

## GREEN COMPUTING: A CONTROVERSY IN IT

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### ABSTRACT

*Green computing, also known as green technology, is the use of computers and other computing devices and equipment in energy-efficient and eco-friendly ways.*

*One of the early green computing initiatives in the United States was the Energy Star labeling program. This voluntary program was developed by the Environmental Protection Agency in 1992 and implemented by manufacturers to promote energy efficiency in computing hardware and other types of appliances. The Energy Star label is common, especially for laptop computers and displays. European and Asian countries have implemented similar programs. During recent years, attention in Green Computing has moved research into energy-saving techniques for home computers to enterprise systems' Client and Server machines. It is needed to find a way to handle computers and its devices for save the environment and society from such E-hazards. This study provides a brief account of Green Computing. The emphasis of this study is on current trends in Green Computing; challenges in the field of Green Computing and the future trends of Green Computing. Since, it is a qualitative research; the researcher used Individual interviews and Observations to collect relevant information to fulfill this research. 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.*

**Keywords:** - Green Computing, Energy, Computer and IT.

### Introduction

A green computer or green IT system is one where the entire process from design, manufacture, use, and disposal involves as little environmental impact as possible. In the design aspect, a green computer is created to perform without a negative environmental impact. Such design includes everything from materials and components to how the computer uses its power supply. Nowadays, most computers are built with a sleep or hibernate mode that allows them to power down when not in use and, therefore, save on energy impact. A green computer will also take into account how it impacts the environment during its life. One way to make a green computer reduce its usage impact is to extend its longevity. The longer the computer lasts, the less impact it will have on the environment because disposal, normally the most significant green influence of the computer's cycle, will be delayed for a longer period of time. To increase a computer's longevity, we suggest looking toward upgrades and modularity. For example, building a new computer from scratch produces a greater environmental effect than building a new RAM module for replacement in computing equipment.

### What is included in a green computing strategy?

IT managers typically focus energy efficiency efforts on data centers, equipment rooms, storage areas and other elements that use energy or are affected by energy use. Saving money is one driving factor. Government regulations dealing with energy conservation also drive green efforts. Concern about climate change, along with internal and external pressure to be environmentally responsible, is a third factor behind the green movement. Companies' green computing strategies can include the following steps:

**Remote work.** The COVID-19 pandemic has spurred many changes in the workplace environment, including ones that have led to reduced energy consumption. It has decreased the number of people commuting to and from work. It has also cut the number of employees present in an organization's facilities, reducing demand for power, water and other resources.

1. **Smart technology.** Organizations can use internet of things sensors and artificial intelligence (AI) monitoring tools to collect and analyze information about the data center and create a power usage model. AI-powered tools can also autonomously manage heating, cooling and power in the data center.

2. **Upgrade and rearrange the data center.** Older equipment often uses more energy and puts out more heat than newer devices. Hot and cold aisle setups can be used to group assets based on energy consumption and temperature, optimizing heating, ventilation and air conditioning (HVAC) efficiency.
3. **Power down.** CPUs and peripherals can be powered down and turned off during extended periods of inactivity. Power up energy-intensive peripherals, such as laser printers, only when needed.
4. **Strategic scheduling.** Do computer-related tasks in dedicated blocks of time, leaving hardware off at other times.
5. **Display selection.** Liquid crystal display monitors use less energy and give off less heat than cathode-ray tube monitors.
6. **Computer selection.** Laptops use significantly less energy than desktop computers.
7. **Power management.** These features can be set to automatically power down hard drives and displays after several minutes of inactivity.
8. **Temperature check.** Newer IT devices can safely run at higher temperatures than older ones, so the data center may not need to be as cool as in the past.
9. **E-waste.** Dispose of e-waste according to federal, state and local regulations.
10. **Alternative energy.** Investigate alternative energy sources, such as geothermal cooling and wind and hydroelectric power.

### Problem

According to a report from the United Nations University, it takes about 1.8 tons of chemicals, fossil fuels and water to produce a typical desktop computer -- and world- wide over one billion PCs have been sold. When it comes to green IT, at least three issues get in the way of doing the right thing.

#### 1. Misaligned incentives

The IT department calls the shots when it comes to managing computer networks, but it doesn't pay the electricity bills. When we work with companies to reduce their IT energy costs, the IT manager often meets the person who pays the utility bill for the very first time.

#### 2. Competing priorities

An IT manager's job, first and foremost, is to keep computer networks up and running. Security threats, viruses, malware, hardware failures and software upgrades ensure that this job remains deeply challenging, and that all other initiatives take a distant back seat.

#### 3. Lack of expertise

Energy efficiency is almost never a part of an IT professional's training. The time it takes to research energy-saving strategies, tools and techniques is often significant enough to serve as a barrier to action.

