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Green Approach for Reducing Energy Consumption- A Case Study Report

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Abstract-- Green computing is the environmentally responsible use of computers and associated accessories. Which include printers, monitors, and networking, storage devices and communications systems—efficiently and effectively with minimal or no impact on the environment and proper disposal of e-waste. In recent times, computer industry have come to realize that going green is in their best interest, in terms of public dealings and reduced costs. College and universities cannot implement the concept of green computing very powerfully. The paper focus to review awareness levels of computer users with regards to Green Computing. Suggestion will be given on how Green Computing strategies can be implemented at our College. The objective of this paper is saving electricity consumption in computer science lab of our college .This paper gives a description about lab of computer science department and electricity consumption of various computers. Also, this paper describes current green computing principles and approaches for reducing energy use. The conclusion of the case study illustrates the saving in electricity charges.

Keywords-- components: Green computing, energy consumption, e waste, save environment

I. INTRODUCTION

Green Computing is the practice of using computer resources efficiently [1]. Another definition is the one which defines green computing as the study and practice of efficient and eco-friendly computing resources and the environmentally responsible use of computers and related resources. The primary goals of green computing are to reduce the use of hazardous materials and to maximize the energy efficiency during the product's lifetime [2]. Green computing is concerned with reducing the environmental impact of Information Technology before IT devices are purchased, during their lifetimes and after we have finished with them. A good number of manufacturers are improving their processes at the different levels of the product life to minimize harm as they are using the materials which are usually eco-friendly, renewable or might use less energy [3]. Various campus and universities are trying to implementing the following strategies to decrease environmental impact of computers during their use; when IT devices are not in use they are put in sleep mode, computer systems are switched off when not in use, sharing documents and files on the screen or use FTP servers and only print on demand and where necessary, using virtualization software instead of physical machines/servers, printing less etc. Old system scan be donated to charity institute which might boost the product life [4].The above are some of the step made in ensuring green computing for sustainable environment. This research paper is concerned with conducting a research on electricity consumption of lab of computer science in our College and approaches for reducing energy.

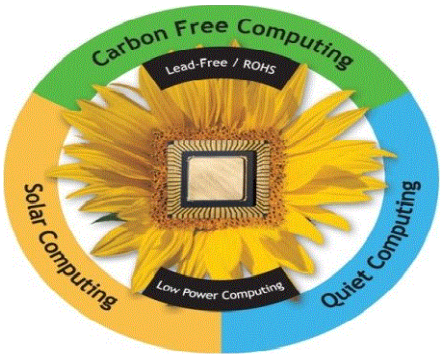

Fig 1 Freen Computing

II. GREEN COMPUTING APPROACHES AND ISSUES

Green IT that studies, develops and promotes techniques for improving energy efficiency and reducing waste in the full life cycle of computing equipment from initial manufacture, through delivery, use, maintenance, recycling and disposal in an cost-effectively practical way [9,13]. Due to the rising cost of energy, reduction of natural resources, and increasing concern for the environment by the general population, sensitivity and interest in the issues of Green Computing are high [14].

As population has increased, energy use has also increased. The widespread use of computers increases in computer energy consumption leading to increases in pollution and related side-effects. The negative side-effects of the computing life cycle include pollution in the form of carbon dioxide from power plants and transportation, lead and mercury from manufacturing processes and power plants, and other toxic materials used in the production, use and disposal of computers [6,7,9]. The need for Green Computing is thus quite clear, yet empirical studies and formalized recommendations have been slow in coming. There is a growing consensus that improving energy efficiency will reduce pollution and save money [10,13]. The matters in question are how to go about implementing efficiency improvements, how to improve these methods and create new methods, and how best to spread this information by engaging computer professional and lay man.

Reducing consumption by printing documents double-sided, viewing documents on-screen, powering off electrical devices that are not in use, placing a computer in sleep mode or powered off when not in use, and similar techniques are effectively free, save for the minimal extra effort involved [14]. Computers in particular are ideal candidates for reducing power consumption, with easy-to-use features such as automatic sleep mode which shuts down an idle computer after a configurable period of inactivity. Using power management settings is a common strategy for reducing energy consumption and carbon dioxide emissions [9, 15].Computer science faculty and students can play a major role in the research and educate others about Green Computing techniques.

III. GREEN COMPUTING TECHNIQUES

One of the primary goals of this computing is to create practical and repeatable benchmarks for computer power consumption. Between 2000 and 2010, the use of computer in business has increased significantly. Computers, monitors and printers used by staff may typically consume more than 150 watts, and a good portion of the energy consumed ends up wasted due to equipment left on when not in use. A report from Environmental Protection Agency (EPA) that 30 to 40% of personal computers and printers are kept ON during the night and on weekends, and are left to idle.

Understanding the ways in which power consumption impacts the "greenness" of any technology, and specifically computing technology, is an essential step toward reducing this consumption. This section describes the various specific techniques that can be used to reduce power consumption.

