



International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirce.com

Vol. 5, Issue 2, February 2017

Green Computing: A Strategic Approach to a Green Future

Dr. Makarand S. Wazal

Principal, Sinhgad College of Commerce, Savitribai Phule Pune University, Pune, Maharashtra, India

ABSTRACT: The tremendous explorations in Information Technologies and the range of new equipment being developed every passing day, 21st century can aptly be labeled as the Century of Gadgets. The term Green Computing refers to the practice of using energy wisely and efficiently, causing negligible degradation to environmental resources and parameters also maintaining feasibility on the other hand. It is basically a balanced and sustainable approach towards the achievement of a healthy and clean environment without compromising the needs and necessities of technology for the present generation. Thus taking up a more holistic and careful approach to making our IT-industry greener definitely falls in our list of responsibilities in creating a more healthier, safer and clean environment. This also revolves on spreading awareness and ensuring people to take their necessary individual steps towards achieving the goals of Green Computing. In the present paper the authors have made a systematic study of several strategies, approaches and practices of green and energy efficient computing, in context to the growth and impact of the IT industry on environment in the recent years. The plans towards a greener IT-industry should include new electronic products and services with optimum efficiency and all possible options solutions towards energy savings.

KEYWORDS: Green Computing, Information Technology, IT Industry, environment, degradation

I. INTRODUCTION

The term Green Computing refers to the practice of using energy wisely and efficiently, causing negligible degradation to environmental resources and parameters. In broader terms, it is also defined as the study of designing, manufacturing/engineering, using and disposing of computing devices in a way that reduces their environmental impact. There is a lot of concern for environmental protection these days. Also, there is a lot of interest in environmental responsibility now-a-days with the concepts of global warming, conserving energy, recycling, hybrid cars, buying environmentally friendly products, reducing e-waste, etc. In addition to that, there has been a growing area of discussion on the subject of Green Computing. In short, we can say that green computing is the practice of using computing resources efficiently where energy is wasted and lost. Green technology is the application of the environmental science and technology for the development and application of products, equipment and systems to conserve the natural resources and environment, as well as to minimize or diminish the negative impacts on the environment from human activities. Green Technology is no other than Clean Technology or even called in a traditional way as Environmental Technology. It encompasses environmental friendly methods and materials to be opted from techniques for generating non-conventional energy source like solar power. Conventional green technologies have been applied in the fields of water and wastewater treatment, air pollution control, environmental remediation, waste treatment and management, and energy conservation. And now-a-days, initiative has been taken for the Green Computing under this green technology.

Green Computing refers to the art of utilizing computing resources in an efficient and eco-friendly, sustainable manner. In recent years, this practice has drawn serious attention both from Educational Institutions, environmental organizations and the corporate and business sector. Going Green has become an agenda for the IT industries in terms of public relations. Green computing is having three major factors viz. environmental impact, economic feasibility and social responsibility. It differs from traditional business practices that focus mainly on economic viability of a computing solution. The term Green Computing came into existence after the Energy Star Programme by the U.S. Environmental Protection Agency in the year 1992. Green computing is an environmentally sustainable approach to



International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirce.com

Vol. 5, Issue 2, February 2017

manage information and communication technologies. It enables organizations to improve environmental stewardship by increasing energy efficiency, improving information management and providing appropriate analytical capability. Green computing which is also called as green technology is environmentally responsible for use of computers and related resources like implementation of energy-efficient central processing units (CPUs), servers and peripherals as well as proper disposal of electronic waste (e-waste). Green computing is important for all classes of systems, ranging from handheld systems to large-scale data centers.

II. OBJECTIVES

The main objectives of the present study are as follows:

1. To know the effect of Green Computing in existing situation
2. To study the emerging trends in the information technology
3. To study the new concepts for environmental protection
4. To study the prospective growth of green computing

III. HYPOTHESIS

- a) There is less awareness of green technology as well as green computing
- b) A huge scope is there for the potential alternatives related to process technology in the form of green computing

IV. RESEARCH METHODOLOGY

The research methodology consists of primary data with the sample size of 150 as well as both quantitative and qualitative research techniques which includes a series of face to face interviews and survey with some IT Industry's high profile personnel as well as staff. The secondary data includes articles from magazines, reference books, different websites and research material available on net.

V. PRESENT SCENARIO OF IT INDUSTRIES

Data centers are one of the fastest growing energy consumers as an industry segment. IT industries are demanding increasing amount of energy to power larger and larger solutions. There is huge increase in energy consumption for physical servers in recent years. New IT Industries are being introduced into the enterprise at a velocity that significantly outpaces solution retirement. Organizations are realizing that the source and amount of their energy consumption contributing significantly to green house gas emission and as a response to this awareness, they are currently using the concept of reducing energy consumption.

