Paper and Energy Audit of Computing and Printing

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III. Executive Summary

Western Michigan University began transitioning administrative offices toward the use of digital documentation. This is a system where old documents are scanned and stored into an oracle database on a linux server located on the third floor of the campus computing center. New documents are also electronically filed in this database. The goal of this process is to cut down the amount of paper usage on campus therefore leading to cost savings and a more efficient system of documentation. Research and data has not been collected on campus to verify if this is actually the case. Along with a lack of research into potential cost savings, no research has been done to examine if digital imaging is reducing or promoting our environmental impact on campus. Our project aimed to be the first of this kind on campus. Power meters were used to compare computing power usage in kilowatt hours (kWh) between digital imaging and standard filing offices. We also recorded data on the number of pages printed in each office for comparative analysis. An audit of two Geographic Information System (GIS) computing labs was also conducted. The two labs are identical in size but use different computer models.

The task of collecting meaningful data proved to be a daunting task. With only one digital imaging office currently on campus this severely limited our options for collection. The power meters provided to us by the Office for Sustainability were the P4400 Kill-A-Watt. Readings collected by this model offered us total hours elapsed and kWh used. Since the meters offered no way to measure frequency and tell when power spikes occurred, this limited the scope of our data. The results of our data showed us that more refined collection methods must be used to find the data accuracy we were looking for. The data we collected provided us with the total kWh used during the sampling period. Through using a conversion factor we were able to convert the kWh figures into pounds of equivalent carbon dioxide emissions (lbs. eCO_2).

Upon further review we believe that future energy audits should be conducted on campus. Valuable insight into our energy consumption habits can be provided through this data. Research should be continued on the pros and cons of digital imaging. Proper data on this subject could be extremely valuable to the university.

IV. Introduction

Western Michigan University has been making an attempt to reduce the amount of paper used across campus as well as the energy used in computer labs and offices. Policies, such as required double-sided printing and automatic shut off on computers have been implemented for campus IT labs. Unfortunately, these policies are not always enforced and computers are often left on when not in use. In order to reduce Western's environmental

impacts and improve sustainability, improving energy conservation is something that will benefit the university now and in the future.

Currently, the United States energy production is largely from nonrenewable sources such as coal, oil, and natural gas. Eventually these resources are going to be depleted and our society will have to find alternative ways to address our energy needs. We will have to create a new renewable energy infrastructure composed of PV solar panels, wind turbines, or other renewable energy sources. Through conducting an energy audit on two offices located in the College of Education and two computer labs using different computer models, data was made available which could help the university reduce their energy demand. First of the two offices is, the Teacher Certification office located in 2217 Sangren Hall. The second office is the College of Education and Human Development Advising Office located in 2504 Sangren Hall. This office was much larger and does not use digital documentation. The two computer labs that we audited were separate GIS labs located in Wood Hall in rooms 2109 and 2107. In room 2109, the computers were OptiPlex 772, and in room 2107, the computers were OptiPlex 990. We are unable to tell which lab is used more, but by looking at each computer separately, we hoped to tell which model uses more energy. Western Michigan University generates their energy from a natural gas power plant located on Stadium Drive. Even though natural gas is better than coal in regards to CO_2 emissions, natural gas is still a non-renewable resource. If we can reduce the amount of energy produced it will not only save the university money, but help reduce greenhouse gas emissions.

Simultaneously to the energy audit, we also conducted a paper audit at the two offices and the GIS computer labs. This data will help us identify which labs and offices use more paper, where most of the paper use is coming from, and if the lab or office is using any paper reduction methods. If no reduction method is used, we can suggest methods and strategies for them. Paper is a valuable resource that needs to be recycled and conserved as much as possible. Identifying areas where paper can be conserved will cut costs for the university and promote campus greening.

V. Methodology and Data

Our research is broken down into two scopes. Scope I focuses on IT and printer energy usage measured in kWh. Data was collected in two administrative offices and two computer labs; the Teacher Certification Office located in 2217 Sangren Hall, and the College of Education and Human Development Advising Office located in 2504 Sangren Hall. GIS computer labs included were, 2109 and 2107 Wood Hall. Scope II of our project focuses on the amount of paper printed in each administrative office and in the computer labs. We measured the kWh using the P3 International, P4400 Kill-A-Watt power meter. The P4400 model is designed to record cumulative kWh at 0.2% accuracy. This is the most basic of their power meters. The

power meters were installed on Monday mornings and left for one work week (101-103hrs). On Friday at 4:00pm of each research week, the kilowatt hour usage was recorded with the number of hours from the time of installation and collection. A cell phone video and picture camera was used to view power meters that were in awkward areas. Power meters were acquired though the Office for Sustainability with assistance from Matt Hollander for ordering 10 meters on February 22 and 15 meters on February 28, 2012. Jeff Spoelstra assisted in meter checkouts. The number of pages printed was recorded using a Print Usage Page available on the printers' memory and by using a tally system where printing is minimal. A Print Usage Page was printed at the time of installation; a second Print Usage Page was then printed at the time of collection. From here we would subtract the total number of prints to calculate the number of pages printed (Appendix F: Print Usage Page).

Coordination for access to research the offices and labs were conducted through emails and meetings. Dr. Glasser provided us contact information for Allison Davis, Project Coordinator of the College of Education and Human Development (CoEHD) Imaging Initiative. Meetings with Allison were set up via email and were held in her office, 3314 Sangren Hall. We discussed goals, history, and current progress of the Imaging Initiative and how it relates to sustainability. Allison provided contact information for Cindy DeRyke in the Certification Office, Laura Ciccantell in the CoEHD Advising office, and Toby Boyle and Tom Marquardt in the University Computing Center (UCC). Tours of each office were conducted during the week prior to installation. These tours allowed us to have an understanding of the layout, as well as number of meters and power strips needed. Our presence in the offices a week prior to installation also allowed us to familiarize with staff and faculty, so there would be less confusion on installation days.

Microsoft Excel 2010 was used to input our data for analysis. Tables are divided into room number, device, use of power strip, time in hours, kWh, and GHG emissions (lbs. eCO_2). Computer and printer totals were included in the tables but omitted from graphs due to the visual manipulation of each series (Appendix-E). A separate table with graphs was made for cumulative printer usage comparing kWh and pages printed.

Greenhouse gas (GHG) emissions were calculated using an emission factor of 2.3 lbs. eCO_2/kWh. This emission factor was found using the *Emissions & Generation Resource Integrated Database (eGRID)* website, and Dr. Glasser's recommendations. The emission factor was last updated in 2005. By selecting the Data tab, Electric Generating Company (EGC) Location (Operator)-based, check Consumers Energy Company and view data. We converted and output emissions rate of 2,231.63 lb/MWh to 2.3 lbs eCO_2/kWh adjusted based on the year last updated and other recommendations.

Scope I- Energy Usage

Teacher Certification Office 2217 Sangren Hall

We chose to audit this office because it is the first administrative office that uses ImageNow for digital documentation. The teacher Certification Office consists of four desks, each with one Dell OptiPlex 755 desktop computer, two flat screen monitors, one set of personal computer speakers, and three main use printers. The layout of the office is designed with a separate interior office, front, back, and side desk (Appendix D-1). The HP LaserJet 4100tn printer is located between the front desk and back desk, the Dell 2335dn printer was located in the back left corner, and the Xerox Copycenter C20 printer/copier is located at the front of the office to the left of the door. One power meter would record the kWh of one desktop computer, two monitors, and one set of personal computer speakers. A total of seven power meters were used in this office. The power meters were plugged into the wall outlet, a power strip was then connected into the power meter. Computer monitors and speakers were then plugged into the power strip. Office 2217-A had the only meter plugged into a power strip first using two power strips total. Printers and copiers were each set on one individual power meter. The power meters were installed on Monday mornings and left for one work week (101-103hrs). On Friday at 4:00pm of each research week, the kilowatt hour usage was recorded with the number of hours from the time of installation and collection.

College of Education and Human Development 2504 Sangren Hall

Our method of kWh data collection for 2504 Sangren was the same as used in 2217 Sangren. The advising office consists of 9 offices and 11 desks with 11 computers, two printers and one typewriter. Four individual advisor offices and one storage room are located in the main office; across the hall are four individual advisor offices (Appendix D-1). Each desk has two flat screen monitors, one computer, and personal speakers. The main lobby has an assistant's desk with an OptiPlex 320 and Brother IntelliFax 2800, front main desk OptiPlex 990 and personal computer speakers, and a Dell Latitude D510 sign-in laptop for students. The printer used in the main lobby is a HP LaserJet P4015x. The main printer/copier, a RICOH Aficio MP C3300 is used for mass print jobs, located in the storage room. Each desk was set up on one power strip connected to the power meter. A total of 14 power meters were used in the advising office. Printers/copiers, the typewriter, and the sign-in laptop were each attached to individual power meters. Power meter installation and collection methods were repeated from the Teacher Certification Office.

GIS Labs 2109 & 2107 Wood Hall

GIS lab 2109 consisted of nine OptiPlex 755 computes that were recorded for useable data in collection and analysis. GIS lab 2107 consisted of 16 OptiPlex 990, computers that were recoded for usable data. Approval for access to these labs was granted by Mary Lou Brooks in the Geography Department. The lay out of the labs can be viewed in Appendix D-2. Power meters were installed on floor outlets located under each desk. The power meters had to be secured using small strips of duct-tape. The best method for this was to tear the tape in half long ways and then set one strip across the top and bottom of the power meter. This prevented the meters from being tampered or knocked out of place by chairs and feet. Computers were plugged into a power strip that was plugged into the power meter. Two of the members in our group are Geography students and have key card access to the labs. Installation and collection dates and times were consistent with the Teacher Certification office and advising office.

Scope II: Paper Usage

Teacher Certification Office 2217 Sangren Hall

The HP LaserJet 4100tn printer is located between the front desk and back desk, the Dell 2335dn printer was located in the back left corner, and the Xerox Copycenter C20 printer/copier is located at the front of the office to the left of the door. Our method for number of pages printed was the use of a tally system for the Certification office, due to small print jobs and no mass printing. When talking with the Certification Director, we agreed that a tally sheet printed from Excel taped near the printers would reasonable.