IV. GREEN COMPUTING TIPS FOR SAVING POWER CONSUMPTION

The following figure shows the average power loads and energy levels that can be achieved by using computer machines.

Table 1

Item	**Average power consumption**	**Stand by energy consumption obtainable(w)**	**Target recovery times (seconds)**
Personal Computers &Monitors	120	30-40	Almost immediate
Personal Computers	40	20-30	Almost immediate
Monitors	80	10-15	Almost immediate
Laser printers	90-130	20-30	30

The above energy levels can be achieved by turn off PCs, terminals, printers and scanners at free time and during break times. Do not switch on computers and printers until they are needed. Don't leave any electrical equipment running overnight or at the weekends unless there is a special reason for doing so. By turning off your monitor you can save half the energy that is used by the system. CRT monitors typically use more power than LCD monitors. LCD monitors typically use a cold-cathode fluorescent bulb to provide light for the display. Some newer displays use an array of light-emitting.

V. GREEN COMPUTING TIPS FOR PRINTERS

A. Discourage Recycling of Toner Cartridges

Recycling of Toner cartridges can lead to paper wastage, deterioration in quality of printer's leakage problems and recycled toner cartridges can add carcinogenic particles in the air and cause cancer.

B. Discourage Buying Different Types of Printers

If you have different black and white laser printers that are all different makes and models you will unable to reuse parts for your broken printers. However if you have 10 laser printers all of same make and model, when one becomes damaged, you can cannibalize the parts and use them as spares for your printer rather than having to dispose of the printer completely.

C. Discourage Unnecessary Printouts

Unnecessary printing and printers have a major environmental impact both in consumption of resources and the energy required to manufacture paper product. You can help save paper, toner, energy and money.

VI. GREEN COMPUTING TIPS BY SOFTWARE

The efficiency of algorithms has an impact on the amount of computer resources required for any given computing function and there are many efficiency trade-offs in writing programs. While algorithmic efficiency does not have as much impact as other approaches, it is still an important consideration. Google search produces 0.2 grams of CO2.and Windows 7 + Office 2010 require 70 times more memory (RAM) than Windows 98 + Office 2000 to write exactly the same text or send exactly the same e-mail than 10 years ago.

VII. GREEN COMPUTING TIPS FOR OPERATING SYSTEM

The dominant desktop operating system, Microsoft Windows, has included limited PC power management features since Windows 95. These initially provided for stand-by (suspend-to-RAM) and a monitor low power state. Further iterations of Windows added hibernate (suspend-to-disk) and support for the ACPI standard. Windows 2000 was the first NT-based operating system to include power management.

Microsoft significantly improved this in Windows Vista by redesigning the power management system to allow basic configuration by Group Policy. The most recent release, Windows 7 retains these limitations but does include refinements for more efficient user of operating system timers, processor power management, and display panel brightness. The most significant change in Windows 7 is in the user experience.

VIII. NEED OF GREEN COMPUTING AT LAB

The main focus of this paper is to decrease the electricity consumption our college computer science laboratory. We noted is that students and staff at department of CS spend an average of seven hours a day on computers in lab, either doing their assignments and doing practical, project or doing their work in everyday. What is evident is that the use of computers is rising up and the consumption of electricity is very high. A computer is made up of many components that consume power: the CPU, HDD, graphic cards, monitors, speakers, printers, communication devices, scanners, etc. The average desktop computer consumes about 120 watts of electricity, on average, the monitor consumes 75 watts, and the CPU consumes 45 watts, laptops consumes between 15 and 45 watts [12]. There are around 100 desktop computers at our department and if they are all left on all the time they would consume a total of 80 kilowatts- per day. Computers not only consume energy but also leave carbon foot prints. IT-related equivalent carbon dioxide (CO2) emissions alone have been estimated at two per cent of the world's total [8]. This research will attempt to establish how much our College community has incorporated green policy strategies.

IX. RESEARCH EVALUATION

Monitor power consumption tests were performed using a 20" Dell 2005 FPW wide screen LCD monitor. As a control, the unplugged state displays the expected 0 watt draw. When the monitor was plugged in but powered off, the draw was 1 watt, a phantom load. In sleep mode, monitor drew 3, and drew 55 watts when powered on. This difference in power use highlights the power savings that are available. Enabling monitor sleep could result in approximately a 94% reduction in power use for the monitor tested, with comparative results shown in Figure 2 [15].

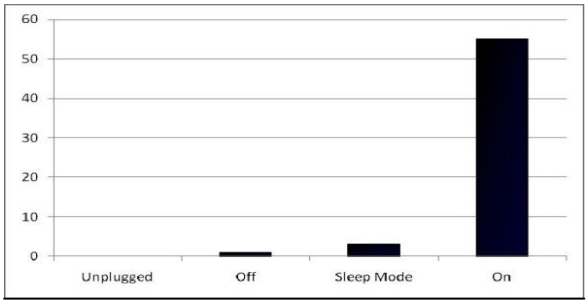

Fig 2. Dell 20" LCD monitor power consumption (watts)

Measurements of desktop computer power use were performed using a custom built AMD Athlon x2 5000+ computer, with laptop tests using an Acer Travelmate 3200 laptop. Results of measuring power consumption for different power modes using these two computers are shown in Figure 3 [15]. The most striking result is the large difference in efficiency between the desktop and laptop computer, with the desktop exhibiting a 4 watt phantom load vs. 0 watts for the laptop.

