for the environment. Greenhouse gas emissions produced per kilowatt hour of electricity created in the Colorado Springs area are higher than the national average due to Colorado Springs Utilities use of coal for a large portion of its electricity production (Environmental Protection Agency, n.d.). Reducing the amount of electricity used by UCCS to power idle electrical devices would also decrease the school's carbon footprint.

The first step in finding and eliminating ghost loads is to define them. According to Lawrence Berkeley National Laboratory, "standby power [ghost loads] is electricity used by appliances and equipment while they are switched off or not performing their primary function." (2009). Any appliance that is left on and not in active use, any device that is in a sleep or power save mode, or any device that has been turned off but still uses a small amount of electricity is included in the ghost load. A large number of computers, printers, and other devices are in a state in which they meet these criteria.

Once devices and appliances that constitute the ghost load are identified, the amount of power drawn by idle electronics, its financial costs and its burden on the environment can be estimated. With these estimates, methods and solutions for lowering the amount of standby power consumed can then be implemented. One of the most common strategies for reducing ghost loads is to plug appliances into a power strip, and to turn them off at the power strip when they are not in use. This has the effect of cutting off the electrical supply to the devices that are a financial drain and preventing them from using electricity when they are not needed.

In the case of UCCS, use of power strips in some areas is not practical and other alternatives need to be considered. In the case of computer labs, turning computers off at a power strip would prevent the campus Information Technology (IT) department from remotely turning computers on and performing essential end-of-day maintenance on campus computers leading to decreased computer performance (Wilson, 2009). Fortunately, there are other solutions that can be implemented in these instances that will help reduce power consumption.

The purpose of this research is to discover the financial cost of the ghost loads attributable to idle computers on the UCCS campus and calculate the carbon footprint directly traceable to this ghost load. Information about the potentially large ghost load of on campus housing is also presented. Finally, potential strategies for reducing the amount of electricity consumed by idle electrical devices including some lessons learned from the University of Colorado (CU) Boulder campus are presented.

Methodology

Data regarding computer lab usage was gathered on the UCCS campus March 18, 19, 20, 30, and 31 of 2009. It is important to note that the 20th was the Friday before spring break. The author's personal experience is that there are low numbers of computer users on campus on Fridays and, being the day before spring break, there were likely fewer users than normal, though the exact difference in user numbers is unknown. The number of users was manually counted in the Columbine Hall Computer Lab (CoH 231), the 24-hour dorm computer lab, the front section of the Math Lab, the second floor of the El Pomar Center (EPC) or library, and the Language Technology Center (LTC) in Dwire Hall, room 270. Sample counts were obtained hourly during the time the labs were open starting the hour after they opened until an hour before they closed. The hours of operation for each lab can be inferred from charts in the appendix that show the hours each lab was monitored.

These labs were chosen for easy and efficient data collection and because data could be collected in these labs without disturbing the academic environment. Some labs, such as the science learning center, would have required a more intrusive presence in order to collect data and were not used. The Columbine Hall Computer Lab and the El Pomar Center were also chosen because they are the largest and most frequently used by students. The 24-hour dorm lab was selected due to its central location in the housing area. The Math Lab and the LTC were chosen to represent the several Excel centers on campus. Excel centers are computer labs that specialize in assisting students in their studies in specific areas. The LTC assists students learning foreign languages, the Science Learning Center assists those studying subjects such as biology and chemistry, while the Writing Center helps students in the writing process. The two labs selected allowed the data collector to simply look in the door and count users thus permitting easy data collection, while preserving the scholarly atmosphere. Other Excel centers such as the Science Learning Center would have required walking into and through them in order to determine the number of users. Data was not collected at the lab in University Hall due to its distance from main campus.

Data was obtained for Monday through Friday, weekends were not sampled due to conflicts with the author's work schedule. In my interview with Jerry Wilson (2009), the head of the IT department, he noted that weekend use of computers was lower than weekday use. His description of weekday computer use was verified by the data gathered, so it is assumed here that his statements regarding computer use on weekends are accurate.

Power consumption data was obtained from various locations. For computers and monitors, four computers in the cartography lab and two in the 24-hour dorm lab were monitored while not in use. Monitoring was conducted by connecting devices to the Kill-A-Watt EZ ™ meter and checking the amount of watts used and kilowatt hours consumed over a two hour time period. For the smart-classroom kiosks, which have several pieces of electronics including a computer, monitor and video equipment, data was obtained from two smart classrooms in Columbine Hall. For printer power consumption, the printer in the cartography lab and two printers in the Columbine Hall computer lab were used. Kiosk and printer energy consumption were determined using the same methods and time interval as for computers and monitors.

Time Use Patterns

Perhaps one of the most visible consumers of electricity is the computers on campus. According to Wilson (2009), there are between 2500 and 3000 computers on the UCCS campus (an exact figure was not available). Using information from the UCCS website (University of Colorado at Colorado Springs, n.d.) and **a** physical count of computers not mentioned on the school's website, it was determined that there are approximately 900 computers and 45 printers on campus in computer labs and classrooms to which students have access. Of those 900, 479 computers and 26 printers are in labs and learning centers. According to Wilson (2009), computers are turned on remotely each morning at 7:20. They are left on (unless manually turned off) through midnight when daily maintenance is automatically performed and then are remotely turned off shortly before 1:00am. This means that each computer and monitor set on campus is turned on, using energy and costing UCCS money, for 16 ½ hours each day whether or not they are being used.