VI. UNDERSTANDING REMEDIAL ASPECTS OF ENERGY CONSUMPTION

Energy efficient computing is the practice of using computing devices, with concerns for energy saving in the proper utilization. Some remedial aspects are there which can be followed efficiently like turning off the computer/s when they are not in use. This turning on/off won't harm the equipment. Computers should not be run continuously unless they are in use. It is better to see for reducing the amount of time the computer is on without adversely affecting the productivity. A good practice can be followed to turn on the required computer equipment if it really needs like immediate access to E-mail or other Internet services or any other peripherals. One can avoid using the switch on a power strip to turn on all equipments. Laser printer should not be turned on until we are ready to print.

As we can't live without PCs it is necessary to learn how to live with them in a way that makes them friendlier to the environment. Personnel Computers consume far too much electricity and generate too much e-waste. A typical PC takes approximately 110 watts to run and with well over 1 billion of them on the planet, it's easy to understand how much energy consumes. To avoid such a huge amount of energy consumption, every user/consumer needs to follow



International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirce.com

Vol. 5, Issue 2, February 2017

some good practices like turn off the entire computer system or at least monitor and printer while going for lunch or will be out of office for a meeting. Computer servers which must be on to serve network functions can be turned off at night at least as well as keeping server monitors off if they are not needed for servers to operate.

Energy-efficiency in hardware of all kinds is necessary. Various computer related tasks are required to fulfill every day, which can be done during adjoining, rigorous blocks of time and leaving hardware off at other times. Also, notebook computers are more beneficial in using rather than desktop computers whenever it is possible. Several power-management features are in the market which can be utilized to turn off displays and hard drives after several minutes of inactivity which makes a sense.

Some other green computing practices are:

- 1) Reducing Paper Waste
- 2) Reusing and Recycling of Hardware Devices
- 3) Purchasing Recommendations

In present situation, there is big use of papers every now and then which needs to minimize and proper recycling of waste paper should be there. There is a great worry of disposing e-waste now-a-days and this dispose of e-waste is required according to the govt. and local regulations. Employing alternative energy sources for computing workstations, data centers, networks and servers will lead to the growth of green computing.

VII. GREEN COMPUTING AND IT'S FUTURE

With the impact of climate change, comes the anticipated impact of green computing, hence the urgent need to reduce the carbon emissions produced by the information technology industry. Global carbon emissions from information and communications technologies are estimated as being roughly equal to those of the airline industry. A massive amount of electricity is needed to operate computers, search engines, and peripheral equipment. The manufacture of a computer chip can generate up to 4,500 times it's own weight in waste. Then there's the pressure of consumer demand. People want the latest, the smartest and the fastest technology. We do not yet know how far consumer attitudes will change the anticipated impact of green computing.

The plan towards green IT should include new electronic products and services with optimum efficiency and all possible options towards energy savings. That is enterprise wise companies are laying emphasis on moving towards Eco-Friendly Components in computers, the use of eco-friendly sustainable components will become the norm rather than the exception in future. It is estimated that out of \$250 billion per year spent on powering computers worldwide only about 15% of that power is spent computing- the rest is wasted idling. Thus, energy saved on computer hardware and computing will equate tonnes of carbon emissions saved per year. The plan towards green IT should include new electronic products and services with optimum efficiency and all possible options towards energy savings. Faster processors historically use more power. Inefficient CPU's are a double hit because they both use too much power themselves and their waste heat increases air conditioning needs, especially in server farms--between the computers and the HVAC. The waste heat also causes reliability problems, as CPU's crash much more often at high temperatures. Many people have been working for years to lice this inefficiency out of computers. Similarly, power supplies are notoriously bad, generally as little as 7% efficient. And since everything in a computer runs off the power supply, nothing can be efficient without a good power supply. Recent inventions of power supply are helping fix this by running at 80% efficiency or better.

VIII. RECENT PROPOSITIONS OF GREEN COMPUTING

Blackle Blackle is a search-engine site powered by Google Search. Blackle came into being based on the concept that when a computer screen is white, presenting an empty word or the Google home, one's computer consumes 74W. When the screen is black, it consumes only 59W. Based on this theory if everyone switched from Google to Blackle, mother earth would save 750MW each year. This was a really good implementation of Green Computing. The principle behind Blackle is based on the fact that the display of different colors consumes different amounts of energy on computer monitors. 6.2 Fit-PC is a tiny PC that draws only 5w. It is the size of a paperback and absolutely silent, yet fit



International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirce.com

Vol. 5, Issue 2, February 2017

enough to run Windows XP or Linux. FitPC is designed to fit where a standard PC is too bulky, noisy and power hungry. If one ever wished for a PC to be compact, quiet and green, then fit- PC is the perfect fit. It draws only 5 Watts, consuming in a day less power than a traditional PC consumes in 1 hour. One can leave fit-PC to work 24/7 without making a dent in one's electric bill.