College of Education and Human Development 2504 Sangren Hall

The printer used in the main lobby is a HP LaserJet P4015x. The main printer/copier, a RICOH Aficio MP C3300 is used for mass print jobs, located in the storage room. A Print Usage Page for the HP LaserJet P4015x was used to record the number of pages printed throughout the week and number of pages printed was recorded using the digital menu on the RICOH Aficio MP C3300. This menu was unable to print a usage page. A Print Usage Page was printed at the time of installation; a second Print Usage Page was then printed at the time of collection. From here we would subtract the total number of prints to calculate the number of pages printed (Appendix F: Print Usage Page). This data was recorded into the Excel spread sheet.

GIS Lab 2109 and 2107 Wood Hall:

The printer in 2109 is a HP LaserJet P4015 and in 2107 is a HP LaserJet 4200n; a print usage page was printed from each to record the number of pages printed. The same process of

subtracting the total prints from the start and end of the week, calculated the exact number of pages printed.

VI. Examples of Best Practice on Campus

Western Michigan University has made significant strides around campus towards limiting our environmental impact. Seen as a leader among universities for promoting campus sustainability, WMU is constantly looking for ways to improve upon our ecological footprint. In 2009 President Dunn signed the American College and University Presidents Climate Commitment (ACUPCC). The ACUPCC requires universities to submit extensive plans on how they plan to reach climate neutrality and documentation of their goals along the way. Commitment to the ACUPCC demonstrates WMU's dedication to improving our ecocultural sustainability.

Computing Energy Reduction

One of the major contributions to help reduce computer related energy consumption was joining the Climate Savers Computing Initiative (CSCI). The policies of the CSCI include enabling power management settings for all applicable computers and printers to reduce electricity consumption. Computers and related equipment are mandated to be turned off during extended periods of non-activity (nights, weekends, holidays, etc.). Computers create heat which in turn creates higher costs for cooling expenses during warmer months. Through the implementation of the CSCI, WMU has saved significant amounts of energy as well as reducing carbon dioxide emissions for campus. WMU has been a member of the CSCI since 2009.

Since 2000 WMU has been a partner of the Energy Star Purchasing Policy. The Energy Star program identifies devices which are 25-50% more efficient and certifies them. Appliances and equipment that are certified will be purchased for use by WMU whenever it is practical. WMU acknowledged that the initial cost of certified devices will generally be higher, but longer life cycles and the reduction of energy costs will prove beneficial down the road. Being an Energy Star purchaser for over a decade shows WMU's commitment to reducing energy consumption and improving the ecocultural sustainability of campus.

Paper Reduction

Paper reduction has been recently evolving around campus. WMU has shown initiative in implementing policies such as mandating all paper purchased must be 30% post-consumer. Currently WMU has been working on offices moving away from printing documents and filing them away. The Teacher Certification Office in Sangren Hall has transitioned to become the first office on campus to use digital imaging. Documents which were on paper have been scanned

and filed electronically. All new documents will be filed electronically, which has significantly decreased the amount of paper waste used by the office. Looking towards the future, WMU plans to transition all offices to using digital imaging. Currently the Arts and Sciences Advising Office and the Education Advising Office are in the process of making the transition. No timetable has been set for the completion of the project however because of limits to developing software.

*Full text documents for Energy Star Purchasing, the ACUPCC, the CSCI, and other initiatives are available at: http://www.wmich.edu/sustainability/policy/index.html

VII. Examples of Best Practice on Other Campuses

The advancement of campus greening has great potential to be multifaceted. Through applications of social learning we can look at what other universities are doing to promote sustainability. This can be a valuable method to stay ahead of the curve and use the lessons others have learned to better guide the initiatives of our own campus. Best practice analysis can be implemented to help decipher the direction of campus greening at WMU. The best practices of energy audits that we found occurred at the University of Colorado at Boulder. We believe that WMU should look strongly at their practices and consider implementation of new policies.

University of Colorado at Boulder

To promote greening of state institutions, the Colorado state government set forth an executive order to ensure the proper measures were being taken. Included in the executive order were actions to reduce electrical and paper consumption. Electricity and paper consumption figures from 2005-2006 were used as the baseline numbers for the university. The goals of the order included having a 20% reduction of both electricity and paper by 2011-2012. In order to achieve their energy reduction goals the university has a program which carries out energy audits to help identify unsustainable practices. Recommendations from the program are taken into consideration and appropriate actions are taken. Sub meters were purchased and installed on buildings which were thought to be inefficient or outdated. This allowed them to identify buildings on campus that could use upgrades. The program has been successful and they have intentions to expand it. The Energy Star program was also put into place to help with future reductions of electricity.

Reduction of paper usage has occurred in several areas on campus. The installation of a "pay for print" policy was labeled as being very successful in reducing the amount of pages printed by each student. They have also had great success switching over to electronic billing

and payment acceptance. This alone is estimated to save the university 400,000 pieces of paper on a yearly basis. The introduction of e-memos, double-sided copying, and imaging services have reduced paper consumption within departments which cooperate. Future projects for the university include reducing telephone directories delivered on campus by 25%. It is estimated this would account for 25 tons of paper reduction. Facilities Management Business Services is looking to convert several forms to an electronic format such as travel authorization forms, official function forms, and leave requests. The University of Colorado at Boulder has outlined their objectives in an organized manner which has allowed them to systematically achieve their goals.

The University of Colorado at Boulder was the only institution we could find that has an energy auditing program. The program is run by a position titled the Energy Audit Officer. A hotline is available to report issues with improperly functioning electronic devices that may be draining energy. The hotline also serves as a way to report unsustainable practices that faculty or students may be taking part in. An energy audit checklist has been developed for systematically performing energy audits. This adds an element of consistency throughout any audits that are performed. Separate checklists are available for auditing whole buildings, labs, and kitchens. After the audit is performed there is a standardized form for a follow up of the audit. Also available on their website is a list for energy conservation tips. This tool can help promote sustainable practices around campus for both faculty and students. The university has created a program called Buff Energy Star. The program promotes good conservation practices around campus. Awards are given out for buildings and offices that follow the guidelines of university conservation policies.

We believe that Western Michigan University can learn a great deal from reviewing the policies above. Future energy audits could be easily compared if an audit checklist is developed. Data collection methods would be standardized therefore providing results which would be comparable between audits. If future audits are to be deeply researched, WMU most develop a structured methodology for data collection.

VIII. Discussion

The discussion section will be divided in the following manner: We will first look at the data results for each office individually, and then compare the offices to one another. Secondly, we will look at the data for each GIS lab individually then a comparison will be conducted between the labs.

College of Education and Development Offices

Teacher Certification Office

Data for this office was collected from February 27th through March 2nd, 2012. Each power meter was installed on a device for a total of 102 hours. The kWh per computer remained relatively static between office employees. The average kWh usage was 3.58 for 4 computers. Computer OptiPlex 755 in room 2217A recorded the highest energy usage at 3.59 kWh. The kWh usage for printers was below the kWh usage for computers which is expected. The Xerox Copycenter/printer had the highest kWh usage in the Certification Office which is expected because it has the capabilities to do much more than simply print. The two printers averaged a kWh usage of 1.71. The complete energy audit results of the Teacher Certification office can be seen in figure 8.1.

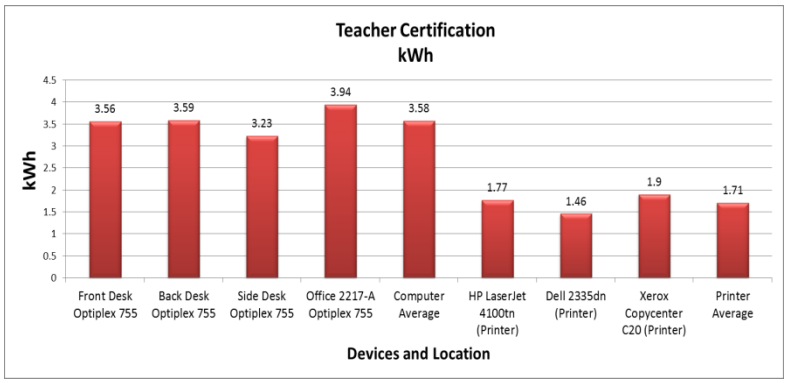

Figure 8.1 – Teacher Certification Office kWh.

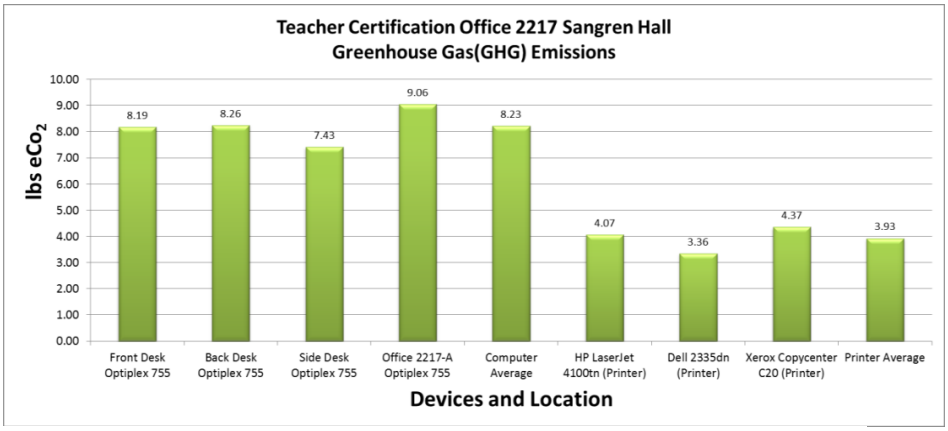

Figure 8.2 – Teacher Certification Office GHG Emissions

Greenhouse gas emissions for the Certification Office correlate to the kWh usage of the devices. With more energy use, more GHG emissions are present. The data that we converted to GHG emissions can be seen in figure 8.2.

