RESEARCH ARTICLE

Study and Approaches to Green Environment through Eco- Friendly Devices

Jamshed Siddiqui[1], Abdus Samad[2], Zaki Ahmad Khan[3]

Department of Computer Science & A.M.U, India

University Women's Polytechnic & A.M.U, India

Department of Computer Science & A.M.U, India

jamshed_faiza@rediffmail.com; abdussamadamu@gmail.com; jmi.amu1@gmail.com

Abstract— Most of the CO_2 emissions are the product of heat generated by computer and various peripheral. Reducing carbon emission is the main task to create environment friendly system devices. The concept of green computing has begun to spread in the past few years, gaining popularity. Besides the widespread sensitivity with ecological issues, such interest also seems from economic needs, since both energy costs and electrical requirement of Information Technology (IT) around the world show a continuously growing trend. The main finding of this study is how to protect our environment from the harmful impact of computer and Eco-friendly devices. A comparison is made between conventional computing devices and environment friendly devices. The comparative study shows that we can save a substantial amount of power, make environment green by lesser heat generation while saving the cost.

Keywords— Eco-friendly Devices; Green Computing; Green IT; Environmental; Carbon Dioxide (CO_2)

I. INTRODUCTION

In today's era computer is the basic need of everyone. Everyone uses a computer for its own purpose. But no one is aware about the harmful impact of the use of computer on the environment. The term " Green Computing" and its alternative "Green IT" have recently become widely popular and taken on increased importance, their conceptual origin is almost two decades old [1]. Green computing or Green IT, Green computing is the environmentally responsible and eco- friendly use of computers and their resources. It is the study and practical of manufacturing, designing, using and disposing of information and communication technologies (ICT) efficiently and effectively with minimal or no impact on the environment. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities. Green IT includes the dimensions of environmental sustainability, the economics of energy efficiency, and the cost of disposal and recycling [2]. It is important to understand the need of the study of green computing. It is a tool by which global warming can be control and reduce. The global warming surface temperature increased by 0.74 ± 0.18 °C (1.33 ± 0.32 °F) during the 100 year ending in 2005. Most conspicuously, according to the latest IPCC report the global surface temperature will likely to rise a further 1.1 to 6.4 °C (2.0 to 11.5 °F) during the twenty-first century [1,3].

In U.S, is the power consumption cost for data center computing and cooling double from 2000 to 2006 to $ 4.5 billions. It's expected to double again by 2011 [5]. When the EPA created energy star, it is a kind of label awarded to computers and other electronics products. Energy star program minimizes the use of energy while maximizing efficiency. One of the first approaches towards green computing was a sleep mode function in computers. Sleep mode function which places a computer place a computer on standby mode for a preset period

of time [7,8]. The whole green aspect came about quite a few years back when the news that the environment was not a renewable resource really hit home and people started realizing that they had to do their part to protect the environment. Basically, the efficient use of computers and computing is what green computing is all about the triple bottom line is what is important when it comes to anything green and the same goes for green computing [9,10]. These are considered social responsibility, economic, viability and the impact on the environment. Many businesses simply focus on the bottom line, rather than a green triple bottom line, of economic viability when it comes to computers. The idea is to make the whole process surrounding computers friendlier to the environment, economy, and society [11]. This means manufacture creates computers in a way that reflects the triple bottom line positively.

The environmental protection agency (EPA) introduced the green lights program to promote energy- efficient lighting. The first and most conclusive research on computing shows that carbon dioxide (CO_2) and other emissions are causing global climate and environmental damage. Preserving our beloved planet is a main and legitimate goal because it aims to preserve life. It has given to minimize e- waste and use of non- toxic materials in preparation of e-equipments. This paper is organized as follows; in section 2 discuss energy consumption agency and in section 3 we will discuss about approaches of green computing and in section 4 benefits and cause of green IT and green computing. Further, section 5 presents the eco- friendly devices as well as the final conclusion of the study.

II. ENERGY CONSUMPTION AGENCY

The computer use in business has increased considerably. Computers, monitors and printers used by staff may typically consume more than 150 watts, and a good portion of the energy consumed wastage up wasted due to equipment left on when not in use. According to the Environmental Protection Agency (EPA), 30 to 40% of personal computers and printers are kept on during the night and on weekends and are left to idle as much as 90% of the time during the work day.