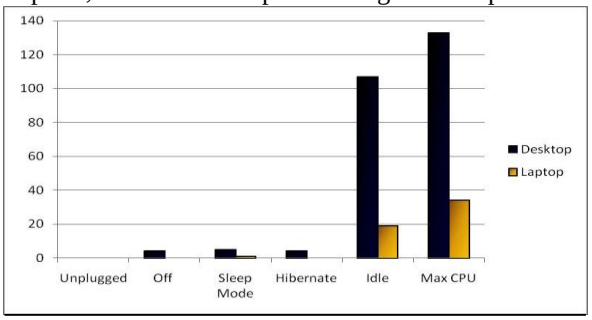

Fig 3. Desktop and laptop power consumption (watts)

It is possible to reduce power use by nearly 97% when using the sleep or hibernate modes rather than leaving computers idling when not in use. Although using hibernate mode offers the greater savings of the two, it takes significantly longer (~30 secs) to wake up from hibernate mode than it does from sleep mode (~3 secs). Thus, for absolute electricity savings the hibernate feature is slightly better, while the sleep mode provides slightly less savings with a much faster wake up time.

The following equation has been devised to estimate how much power a PC will use, and can also be used for any electricity consuming device. The average watts/hour can be used to estimate how much it costs to run a PC in the average case. Given the local cost of electricity per kWh, the cost to run a computer is calculated as:

$$\frac{\textbf{Watts} \times \textbf{Hours Used}}{\textbf{1000}} \times \textbf{Cost per kilowatt-hour} = \textbf{Total Cost}$$

To calculate the cost for a computer lab of N computers, simply calculate the cost for one computer and multiply by N.

Case Study

a). Objective:-

1. To identify electricity consumption at department lab based on data collection and analysis
2. Preventive measure to reduce the electricity consumption
3. To make awareness about green among the students and faculty members based on the analysis

b). Lab details:-

There are total numbers of 100 computers, out of which 65 are CRT and 35 are LCD. Two labs are functioning in the department and the total working hours per day is 7 and lab working 5 days per week. Table 2 shows the electricity charges for single CRT and LCD monitor system.

Table 2 +Cost of electricity charge / unit is 5.10

Monitor	QQ ty	Hrs work/da y	Power usage/hr	Unit /day	Cost of electricity / year
CRT	1	7	120 w	0.84	899
LCD	1	7	70 w	0.49	463

CRT monitor consume 80 watts and LCD monitor consume 30watts. One CRT System is ON for 35 hours per week and it consume 4.2 Unit / week and the cost per year is 899/-. LCD monitor is ON for the same hours/week and it consume only 0.49 unit and cost is 463/- per year. This is exactly half as compare to CRT. Table 3 shows cost of electricity charges for 100 systems are shown below.

Table 3

Monitor	Qty	Hrs work	Power usage/hr	Unit /day	unit/year
CRT	65	7	120 w	54.6	10920
LCD	35	7	70 w	17.15	3500

The table 3 shows further calculations. Utilize 65 CRT monitor for 35 hrs/ week , it consume 10,920 unit current and costs is around 55,692/- per year and LCD monitor consumption cost is 17,850/- per year. The case study shows that Computer science laboratory consume total of 14,420 unit current per year and total charge per year is around 73,542 /- . We conclude that better option is to replace CRT with LCD monitors. This amount is coming without green implementation in our lab. Suppose replace all CRT and LCD system with laptop, it consume 4200 unit per year and the electricity cost will be around 21,420 per year. The laptop generally used about four times less electricity than our desktop PC and monitor use .So we suggest some guidance given to the college authorities to implement green concept immediately for save power consumption and save our environment.

c) Recommendations:

i) Replace all CRT and LCD system with Laptop

X. CONCLUSIONS AND FUTURE WORK

This paper was motivated by the increasing cost of electricity in our college. The conclusion of the case study demonstrates the saving in electricity in case of LCD and CRT monitors. We had kept fans, personal computers in OFF mode when work is over. Power management features such as the sleep and hibernate modes are most likely to be effective because computers can automatically go into low power states after a preset idle time without human intervention. The aim of this paper is to measure awareness levels of students and staff at our College with regards to Green Computing. The research established that the awareness levels to electricity saving techniques. By incorporating the green computing techniques discussed in this paper into our College campus can have an immediate impact by

reducing power consumption by computers and associated peripherals. In the future, plan to conduct a more comprehensive series of case studies to improve the understanding of how these techniques perform in real world scenarios.

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