International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 05 | May 2021 www.irjet.net p-ISSN: 2395-0072

"GREEN COMPUTING – A LATE START"

Jaskirat Kaur

Assistant Professor, Department of Computer Science, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab, India

---

Abstract - *Green Computing is a term used to describe an innovative way on how technology and ecology converge together. Green computing is "The study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems -such as monitors, printers, storage devices, and networking and communications systems – efficiently and effectively with minimal or no impact on the environment". Green Computing reduces the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste. This paper discusses about the Green computing, its needs and some practices of green computing, steps toward Green computing by a common man and recent implementations of green computing. This research paper describes that today computer is basic need of everyone. No individual or organization can work without computer, but they also have to aware about the harmful impacts to use of computers, its manufacturing and disposing and what steps we should take to reduce the harmful impacts and save our environment.*

Keywords: Green computing, eco-friendly, power management, Virtualization, Reuse, Recycle.

1. INTRODUCTION

Use of computer system and IT services had made one's life easier and more comfortable. It increases the processing speed and power consumption also. This large amount of power consumption increases the emission of green house gases and increases the pollution as well. About 60-70 percent energy is consumed by computers which are not in use but still turned ON and that consumed energy is the main reason of CO2 emission. For example, the average CRT monitor requires between 66W and 135W when active, between 0W and 19W when low power mode, and between 0W and 5W when switched off [4]. So there is a great need to implement the concept of Green computing to save our environment. The goals of green computing are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of non-operational products and factory waste [2]. This technology is beneficial as it:

- Reduce energy consumption of computing resources during peak operation.
- Save energy during idle operation.
- Use eco-friendly sources of energy.
- Reduce harmful effects of computing resources.
- Reduce computing wastes.[1]

2. PRACTICES IN GREEN COMPUTING

There are lots of fundamental steps that can be taken to significantly decrease the power consumption and impact on environment. Main three approaches are:

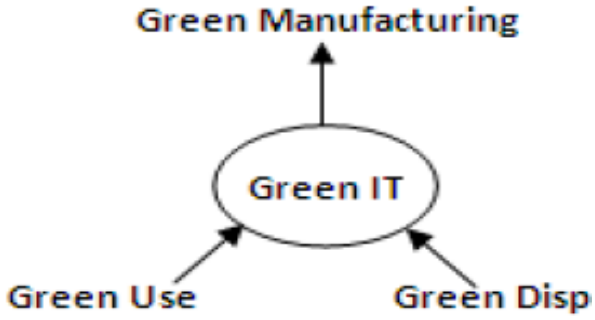

Fig.1. Dimensions of Green Computing

1.1. Green Manufacturing: Process of production of computers and associated devices include methods of manufacturing and biodegradable components for minimal or no impact on environment. This approach allows providing economic benefits like long-term cost savings, and business process efficiency improvements. Main areas in green manufacturing of computers are:

- Eco-friendly design: It is important to design computers which can be powered with low power. They can make use of energy obtained from nonconventional energy sources like solar energy, wind energy pedaling a bike etc. In addition to this, the manufacturing process of computers should be energy efficient. For example, The Energy Star devices can be programmed to power-down to a low electric state when they are not in use, helping to save energy and run cooler which helps them last even longer [6].
- Use of bio-products: Bio-plastic or plant-based polymer that requires less oil and energy to produce should be used in comparison to traditional petroleum-filled plastic with a challenge to keep these bio-plastic

computers cool so that electronics won't melt them. Power-sucking displays can be replaced with green light displays made of OLEDs (Organic Light-Emitting Diodes). Use of toxic materials like lead can be replaced by silver and copper making recycling of computers more effective by recycling computer parts separately with an option of reuse or resale.

- Green computer design: It aims to reduce the environmental impact of computers by adopting new technologies and using new techniques and materials while balancing environmental compatibility with economic viability and performance. Many computer manufacturers are successfully in the process of making green PCs using nontoxic materials that consume less and less of electrical power and can be easily reassembled. These new computers are highly upgradable thus their useful lifetime is extended. Dell aims its new Zero Carbon Initiative at maximizing the energy efficiency of Dell products, and over time plans to offset its carbon impact. As a major aspect of this initiative, its suppliers have to publicly report their greenhouse gas emissions. Apple is also committed and has said it will reduce or eliminate toxic chemicals present in its new products and more aggressively recycle its old products. Companies have launched new tools, standards, and product registration to help customers in assessing the environmental attributes of PCs, notebooks, servers, and other hardware [2].