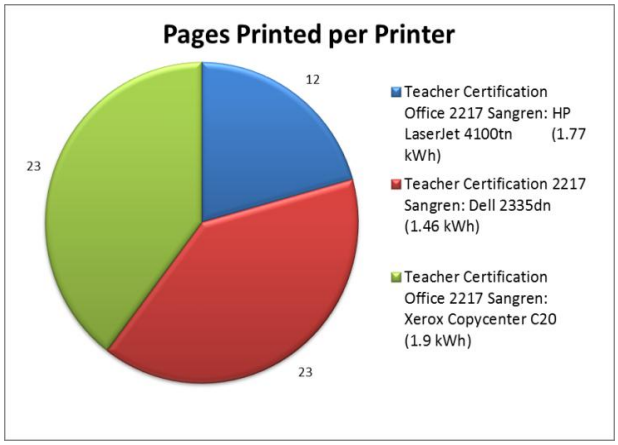

Figure 8.3 – Teacher's Certification Office print totals.

The Certification Office had the lowest paper use of any of the offices or labs that we audited across campus. The Certification Office is the only office that claims to be paperless and it shows with only 58 pages printed throughout the course of the week. This office is small in terms of size, but averaging about 12 pages a day for an entire office is very minimal. A breakdown of where the prints came from can be seen in figure 8.3. The interesting thing to note is that each printer used

around the same amount of kWh and there was not a large difference in pages printed. The Copycenter did have the highest kWh but it had the same amount of pages printed as the Dell 2335dn located in the center of the office, as you can see in appendix D-1. The printer located in the back of the office has median kWh usage but the minimum number of prints. We can't conclude if any of these printers were turned off at night or were on power saver mode.

Looking at the data for the certification office not much can be concluded in terms of which computer model used more energy, or which printer uses more energy when it prints; however, we can conclude that different power meters and a more controlled data collection process is needed to run an in-depth analysis. If this was done, we could include which computer model uses more energy, the GHG translation, and the kWh usage when a printer is processing a job.

College of Education Advising Office

We collected data in the Advising Office from March 12th through March 16th, 2012. The power meters were recording data for a total of 102 hours. The kWh data for this office varied between computers more so then we expected because the advising office has multiple offices that should be completing the same work. The GX620 located in room 2505(See appendix D-1 for location) had an extremely high kWh usage compared to the other computers. We noticed that the computer in this office was left on overnight during the week. The kWh for the Advising office can be seen in figure 8.4.

The greenhouse gas emissions for the Advising Office correlate to the kWh usage. The higher the energy use, the greater the eCO_2 emissions. The OptiPlex GX620 located in room 2505 had the highest kWh usage and the greatest GHG emissions at 37.5 lbs of eCO_2. The typewriter that was used very rarely to produce labels for the filing cabinets had the lowest kWh

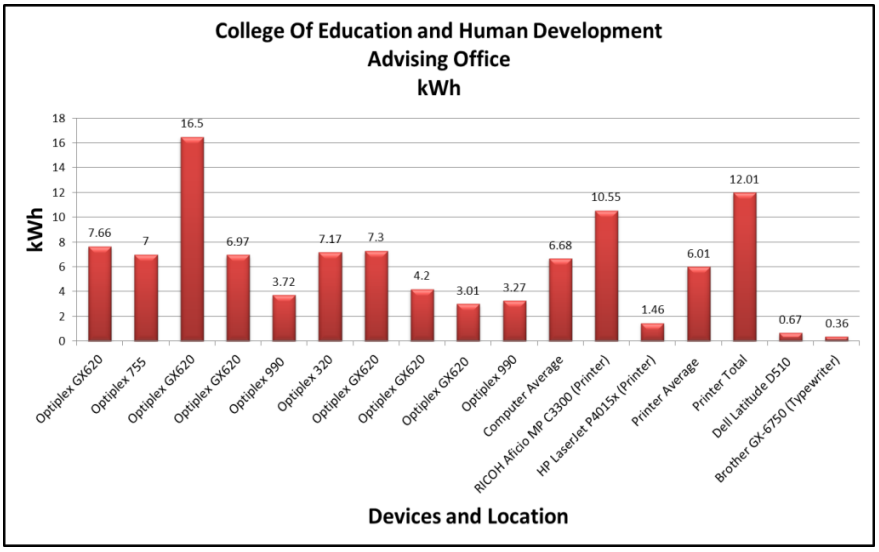

Figure 8.4 – Advising Office kWh.

and GHG emissions at only .36 kwh and .83 lbs. of eCO_2 respectively. A graphical representation of the GHG emissions can be seen in figure 8.5.

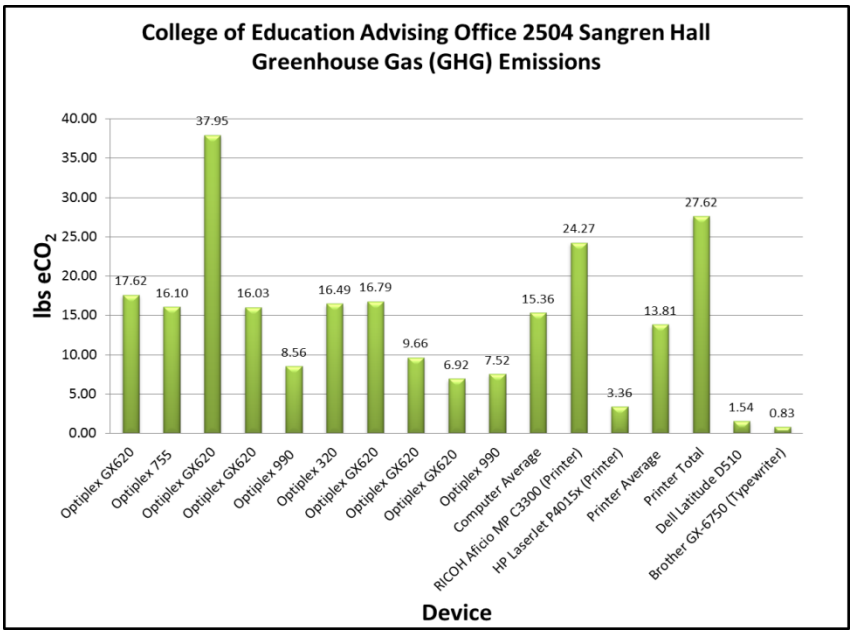

Figure 8.5 – Advising Office GHG emissions.

The total number of pages printed in this office is extremely high, but that can be expected because the Advising Office is responsible for keeping a detailed record of every student that is enrolled in the College of Education. The grand total of prints in the advising office was just over 2 reams at 1266 pages. (1 ream = 500 sheets). In one week that is a high volume of pages printed. Figure 8.6 gives a graphical breakdown of the prints per printer. The Advising Office's two printers differed greatly in total prints. The RICOH Aficio MP had the majority of the prints at 1085, compared to the HP LaserJet that only had 181 prints. It seems possible that the Advising office could go without the HP LaserJet and simply rely on the RICOH for all their printing needs.

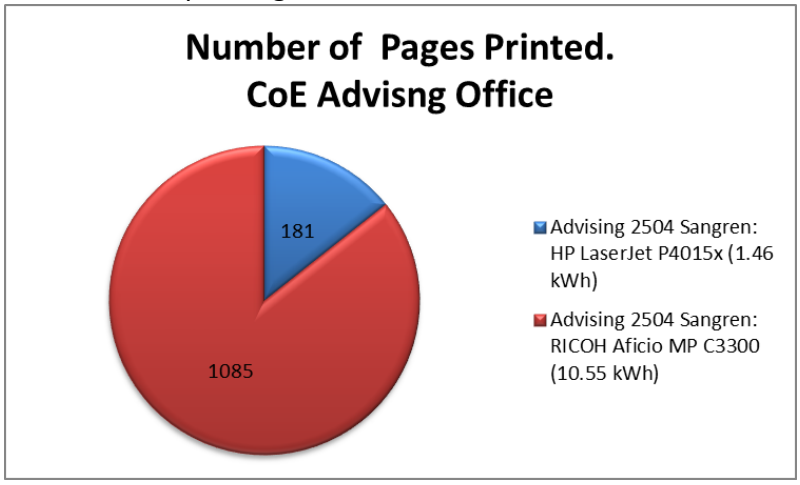

Figure 8.6 – Advising Office Print totals.

Looking at the data for the Advising Office, not much can be concluded in terms of which computer model used more energy, or which printer uses more energy when it prints; however, we can conclude that different power meters and a more controlled data collection process is needed to run an in-depth analysis. We can also conclude that leaving a computer on overnight easily uses more energy than powering down at the end of the day. If the OptiPlex GX620 located in room 2505 was turned off at night, the GHG emissions and kWh usage could be cut in half.

Comparison of Certification Office and Advising Office

When comparing the two offices, we cannot conclude that the type of computers and printer had an effect on the kWh usage or the GHG emissions. The two offices varied greatly in size and student traffic. No traffic data was recorded but it is expected that the Advising Office sees more students on a day to day basis. On average, the kWh for computers in the Teacher Certification Office was about half the average kWh for the Advising Office. We cannot conclude what the exact reasons for this are, but we hypothesize that it is due to student traffic. In terms of GHG emissions, the advising office had a higher on average GHG release then the Teacher Certification Office but this correlates to kWh usage, where the advising office had higher energy usage. Paper usage in the two offices varied greatly and we hypothesize this is because of the Advising Office does not partake in the ImageNow software and also have to record information on a greater number of students. The Teacher Certification Office had a total of 58 prints throughout the week, compared to the Advising Office who had 1,266 prints. Figure 8.7 shows this comparison graphically. The Advising Office had 21 times as many prints as the Certification Office but only used twice as much kWh on average. This could allow us to conclude that the number of prints does not correlate to energy usage, but we cannot be certain because a more detailed analysis must be done.

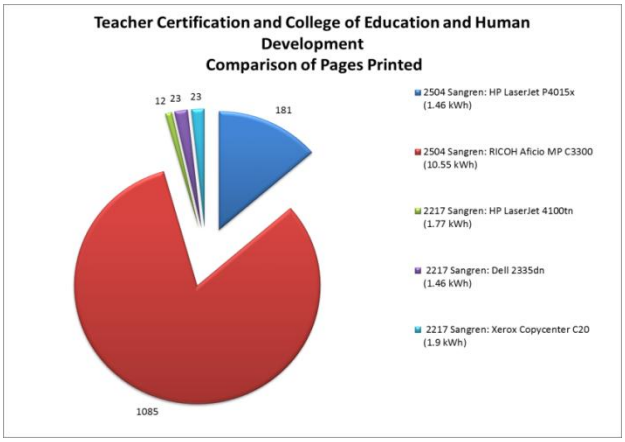

Figure 8.7 – Print Comparison of Certification Office and Advising Office.