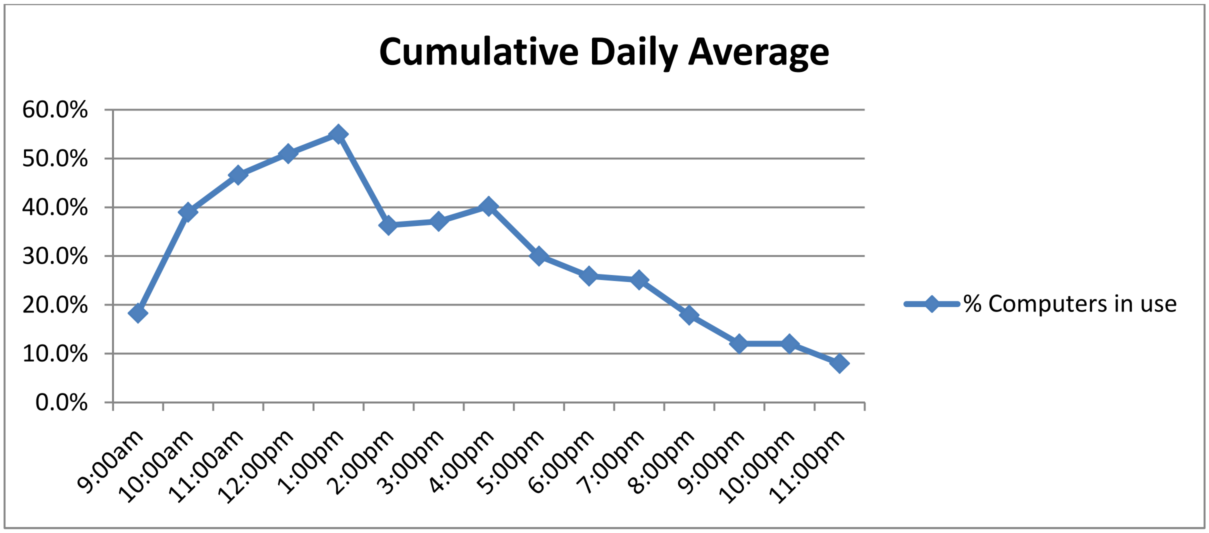

Figure 1 Averaged usage for Monday through Friday use of computers in selected labs on campus. Percentage was arrived at by adding the number of users for each hour and dividing by the number of days for which data was available. The average number of users was then divided by the number of computers surveyed to arrive at the hourly average percentage. Data is from sample counts of users in selected labs.

Knowing that the computers are on 16 ½ hours each day, how much are they being used during that time? Based on surveys of the number of users in labs displayed in Figure 1, we see that there are two peaks in use during the day.

The first peak in campus computer use is a peak of 55% of computers being used at 1:00pm followed by a smaller peak of 40% of computers being used at 4:00pm. It is important to note that use of computers on Friday is lower than that of other weekdays. When data for Friday is not included in the calculations (Figure 2), computer use is nearly 10 percentage points higher on average during peak use. The gap in the average hourly use between the Monday through Thursday average and the Monday through Friday average narrows throughout the day until it disappears at 9:00 pm.

Computer use on Friday is notably low. While there are time periods during the day from Monday through Thursday when a majority of the computers in labs are in use, peak use on Fridays does not rise above 30% as shown in Figure 3. According to Wilson (2009), use of campus computers is even lower on the weekends than it is on Friday.

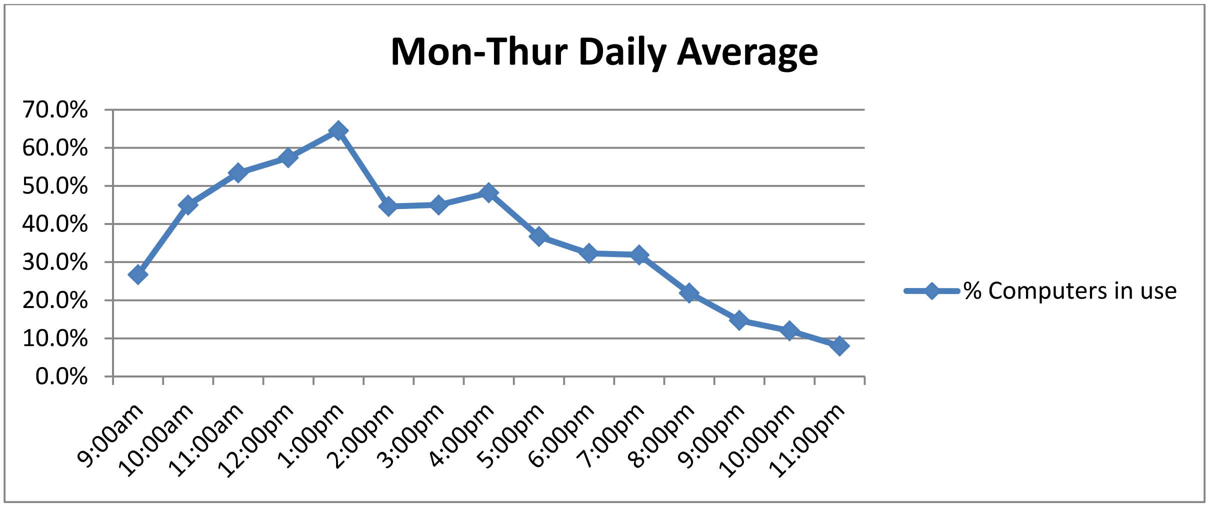

Figure 2 The method for finding the percentage use of computers is the same as for Figure 1 with the exception that data for Friday is not included.

The data collected shows that for a majority of the time that computers are turned on, they are sitting idle, costing UCCS money. It is only between 10:30 am and 1:30 pm Monday through Thursday that computer use on campus is above 50%. Friday, Saturday, and Sunday, computer use is much lower. It is important to note that the El Pomar Center computers and the computers in Columbine Hall Computer Lab do experience higher use than other labs. These are the two general use labs on campus that students use to work on homework assignments and to access the internet. The other labs are for specialized use such as math, science or language tutoring in the case of the Math or Science Learning Centers and the Language Technology Center, or for editing papers in the case of the writing lab. During periods of peak use, the percentage of computers in use in the El Pomar Center and Columbine Hall Computer Lab approaches 80%-90%.