Zonbu Computer Zonbu is a new, very energy efficient PC. It consumes just one third of the power of a typical light bulb. The device runs the Linux operating system using a 1.2 gigahertz processor and 512 Mb of RAM. It also contains no moving parts, and does even contain a fan. One can get it for as little as US\$99, but it does require one to sign up for a two-year subscription.

Sunray thin client Sun Microsystems is reporting increased customer interest in its Sun Ray, a thin desktop client, as electricity prices climb, according to Subodh Bapat, vice president and chief engineer in the Eco Responsibility office at Sun. Thin clients like the Sun Ray consume far less electricity than conventional desktops, he said. A Sun Ray on a desktop consumes 4 to 8 watts of power, because most of the heavy computation is performed by a server. Sun says Sunrays are particularly well suited for cost-sensitive environments such as call centers, education, healthcare, service providers, and finance. PCs have more powerful processors as well as hard drives, something thin clients don't have. Thus, traditional PCs invariably consume a substantially larger amount of power. In the United States, desktops need to consume 50 watts or less in idle mode to qualify for new stringent Energy Star certification. [9] 4. The Asus Eee PC and other ultra-portables The "ultra-portable" class of personal computers is characterized by a small size, fairly low power CPU, compact screen, low cost and innovations such as using flash memory for storage rather than hard drives with spinning platters. These factors combine to enable them to run more efficiently and use less power than a standard form factor laptop. The Asus Eee PC is one example of an ultraportable. It is the size of a paperback, weighs less than a kilogram, has built-in Wi-Fi and uses flash memory instead of a hard drive. It runs Linux too.

IX. E-WASTE RULES: HELPING TOOL FOR GREEN COMPUTING

Government of India has established certain rules in the law under the Ministry of Environment, Forest and Climate Change. The detailed rules are given in the Gazette of India, Extraordinary Part-II, Section-III, Sub-section (i) as per GSR 338(E), dated 23rd March, 2016 under the Environment (Protection) Act 1986 (29 of 1986) regarding responsibilities of manufacturer, responsibilities of producer, responsibilities of collection centers, dealers, refurbisher (who makes in new form), responsibilities of consumer and bulk consumer, dismantler, recycler, responsibilities for State Government for environmentally sound management of E-waste. Hence, it can be followed to have green technology and green computing.

X. FACTS AND PREVENTIVE MEASURES OF GREEN COMPUTING

Green Computing can be implemented

- To reduce the use of hazardous materials
- To maximize energy efficiency during the product's lifetime
- To have recyclability or biodegradability of non-operational products and factory waste.
- Government regulation, however well-intentioned, is only part of an overall green computing philosophy.
- Many corporate IT departments have green computing initiatives to reduce the environmental effect of their IT operations.

The work habits of computer users and businesses can be modified to minimize adverse impact on the global environment. The relationship between Information Technology (IT) and the environment is complex. Green Information Technology has been termed because of the negative environmental impact of IT production, its use and then disposal which considers IT's environmental impact primarily as a problem to be mitigated. Another effect involves the positive impact of using Information Systems (IS) to improve the eco-sustainability of businesses and society which is termed as Green IS. Green IS is a solution for the negative environmental effect of information technology. One of the earliest initiatives toward green computing in the United States was the voluntary labeling



International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirce.com

Vol. 5, Issue 2, February 2017

program known as Energy Star. It was conceived by the Environmental Protection Agency (EPA) in 1992 to promote energy efficiency in hardware of all kinds. The Energy Star label became a common sight, especially in notebook computers and displays. Similar programs have been adopted in Europe and Asia.

Green computing aims to attain economic viability and improve the way computing devices are used. Green IT practices include the development of environmentally sustainable production practices, energy efficient computers and improved disposal and recycling procedures.

Following four complementary approaches are employed to promote green computing concepts at all possible levels,

- 1) **Green use:** Minimizing the electricity consumption of computers and their peripheral devices and using them in an eco-friendly manner
- 2) **Green disposal:** Repurposing an existing computer or appropriately disposing of, or recycling, unwanted electronic equipment
- 3) **Green design:** Designing energy-efficient computers, servers, printers, projectors and other digital devices
- 4) **Green manufacturing:** Minimizing waste during the manufacturing of computers and other subsystems to reduce the environmental impact of these activities

Sr	Topic	Know/Yes	Know/Yes Partly	Don't Know
1	Awareness of Green Computing	50	35	65
2	Reduction of Energy concept	70	30	50
3	Implementation of Remedial Things	30	50	80
4	Ready to do Social Awareness	40	52	58
5	Ready to accept new Challenges	120	20	10

