

# Green Computing: Future of Mankind

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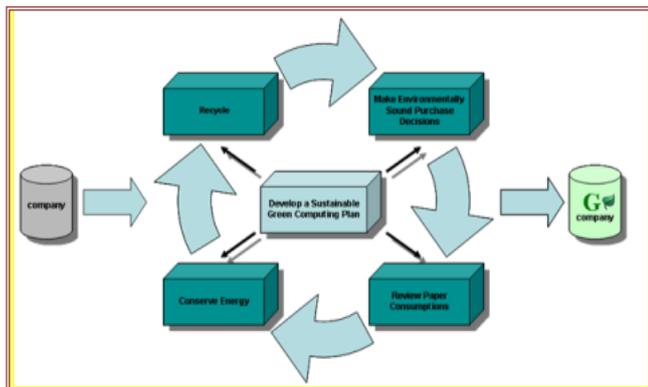
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**Abstract** - Initially, computing has its focus on fast analysis, speedier calculations and solving complex problems. But in recent years, Green computing gained the attention from environmental organizations and business industries. It refers to effective and efficient ways of designing, manufacturing and using computer and related products such that it reduces the harmful effect on environment. Due to its introduction computer industries have realized that going green is innovative and better way to reduce costs and maintain public relations. Our work includes use of Green computing in today's world and tells about how green technology reduces environmental problems and protect future.

**Key Words:** Green computing, Green IT, Virtualization, E-waste, Climate Change.

## 1. INTRODUCTION

Green computing is also known as green information technology (green IT). It is the study and practice of minimizing the environmental impact of computer system and related resources effectively and eco-friendly. It is an emerging concept towards reducing the hazardous material and save our environment from the harmful impacts of the computer, CPU, servers and other electronic devices<sup>1</sup>. It aims to attain economic viability and improve the way computing devices are used. It lays out four paths along which the environmental effects of computing should be addressed. These are Green use, Green disposal, Green design and Green manufacturing. By adapting these four paths, a normal company can change itself to a green company (as shown in fig 1).



(Fig 1: Green Computing migration framework)

In the recent years many industries and companies have turned their attention in realizing how going 'green' can

benefit public relations, reducing costs, and lowering global emissions from industrial manufacturing.

As 21st century belongs to computers and electronic items, energy issues will get a serious ring in the coming days, as the public debate on carbon emissions, global warming and climate change gets hotter<sup>6</sup>. Therefore Government regulatory authorities also actively work to promote green computing concepts by introducing several voluntary programs and regulations for their enforcement. Hence using green computing is the first and foremost need of modern age that can decrease the overall energy consumption of computation, storage and communications. The 5 core green computing technologies advocated by GCI are Green Data Center, Virtualization, Cloud Computing, Power Optimization and Grid Computing<sup>3</sup>.

Some steps to implement green computing are:

- a) By using energy star qualified products help a lot in energy conservation.
- b) Instead of using regular monitors organic LED should be used<sup>2</sup>.
- c) When the computers are turned off, the green computing provides the benefit to cut off the power of peripheral devices.
- d) Donation of old computers and other peripherals reduces the rate of generation of e-waste which in terns reduces environmental pollution.
- e) Use of computers greatly reduces the use of papers, because a huge amount of data can be stored in Hard Disk of computers and avoids the placing record on papers.
- f) Use the device only if it is necessary otherwise unplug them.
- g) Use of 'Local Cooling' software can help in monitoring and thereby, bringing down the energy consumed by computer. This Windows program makes adjustments to the power options of computer and helps in minimizing energy consumption.