GIS Computer Labs

Lab 2109

Data was collected for this lab during the week of March 26th through March 30th, 2012. Most of the data was collected for a total of 102 hours. There was one case in which the power meter was unplugged by a student so the meter only recorded data for 71 hours. There were 20 computers in lab 2109, all of which were the Dell OptiPlex

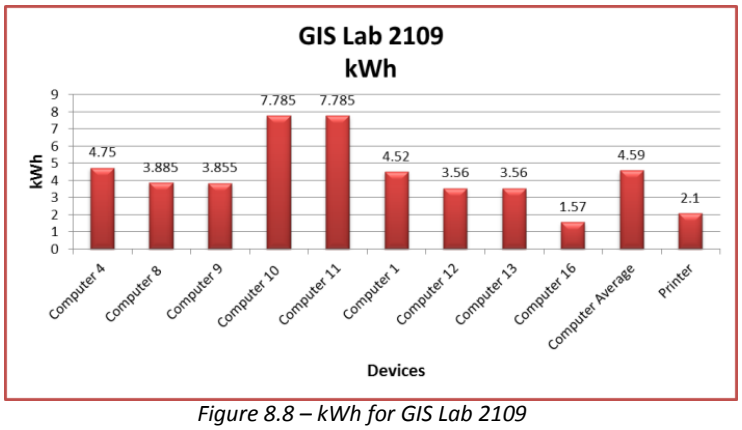

Figure 8.8 – kWh for GIS Lab 2109

755 but only 9 of these computers took part in the audit. We chose the computers in a random sample but the computers also needed to not be in use at the time of installation. The general layout for the computer lab can be viewed in Appendix D-2.

The kWh usage for lab 2109 gives us a lot of information. There are two computers, #10 and #11, that used more energy than the other computers in the lab. These computers were recorded on the same power meter due to the limited number of outlets in the labs. There is no way to tell if computer #10 used more energy than #11, or vice versa. In order to analyze the data for these computers, we had to average the initial reading to 7.785 kWh per computer. We had to do this for multiple computers in the lab. The kWh readings for the lab can be seen in figure 8.8. There was a wide range of energy usage between the computers. Computer 16 only recorded 1.57 kWh for the entire week which could mean that it was hardly turned on throughout the week.

Greenhouse gas emissions for lab 2109 correlate to energy usage. Computers #10 and #11 have the highest lbs. of eCO_2 because they had the highest energy usage. Figure 8.9 is a graphical representation of the GHG emissions for GIS Lab 2109. Computer #16 only used 1.57 kWh and had 3.61 lbs. of eCO_2 respectively.

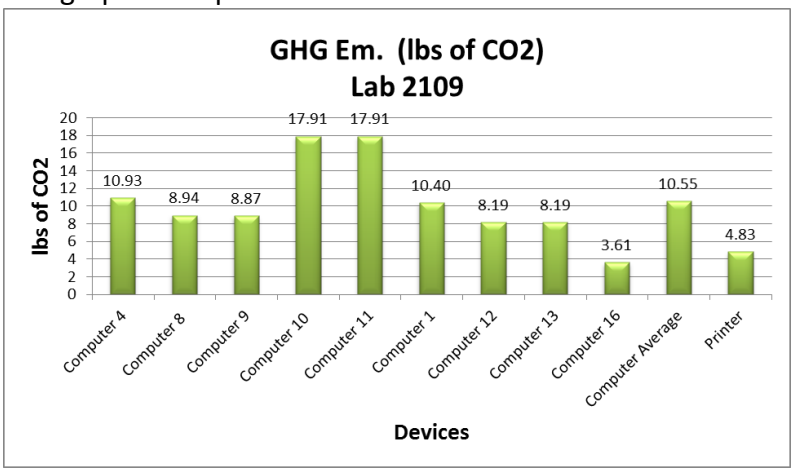

Figure 8.9 – GHG emissions of Lab 2109

Paper usage in the GIS Lab was extremely high considering that there is only printer in the lab and that there is no paperwork being printed for faculty use. Lab 2109 is primarily used by students where they can print at their convenience. The lab had 1068 prints in one week all of which came from the single HP LaserJet printer.

Looking at the data for Lab 2109, not much can be concluded in terms of which computers used more energy, or how many kWh the printer used in processing the jobs; however, we can conclude that different power meters and a more controlled data collection process is needed to run an in-depth analysis. It would also be beneficial if we could record one computer on a single

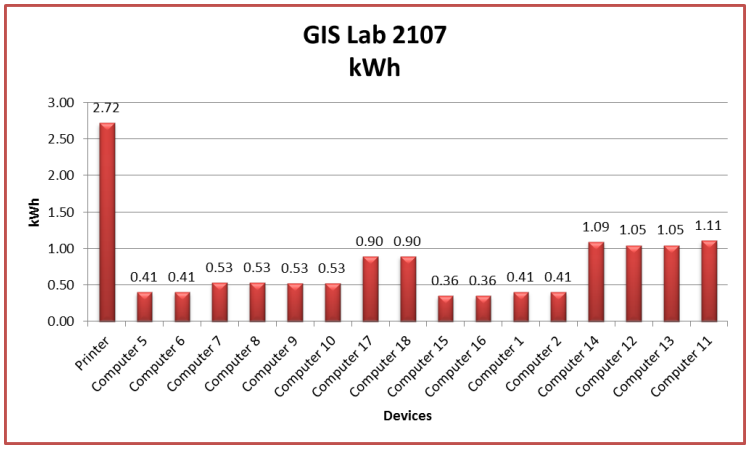

Figure 8.10 – kWh for Lab 2107

power meter and record if and when the computer was used. This would alleviate multiple computers being recorded on a single power meter which makes it hard to tell which computer was actually used. If these steps were taken, we could conclude how many kWh the computers use on average and the difference in usage when in use and not in use.

Lab 2107

Data was collected for this lab during the week of April 2nd[h] through April 6th, 2012. Most of the data was collected for a total of 102 hours. There were a total of 20 computers in lab 2107 but we only collected data on 16 of them due to a limit in the number of power meters and some computers being in use at the time of installation. The computers in lab 2107 were OptiPlex 990. Figure 8.10 graphically displays the kWh usage for lab 2107. The kWh is so low because in order to record data for as many computers as possible, multiple computers were hooked up to each power meter. The final readings were then averaged between the two computers to give us the best estimation on what the kWh was for each computer individually. The information presented shows that the kWh usage remained relatively static across the lab. The computers toward the back of the lab (see appendix D-2) have the highest energy usage. The printer is the only unit that was recorded individually in lab 2107 and had 2.72 kWh in energy usage throughout the week.

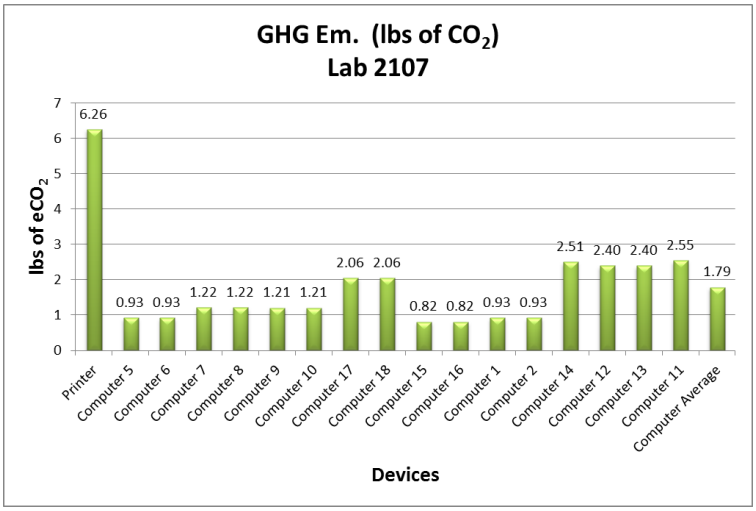

Figure 8.11 – kWh for Lab 2107

Greenhouse gas emissions for Lab 2107 correlate to energy usage. Computers 11 -14 experienced the highest kWh usage and in turn have the greatest lbs. of eCO_2 released at around 2.5 lbs. e CO_2. The graphical representation of GHG emissions can be seen in figure 8.11. The printer used in this lab had the greatest emission factor in terms of lbs. of eCO_2 but the printer was also recorded on a single power meter which and was not averaged across any other device. Like kWh, GHG emissions are relatively static across lab 2107. There are not big outliers that skew the data in anyway.

Paper use in lab 2107 was high considering there was only printer in room 2107. Throughout the week, lab 2107 saw a total of 722 prints. These prints all came from the HP LaserJet printer located inside the lab.

Looking at the data for Lab 2107, not much can be concluded in terms of which computers used more energy, or how many kWh the printer used in processing the jobs; however, we can conclude that different power meters and a more controlled data collection process is needed to run an in-depth analysis. It would also be beneficial if we could record one computer on a single power meter and record if the computer was used. This would alleviate from multiple computers being recorded on a single power meter which makes it hard to tell which computer was actually used. If these steps were taken, we could conclude how many kWh the computers use on average and the difference in usage when in use and not in use.

Comparison of GIS labs

When comparing the two labs, we cannot conclude that the different types of computers correlated to the kWh used or the GHG emissions. The Dell OptiPlex 990 was used in lab 2107 and the Dell OptiPlex 755 in Lab 2109. The result for each lab does not allow us to conclude that either of the computers was better in terms of energy use then the other. The kWh and the GHG emissions between the two computer labs are similar but lab 2107 had less in each category which may conclude that lab 2107 was used less throughout the audit week. We do not know this for sure because the power meters were not advanced enough. Comparing the paper use between the two labs also suggests that Lab 2107 was used less than Lab 2109. Lab 2109 had 1098 prints compared to only 722 for Lab 2107. A more detailed analysis is needed to fully understand the energy use, GHG emissions, and paper use in relation to these labs.

