GREEN COMPUTING: ECO-FRIENDLY TECHNOLOGY

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ABSTRACT

Green computing, the study of efficient and eco-friendly computing resources is under the attention of environmental organizations, and businesses from other industries. In recent years, companies in the computer industry have come to realize that going green is in their best interest, both in terms of public relations and reduced costs. This paper presents at several green initiatives currently under way in the computer industry, as well as issues that have been raised regarding these initiatives and presents a study with an example to learn more about the future of green computing.

Keywords: Energy Star, Environment, Green, Computing, Recycle, Sustainable.

I INTRODUCTION

Term 'Green Computing' is the study and practices that covers the computing lifecycle from cradle to grave. It start from design to manufacturing to use of equipment and then safely disposing-off computers, related devices, networking and communications equipments efficiently and effectively with negligible or no impact on the environment [1]. First and most conclusive research on computing shows that Carbon Dioxide (CO2) 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 extreme attention by researchers and professionals to minimize e-waste and use of non-toxic materials in preparation of e-equipments. Energy efficiency is increasingly important for future ICT (Information and Communication Technologies) as the cost, and availability of energy is rising day by day. The increased usage of ICT with increasing energy costs and the need to reduce greenhouse gas emissions demand for energy-efficient technologies that decrease the overall energy consumption of computation, storage and communications. The very first and most conclusive research shows that CO2 and other emissions are causing global climate and environment a huge damage Therefore it is the top most priority and challenge for Green Computing technologist to preserve our beloved planet. On the other hand a study by "The Climate Group" entitled Smart 2020 (http://www.theclimategroup.org/programs/ict/) predicts that, greenhouse gas emissions from the Internet industry will raise to approximately 1.3 Giga-tons of CO2, and the combined impact of smart grid; smart logistics; smart buildings; and videoconferencing could reduce emissions by approximately 7.8 tons.

1.1 History of Green computing

I n 1 9 9 2 , t h e U.S. Environmental Protection Agency launched Energy Star, a voluntary labeling program which is designed to promote and recognize energy efficiency in monitors, climate control equipment, and other technologies. This resulted in the widespread adoption of sleep mode among consumer electronics. The term green computing" was probably coined shortly after the Energy Star program began; For a PC disposal, it is necessary to know everything there is to know in order to be involved in green computing. Basically, the whole green aspect came about quite a few years back when the news that the environment was not a renewable resource really hit ome 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. This considers social responsibility, economic viability and the impact on t h e e n vi r on m e n t. The idea is to make the whole process surrounding computers friendlier to the environment, economy, and society. This means manufacturers create computers in a way that reflects the triple bottom line positively. Once computers are sold businesses or people use them in a green way by reducing power usage and disposing of them properly or recycling them. The idea is to make computers from beginning to end a green product.

1.2 Background

Governments go green: Many governments worldwide have initiated energy-management programs, such as Energy Star, an international standard for energyefficient electronic equipment that was created by the United States Environmental Protection Agencyin 1992 and has now been adopted by several other countries. Energy Star reduces the amount of energy consumed by a product by automatically switching it into ―sleep‖ mode when not in use or reducing the amount of power used by a product when in wstandby‖ mode. Surprisingly, standby ―leaking, the electricity consumed by appliances when they are switched off, can represent as much as 12 percent of a typical household's electricity consumption. In Australia, standby power is a primary factor for the country's increased greenhouse gas emissions — more than 5 megatons (CO2 equivalent) annually.

II STEPS TO GREEN COMPUTING

1. **Develop a sustainable green computing plan**. Discuss with the business leaders the elements that should be factored into such a plan, including organizational policies and checklists. Such a plan should include recycling policies, recommendations for disposal of used equipment, government guidelines and recommendations for purchasing green computer equipment. Green computing best practices and policies should cover power usage, reduction of paper Consumption, as well as recommendations for new equipment and recycling old machines. Organizational policies should include communication and implementation.