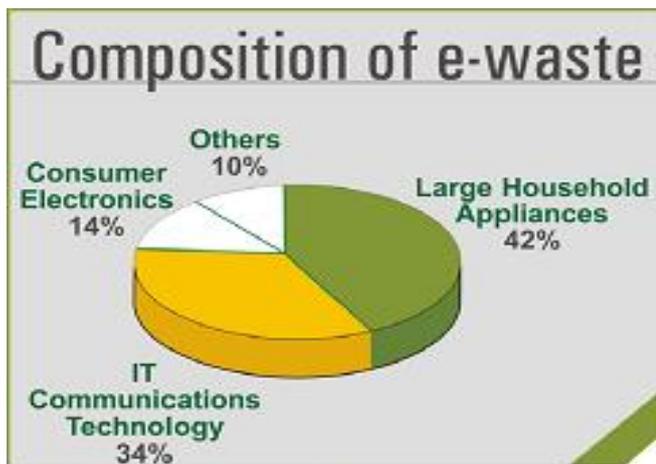
## 2. ORIGIN

In 1992, the U.S. Environmental Protection Agency launched Energy Star, a voluntary labelling program that is designed to promote and recognize energy-efficiency in monitors, climate

control equipment, and other technologies<sup>7</sup>. This resulted in the widespread adoption of sleep mode among consumer electronics. Concurrently, the Swedish organization, TCO Development launched the TCO Certification Program to promote low magnetic and electrical emissions from CRT-Based computer displays; this program was later expanded to include criteria on energy consumption, ergonomics and the use of hazardous materials in construction.

### 3. NEED OF GREEN COMPUTING

As energy crisis deepens and the resources deplete, we need to seriously think about making substantial changes in our lifestyle for energy conservation. Green computing is one way of dealing with the energy crisis. It is possible to reduce carbon emissions, save energy and protect the environment as a whole with this approach. The traditional way of manufacturing computers involves the use of Lead, Cadmium, Mercury, and other toxic elements. According to environmentalists, the amount of Lead present in a computer could be anywhere up to 3 to 4 kg. Figure-2 displays the composition of electronic waste. The growing use of electronic devices among every strata of the society is resulting in unrestrained disposal of e-waste, posing a grave threat to the health and environment.



(Fig 2 : Composition of E-Waste)

So it is highly important to manage these computing devices in such a way that they last longer and even if they are disposed of, they shouldn't cause much harm to the nature. In India, leading vendors namely Hewlett-Packard (HP), Dell and Acer are adopting 'Green Computing' on a large scale. The green initiative involves launching of energy efficient computers made from recyclable materials as well as recycling programs to minimize E-waste.

Some major reasons to use green computing are:

- a. Computers and electronic devices consume a lot of electricity that have some harmful impact on our environment. It produces air pollution, Land pollution and water pollution. Electricity generated

through fossil fuel power plants release air pollution and requires a lot of water that effect our environment like climate change, acid rain (pH<5), ozone(O3) and air toxic.

- b. Most of electronic devices generate a lot of heat which cause the emission of CO<sub>2</sub>. CO<sub>2</sub> is the greenhouse gases, warming the earth surface to higher temperature by reducing outward radiation with the rapidly increasing of carbon dioxide the rate of global warming became increase causing and through anthropogenic climate change.
- c. While disposing of computers and it resources produces a lot of hazardous waste that really damage our environment. It also releases heavy metal like lead (Pb), mercury (Hg), cadmium (Cd) into air.
- d. The manufacturing of computers products relied heavily on the use of toxic chemical for electrical insulation, soldering, and fire production. Exposed to the chemical fumes over the long term one can cause cancer and miscarriages.

These all problems can be solved by using green computing efficiently.

### 4. ADVANTAGES OF GREEN COMPUTING

- Reduced energy usage from green computing techniques translates into lower carbon dioxide emissions, stemming from a reduction in the fossil fuel used in power plants and transportation.
- Conserving resources means less energy is required to produce, use, and dispose of products.
- Saving energy and resources saves money.
- Uses ecofriendly source of energy which is clean.
- Green computing even includes changing government policy to encourage recycling and lowering energy use by individuals and businesses.
- Reduce the risk existing in the laptops such as chemical known to cause cancer, nerve damage and immune reactions in humans.