IX. Limitations of Analysis and Future Work

Limitations

The P4400 Kill-A-Watt power meters are poorly designed in our opinion. The design does not allow for multiple devices to be plugged into the same outlet housing. We needed separate power outlet housings for each individual power meter which caused some problems. The poorly designed power meters prevented office faculty from plugging anything else into the outlet above or below the meter. (Appendix C: 1) We were forced to use multiple power strips which may have caused variations in our data. (Appendix C: 3) This could have resulted in faculty plugging into power strips directly connected to the power meters. We are unaware if this happened but if so it could have altered the data. The offices also had many appliances plugged in such as phone chargers, coffee makers, mug warmers, pencil sharpeners, and space heaters. We had to work around these and make sure no appliances were plugged into our power meters. With the poor design of the meters, some of these items had to be unplugged or moved to different outlets which may have frustrated some faculty members. Staff members were asked to not use power strips connected to meters and seemed to be cooperative in doing so.

The GIS labs in Wood Hall had power outlets located on the ground beneath the computers. There was dust surrounding and inside the outlets which could have been a fire hazard. The outlets were close enough to be reached by the wheels of computer chairs and feet of students which could cause meters to be unplugged. To fix this solution a strip of duct tape was placed over top of the meters to secure them to the floor. Due to the poor positioning of the outlets in the GIS labs, some meters needed to record data for two computers. Compensating for this issue the data was divided in half and equal data values were assigned to each computer. This prohibited us from knowing which computer had more usage.

If the power meters were able to store data long term, it would have been very beneficial. The power meters that were provided to us by the Office of Sustainability only record data until they are unplugged. Power meters that are able to store data once they are unplugged and could provide information on times when power spikes occurred would have been helpful.

Western Michigan University also has a very limited number of digital imaging offices on campus. The Teacher Certification Office is the only digital imaging office on campus. This limits our data collection options because we only have one digital imaging office for research. It would have been advantageous for the Teacher Certification Office to be similar in size to the College of Education Advising Office. This would allow for more comparable results.

Limitations also included any unknown variables that we could not control or were unable to monitor. The computers in the Advising Office and the Certification Office were supposed to be turned off at night, but we have no way of verifying that this was done. Visits to the offices after hours revealed that some monitors, speakers, and personal printers were left on after staff was gone. The data collection involved a lot of trust with faculty members. Additional appliances or devices could have been plugged into the power meters which could have impacted our data. In the Teacher Certification Office we relied on the faculty members to log how many prints they made throughout the week. It would have been easy for an employee to forget to record their prints. In the GIS labs, instead of faculty members to trust, we had to trust Western Michigan University students. A student could plug in devices such as a phone charger into the power meters and there would be no way for us to document this. We did leave a note on the whiteboard but we cannot trust that this was followed. With so many computers in the GIS labs it is hard to tell which were used more frequently and what the reasoning behind this is. The computers and printers in the GIS labs may or may not have been turned off at night. It is the student's responsibility to turn off the computers after use. It is possible that certain computers in the labs operated faster than others based on the amount of programs unknowingly running in the background. We were not able to identify which computers operate more efficiently.

Future Work

We recommend that the Teacher Certification Office and the Advising Office be audited again when the new Sangren Hall is completed in August of 2012. The faculty members in these offices were very eager to move buildings and had a great desire to learn of the results from our audit. Conducting a comparative analysis of our data and data collected from the new building could show positive changes in sustainably practices for the university. This opportunity does not come along frequently and should be taken advantage of.

It would be beneficial for a future audit to be done over a longer period of time allowing for a longer data collection period. Data that is collected for a longer period of time may show more trends and be more accurate. We would suggest running a two week energy and paper audit on each individual office and lab rather than the 1 week audit we conducted.

The power meters that we used should be substituted with a more efficient model. The P440 Kill-A-Watt power meter did accomplish what we wanted it to do, however it would have been nice for some added features or a more effective design. With no way of plugging anything else into the same power outlet, it was difficult to record individual devices with the limited number of power outlets. If the meters had a way to record data spikes throughout time, then further analysts could have been done. We could identify busy and slow times in terms of computer use and what the causes may have been.

The College of Education and Human Development Advising Office, along with other advising offices such as Arts and Sciences, are scheduled to be going paperless in the summer of 2012. These offices will use the ImageNow software that is currently being used in the Teacher Certification Office. We recommend that audits be done of these offices both before and after moving to digital imaging. Through comparative analysis more information could be collected on whether digital imaging is actually promoting campus greening.

Finally, we would recommend auditing a computer lab where it is easy to tell how frequently the computers are being used. Labs such as the BCC (Bernard Computing Center) or the UCC (University Computing Center) both have this to offer. The computers and printers are always turned off at night which is also something that cannot be guaranteed in the GIS labs. We were unable to audit these labs because of the way the computers are plugged in; easy access was not allowed for our power meters. To audit a lab of this size, sub metering may prove to provide more compelling data.

X. Recommendations

In order to lower Western Michigan University's energy use, we believe several actions should be taken in the two offices and GIS labs that we audited. Our recommendations should also be applied to other offices and labs across campus where necessary or appropriate.

Energy Recommendations

Western Michigan University signed on to The Climate Savers Computing Initiative (CSCI) in 2009, but very few of the policies outlined in the CSCI are being followed or enforced. One policy especially being ignored details that computers and related equipment are mandated to be turned off during extended periods of non-activity (nights, weekends, holidays, etc.). We made visits to the Teachers Certification Office and the Advising Office after hours and noticed that several of the computers, monitors, and printers were left on. Signage should be posted in these offices to remind the employees of what university policies are. If this does not work, then there needs to be some sort of consequence that will make sure these policies are enforced. Repercussions could be anything from warnings, volunteering on campus, to loss of personal days for repeat offenders. These consequences may sound strict but the university signed on to the CSCI in an effort to save money and energy. If this cannot be accomplished because of employees then measures need to be taken. The signage could be a small slip of paper on the top of the monitor that reads "Turn Computer and Monitor off after hours." A supplementary email should also be sent to each employee in the office explaining the policies and consequences for neglect.

The GIS labs are different because they are used primarily by geography students whom are granted 24 hour access to the computer labs. It is up to them to turn off the lights, computers, and monitors after they have been used. If this is not done by the student it is very unlikely that these steps will be taken until another student uses the computer. The printers in these facilities are on power-save mode when not in use. It is very unlikely that any student would take the initiative to turn off the printer if they are the last to leave the lab that night. We believe this could be solved in two ways. First, signage could be posted at each computer to remind the student to shut down the work station when finished. This would still leave the responsibility on a student and we cannot guarantee that this will be done. A second method, which could guarantee that the computers are being shut down at night, would be to have nighttime janitors power down all computers. There are janitors in the building throughout the night and one of them could easily come into the computer labs around midnight to turn off all the computers. This would leave the responsibility in the hands of a paid employee and is much more certain to be done. Through our observations much of the janitorial staff spend ample time playing cards and board games late at night, therefore they should be able to fit this task into their schedule.

Proper electrical cord organization would also help reduce the university's energy usage. During power meter installation in the offices we noticed that a lot of unnecessary appliances were plugged into the outlets. There were coffee makers, cell phone chargers, mini refrigerators and other non-necessary equipment plugged into the outlets. The university cannot force employees to not plug in any unnecessary equipment but it could provide a location where all of these could be consolidated in one central place. We found multiple coffee makers but this could be reduced to a single coffee maker in a break room area.

The GIS labs did not have any unnecessary items plugged into the outlets primarily because they are fully accessible by geography students and the students are aware that items left in the lab may be stolen.

Paper Recommendations

The GIS labs experienced an exceptionally large number of prints in the week of our analysis. There are multiple ways to address the paper usage in these computer labs. One method would be to connect the GIS labs to the students' individual printing account so any pages that are printed in the GIS labs count toward the 500 page semester allotment. This way a student does not feel the need to print off excessively large projects and have no consequences. The printers in these labs are not set up in a way that automatically prints double-sided. If a student wishes to print double-sided then they have to change this manually. Pages could easily be saved if the computers are set to print double-sided because it takes away the student responsibility to change the print set up.

In the Teacher Certification Office, only 58 pages were printed in the office over an entire week which is exceptionally low compared to the other offices and labs. The printers were set to double-sided printing which saved some paper. The office could make improvements in limiting the number of printers in the office. The Teacher certification office had three working printers. This could easily be cut to one which would save energy and ink. Our recommendation is to input a weekly goal for the number of pages printed. At the end of each week, the employees add up how many pages were printed throughout the week and see if they can get below what they printed the week before. Incentives for reducing prints below a certain number of prints could be implemented.

The Advising Office printed a total of 1986 pages throughout the week. This is very high but is difficult to reduce because a lot of these prints are necessary for students' academic filing. If the office is able to switch to ImageNow software in the future, there could be a significant reduction in the number of prints. Our recommendation is to input a weekly goal for the number of pages printed. At the end of each week, the employees add up how many pages were printed throughout the week and see if they can get below what they printed the week

before. Incentives for reducing this number below a certain number of prints could be implemented. We also recommend that communication between office employees occur through email or voicemail rather than printing messages and having them delivered to other employees.

Other computer labs across campus could take several actions in reducing the number of pages printed throughout the year. One recommendation would be to reduce the 500 page allotment to a more reasonable number like 250. We have talked to multiple students across campus and they say they have never even come close to reaching that limit. However if a student knows that they will never go beyond the limit, then they will print whatever they wish without putting any thought into it. If the student knows the limit could be reached, then they would take the steps in trying to reduce the number of pages they are printing. A second recommendation would be make sure that PowerPoint is programmed to always print presentations at a 6 slide per page layout. We and other students have noticed that some students print off an exceptionally large presentation at one slide per page when this could easily be done at 6 per page. The university would save 6 pages of paper for every 1 page printed if this was implemented. Thousands of dollars would be saved if any combination of these policies is implemented.