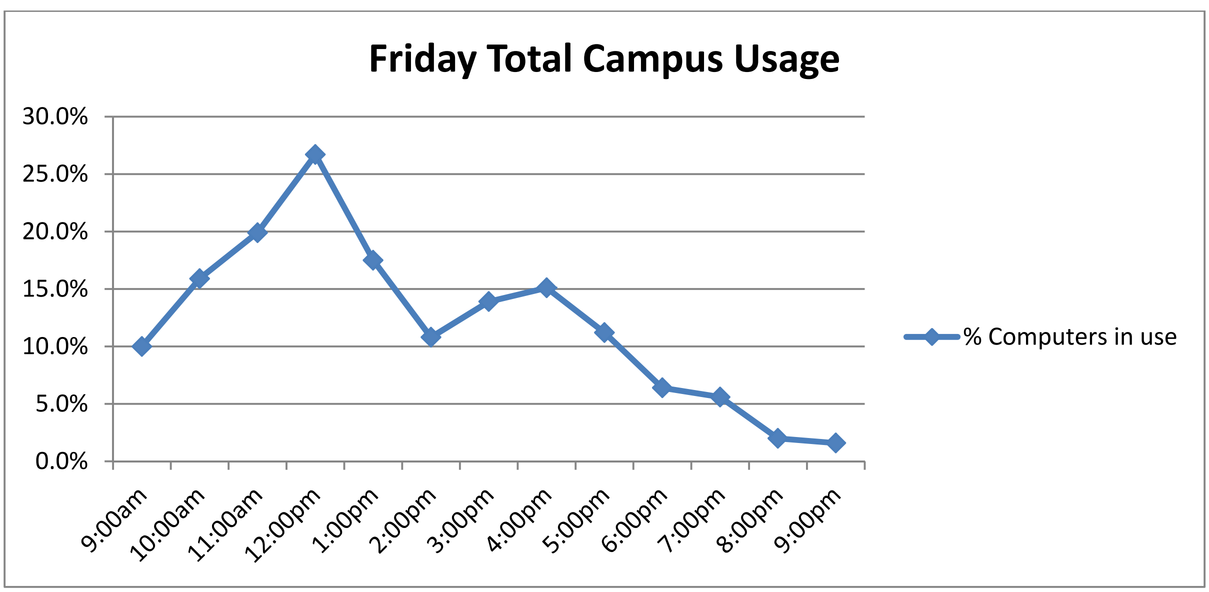

Figure 3 Percent use of surveyed campus computers on Friday.

According to data collected from the Kill-A-Watt EZ ™ meter, each computer and monitor set uses 81 watts of energy while they are turned on and sitting idle. When this is multiplied by the 900 computers accessible by students, the total energy consumption is 72 kilowatts an hour (kW/h) while the computers are turned on and the monitors are not in a sleep mode. For the 2500-3000 computers on campus, 200-240kW/h are being consumed, when they are sitting idle. The monitor consumes the most energy of the set, using 45 of the 81 watts. After ten minutes, the monitor goes into a standby mode in which it uses 0.6 watts which means the entire set uses 36.6 watts (36 watts for the computer plus the 0.6 for the monitor) when it is in a sleep or hibernation mode. How much energy a set uses (36.6 or 81 watts) during its idle time depends on patterns of use. In some locations, computers may sit idle long enough for the monitor to go into standby mode, while in others, it may not. In the author's observations, it was noted that students preferred to sit where they had an empty chair on both sides, newcomers would then pick computers where they had an empty chair on at least one side, and finally, they would fill in empty seats that had no empty chairs on either side during peak use times. From 5:00 pm or 6:00 pm until midnight, there were usually enough empty seats for students to have seats empty on both sides. It is for this reason that my estimate of energy consumption for each computer set ranges from 36.6 to 81 watts. In high use labs, computers may be using more electricity because their monitors are fully turned on more of the time. This is due to the fact that students would often sit at a computer before the monitor went into a sleep mode. In labs with low rates of use, more of a monitor's idle time is going to be in a standby mode because there are not going to be enough students using the lab for the monitor to remain on.

The Fiscal Burden

Knowing the patterns of use and how much energy computers use, assists in estimating how much computer ghost loads cost UCCS. The university is charged for electricity in on-peak and off-peak periods. According to Colorado Springs Utilities (2009), on-peak periods are Monday through Friday 4 pm to 10 pm October through March and Monday through Friday 11 am to 6 pm April through September. On-peak hours are those hours when demand for electricity is highest throughout the electrical grid. Off-peak periods are non-on-peak hours and include legal holidays. Rates vary with UCCS being charged $0.0215 for every kilowatt hour (kWh) used during off-peak hours and $0.0512, or more than double the off-peak rate, during on-peak hours as**.** In addition, a $0.03 access charge per kWh used regardless of whether it is on-peak or off-peak (Colorado Springs Utilities, 2009).

If the rates of computer use are applied to all 2500-3000 computers on campus (which include offices, classrooms, and other labs which were not counted in the sample) and the correct on- and off-peak rates are applied to this rate of use, the amount UCCS pays during a semester can be derived. Figures 4 to 7 show the cost for each hour of the ghost load of UCCS computers.