### 5. APPROACHES TO GREEN COMPUTING

Few approaches towards green computing are:

- 1) **Dynamic Power Scaling Technology**-Dynamic power scaling is a computer architecture technique that allows a drastic reduction in the working rate or frequency of a microprocessor or link interfaces to reduce energy consumption and generation of heat by the chip. CPU throttling is most common in mobile devices and laptops, where power comes from a battery and hence is limited.

Dynamic power scaling uses two main techniques; namely, low power idle and adaptive rate. The former forces the processor to operate on a low-power state when not processing packets, and rapidly switch to a high-power state when processing one or more packets. The latter technique works by dynamically adjusting the capacity of a processor or a link according to the service requirements and traffic load.

- 2) **Virtualization**- Virtualization is a modern IT paradigm that allows separation of technology implementations and computing functions from physical hardware, while cloud computing is virtualization of computer programs via the internet. Virtualization eliminates the need for hardware associated with certain IT functions, which in turn reduces energy consumption. It works by running two or more computer systems on a single, powerful hardware unit.
- 3) **Cloud Computing**- Cloud computing is a modern technology that is rapidly gaining traction in the information technology industry. Exponential data growth has led to the increased demand for data storage systems, power, cooling technology, labor, and space. The traditional approach of adding more storage disks, processors and other IT hardware results in increased energy demands hence it is not sustainable.

The United States Department of Energy estimates that data centers use up to 100 to 200 times more power than normal office buildings; therefore, a more energy-efficient design for data centers is necessary. Research shows that widespread use of cloud computing can result in a 38% reduction in global data center energy demand by 2020.

- 4) **Terminal Server Technology**- Using terminal servers is a green computing technique that allows multiple users to connect to a central server, which performs all the processing; however, each user experiences the system on his or her terminal. This technique works best when combined with thin clients, which consume as little as an eighth the amount of power a normal workstation consumes<sup>5</sup>.
- 5) **Energy Star Hardware Components**- Energy star labeled computer monitors, laptops, desktops and printers consume less power and power down when not in use. Technological advances have enabled the development of more powerful, energy-efficient hardware, such as LCD monitors rather than CRT's that require significantly less power to operate<sup>4</sup>.

## 6. INITIATIVES TOWARDS GREEN COMPUTING

Non-governmental organizations (NGO's), Governments, Multinational corporations etc. are now joining the move towards Green Computing which is a completely new environmentally friendly and cost-effective way of power usage.

Businesses and individuals are being called upon to:

- Reduce the amount of energy used in their computing needs.
- Start Using green(er) or more sustainable energy sources.
- When replacing their IT infrastructure, to buy more Earth-friendly IT infrastructure - in terms of the energy they consume and the material from which they are made.
- Adopt more environmentally friendly practices<sup>9</sup>.

## 7. BARRIERS TO ADOPT GREEN COMPUTING

Though green computing is largely considered as the future of things, there are still some issues that are barriers to the green computing adoption. For example the "privacy issues" that arise from the recycling of the old computer, costly equipment to implement green data center design and industry regulations<sup>8</sup>. Going green isn't just for the industry but also for the individuals. Industries and individuals should work collaboratively and independently to accelerate the Green IT and to contribute as a helping hand to save earth by computing more while consuming less.

## 8. CONCLUSION

Adopting Green Computing Strategies is useful not only from an ethical or moral stand-point, but also from a commercial stand-point. There are many business benefits achievable through the implementation of a green computing strategy such as cost savings, resilience, disaster recovery, business continuity planning and of course public relations. Given the prolific nature of IT within today's information economy IT leaders have an excellent opportunity to significantly impact the fight against global warming, whilst enhancing the business operation and efficiency. So Green computing is the utmost requirement to protect environment and save energy along with operational expenses in today's increasingly competitive world. Adopting a holistic approach to greening IT is our responsibility towards creating a more sustainable environment.

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