Other Recommendations

Throughout the installation process of the power meters we noticed that there were many fire hazards that were not being monitored. In the GIS labs, there was an excessively large amount of dust around and in the electrical outlets and there were times when three computers were plugged into a single power strip. In the offices, we noticed that the electrical cords were poorly organized and too many cords were plugged into the same outlet. Some of the power strips in the offices were also severely outdated. We recommend that the janitors in Wood Hall dust every so often around the power outlets and that additional power outlets be installed so each computer has its own outlet. The offices should go through and organize the power cords to make sure only one item is in each outlet.

If enforcing the policies set forth by the university is difficult, we recommend an energy conservation officer position be established. The energy conservation officer would be responsible in monitoring all energy use in computer labs and offices across campus. The officer would make sure that printers and computers are getting turned off at night and that employees are following any policy set forth by the university. Implementing this position would also ensure that future energy audits would be assimilated to ensure that data quality is at a level that would be acceptable for university decision making.

XI. References

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- "Myths and Facts." Sustainability of the Print & Paper Industry. Web. 5 Feb. 2012. http://www.twosides.info/Myths-and-Facts
- "Sustainability." Western Michigan University. Web. 4 Mar. 2012. http://www.wmich.edu/sustainability/

XII. Appendices

Appendix A: Group Member Contact List

Name	Phone Number	Email
Sean Kennedy	(313) – 407 – 8333	Sean.M.Kennedy@wmich.edu
Spencer Welling	(269) – 370 – 4469	Spencer.J.Welling@wmich.edu
Kris Dunlap	(269) – 317 – 6505	Kristopher.T.Dunlap@wmich.edu

Appendix B: Reference Contacts

Allison Davis
Project Coordinator
CoEHD Imaging Initiative
Email: allison.e.davis@wmich.edu
Phone: (269)387-2939
3314 Sangren Hall
**Provided contact information and coordination with Certification and advising offices; Toby Boyle and Tom Marquardt in the University Computing Center; informed us of the progress of the Imaging Initiative. *Arranged meetings: 2:00pm, February 10, 2012, in 3314 Sangren Hall; February 20, 2012, with Cindy Deryke for a tour of the Teacher Certification Office; 2:30pm, April 4, 2012, in 3314 Sangren Hall.*

Carol Morris-Mier
Office Manager
Office of Undergraduate Advising /College of Education and Human Development
Email: carol.morris-mier@wmich.edu
Phone: (269)-387-3474
2504 Sangren Hall
**Arranged meeting: 12:30pm, February 28, 2012, with Laura Ciccantell for tour of CoE&HD Advising Office.*

Carolyn Noack
Manager of Waste Reduction Services
Western Michigan University
Email: carolyn.noack@wmich.edu
Phone: 269-387-8165
232 Physical Plant
**Provided recycling services for the removal of metal file hangers in the Teacher Certification Office. *Arranged meeting: 10:30am, April 4, 2012, in Bernhard Center Cafeteria.*

Cindy DeRyke
Director of Teacher Certification
Email: cindy.deryke@wmich.edu
Phone: (269) 387-3476
2217 Sangren Hall
**Coordination of times for power meter installation and collection in Teacher Certification Office; brought to attention the need for recycling steel file hangers.*
**Arranged meeting: February 20, 2012, with Allison Davis for a tour of the Teacher Certification Office.*

Harold Glasser
Executive Director for Campus Sustainability
WMU Office for Sustainability
Email: harold.glasser@wmich.edu
Phone: (269) 387-0944
1309 Faunce Hall
**Professor of ENVS 4100 class; provided emission factors and weekly advise for project; provided contact information for Allison Davis and Cindy DeRyke.*
**Arranged meeting with Allison at 12:30 January 31, 2012, to discuss Imaging Initiative involvement in sustainability at WMU.*

Jeff Spoelstra
Sustainability Coordinator
WMU Office for Sustainability
Email: jeffrey.spoelstra@wmich.edu
Phone: (269)-387-0943
Faunce Hall
**Provided assistance in checking out power meters and power meter deliveries.*

Krystal Jansen
Certification Associate
Email: krystal.jansen@wmich.edu
Phone: (269) 387-3473
2217 Sangren Hall
**Helped coordinate meter installation times and collection times for the Teacher Certification Office. Prepared metal file hangers for collection.*

Laura Ciccantell
Director of Undergraduate Advising/College of Education and Human Development
Email: laura.ciccantell@wmich.edu
Phone: (269) 387-3479
2504 Sangren Hall
**Approval of access to CoE&HD Advising offices to conduct research; assisted in coordination of times for power meter installation and collection.*
**Arranged meeting: 12:30pm, February 28, 2012, with Carol Morris-Mier for tour of CoE&HD Advising Office.*

Matthew F. Hollander
Coordinator of Sustainability Projects
WMU Office for Sustainability
Email: matthew.f.hollander@wmich.edu
Phone: (269) 387-0941
Faunce Hall
**Coordinated with Dr.Glasser for purchasing of power meters; coordinated with Jeff Spoelstra in meter deliveries and check out.*
**Arranged meeting: 9am-11am, February 22, 2012, to discuss ordering power meters.*

Mary Lou Brooks
Administrative Assistant
Department of Geography
Email: mary.brooks@wmich.edu
Phone: (269) 387-3415
**Approval for GIS Lab access. Contact via email.*

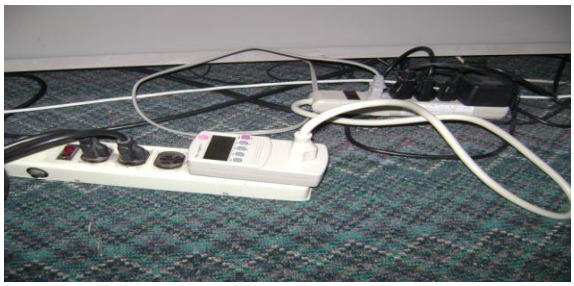
Nola Wiersma
Western Michigan University
Email: nola.c.wiersma@wmich.edu
232 Physical Plant
**Assisted Carolyn in meeting to discuss recycling of metal file hangers.*

Toby Boyle
Systems Programmer
Email: toby.boyle@wmich.edu
Phone: (269) 387-3825
Fax: (269) 387-5473
3106 University Computing Center
**Campus IT staff implementing ImageNow software at WMU.*
**Arranged meeting: 10:30am April 11, 2012, in Campus Computing Center* to discuss research progress, design, purpose, *and progress of ImageNow software at WMU.*

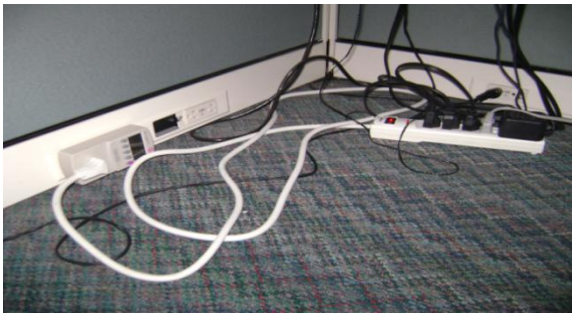
Tom Marquardt
Project Lead SIS
Email: thomas.marquardt@wmich.edu
Phone: (269) 387-3866
Fax: (269) 387-5473
3110 University Computing Center
**Campus IT staff implementing ImageNow software at WMU.*
**Arranged meeting: 10:30am April 11, 2012, in Campus Computing Center to discuss research progress, design, purpose, and progress of ImageNow software at WMU.*

Appendix C: Photo Archive

1. Power meter blocking bottom outlet from usage.



2. Use of two power strips required due to design of power meters.



3. *Installation example for one hard drive, two monitors, speakers, and personal printer*

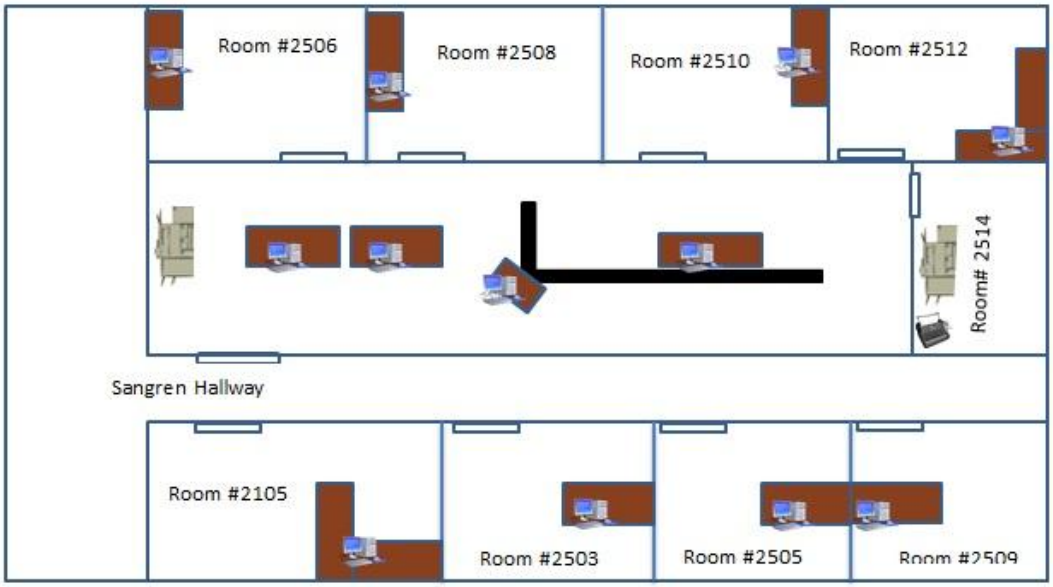
4. Potential fire hazard from outdated power strips in offices.