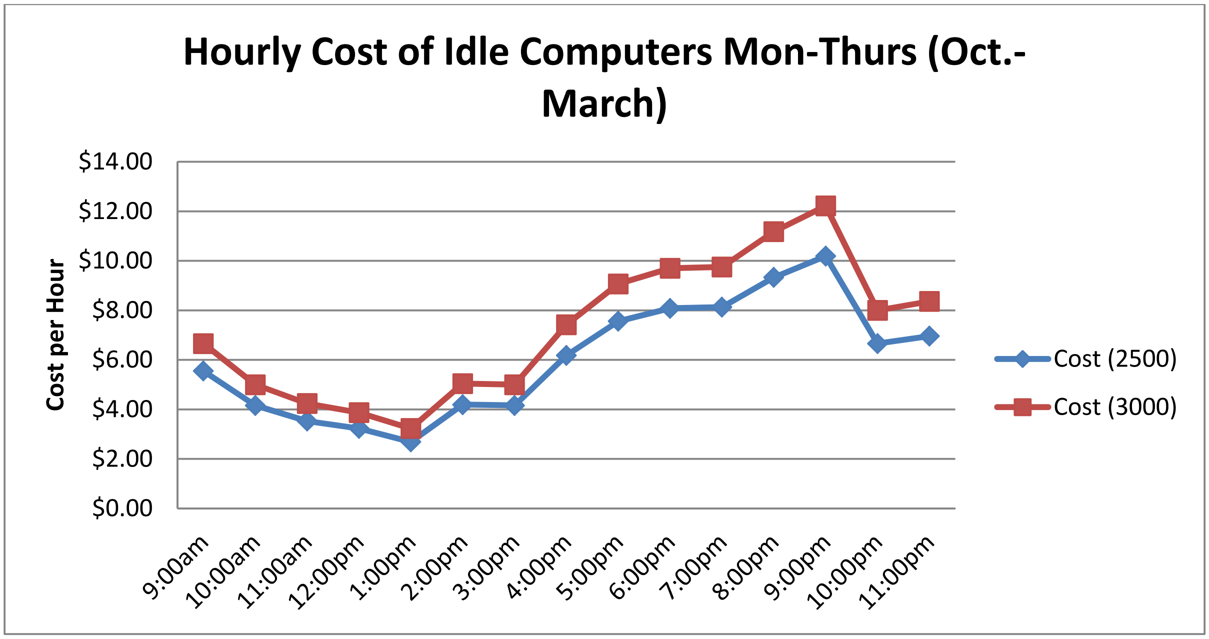

Figure 4 Hourly cost of idle for Monday – Thursday (during a semester) using the October – March on-peak hour expenses.

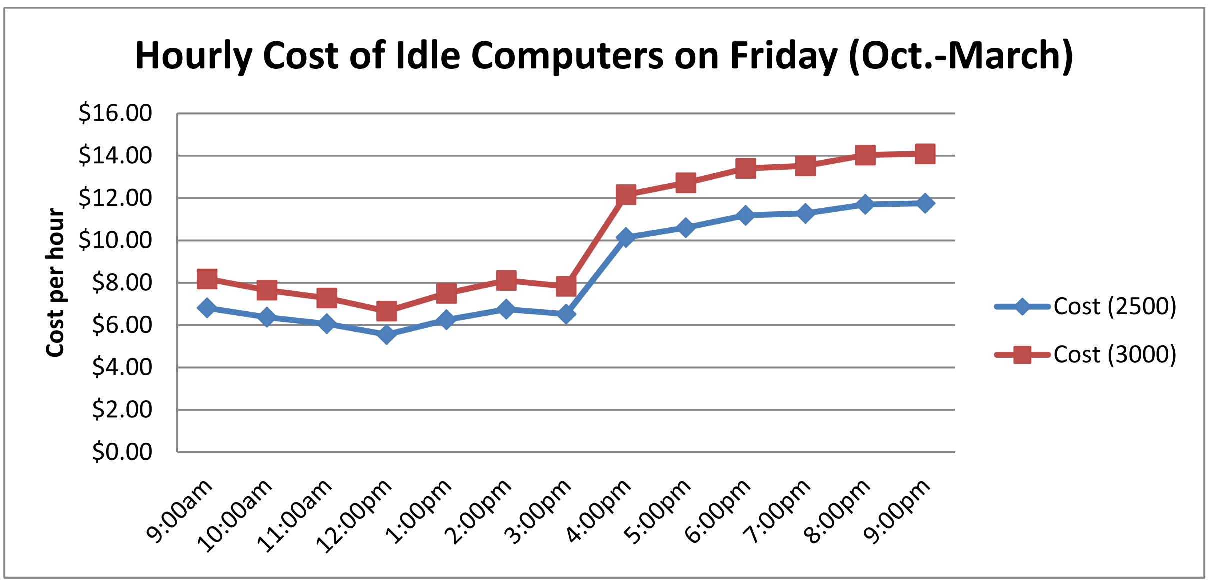

Figure 5 Hourly cost of idle computers on Fridays (during a semester) using the October – March on-peak hours.

In Figure 4, the drop in hourly cost once the University is charged the off-peak rate starting at 10:00pm is apparent. The increase in hourly cost once the University begins to be charged the on-peak rate at 4:00 pm is readily apparent in Figure 5.

