



## Sustainable Environment Friendly Green Computing for Futuristic Technologies

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### Abstract

Green computing is the study of designing, manufacturing/engineering, usage and disposal of computing devices in a way that reduces the environmental impact. Green computing aims on reducing the use of hazardous materials, maximize energy efficiency during the product's lifetime and promote the recyclability. It also motivates towards biodegradability of obsolete products and factory waste. The usage of computers is increasing day by day which increases the consumption of electricity. This crisis has been realized by people and measures are being taken which help in minimizing the power usage of computers. This initiative can be called as Green Computing. This paper focus on current trends in Green Computing approaches, technologies in green computing and means to address the challenges of Green Computing.

Key words: Green computing; sustainability; environment; energy-efficient.

### 1. Introduction

Green computing is the study of utility of the resources which are efficient and eco-friendly in a sustainable manner. Green computing includes using resources in a way that reduces the usage of hazardous materials, Designing objects and services that comply

with the environment, recycling e-waste with no or little impact on the environment is the prime motto behind the green computing. This includes discovery and development of new products that reduces or eliminates the use of hazardous substances in

Manufacturing [8]. Many organizations are continuously investing in designing the devices which are energy efficient and thus encourage the recyclability. Hence, the main idea of green computing is to find the solution of these indirect adverse effects on the environment.

#### 1.1 History

In 1992, the U.S Environmental Protection Agency has launched Energy star which is an international standard for energy-efficient electronic equipment, climate control equipment and other technologies. Energy Star switches the product into “sleep” mode when not in use for reducing the amount of energy consumed by a product rather than the amount of power used by a product when it is in “standby” mode. At the same time for achieving low magnetic and electrical emissions from CRT-based computer displays. Swedish organization TCO had launched the TCO Certification program which includes standard of energy consumption. In 1998, the China National Development and Reform Commission (NDRC) founded the China Energy Conservation Program (CECP) which is a non-profit organization in-charge of the administration,

management and implementation of energy certification, conserving, water-saving, and environmentally friendly products. The Energy Conservation Center in Japan is responsible for raising public awareness on conservation of energy, training, state examinations for energy managers and their energy-conservation campaign[6][4].

## 1.2 Current scenario of green computing

**1.2.1 Electronic waste:** Electronic waste is an increasing problem globally due to the quick replacements of electronics devices and components. E-waste includes discarded electronic appliances such as mobile phone, computers, and televisions etc. Based on the Gartner estimations over 133,000 PCs are discarded by U.S. homes and businesses every day and less than 10 percent of all electronics are currently recycled[3].

**1.2.2 Wasting Electricity and Environmental Statistics:** Research shows that most PC's are left idle whole day, which leads to wastage of electricity. CRT monitors typically use more power than LCD monitors. According to OECD in 1990 there were 6169592.14 tons of CO<sub>2</sub> equivalent, thousands emission in USA which has been increased to 6665700.866 tons of CO<sub>2</sub> equivalent, thousands in 2011. There is also an increasing growth in the e-waste generated. This shows how vastly the environment is contaminated.

## 2.0 Need for green computing

**2.1 Climate Change:** The Research shows that CO<sub>2</sub> and other emissions are causing global climate and environmental damage. It's leads to global warming. The major task in front of the world is to preserve the planet.

**2.2 Reliability of Power and Performance Tuning :** Reduction in the energy costs leads to the serious cost savings. As the demand for energy increases the supply decreases. Performance tuning is the process of adjusting a computer so that it will perform to the best of its ability, given its current or aggregate workload. It reduces the overall energy of the given system[1].

**2.3 Capacity Planning and Reliability Considerations:** Capacity Planning minimizes the amount of hardware needed to perform all required operation. Its avoids the purchasing of overpowered and underpowered equipments. Reliability of hardware

reduces the overall costs of energy associated with system failures and E-waste[5]

## 3.0 Recent implementations motivations for Green Computing

**3.1 Blackle :** It is a search –engine site developed by the Google search. The principle of Blackle is that the display of different colors consumes the different amount of energy on computer monitors. In brief, when a computer screen is white, computer consumes 74W. When the screen is black it consumes only 59W. Based on this if everyone change from Google to Blackle, it would save 750MW each year. This reduces the energy consumption

**3.2 Fit-PC:** A tiny PC that consumes only 5w. It has the size of a paperback and it is extremely silent. It is enough to run Windows XP or Linux .fit-PC is designed to replace the PC which is too bulky, noisy and consume more power. It consumes less power than a traditional PC. we can work 24/7 on a fit-PC without having an adverse effect on electricity bill[2].

**3.3 Zonbu Computer:** It is an energy-efficient PC. This device runs the Linux operating system using 512 megabytes of RAM and 1.2 gigahertz processor and. It does not enclose moving parts and does even contain a fan. It just consumes one-third of the power of a typical light bulb .we can buy it for US\$99, but it requires to signing up for a two-year subscription.

**3.4 The Asus Eee PC and other ultra portables:** The ultraportable classes of personal computers are of small size, low power CPU, low cost and innovations such as using flash memory for storage rather than spinning platters, compact screen. All this factors enable them to consume less power and run more efficiently. The Asus Eee PC is an example of an ultraportable. It has the size of a paperback, weight less than a kilogram. It uses flash memory instead of the hard drive and built in WI-FI. It runs Linux too costs for office space.

**3.5 IBM and its “Aquasar”:** It is the cooling system. It has energy efficiency of about 450 megaflops per watt. To reduce the power consumption of the supercomputer stationed at the "Swiss Federal Institute Technology Zurich" it uses hot water. An additional energy of nine kilowatts is used by the thermal power to the building's heating system.