5 .PW440 Power Meter

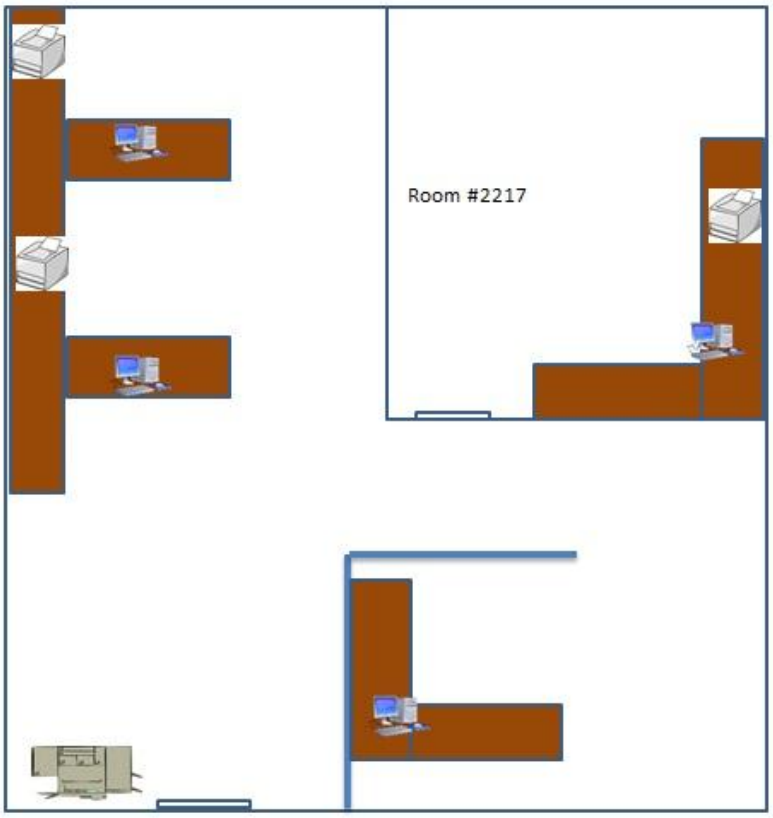
6. *Potential Fire hazard from high amounts of dust and debris around outlet in GIS labs.*

Appendix D-1: Office Layouts

College of Education and Development Advising Office

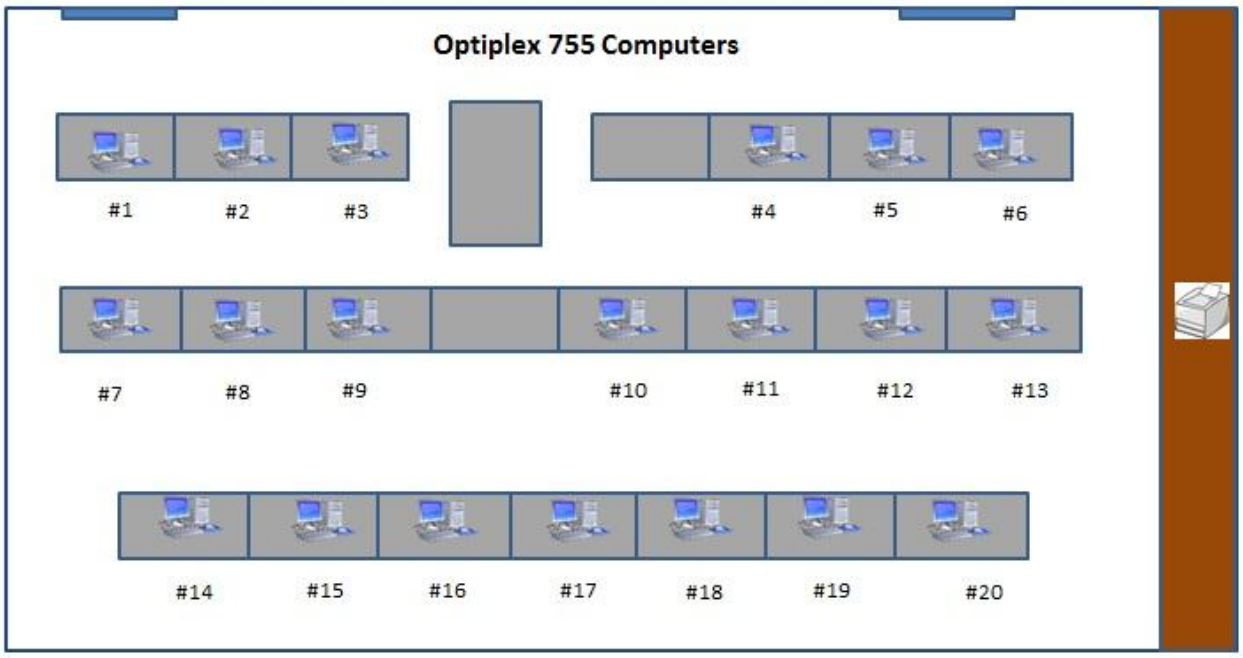


College of Education and Development Teachers Certification Office.

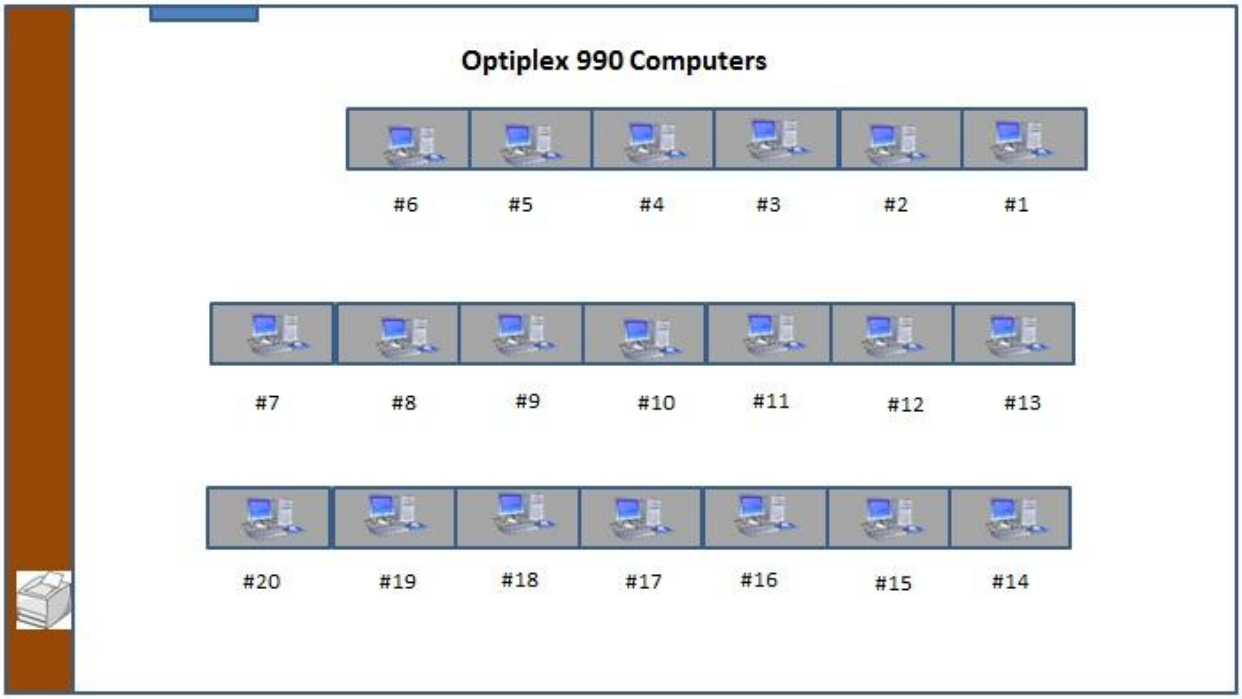


Appendix D-2: Lab Layouts

Wood Hall GIS Room 2109



Wood Hall GIS Room 2107



Appendix E: Tables

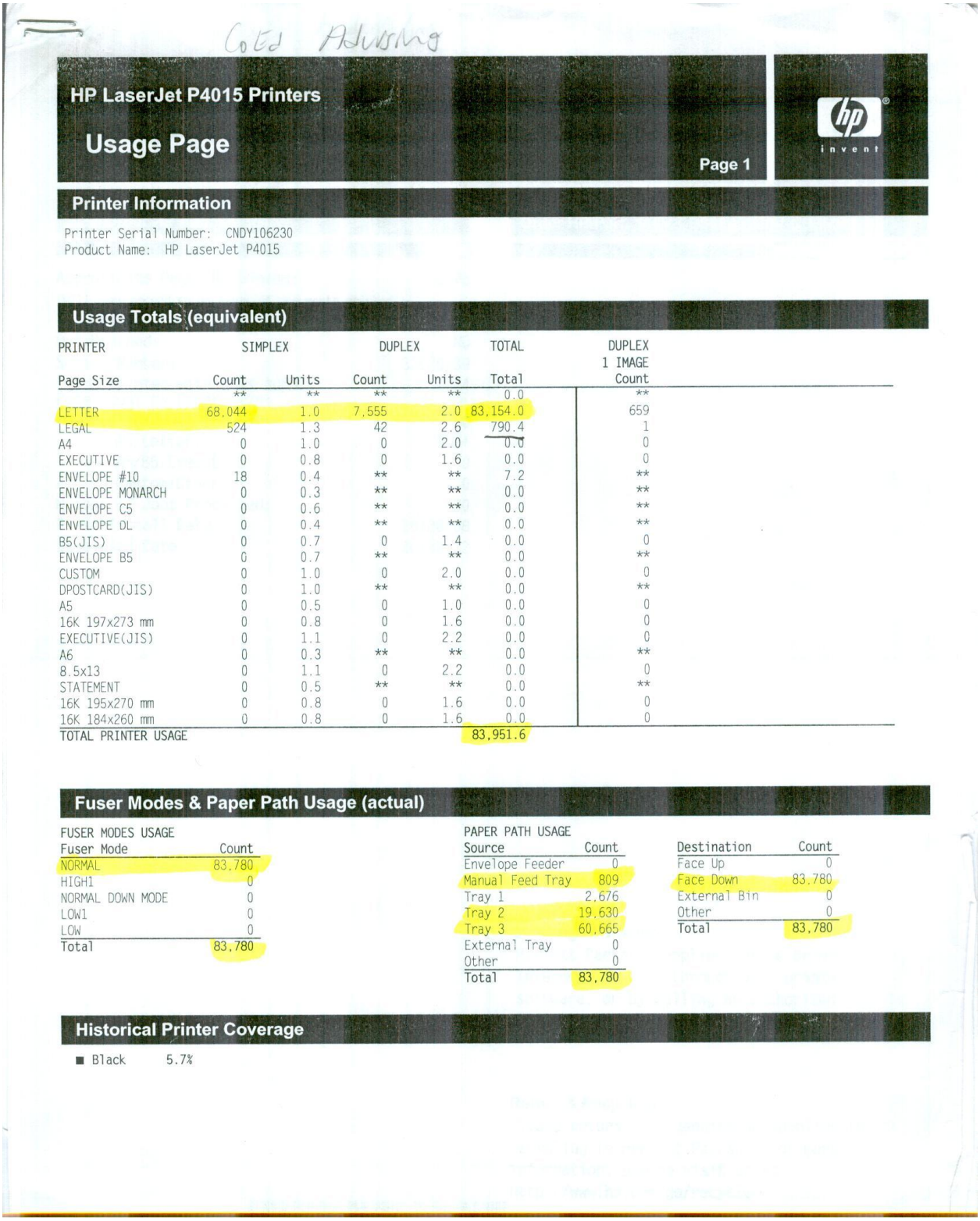
Teachers Certification office 2217 Sangren Hall								
Energy Audit						Paper Audit		
Room #	Devices	Power Strip	Time Frame(Hr)	Kw/Hr	GHG Em.	Device	Time Frame (hr)	Total Prints
2217	Front Desk Optiplex 755	x	101	3.56	8.19	Front Copier/printer	101	23
2217	Back Desk Optiplex 755	x	102	3.59	8.26	black printer	102	23
2217	Side Desk Optiplex 755	x	101	3.23	7.43	main printer	102	12
2217	Office 2217-A Optiplex 755	xx	100	3.94	9.06	Totals		58
	Computer Average			3.58	8.23			
2217	HP LaserJet 4100tn (Printer)		102	1.77	4.07			
2217	Dell 2335dn (Printer)		102	1.46	3.36			
2217	Xerox Copycenter C20 (Printer)		101	1.9	4.37			
	Printer Average			1.71	3.93			
	Printer Total			3.23	7.43			
	Computer Total			14.33	32.96			
	Total			17.56	40.39			