To arrive at these hourly charges, 36.6-81 watts per computer and monitor was multiplied by the number of computers estimated to be on campus (2500-3000). This produced a range of energy consumption for the computers on campus. If the 2500 computers each hour no**t** in use had monitors in standby mode, the campus would be charged for 91.5 kWh. The charge would increase to 202.5 kWh if all idle computers had monitors that were not in standby mode, producing a range of 91.5-202.5 kWh. The mean was calculated for the hourly charge for the campus. For 2500 computers, the calculated mean of 91.5 kWh and 202.5 kWh is 147 kWh while for 3000 computers the mean was 176.4 kWh. The mean kWh consumed was used to avoid overcomplicating the calculations of cost. Using the mean of the minimum potential energy consumed (91.5 kWh for 2500 computers) and the maximum potential energy consumed (202.5 kWh for 2500 computers) indicates that for the purpose of hourly cost, it is assumed that half of the idle computer and monitor sets on campus have a monitor in standby mode and half of the sets have a monitor that is fully turned on. Once this mean for energy consumption was calculated, the appropriate on or off peak rate per kWh was applied at the appropriate time of day. For example, on a typical Monday through Thursday weekday at 9:00am, 26.7% of computers are in use and 73.3% of computers are sitting idle. This is an off peak hour, and it costs UCCS $0.0515 per off-peak kWh use.[1] Applying this rate to the 147 kWh mean and the 176.4 kWh mean produces a total hourly charge of $7.57 for the operation of 2500 computers and $9.09 for 3000 computers when off-peak rates apply. When the hourly rate is multiplied by the percentage of idle computers (73.3%), the total cost is $5.55 (2500 computers) or $6.66 (3000 computers) for the operation at 9:00 am. Once the cost for the average use each hour was calculated, a total cost for each day was derived by adding the total cost of the operation of idle computers for each hour of the average day.

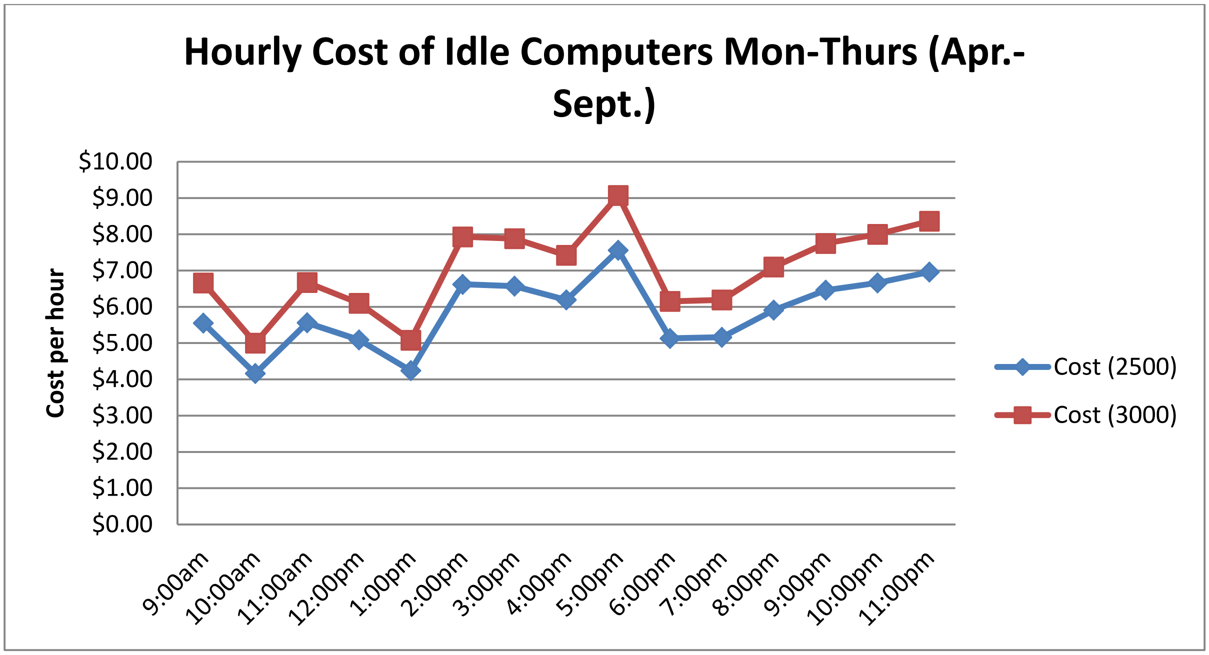

Figure 6 Hourly cost of idle computers Monday-Thursday (during a semester) using the April-September on-peak hours.

[1] This includes the $0.0215 per kWh off peak rate plus the $0.03 per kWh access charge.

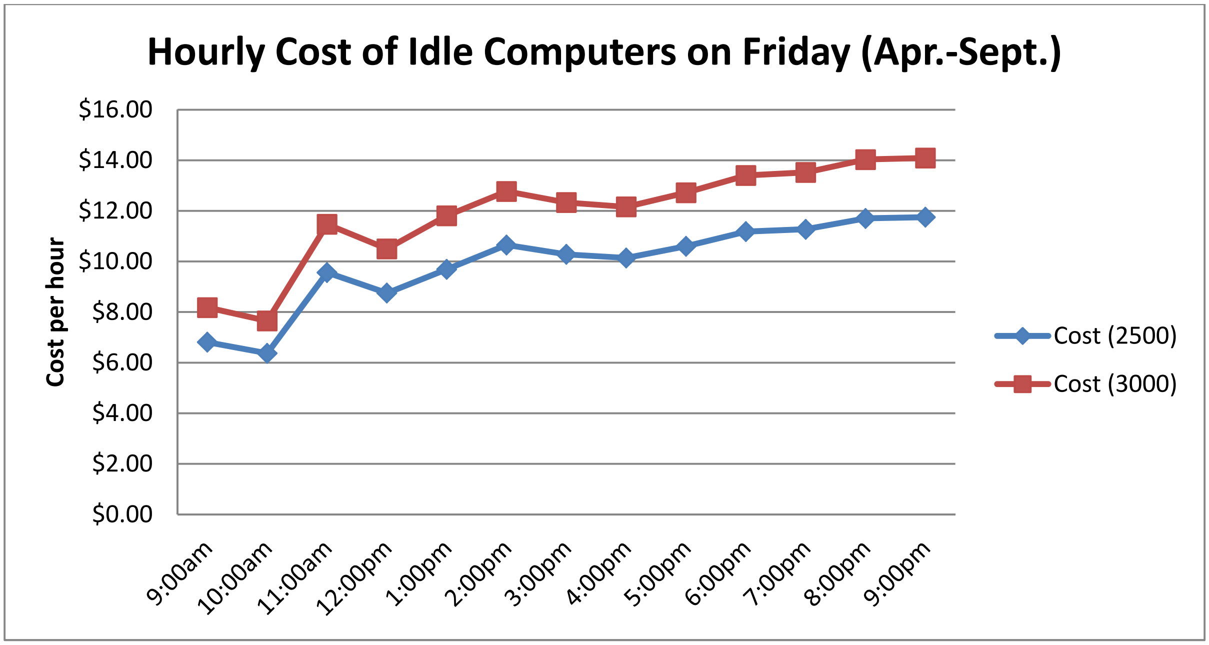

Figure 7 Hourly cost of idle computers on Friday (during a semester) using April-September on-peak hours.