**3.6 HP Labs Data Center in a Dairy Farm:** HP Labs Design is utilizing a Farm Waste Data Center Ecosystem. This data center refers to a farm that power up a typical modern data center and the dairy farm using 10,000 cows which provide methane gas. In rural areas, the animal manure power is abundant. It also helps the other farmers to get rid of their farm wastes.

**3.7 Google's Sustainable Operations:** Google, which flourish in data centers is well-known for being at the forefront of advocating the benefits of green computing. The company's data centers depend on Google-designed edifices that utilize only half the energy used by a typical data center. The energy used by Google search consumes only about 0.0003 kWh and 0.2g of CO<sub>2</sub> emission. Google is out to prove that energy will be preserved by encouraging other data centers to do the same.

#### 4.0 Issues and hurdles

- Manufacturers are preparing devices which are more efficient and accurate but they use more energy and evolve very toxic, dangerous gases and chemicals[4][6].
- Several electronic companies use lead (4 to 8 pounds), mercury, cadmium and other toxic chemicals in computers.
- New research has estimated that computers and other electronic devices make up two-fifth of all lead in land-fills on the earth which increases pollution rapidly.
- By conducting survey in America energy consumed by data center in USA and all over the world will be doubled in next few years.
- Green computing could actually be quite costly. Some computers that are green may be considerably low powered also.
- Rapid change in technology.
- Implementation cost for installing, training, updating and technology support.

#### 5.0 Challenges

According past researchers, the main focus was on efficient computing, cost associated with IT equipments and infrastructure services were considered low cost and available. By growing computing needs, cost of energy and global warming is becoming the bottleneck in IT environments and this shift is a big challenge to the IT industry. Currently, the researchers are focusing on the cooling system, power and data center space. Processing power which is important to business is

extreme and maintaining it is the real challenge of environment-friendly system. Green computing challenges are for IT equipments users and vendors. For example, Hewlett-Packard recently unveiled what it calls "the greenest computer ever"—the HP rp5700 desktop PC which exceeds U.S. Energy Star 4.0 standards, and is expecting at least five years life, and 90% of its materials are recyclable. Dell is speeding up its programs by providing new Dell OPTIPLEX Desktops which are 50% more energy-efficient than similar systems manufactured in 2005. Credit goes to more energy-efficient processors, features of new power management and other related factors. Currently, IBM is working on new technology to develop cheaper and more efficient solar cells and also solutions for supporting sustainable IT[7][6].

According to researchers the few prominent challenges of Green Computing are as follows:

- Equipment power density / Power and capacity of cooling.
- Growing of energy cost and requirements for Data Centers.
- Control on requirements of heat removing equipment, which increases in total power consumption by IT equipments.
- Equipment Life cycle management.
- Disposal of Electronic Wastes[5].

#### 5. Some tips for green computing practices

- When electronic devices are not in use turn off the devices.
- Buy an Energy star computer of good quality which observes the power consumption.
- Set the computers for enabling standby/sleep mode and power management.
- As many times as you can recycle the waste papers.
- Print as little as possible. Evaluate and modify documents on the screen and use print preview. Minimize the number of hard copies. Instead of printing, save information to disks.
- If you use a laser printer, don't turn your printer on until you are ready to print.
- Instead of using bright colored display, choose dark background screen display which consumes less power.
- Although a bit slower than laser printers, using ink-jet printer consumes 80-90 percent less energy.

- When you are working on computer reduce the room light.
- Instead of printing the document drafts and e-mails, review it.
- Petroleum filled plastic may be substituted by Bio plastic (plant based polymers) which require less oil and energy. Bio plastic materials made computer are more secure and cool.

## 6. Advantages

Green IT technologies and other computing initiatives have enabled people from all over the world to interact as one global community without worsening the CO2 emissions and the E-wastes. The IT industry has begun to address energy consumption in the data center through a variety of approaches including the use of more efficient cooling systems, storage area networks, virtualization and blade servers. Green Computing can help us to secure and safe place for us in the world to live. If each person tend to save the environment then the planet earth would be healthy and happier for survival.

- By reducing the energy usage by green computing techniques leads to lower carbon dioxide emission and also reduces the fossil fuel used in power plants and transportation.
- By the saving energy and resources saves money.
- Green computing even includes changing government policies governing the acquisition, usage and disposal of electronics to minimize energy consumption and environmental impact
- Preventing the overuse of resources means less energy is required to produce, use, and dispose of products.
- Recycling the products leads to the reduction in the e-waste.
- Green computing plays the major role in the development of a business by meeting requirements. It also a good way to meet demands of the customers and employees.
- Reduce the hazard existing in the laptops such as chemical is known to cause cancer, nerve damage and immune reactions in humans.
- Green computing leads to reduction in energy bills, Less wasted power, paper, and storage space, environmental consciousness, improved public image and decreased need for travel.
- Virtualization technique of green computing can enhance the server utilization rates for the organizations.

- Green computing reduces the pressure on paper industry which is a main issue of conservation. Renewable resources are encouraged for reuse.
- Green computing techniques help us to reduce the amount of pollution in air or surrounding.

## 7. Conclusion

Green computing represents a responsible way to address the issue of global warming. Green manufacturing is the key initiatives towards Green computing. Current challenges to achieve Green Computing are enormous and the impact is on computing performance. Government norms are pushing the organizations to act green; behave green; do green; go green; think green; use green and to reduce energy consumptions as well. This paper has depicted the importance of Green computing. Today awareness about the benefits of green computing and the use of environmentally sustainable products is a must to common man and save world from harmful impacts of CO2 emission.

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