College of Education Advising Office 2504 Sangren Hall								
Energy Audit						Paper Audit		
Room #	Devices	Power Strip	Time frame(hr)	kWh	GHG Em. (lbs of CO2)	Device	Time Frame	Total prints
Room 2501	Optiplex GX620	x	102	7.66	17.62	Xerox	103	1805
Room 2503	Optiplex 755	x	102	7	16.10	Laserjet	103	181
Room 2505	Optiplex GX620	x	101	16.5	37.95	Totals		1986
Room 2509	Optiplex GX620	x	102	6.97	16.03			
Front Main Desk	Optiplex 990	x	102	3.72	8.56			
Assistant Desk	Optiplex 320	x	102	7.17	16.49			
Room 2506	Optiplex GX620	x	102	7.3	16.79			
Room 2508	Optiplex GX620	x	102	4.2	9.66			
Room 2510	Optiplex GX620	x	103	3.01	6.92			
Room 2512	Optiplex 990	x	103	3.27	7.52			
	Computer Average			6.68	15.36			
2514 Sangren (Supply Room)	RICOH Aficio MP C3300 (Printer)		103	10.55	24.27			
2504 Sangren (Main Lobby)	HP LaserJet P4015x (Printer)		103	1.46	3.36			
	Printer Average			6.01	13.81			
	Printer Total			12.01	27.62			
Sign in Laptop	Dell Latitude D510		103	0.67	1.54			
2514 Sangren (Supply Room)	Brother GX-6750 (Typewriter)		101	0.36	0.83			
	Computer Total			66.8	153.64			
	Total			78.81	181.26			

GIS Lab 2107(Optiplex 990)							
Energy Audit					**Paper Audit**		
Devices	Power Strip	Time frame(hr)	Kw/Hour	GHG Em. (lbs of CO2)	Device	Time Frame	Total prints
Printer	x	102	2.72	6.26	HP LaserJet 4200	102	722
Computer 5	x	102	0.41	0.93			
Computer 6	x	102	0.41	0.93			
Computer 7	x	102	0.53	1.22			
Computer 8		102	0.53	1.22			
Computer 9	x	102	0.53	1.21			
Computer 10	x	102	0.53	1.21			
Computer 17	x	102	0.90	2.06			
Computer 18	x	102	0.90	2.06			
Computer 15	x	102	0.36	0.82			
Computer 16	x	102	0.36	0.82			
Computer 1		102	0.41	0.93			
Computer 2	x	102	0.41	0.93			
Computer 14	x	102	1.09	2.51			
Computer 12	x	102	1.05	2.40			
Computer 13	x	102	1.05	2.40			
Computer 11	x	102	1.11	2.55			
Computer Average			0.78	1.79			

GIS Lab 2109 (Optiplex 755)							
Energy Audit					**Paper Audit**		
Devices	Power Strip	Time frame(hr)	Kw/Hour	GHG Em. (lbs of CO2)	Device	Time Frame	Total prints
Computer 4	x	102	4.75	10.93	HP LaserJet P4015	103	1068
Computer 8	x	71.5	3.885	8.94			
Computer 9			3.855	8.87			
Computer 10	x	102	7.785	17.91			
Computer 11			7.785	17.91			
Computer 1		102	4.52	10.40			
Computer 12			3.56	8.19			
Computer 13	x	102	3.56	8.19			
Computer 16	x	102	1.57	3.61			
Computer Average			4.59	10.55			
Printer	x	103	2.1	4.83			
Totals		581.5	41.27	66.032			

Appendix F: Print Usage Page



CoEd Advising

HP LaserJet P4015 Printers

Usage Page

Page 1

Printer Information

Printer Serial Number: CNDY106230
Product Name: HP LaserJet P4015

Usage Totals (equivalent)

PRINTER	SIMPLEX		DUPLEX		TOTAL	DUPLEX 1 IMAGE
Page Size	Count	Units	Count	Units	Total	Count
	**	**	**	**	0.0	**
LETTER	68,044	1.0	7,555	2.0	83,154.0	659
LEGAL	524	1.3	42	2.6	790.4	1
A4	0	1.0	0	2.0	0.0	0
EXECUTIVE	0	0.8	0	1.6	0.0	0
ENVELOPE #10	18	0.4	**	**	7.2	**
ENVELOPE MONARCH	0	0.3	**	**	0.0	**
ENVELOPE C5	0	0.6	**	**	0.0	**
ENVELOPE DL	0	0.4	**	**	0.0	**
B5(JIS)	0	0.7	0	1.4	0.0	0
ENVELOPE B5	0	0.7	**	**	0.0	**
CUSTOM	0	1.0	0	2.0	0.0	0
DPOSTCARD(JIS)	0	1.0	**	**	0.0	**
A5	0	0.5	0	1.0	0.0	0
16K 197x273 mm	0	0.8	0	1.6	0.0	0
EXECUTIVE(JIS)	0	1.1	0	2.2	0.0	0
A6	0	0.3	**	**	0.0	**
8.5x13	0	1.1	0	2.2	0.0	0
STATEMENT	0	0.5	**	**	0.0	**
16K 195x270 mm	0	0.8	0	1.6	0.0	0
16K 184x260 mm	0	0.8	0	1.6	0.0	0
TOTAL PRINTER USAGE					83,951.6	

Fuser Modes & Paper Path Usage (actual)

FUSER MODES USAGE

Fuser Mode	Count
NORMAL	83,780
HIGH1	0
NORMAL DOWN MODE	0
LOW1	0
LOW	0
Total	83,780

PAPER PATH USAGE

Source	Count
Envelope Feeder	0
Manual Feed Tray	809
Tray 1	2,676
Tray 2	19,630
Tray 3	60,665
External Tray	0
Other	0
Total	83,780

Destination	Count
Face Up	0
Face Down	83,780
External Bin	0
Other	0
Total	83,780

Historical Printer Coverage

■ Black 5.7%

Cost Adjust

HP LaserJet P4015 Printers

Usage Page

Printer Information

Printer Serial Number: CNDY106230
Product Name: HP LaserJet P4015

Usage Totals (equivalent)

PRINTER	SIMPLEX		DUPLEX		TOTAL	DUPLEX 1 IMAGE
Page Size	Count	Units	Count	Units	Total	Count
	**	**	**	**	0.0	**
LETTER	68,225	1.0	7,555	2.0	83,335.0	659
LEGAL	524	1.3	42	2.6	790.4	1
A4	0	1.0	0	2.0	0.0	0
EXECUTIVE	0	0.8	0	1.6	0.0	0
ENVELOPE #10	18	0.4	**	**	7.2	**
ENVELOPE MONARCH	0	0.3	**	**	0.0	**
ENVELOPE C5	0	0.6	**	**	0.0	**
ENVELOPE DL	0	0.4	**	**	0.0	**
B5(JIS)	0	0.7	0	1.4	0.0	0
ENVELOPE B5	0	0.7	**	**	0.0	**
CUSTOM	0	1.0	0	2.0	0.0	0
DPOSTCARD(JIS)	0	1.0	**	**	0.0	**
A5	0	0.5	0	1.0	0.0	0
16K 197x273 mm	0	0.8	0	1.6	0.0	0
EXECUTIVE(JIS)	0	1.1	0	2.2	0.0	0
A6	0	0.3	**	**	0.0	**
8.5x13	0	1.1	0	2.2	0.0	0
STATEMENT	0	0.5	**	**	0.0	**
16K 195x270 mm	0	0.8	0	1.6	0.0	0
16K 184x260 mm	0	0.8	0	1.6	0.0	0
TOTAL PRINTER USAGE					84,132.6	

Fuser Modes & Paper Path Usage (actual)

FUSER MODES USAGE

Fuser Mode	Count
NORMAL	83,961
HIGH1	0
NORMAL DOWN MODE	0
LOW1	0
LOW	0
Total	83,961

PAPER PATH USAGE

Source	Count
Envelope Feeder	0
Manual Feed Tray	815
Tray 1	2,676
Tray 2	19,648
Tray 3	60,822
External Tray	0
Other	0
Total	83,961

Destination	Count
Face Up	0
Face Down	83,961
External Bin	0
Other	0
Total	83,961

Historical Printer Coverage

■ Black 5.7%