Hence the problem with "Green IT": The people we most need to act have the least to gain from doing so.

So what can you do? As a sustainability, Environmental Health & Safety or facility manager, you're probably accustomed to championing such initiatives, but in the case of green IT, you'll likely need more than charm and grit on your side.

#### Objectives of the study :

In recent years focus of enterprises and technology firms has been shifted towards Green Computing rapidly. The goal of green computing is to attain economic viability and improve the way computing devices are used. Green computing practices include the development of environmentally sustainable production practices, energy efficient computers and improved disposal and recycling procedures.

#### Current Trends on Green Computing :

Current trends of Green Computing are towards efficient utilization of resources. Energy is considered as the main resource and the carbon footprints are considered the major threats to environment. Therefore, the emphasis is to reduce the energy utilization & carbon footprints and increase the performance of Computing. There are several areas where researchers are putting lots of efforts to achieve desired results:

##### A. Energy Consumption

Organizations are realizing that the source and amount of their energy consumption

significantly contributes to Greenhouse Gas (GhG) emissions. In response to this finding, organizations are currently using the following equation:

$$\text{Reduced energy consumption} = \text{Reduced greenhouse gas emissions} = \text{Reduced operational costs for the data center}$$

It means adopting fewer and more energy efficient systems while refactoring application environments to make optimal use of physical resources is the best architectural model. According to Environmental Protection Agency in around 30% to 40% of personal computers are kept 'ON' after office hours and during the weekend and even around 90% of those computers are idle.

#### B. E-Waste Recycling

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. Majority of countries around the world require electronic companies to finance and manage recycling programs for their products especially under-developed Countries. Green Computing must take the product life cycle into consideration; from production to operation to recycling. E-Waste is a manageable piece of the waste stream and recycling e-Waste is easy to adopt. Recycling computing equipment such as lead and mercury enables to replace equipment that otherwise would have been manufactured. The reuse of such equipments allows saving energy and reducing impact on environment, which can be due to electronic wastes .

#### C. Data Center Consolidation & Optimization

Currently much of the emphasis of Green Computing area is on Data Centers, as the Data Centers are known for their energy hunger and wasteful energy consumptions. United State Department of Energy (DoE) reported in its study in 2006 that United States data centers consumed 1.5% of all electricity and their demand is increasing by 12% per year and cost \$7.4 billion per year by 2011. According to DoE's current report in July 2011 Data Centers are consuming 3% of all US electricity and this consumption will double by 2015. With the purpose of reducing energy consumption in Data Centers it is worthwhile to

concentrate on following :

- Information Systems – efficient and right set information systems for business needs are a key in building Green Data Centers. As per green computing best practices efficient servers, storage devices, networking equipments and power supply selection play a key role in design of information systems.

- Cooling Systems – it is suggested by the researcher s that at the initial stage of design process for data center cooling systems, it is significant to consider both current and future requirements and design the cooling system in such a way so it is expandable as needs for cooling dictates.

- Standardized environment for equipment is must for Data Center Air Management and Cooling System.

- Consider initial and future loads, when designing & selecting data center electrical system equipment.

#### D. Virtualization

One of the main trends of Green Computing is virtualization of computer resources. Abstraction of computer resources, such as the running two or more logical computer systems on one set of physical hardware is called virtualization. Virtualization is a trend of Green computing it offers virtualization software as well as management software for virtualized environments . One of the best ways to go towards green and save enough space, enough resources, and the environment is by streamlining efficiency with virtualization. This form of Green Computing will lead to Server consolidation and enhance computer security. Virtualization runs fewer systems at higher levels of utilization. Virtualization allows full utilization of computer resources and benefits in:

- Reduction of total amount of hardware;

- Power off Idle Virtual Server to save resources and energy; and

- Reduction in total space, air and rent requirements ultimately reduces the cost

#### E. IT Products and eco-labeling

Another approach to promote Green Computing and save environment is to introduce policies all around the World, so that,

companies design products to receive the eco-label. There are several organizations in the world which support eco-label. IT products. These organizations provide certificates to IT products based on factors including design for recycling, recycling system, noise energy consumption etc.

### 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. III. CHALLENGES IN GREEN COMPUTING 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. Following are some of the Challenges that Green computing is facing today.

1. Return of Investment The major problem was educating the stakeholders regarding the environmental impact of computers. For a project that involves Greening, the returns are generally seen after a long period of time. Hence an important challenge in this project was to show immediate returns after the successful implementation of Green IT in the computer center.