The total cost of idle computer operation for an average weekday in the Monday through Thursday portion of the week during the semester in the months of October through March came to $90.60-$108.74 per day. For a Monday through Thursday during the months of April through September, the daily cost range is $87.82-$105.36. For lower daily levels of computer use, the amount of money that idle computers cost UCCS increases. For a Friday in October through March, idled computers cost UCCS $110.95-$133.13 while Fridays cost UCCS $128.75-$154.63 April through September. These figures do not include the first hour and a half of the day and Friday's estimates are for hours when labs are open, they do not include the 9:00 pm-12:00 pm time period when labs are closed, and computers are turned on and sitting idle until the maintenance period begins at midnight. Costs for times when regular classes are not in session are not included. The costs during weekends and over breaks are likely higher than the costs for Friday due to lower rates of computer use.

An estimated annual cost of idle computers can be computed knowing the daily costs of idle computers on campus. For the 16 weeks of spring semester or fall semester, based on the observed patterns of computer use Monday through Friday, UCCS is paying $7613.68-$9137.32 due to the ghost load caused by idle computers on campus. For an academic year, this comes to $15,227.36-$18,274.64 spent. If we assume that computer use on Saturday and Sunday is the same as on Friday's (and it is likely lower, meaning the cost estimate is low), and include the costs of idle computers on weekends, the cost of idle computers during an academic year increases to $22,755.36-$27,310.96. If it is assumed that computer use over the 20 weeks of the year that are not during the fall and spring semesters is the same as during the semester the calculated total cost comes to $37,505.96-$45,017.56. This estimate is likely below the actual cost because computer use over the 20 weeks is probably lower than the 32 weeks that fall during spring and fall semesters; the fact that the first hour and a half of computer use was not calculated in the daily totals, computers left idle overnight for remote access were not taken into account, and weekend use was estimated using numbers for Friday which are likely higher than the actual numbers for a weekend accounts for the low estimate.

As a percentage of total electricity use on campus, the ghost load appears to be a relatively small percentage of total campus energy use. During fiscal year 2008, UCCS consumed 18,345,815 kWh of electricity (Kogan, 2008). Keeping in mind the same limitations in the calculation of the actual monetary cost of the ghost load as well as the same methods for calculation, the total kWh of electricity consumed that can be attributed to ghost load is 555,030.84 kWh for 2500 computers and 666,069.56 kWh for 3000 computers. This means that 3.03%-3.63% of the annual electricity consumption at UCCS is attributable to ghost load from computers. This neither takes into account the ghost load from other electronic devices in classrooms and offices nor those in student housing.

It is important to note that adjustments are given for every kWh used each month by Colorado Springs Utilities if the cost of purchasing electricity is lower or higher than the rate charged. Adjustments were not taken into consideration in the calculations of fiscal cost because the amount of a per kWh adjustment may vary from month to month, may be non-existent, or may add to the cost of electricity (Colorado Springs Utilities, 2009). Adjustments of $0.01 per kWh occurred in 2003, 2004 and 2007 (Gilford, 2009), but are rare events. Because adjustments are not regularly applied, their negligible impact on cost, and the fact that there had not yet been any adjustments applied for the Fiscal Year 2009 at the time this paper was written, they were not included in the calculations of cost in this project.

The Environmental Burden

In the Colorado Springs region, most electricity is produced using coal and natural gas with hydroelectric production accounting for a very small amount of energy creation (Environmental Protection Agency, n.d.). Coal accounts for most energy production, and because of this, the carbon emissions for each kWh of energy produced is higher than the average emissions rate for the rest of the nation (Environmental Protection Agency, n.d.). For every kWh of electricity that the UCCS campus consumes, 1.88 lbs of Carbon Dioxide (CO_2) is produced (Environmental Protection Agency, n.d.), enlarging the school's carbon footprint. Idle computers and other electronics mean that a portion of those emissions are caused by needless energy consumption. Figures 8 and 9 show the daily CO_2 emissions caused every hour by the ghost load in computer labs at UCCS.

The hourly totals for CO_2 emissions were calculated in a manner similar to the hourly cost of ghost loads. The kWh means (average) for 2500 computers (147 kWh) and 3000 computers (176.4 kWh) were multiplied by the pounds of carbon emitted in the production of 1 kWh of electricity in Colorado Springs (1.88 lbs per kWh) to arrive at a total amount of CO_2 emissions caused by the computers on campus in an hour. For the 2500 computer estimate, a total of 276.36 lbs of CO_2 are emitted in the production of the electricity used by those computers each hour. For the 3000 computer estimate, 331.63 lbs of CO_2 were emitted when the electricity for those computers was created. This hourly total was multiplied by the percentage of idle computers every hour to arrive at the total pounds of CO_2 emitted every hour which is caused by the idle computers at UCCS.