All the energy star labelled products are manufactured by keeping in mind the term green computing and its features. These products are manufactured with the idea of less power consumption. These devices are programmed to power down to a low power state or when they are not in use. Therefore, using "Energy Star" labelled desktop, monitor, laptop, printer and other computing devices is promising approach towards green computing.

Fig. 1 Energy Star

Vidarbha produces most of their electricity from burning coal. Coal is one of the important natural resource. Excessive use of electricity can exhaust this resource. Being energy-conscious and buying energy-efficient computers and peripherals will help.

- To save natural resources
- Save and protect water
- Make your home / workspace more affordable
- Improve air quality
- Reducing mercury emissions

Identify and purchase energy-efficient products that offer savings on energy bills without sacrificing performance, features, and comforts.

III. APPROACHES OF GREEN COMPUTING AND GREEN IT

A. Virtualization

Computer virtualization is the process of running two or more logical computer systems on one set of physical hardware. The concept originated with the IBM mainframe operating systems of the 1960s, but was commercialized for x86- compatible computers only in the 1990s. With virtualization, a system administrator

could combine several physical systems into virtual machines on one single, powerful system, thereby unplugging the original hardware and reducing power and cooling consumption. Several commercial companies and open-source projects now offer software packages to enable a transition to virtual computing. Intel Corporation and AMD have also built proprietary virtualization enhancements to the x86 instruction set into each of their CPU product lines, in order to facilitate virtualized computing. One of the primary goals of almost all forms of virtualization is making the most efficient use of available system resources. With energy and power costs increasing as the size of IT infrastructures grow, holding expenses to a minimum is quickly becoming a top priority for many IT pros. Virtualization has helped in that respect by allowing organizations to consolidate their servers onto fewer pieces of hardware, which can result in sizeable cost savings. The data center is where virtualization can have the greatest impact, and it's there where many of the largest companies in the virtualization space are investing their resources. Virtualization also fits in very nicely with the idea of "Green Computing"; by consolidating servers and maximizing CPU processing power on other servers, you are cutting costs (saving money) and taking less of a toll on our environment Storage virtualization uses hardware and software to break the link between an application, application component, system service or whole stack of software and the storage subsystem. This allows the storage to be located just about anywhere, on just about any type of device, replicated for performance reasons, replicated for reliability reasons or for any combination of the above.

B. Life Cycle

It is important to understand the life cycle of computer while applying the concept of Green IT. This was explained with the help of Figure 2.
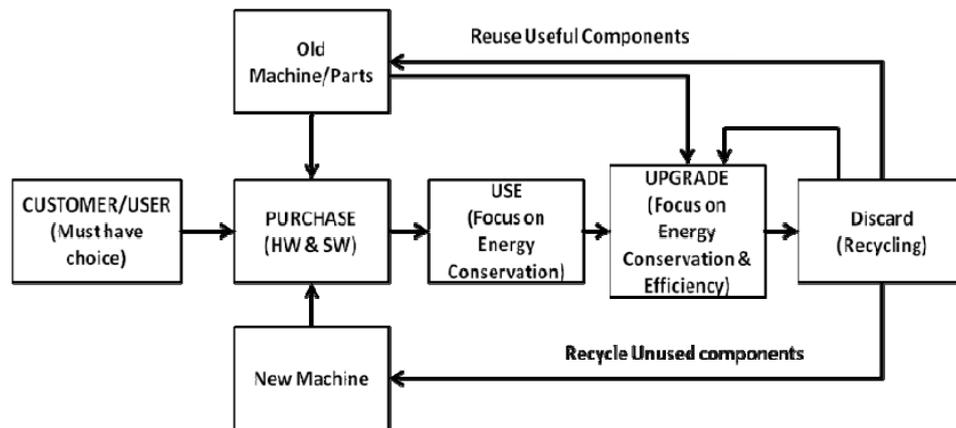

Fig. 2 Life cycle approach to Green IT

From the view of a user in an organization. Following is the life cycle approach to making Green IT.

- Purchase- responsible computer purchase.
- Energy consumption- saving energy while in use.
- Reducing waste- using computers to reduce the use of natural resources.
- Recycling- disposal considerations.
- Energy uses- Energy use and efficient ways of computing.