1.2. Green Use: Reducing the power consumption of computers, information systems and their peripheral subsystems in environmentally friendly manner.

- Power management: Reduction in energy consumption would be an important step by computer users towards a more sustainable environment. The Advanced Configuration and Power Interface (ACPI) is an open industry standard that allows an operating system to directly control the power saving aspects of its underlying hardware. It can be done by setting the Power Options of computer to switch to sleep mode when it is not active. It enables PC's to go to stand-by mode and turn off the monitor when the PC is idle for a few minutes. Further avoidance of the use of screen savers contribute to energy savings by allowing a monitor to enter in stand-by mode. In addition, a system may hibernate, where most components including the CPU and the system RAM are turned off [3].
- Virtualization: In the traditional IT infrastructure servers are dedicated to specific computing functions like storage, communication, database and so on. Virtualization eliminates the need for a dedicated server to run applications – it enables at the same time to run multiple operating systems on the same hardware platform and the system at maximum possible performance [3]. With virtualization, a system administrator could combine several physical systems into virtual machines on one single server to run multiple operating systems and make it more powerful. Energy-efficiency can be achieved with less physical equipment plugged in, which reduces power and consume less electricity. Virtualization contributes in green technology on the one hand by reducing: number of servers, power and disposal requirements of desktops and limiting costly business travels of staff, customers and suppliers as well as replacing paper systems with on-line communication platforms.
- Algorithmic Efficiency: The efficiency of algorithms has too an impact on the amount of computer resources required for any given computing function and there are many efficiency trade-offs in writing programs. A more efficient algorithm for a computer application will require less processing time which in turn will lead to less consumption of power and less emission of carbon dioxide.

1.3. Green Disposal: It includes refurbishing and reusing old existing computing equipment and proper recycling of obsolete, unwanted or broken computers and its subsystems. By upgrading the computer, one can increase speed, memory, performance and can also extend the life of the system and some of the components. So reuse first, and then recycle [5].

- Reuse: An old computer should continue to be used if it meets the user requirements. Otherwise, it can be given to someone who needs it or the functional components may be used from a retired product. By using the hardware for a longer period of time, the total environmental footprint caused by computer manufacturing and disposal will be reduced greatly [7].
- Refurbish: An old computer and other IT hardware can be made almost new again by reconditioning and replacing their parts. Rather than buying a new computer, refurbished IT hardware can be bought from the market [2]. At this point it is important to understand the difference between "refurbished" and "used" product. Refurbishing gives the guarantee that the product was tested and verified to function properly while "used" products may or may not be defective. Hardware vendors often resell equipment that was returned under warranty after repairing the defects and checking proper function. Refurbished hardware provides a cost-effective alternative.
- Recycle: When computers cannot be reused, even after considering the prospects of refurbishing, they must be disposed properly in environmentally friendly ways. Vast majority of unwanted computers and electronic goods end up in landfills. Apart from containing toxic materials like lead, chromium, cadmium, and mercury, computer components contain many other harmful materials. If computers are buried in landfills, harmful chemicals from them may leak into waterways and the environment. If burned, they release toxic gases into the air we breathe, so if e-waste is not discarded properly, it will be harmful to the environment and people. On the other hand, e-waste can be a valuable source for secondary raw materials. Old electronic systems should

be recycled by taking component material and reprocessing it into the same material or breaking it down into constituent materials for reuse.

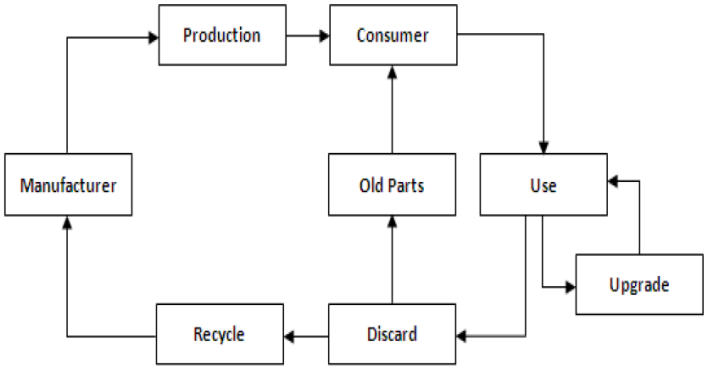

Fig.2. Life cycle of green computers

To sum up, the above figure states that the cycle starts with the role of manufacturers in making the computers that are energy efficient and are built using non-toxic, bio-degradable materials. After that, consumers must be aware of purchasing eco-friendly computers. After purchasing they must use them in a green way by reducing power usage and by reducing e-waste with timely up-gradation and maintenance of computers. After usage disposing or recycling of computers properly and efficiently is also essential. In short, green manufacturing, use and disposal are the efforts that lead to economic and ecological benefits".