Table No. 1 Opinion about Green Computing Implementation

XI. CONCLUSION

It has been observed from the responses from the respondents that there is huge need of getting aware about the green computing and act accordingly. In today's world the driving force of computing has shifted from faster analysis, speedier calculations and solving of more complex problems to achieve energy efficiency, minimization in consumption of electronic equipments, minimization of e-waste and use of non-toxic materials in preparation of electronics. The practice of using computing resources efficiently is gaining serious momentum and thus the goals of reducing the use of hazardous materials, maximizing energy efficiency during the product's lifetime, and promotion of recyclability or biodegradability of defunct products and factory waste are being realized. This radical change in perspective amongst the developers has led to a revolution in the field of computing technology and this revolution has been coined as green computing. Green computing is basically the study and practice of efficient and eco-friendly computing which will help a typical organization to reduce their energy footprint while maintaining required levels of computing performance. With the challenges of climate change, peaking oil prices, and a double-dip recession looming, businesses and individuals urgently need to adopt precautionary principles and learn from best practices if they are to lend vision to the anticipated impact of green computing.

XII. SUGGESTIONS

- 1) Green technology development should balance the fulfillment of human needs with the protection of natural environment and resources so that these needs can be met not only in the present, but in the indefinite future. It must be sustainable.
- 2) Use of LCD (Liquid Crystal Display) monitors is preferable than CRT (Cathode Ray Tube) monitors.
- 3) Power-down the CPU and all peripherals during extended periods of inactivity.
- 4) Energy-intensive peripherals like Scanner, Laser Printer etc. can be Power up and down according to the need.



ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirccce.com

Vol. 5, Issue 2, February 2017

REFERENCES

1. Biac (2010), 'Technology development and deployment to address green growth challenges', Business and Industry Advisory Committee to the OECD, 2010, Paris.
2. Shalabh Agarwal and Asoke Nath, 'Green Computing - a new Horizon of Energy Efficiency and Electronic waste minimization: a Global Perspective', Proceedings of IEEE CSNT-2011 held at SMVDU(Jammu), June 2011, Page 688-693
3. Shalabh Agarwal and Asoke Nath, 'Desktop Virtualization and Green Computing Solutions', 2012
4. Shalabh Agarwal, Asoke Nath, 'A Study on implementing Green IT in Enterprise' International Journal of Advanced Computer Research, Vol-3, No.1, Issue-3(march)
5. Chiranjeeb Roy Chowdhury, Arindam Chatterjee, Alap Sardar, 'A Comprehensive study on Cloud Green Computing : To Reduce Carbon Footprints Using Clouds', International Journal of Advanced Computer Research, Vol-3, No.1, Issue-3(march)
6. Alvin Galea, Michael Schaefer, Mike Ebberts, , 'Green Data Center: Steps for the Journey', Shroff / IBM Redbooks, 2011
7. Aritra Mitra, Riya Basu, Avik Guha, Shalabh Agarwal , 'Application of Green computing in Framing Energy Efficient Software Engineering', International Journal of Advanced Computer Research, Vol-3, No.1, Issue- 3(march), 2013
8. Bud E. Smith, 'Green Computing: Tools and Techniques for Saving Energy, Money, and Resources', Auerbach Publications, 2013
9. Bud E. Smith, 'Green Computing: Tools and Techniques for Saving Energy, Money, and Resources', Auerbach Publications, 2013
10. Wu-Chun Feng, 'The Green Computing Book: Tackling Energy Efficiency at Large Scale', CRC Press, 2014

Web References

1. www.greenbiz.com
2. <http://www.phonebloks.com>
3. <http://www.thegeekslub.com/green-computingtips-for-greenerenvironment>
4. <https://www.kbmanage.com/concept/green-computing>
5. www.explainingcomputers.com/green.html

BIOGRAPHY

Dr. Makarand S. Wazal is a Principal of Sinhgad College of Commerce, Savitribai Phule Pune University, Pune, India. He received Master in Computer Management (MCM) degree in 1993 from Savitribai Phule Pune University, Pune, India, Master of Business Administration (MBA) degree in 1996 from BAMU, Aurangabad, MS, India, Master of Philosophy (M.Phil.) in Computer Science in 2009 from Alagappa University, Tamilnadu, India, Master of Commerce (M.Com.) in 2011 from Savitribai Phule Pune University, Pune, India and Doctor of Philosophy (Ph.D.) in Management Science in 2008 from Swami Ramanand Teerth Marathwada University, Nanded, India. He is guide for Doctoral Research (Ph.D.) in Savitribai Phule Pune University, Pune, India and Tilak Maharashtra Vidyapeeth, Pune, India having six students doing research under him. Her areas of research interest are Computer Management, Marketing Management and Information Technology etc.