2. New Optimization Techniques in Performance-Energy-Temperature aware Computing The exponential growth in computing activity and the rising concern for energy conservation have made energy efficiency in computers a technological issue of prime importance. The tradeoff between Performance-Energy-Temperature has to be made so that the maximum benefits can be achieved. Designing techniques that are optimal with respect to performance, energy, and temperature are of utmost requirement as far as green computing research challenges are concerned.

3. Disposal of Electronic Wastes Reliability about the use of green materials in computer is perhaps the biggest challenge

that the electronics industry is facing. Electronics giants are about to roll out eco-friendly range of computers that aim at reducing the e-waste in the environment. They are likely to be free of hazardous materials such as brominated flame-retardants, PVCs and heavy metals such as lead, cadmium and mercury, which are commonly used in computer manufacturing.

4. Perspective with respect to Indian Scenario In India, the implement-ability of principle of "Green Computing" is facing a dilemma due to many socio-economic matters and those are linked to be souged out to pull India in the mainstream movement of "Green Computing". Lack of basic research initiative and congenial infrastructure has resulted in absence of good patents and commercial production of indigenously built equipments.

5. Power Consuming Leaderships in the field are trying to find a generation of IC chips that have high efficiency and give higher performances without consuming too much power but this is not a simple process, it takes a huge effort, amount of a lot of time, and needs high levels of skilled engineers to reach and achieve this goal.

6. Increase in energy requirements Some people need or prefer to use high processors to achieve their tasks. However, these requirements need a great amount of power with the green computers with the same specifications considered extremely expensive virtualization, cloud computing, power management, Green manufacturing are the key initiatives towards Green computing.

### Future Trends

As discussed earlier the reason for shift is because of growth in computing needs, energy cost and global warming and this shift is great challenge for IT industry. The future of Green Computing is going to be based on efficiency, rather than reduction in consumption. The primarily focus of Green IT is in the organization's self interest in energy cost reduction, at Data Centers and at desktops, and the result of which is the corresponding reduction in carbon generation. The secondary focus of Green IT needs to focus beyond energy use in the Data Center and the focus should be on innovation and improving

alignment with overall corporate social responsibility efforts. This secondary focus will demand the development of Green Computing strategies. The idea of sustainability addresses the subject of business value creation while ensuring that long-term environmental resources are not impacted. There are few efforts, which all enterprises are supposed to take care of :

#### A. *Certifications*

There are several organizations providing certificates to green technology. Vendors are based on their product quality, material, life of the product and recycling capabilities. In future such certifications together with recommendations and government regulations will put more pressure on vendors to use green technology and reduce impact on environment.

#### B. *Cloud Computing*

Cloud Computing has recently received significant attention, as a promising approach for delivering Information and Communication Technology services by improving the utilization of Data Center resources. In principle, cloud computing is energy-efficient technology for ICT, provided that its potential for significant energy savings that have so far focused on only hardware aspects, can be fully explored with respect to system operation and networking aspects also. Cloud Computing results in better resource utilization, which is good for the sustainability movement for green technology.

#### E. *Leveraging Unused Computer Resource*

One of the exiting areas where Green Computing can grow is the share and use efficiently the unused resources on idle computers. Leveraging the unused computing power of modern machines to create an environmentally proficient substitute to traditional desktop computing is cost effective option. This makes it possible to reduce CO2 emissions by up to 15 tons per year per system and reduce electronic waste by up to 80%.

#### F. *Data Compression*

In enterprise, huge amount of data that is stored is somehow or other duplicated information. Information System backups are true example of such duplicated data. Intelligent compression techniques can be used to compress the data

and eliminate duplicates help in cutting the data storage requirements.

#### G. *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 :

- Equipment design;
- Equipment recycling;
- Data Center optimization and consolidation;
- Virtualization;
- Paper free environment;
- Application Architecture; and
- Power Management

#### **Findings & Conclusion:**

Green computing is not about going out and designing biodegradable packaging for products. Now the time has come to think about the efficient use of computers and the resources which are non renewable. It opens a new window for the new entrepreneur for harvesting with E-waste material and scrap computers. There is an alternative way to design a processor and a system such that we don't increase demands on the environment, but still provide an increased amount of processing capability to customers to satisfy their business needs. This research paper shows the importance, challenges and the need 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 Green computing. The computing industry is more prepared and far more competent than almost any other industry when it comes to facing and responding to rapid change. Environmentally it is not a good thing that most PCs -- especially in companies -- have typically entered a landfill after only a few years in service. However, this reality does at least mean that a widespread mindset already exists for both adapting to and paying money for new computer hardware on a regular basis.

Hence, whereas it took decades to get more energy efficient cars on the roads, it will hopefully only take a matter of years to reach a state of affairs where most computers are using far less power than they needlessly waste today. 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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