IV. **BENEFITS AND CAUSE OF GREEN COMPUTING AND GREEN IT**

A. *Benefits*

The Green IT was recently proposed by practitioners, most articles we identified aimed to inform the managers that Green IT initiatives were not simply a liability and companies could benefit from adopting Green IT initiatives. For example, [16] exemplified how Green IT initiatives could reduce data centers' energy consumption. In another example, IBM launched a program to monitor energy consumption and demonstrate cost savings [17]. Reported that Vista Print received significant savings and cut carbon emissions with Green IT initiatives [18]. In a talk about energy efficiency, Michael Dell discussed that Dell was committed to reducing energy consumed by data centers [19] With Green IT initiatives, Raytheon realized more than $11 million of savings in [20]. In Europe, companies which conducted Green IT initiatives were found to earn 2% higher profit margin than others in the same industry [21]. Lastly, some studies tried to show specific technology in Green IT

initiatives. For example, [22] discussed a power-saving green hard drive. The importance of Green IT is becoming slowly recognized in the practitioner literature [23], in a Gartner presentation at the World Economic Forum in Davos, Switzerland, called Green IT a "new industry shock wave." [24] pointed out in a report on green and sustainable IT oriented to education, "seldom does a day pass in which we don't hear or read about sustainability or 'going green'." However, although many organizations have a heightened awareness level regarding Green IT, they may not be completely committed to Green IT beyond simple energy savings. According to GreenerComputing.com [25], energy efficiency was being used in one way or another to reduce environmental impacts and to cut costs by at least 65% of IT managers. In a survey by Sun Microsystems Australia, reducing power consumption and lowering costs were the major reasons for adopting Green IT initiatives [25]. We argue that the narrow focus of the benefits of Green IT initiatives may limit the potential of Green IT and prevent companies from thinking of Green IT initiatives from a strategic perspective.

B. *Cause*

The cause of green Computing are Use of lot of electricity, create lot of toxic waste, impact of electricity to the environment and impact on toxic waste of environment. Now, we will elaborate all cause below:

1) Impact of Electricity to the Environment

The electric power produces more pollution to the environment. They are air pollution, water pollution. Fossil fuel power plants release air pollution and require lots of water. Nuclear power plants release lot of radio active energy and hazardous waste. Even renewable energy sources are affecting water and wild life and even hurting the food chain too.

Air pollution impact on climate change, acid rain, ozone, air toxics, water pollution in impact on water bodies, land pollution impacts on degrade and devalue the land impacting ecosystem and aesthetics.

2) Impact of toxic waste to the Environment

The Computer crowding our landfills contains lead, mercury, cadmium, beryllium and traces of many other hazardous materials. Incineration, release heavy metals like lead, mercury and cadmium into air and ashes.

3) Creates lots of toxic waste

Most of us are updating our computers, throwing our outdated computer resources, peripherals, and other hardware device etc, these are the hazardous toxic waste we are producing that is really damaging the environment now a days.

V. ECO- FRIENDLY DEVICES

The Present study is carried out on four Eco-friendly devices which are essentially considered the main resource of computing. There are computers with new and old models, monitors, LCD Monitors and Mac computers. The energy requirements of these devices are measured in watts (W) , which is an indication of how much energy a device requires at any given moment.

A. *Computers*

There is huge variation in energy required by different computers. The average computers requirements between 36W and 250W when it is active, between 1W and 27W in low power mode, and between 1.5W and 3W when it is turned off but plugged into a mains socket.

TABLE I
Summaries of the results of Computer in Watt

Description	Active	Low Power	Off
Desktop with Power management	36	27	-
Desktop without Power management	48		-
Desktop (Pentium and pre- Pentium)	55	25	0
Desktop (Macintosh)	50	48	0
Desktop (Kawamoto 2001)	55	25	1.5
Desktop manufactured	70	9	3
Integrated computer system manufactured	54-131	4-131	4-8
Desktop (Kawamoto 2004)	55	25	1.5
Desktop (Blue jay)	60-250	1-6	-

These studies shows that, on average, newer computers use 70W when active and 9W in Low power mode [16] whereas older computers use 55W when active and 25W in Low power mode [17].