3. INDIVIDUAL GREEN COMPUTING

As an individual we have to do some efforts to make environment healthy. The following actions should be taken by us:

- *Use Energy Star labeled products*: These products are manufactured on 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. So, we have to use "Energy Star" labeled desktops, monitors, laptops, printers and other computing devices**.**
- *Turn off your computer*: PC's and its peripherals consume more power and resultant is the high amount of CO2 emission. So, we have to turn off our personal computers when they are not in use.
- *Sleep Mode*: Sleep mode save our session and put our computer in a low power state so that we can quickly resume windows. Always put our PC on sleep mode when not in use. It saves 60-70 percent of electricity.
- *Hibernate your computer*: This mode allows us to shut everything down. When we are not using our computer for a short period of time we have to hibernate it. It saves the electricity when computer is not in use.
- *Avoid using screen saver*: Screen savers also consume electricity even when a computer is not in use. Screen saver can be a graphic, text or an image that shows on computer screen when it is not used for pre-set time. But the best option for energy saving than screen saver is turn off your monitor when not in use.
- *Turn down monitor brightness*: Electricity consumption plays a main role in CO2 emission. If we use our PC at a high brightness, it consumes more electricity than using at a normal brightness. So, we should always turn down our PC's brightness to save electricity.
- *Stop informal Disposing*: Computer and its components use toxic chemicals when manufactured and when we use informal disposing, they put harmful impacts on our environment. So, to minimal or reduce these harmful impacts we have to use formal disposing.
- *Use LCD rather than CRT monitors*: LCD (Liquid Cristal Display) is the less power consumption device then CRT (Cathode Ray Tube). So, if we have to save our environment from the effect of CO2 emission, we have to use LCDs rather than CRTs.

4. RECENT IMPLEMENTATIONS OF GREEN COMPUTING

4.1. 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, the energy 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 save750MW each year. The principle behind Blackle is based on the fact that the display of different colors consumes different amounts of energy on computer monitors [8].

4.2. Fit-PC: a tiny PC that draws only 5w. Fit-PC is the size of a paperback and absolutely silent, yet fit enough to run Windows XP or Linux. Fit-PC draws only5 Watts, consuming in a day less power than a traditional PC consumes in 1 hour.

4.3. Zonbu Computer: The Zonbu is a new, very energy efficient PC. The Zonbu consumes just one third of the power of a typical light bulb. The device runs the Linux operating system using a1.2 gigahertz processor and 512 MB of RAM [8].

4.4. 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.

5. CONCLUSION

Computers and related infrastructure (e.g., data centre) are not only costly to maintain, but also harmful to the environment due to the carbon emission. Hence, there is a necessity to balance the dramatic growth of utilizing computing resources with green technology to reduce environmental impact. This solution protects the environment by dealing with the power management techniques, saving electricity and reducing e-waste. 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 Green computing. Governments regulations are pushing Vendors to act 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.

REFERENCES

1. Gaurav Jindal, Manisha Gupta, "Green Computing, Future of Computers", International Journal of Emerging Research in Management &Technology, pp. 14-18, dec 2012.
2. Biswajit Saha, " Green Computing", International Journal of Computer Trends and Technology (IJCTT), vol 14 ,pp. 46-50, aug 2014.
3. A.Divya, S.Girija."Green computing", International journal of scientific & engineering research, vol 8, issue 7, july-2017.
4. S.Agarwal et al. "Trends and Awareness in Green Computing Initiatives: a Comprehensive study", International Journal of Advance Research in Computer Science and Management Studies, vol 3, issue 4, april-2015.
5. R. A. Sheikh and U.A. Lanjewar, "Green Computing – Embrace a Secure Future", International Journal of Computer Applications, vol 10, issue 4, pp. 22-26, 2010.
6. P. Kiruthiga, T. V. Kumar, "Green Computing – An ecofriendly approach for energy efficiency and minimizing e-waste", International Journal of Advanced Research in Computer and Communication Engineering, vol 3, issue 4, 2014.
7. R. Gowtham et al. "Contributing solutions and latest developments in green cloud", International Journal of Computer Applications, 2011.
8. [Online] http://itmambersmitec.blogspot.com/2013/12/recent-implementation-of-green-computing.html