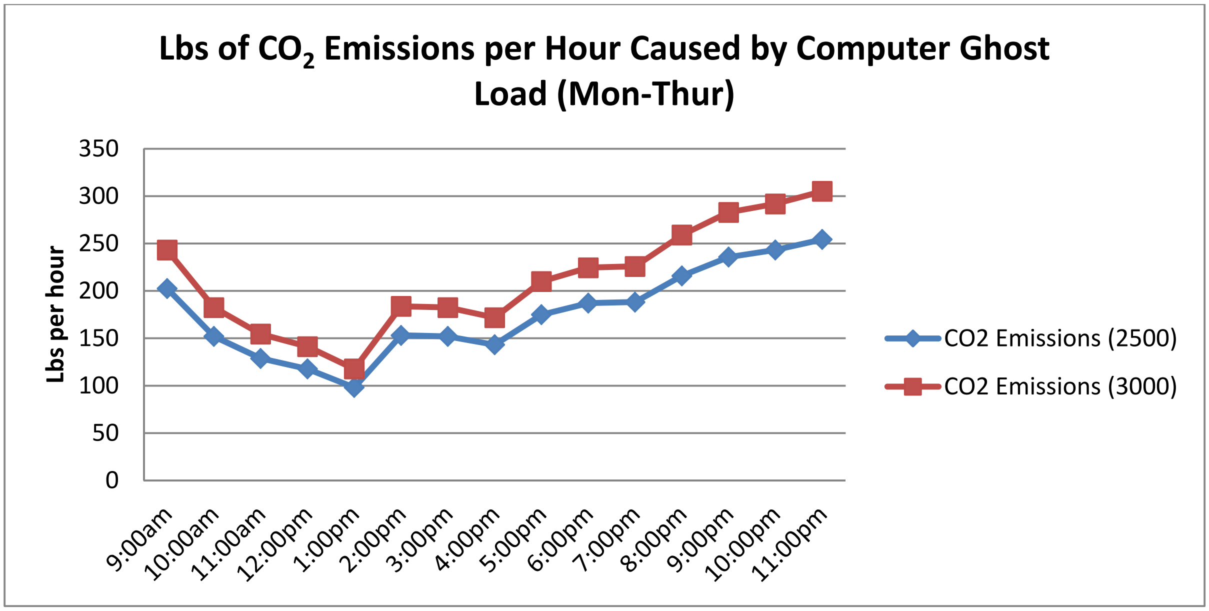

Figure 8 Hourly emissions of CO_2 caused by computer ghost load at the UCCS campus for weekday in the Monday through Thursday time frame during a semester.

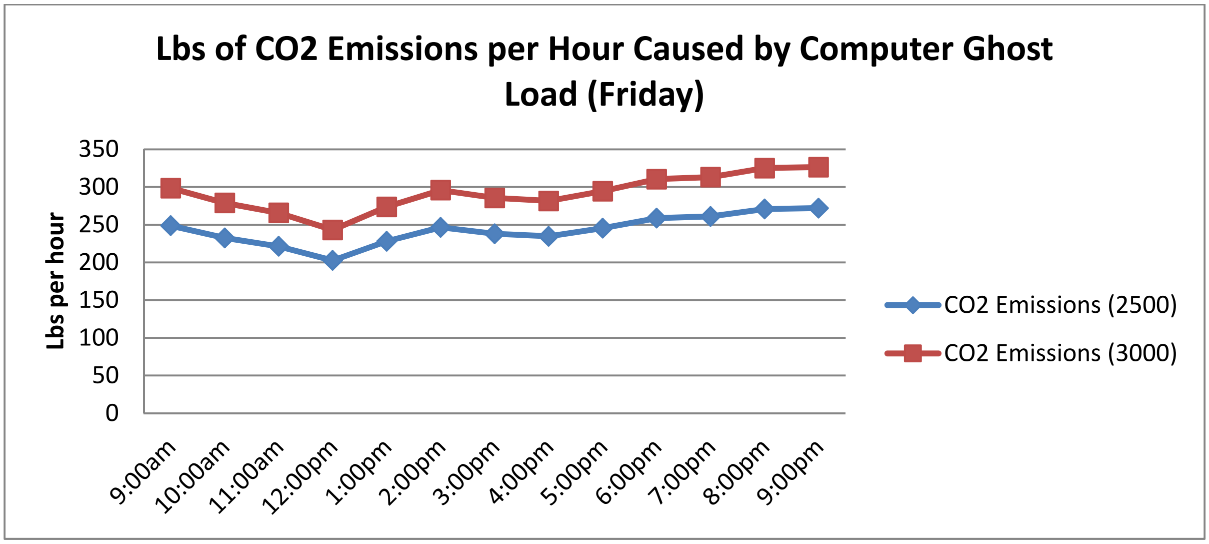

Figure 9 Hourly emissions of CO_2 caused by computer ghost load at the UCCS campus for Fridays during a semester.

On an average weekday in the Monday through Thursday time frame during a semester, idle computers cause the emission of 2646.72 lbs (for 2500 computers) to 3176.01 lbs (for 3000 computers) of CO_2 per day on the UCCS campus. On the average Friday during a semester, ghost loads in computer labs cause the production of 3159.89-3791.87 lbs of CO_2 which are emitted into the atmosphere. Similar to the cost calculations, the first hour and a half of the computers on campus being turned on, and the last few hours of Friday are not counted in these totals. This means that these daily emissions estimates, like the fiscal cost estimates, are likely lower than the actual emissions. Again, due to higher numbers of computers being idle on weekends and during school breaks, daily emission totals attributable to computer ghost loads are higher than during the academic year.