B. *Monitors*

Monitors, like computers, vary in the amount of energy they require. The average CRT Monitor requires between 66W and 135W when active, between 0W and 19W in Low Power mode, and between 0W and 5W when switched off.

Newer monitors are more energy efficient than older monitors. Two factors contribute to the increased energy efficiency of monitors.

- New CRT Monitors require less energy than older CRT Monitors of equivalent size.
- LCD Monitors require much less energy than CRT Monitors.

TABLE II
Summaries of the results of Monitor in Watt

Description	Active	Low Power	Off
CRT	85	5	0.5
CRT with power management	66	15	-
CRT without power management	67	-	-
CRT 15"	75	10	0
CRT 17"	90	10	0
CRT 21"	120	10	0
CRT 14"-15"	61	19	3
CRT 15"- 21"	76	7	1
CRT 17"-21"	90-135	9-16	4-5
CRT and LCD average	55	5	1

These studies show that, for 17 inch CRT monitors, the newer models require 61W when active, 2W in Low power mode, and 1W turned off [16]. In contrast, the older models requires 85W when 5W in Low power mode, and 0.5W when turned off [17].

C. *LCD Monitors*

LCD Monitors require a fraction of the energy CRT Monitors. The average LCD Monitors requires 15W when turned off [18].

TABLE III
Summaries of the results of LCD in Watt

Description	Active	Low Power	Off
LCD	15	1.5	0.5
LCD 15"-18"	30	2	2
LCD 17"	35	0-15	0

Anecdotal evidence suggests that although offices may update their computers regularly, they do not update their monitors as after. On average, 17% of office monitors are LCD [19]. CRT Monitors requires 0.53 W/inch, and LCD Monitors require 0.23 W/inch. However, the research suggests that difference in energy consumption between CRT Monitors decreases and LCD Monitors decreases as size increase [16].

D. *Mac Computers*

Although some of the research includes Mac computers in their sample, they rarely report the results separately. We did not find any research that focused solely on Mac computers. As such, there are no average values for the energy requirements of Mac computers. Based on the environment specifications provided by Apple, current model Macs are more energy efficient than older models. Most current model Macs are also more energy efficient than the average results reported by the studies [20].

TABLE IV
Energy requirements of current model Mac computers

Description	Active	Low Power	Off	Notes
Mac Mini	21-23	2.3-2.4	1.3-1.5	Computer only
17" i Mac	44-56	3.1-3.6	2.2-2.6	Computer & 17" LCD monitor combined
20" i Mac	83-84	3.4-3.5	2.5-2.7	Computer & 20" LCD monitor combined
24" i Mac	116-120	4.1-4.5	2.6-2.8	Computer & 24" LCD monitor combined
Mac pro	250	13	2	Computer only

VI. CONCLUSIONS

In this paper we have discussed the way to save energy and help protect the environment for example:- saving of power in computing resources when they are not in functional use even screen saver uses a lot of power that can be saved by efficient utilization of machine. Turn on power management features during shorter periods of inactivity. Power management allows monitors and computers to enter low-power states when sitting idle. By simply hitting the keyboard or moving the mouse, the computers or monitors awakens from its low power sleep mode in seconds. Power management tactics can save energy and help protect the environment. All the studies indicate that newer computers using much more energy from older computers when it's active but in low power mode, it's using less power from the older computers. The newer 17 inch CRT Monitors require less power from the older CRT Monitor when active and low power mode. Most current model Macs are also more energy efficient than the average results reported by the studies. This is true for both older and newer models. Computer and monitors vary significantly in their power requirements. Computers and Monitors with a lower power can make a contribution to reducing energy costs. It appears that the most significant saving would be achieved by replacing CRT Monitors with LCD Monitors and Mac Computers.

REFERENCES

[1] R. R. Harmon and N. Auseklis, " Sustainable IT Services: Assessing the Impact of Green Computing Practices," in proceeding of PICMET Portland, Oregon USA, pp. 2-6, Aug. 2009.

[2] R. A. Sheikh and U.A. Lanjewar, "Green Computing- Embrace a Secure Future," International Journal of Computer Applications, vol 10-N.4, pp. 0975 – 8887, Nov. 2010.

[3] P. Kurp, "Green Computing – Are you ready for a personal energy meter," Communication of the ACM, Vol 51, No. 10, 2008.