2. **Recycle.** Discard used or unwanted electronic equipment in a convenient and environmentally responsible manner. Computers have toxin metals and pollutants that can emit harmful emissions into the environment. Never discard computers in a landfill. Recycle them instead through manufacturer programs such as HP's Planet Partners recycling service or recycling facilities in your community. Or donate still-working computers to a non-profit agency.
3. **Make environmentally sound purchase decisions**. Purchase Electronic Product Environmental Assessment Tool registered products. EPEAT is a procurement tool promoted by the nonprofit Green Electronics Council to:
   i. Help institutional purchasers evaluate, compare and select desktop computers, notebooks and monitors based on environmental attributes
   ii. Provide a clear, consistent set of performance criteria for the design of products
   iii. Recognize manufacturer efforts to reduce the environmental impact of products by reducing or eliminating environmentally sensitive materials, designing for longevity and reducing packaging materials
4. **Reduce Paper Consumption.** There are many easy, obvious ways to reduce paper consumption: email, electronic archiving, use the ―track changes‖ feature in electronic documents, rather than redline corrections on paper. When you do print out documents, make sure to use both sides of the paper, recycle regularly, use smaller fonts and margins, and selectively print required pages.
5. **Conserve energy.** Turn off your computer when you know you won't use it for an extended period of time. 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 computer or monitors awakens from its lowpower sleep mode in seconds. Power management tactics can save energy and help protect the environment.

III CHALLENGES

According to researchers in the past the focus was on computing efficiency and cost associated to IT equipments and infrastructure services were considered low cost and available. Now infrastructure is becoming the bottleneck in IT environments and the reason for this shift is due to growing computing needs, energy cost and global warming. This shift is a great challenge for IT industry. Therefore now researchers are focusing on the cooling system, power and data center space. At one extreme it is the processing power that is important to business and on the other extreme it is the drive, challenge of environment friendly system, and infrastructure limitations [9]. Green Computing challenges are not only for IT equipments users but also for the IT equipments Vendors. Several major vendors have made considerable progress in this area, for example, Hewlett-Packard recently unveiled what it calls "the greenest computer ever"—the HP rp5700 desktop PC. The HP rp5700 exceeds U.S. Energy Star 4.0 standards, and has an expected life of at least five years, and 90% of its materials are recyclable [3]. Dell is speeding up its programs to reduce hazardous substances in its computers, and its new Dell OptiPlex desktops are 50% more energy-efficient than similar systems manufactured in 2005, credit goes to more energy-efficient processors, new power management features, and other related factors [3]. IBM is working on technology to develop cheaper and

more efficient solar cells plus many other solutions from IBM to support sustainable IT. According to researchers of Green Computing following are few prominent challenges that Green computing is facing today [9]:

i. Increase in energy requirements for Data Centers and growing energy cost;
ii. Control on increasing requirements of heat removing equipment, which increases because of increase in total power consumption by IT equipments;
iii. Equipment Life cycle management – Cradle to Grave; and
iv. Disposal of Electronic Wastes

IV APPLICATIONS

Green Computing is a diverse field and due to its nature and priority from all fields of life Green Computing has applications in every sector of computing as the goal is to save the environment and ultimately the life. The current main applications of Green Computing are covering following computing sectors [15]:

i. Equipment design;
ii. Equipment recycling;
iii. Data Center optimization and consolidation;
iv. Virtualization;
v. Paper free environment;
vi. Application Architecture; and
vii. Power Management

V SUSTAINING THE FUTURE

The greatest challenges for businesses trying to be eco-responsible are really understanding what that really means, then making changes that are sustainable over time, while adding business value,‖—Another challenge is balancing the needs of various stakeholders who each have different ideas of what changes should be made.‖ Some environmental non-governmental organizations would like certain flame retardants removed from electronic products, while the fire safety community is concerned about removing or changing flame retardants in electronics. One problem is that the substitute replacement must be assessed to ensure that environmental and health impacts are lower than the original material; however, since most replacements are fairly new, they have not been necessarily assessed with the same rigor applied to the original materials.

VI CONCLUSION

Technology is not a passive observer, but it is an active contributor in achieving the goals of Green Computing. IT industry is putting efforts in all its sectors to achieve Green computing. Equipment recycling, reduction of paper usage, virtualization, cloud computing, power management, Green manufacturing are the key initiatives towards Greencomputing. Current challenges to achieve Green Computing are enormous and the impact is on computing

performance. Efforts of Governments and Non-Government Organizations (NGOs) are also appreciate-able. Government regulations are pushing Vendors to act green; behave green; do green; go green; think green; use green and no doubt to reduce energy consumptions as well. All these efforts are still in limited areas and currently efforts are mainly to reduce energy consumption, e-Waste but the future of Green Computing will be depending on efficiency and Green products. Future work in Green Computing discipline will also rely on research work in academics since this is an emerging discipline and there is much more need to be done. There is need for more research in this discipline especially within academic sector

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