Making the same assumptions made in the calculation of the fiscal impact, the cumulative emissions caused by ghost loads in computer labs can be calculated. Rather than the large figures produced using pounds of CO_2 per kWh, the totals have been converted to tons of CO_2 per unit of time for ease of comprehension. For a spring or fall semester (again, including weekends using Friday's estimate), 160.53-192.64 tons of CO_2 are caused as a result of idle computers. For an academic school year, the CO_2 produced comes to 321.07-385.27 tons; for an entire calendar year, 521.73-626.07 tons of CO_2 are produced. For the same reasons that the fiscal estimates are low, the CO_2 emissions estimates are low and the actual emissions due to idle computers are likely higher than these estimates.
Other Sources of Ghost Loads

Computers are not the only electronic devices that idly use electricity in computer labs and classrooms. Printers are another consumer that cost the campus money. The 46 printers that students have access to consume between 40 and 80 watts, while sitting idle. Meanwhile, in the smart classrooms, the podiums us**e** electricity at a rate of .09 kW/h. With 58 of these on campus (University of Colorado at Colorado Springs, n.d. a), they are roughly drawing 5.22 kW/h, and consume a large amount of electricity. The amount of electricity that could be saved is greater than that calculated here. Scanners, copiers, microfilm readers and other devices consume electricity but have not been included in the calculations.

The student dorms are a location where energy consumption was not assessed and the cost not calculated in this project. The potential for reducing ghost loads in campus housing is possibly great. According to the Department of Energy, 75% of the electricity consumed by home electronics is used while they are turned off (Mother Earth News, 2008). If the figures were applied to the student dorms, then a large amount of electricity consumed is needlessly costing UCCS money. Game consoles, personal computers, stereos, phone chargers, TVs, and DVD players are but a few of many potential sources of resident student ghost loads. A listing of the power consumption for various electronic devices is available on the Lawrence Berkeley National Laboratory website, describing the energy consumption for various electronics, including many that could be and are likely found in many dorm rooms.

Solutions

UCCS has some options available to reduce electricity used by computers on campus. One action that could save money early in the morning would be to not remotely turn on computers first thing in the morning, permitting the first user of the day on that computer to turn it on. This would keep computers turned off until they are actually needed. A reminder affixed to computer monitors for users to simply turn off the monitor when they are done would also help reduce power consumption. Running a program that would shut down computers within a couple minutes of a user logging off would ensure that computers would not needlessly remain on after peak use periods. There are also programs, such as Verdiem and Night Watchman, which reduce energy consumption of computers, monitors, and other devices such as printers without interfering with user tasks and maintenance. California State University-Fresno, for example, has used Verdiem to reduce its computer energy consumption (Kus, 2009). Strategies for other devices include manual shutdown of devices like scanners, DVD players, and other electronics. In labs with multiple printers, routing print jobs to one or two printers and shutting down the others after peak use would reduce not only electricity consumption, but reduce wear and tear on those printers that are turned off.

Finally, one possible solution that may be promising is to allow students to use their own computers in a place such as the El Pomar Center. Rather than providing a computer and monitor set, it may be enough to simply provide an Ethernet cable where students could plug in a laptop, log into the campus network and be able to print in a lab. This could save money in the future as the campus would need to purchase fewer computers and decrease maintenance costs. This would also eliminate the ghost load of the computer at that location as the only cost to the school would be the cost of electricity consumed while that student's laptop is plugged in. Because some laptops consume less electricity than a computer and monitor set (Lawrence Berkeley National Laboratory, 2009a), the cost to power a student's laptop may also be less than the cost of powering a computer for the same amount of time.

The student dorm consumption is a more complicated problem to solve. According to Robert Hall (2009), the Energy Program Manager at CU Boulder, the housing department at that campus bought "Smart Strips ™" for their largest dorm but saw no noticeable reduction in power consumption. Hall felt that this was due to the complexity of the Smart Strip ™. The Smart Strip ™ is similar to a regular power strip that one can plug various devices into and turn off with the push of a button. The Smart Strip™ is different from a regular power strip in that it has a control outlet for a computer and several other switched outlets connected to the control outlet for computer accessories like a monitor and printer. When the computer is turned off, the Smart Strip™ senses this and shuts off power to the monitor and printer. In addition to these three dependent outlets, the Smart Strip™ also has several constant hot outlets for electronic items that need to remain turned on, such as an alarm clock or a cell phone charger (Hall, 2009). Purchasing and distributing power strips to dorm residents may be the most viable and effective solution to reducing power consumption. Using simple power strips may be more effective if students do not have to think too much about how they work. This would avoid the issue of complexity that may have been the downfall of the CU Boulder Smart Strip ™ distribution program. Encouraging students to plug computers, game consoles and other electronics into power strips and then turning the strip off when the devices are not in use could help lower the ghost load produced by electronics in on-campus housing, saving the campus money spent on electricity and reducing the overall carbon footprint of the school. Coupling power strip distribution with an incentive program may lead to a noticeable reduction in energy consumption. A comprehensive sustainability competition that pits the several houses against each other in areas such as energy consumption, water use, recycling rate, and other areas may be a useful motivational tool.

Conclusion

Ghost loads are currently gaining attention as a consumer and waster of large amounts of energy and money worldwide as well as the cause of large amounts of greenhouse gas emissions. UCCS is no exception to this with hundreds of dollars a week being spent to power computers and other equipment in labs and offices that sit idle. Solutions and strategies for reducing energy consumption are more important now than ever before due to budget reductions because of the poor economy. Implementing creative solutions that could save UCCS $37,505.96-$45,017.56 per year leads to a more effective and efficient use of the school's budget, hopefully, making hard economic times a little less painful. Ghost loads also present UCCS with the opportunity to make the planet a better place by reducing the amount of emitted CO_2 directly attributable to electricity consumption at the school by 521.73-626.07 tons. As a rising innovator and leader in the field of sustainability, the University has the opportunity to become a good example to others in implementing practical solutions that can make a carbon footprint a little smaller by reducing the amount of energy consumed by idle electronics.

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