[4] D. T .Tohmatsu, "The Next Wave of Green IT," CFO Research Services, Boston,Vol 32 pp-32, Jan 2009.

[5] A. Fanara, "Report to Congress on Server and Data Center Efficiency: Public Law 109-431, U.S. Environmental   Protection Agency: Energy Star Program, pp. 133, Feb 25, 2009.

[6] L. Wilbanks, "Green: My Favorite Color," IT Professional, pp. 63-64, November-December, 2008.

[7] A. Clifford, "Sustainable IT," it.toolbox.com: Project Management Community, Feb 25, 2009.

[8] S. Nagata. and O. Shoji, "Green Process Aiming at Reduction of Environmental Burden," Fujitsu Science and Technology Journal, Vol. 41(2), pp. 251-258, Jul 2005.

[9] S.V.S.S.Lakshmi, I.S.L.Sarwani and M.N.Tuveera," A Study On Green Computing: The Future Computing And Eco-Friendly Technology," International Journal of Engineering Research and Applications (IJERA), Aug 2012.

[10] R. R. Schmidt and H. Shaukatallah, "Computer and Telecommunication Equipment Room Cooling: A Review of the Literature," IEEE Inter Society Conference on Thermal Phenomena, pp. 751-766, 2002.

[11] E. Baldwin and M. Curley, Managing IT Innovation for Business Value, Intel Press, 2007.

[12] D.usnetzky,"VirtualizationandGreen Computing," http://www.zdnet.com/blog/virtualization/virtualization-and-greencomputing/141, May 17, 2007.

[13] H. Sato, "Eco-Labelling and Green Procurement Schemes for IT Products: The Japanese Approach, http://enviroscope.iges.or.jp/modules/envirolib/upload/1511/attach/Paper %209.pdf, Retrieved December 2011-12-31.

[14] Kurp, P. (2008). Green computing. Communications of the ACM, 51(10), 11–13.

[15] CACM Staff. (2007a). Big blue goes green. Communications of the ACM, 50(12), 7.

[16] Overby, S. (2007). Clean, green machines. CIO, 20(12), 36–44.

[17] Beach, G. (2008). Are you green? CIO, 21(10), 8.

[18] Swanborg, R."Where green IT is no fad," CIO, 22(15), 20, 2009.

[19] Ricknas, M. "Greener profits," CIO, 22(11), 18, 2009.

[20] Perenson, M. "Western digital debuts first 2TB hard drive," PC World, 27(4), 60, 2009.

[21] Mingay, S. "Green IT: The new industry shock wave," Gartner RAS Research Note G00153703, 2007

[22] Pollack, T. A "Green and sustainable information technology: A foundation for students ASCUE 2008 Proceedings, pp. 63–72, 2008

[23] Murugesan, and S. Harnessing, "Green IT: Principles and practices," IT Professional, 10(1), 24–33, 2008

[24] Roberson, J. A., Homan, G. K., Mahajan, A, Webber, C. A., Nordman, B., Brown, R. E., McWhinney, M. and Koomey, J. G. (2002), 'Energy Use and Power Levels in New Monitors and Personal Computers', LBNL-48581, Lawrence Berkeley National Laboratory, California. <http://enduse.lbl.gov/Projects/OffEqpt.html>.

[25] Kawamoto, K., Koomey, J. G., Nordman, B., Brown, R. E., Piette, M. A., Ting, M. and Meier, A. K. (2001), 'Electricity Used by Office Equipment and Network Equipment in the US: Detailed Report and Appendices', LBNL-45917, Lawrence Berkeley National Laboratory, California.<http://enduse.lbl.gov/Projects/InfoTech.html>.

[26] Kawamoto, K., Shimoda, Y. and Mizuno, M. (2004), 'Energy Saving Potential of Office Equipment Power Management', Energy and Buildings, 36, pp915-923.

[27] Webber, C. A., Roberson, J. A., McWhinney, M. C., Brown, R. E., Pinckard, M. J.and Busch, J. F. (2006), 'After-hours Power Status of Office Equipment in the USA', Energy, 31, pp2823-2838.

[28] Apple Product Environmental Specifications, Apple Computer, Inc (as of November2006).http://www.apple.com/environment/resources/specs.html.