

Green Computing: Emerging Trends in Information and Communication Technology

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Abstract: Green computing or green IT, refers to environmentally sustainable computing or IT whose goals are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste. Green computing is the term used to denote efficient use of resources in computing. This term generally relates to the use of computing resources in conjunction with minimizing environmental impact, maximizing economic viability and ensuring social duties. Green Computing concentrates on energy efficiency, reducing resource consumption and disposing of electronic waste in a responsible manner. Green computing is the environmentally responsible use of computers and related resources. Such practices include the implementation of energy-efficient central processing units (CPUs), servers and peripherals as well as reduced resource consumption and proper disposal of electronic waste (e-waste). Computers today have become a necessity not only in offices but also at homes.

Keywords: Green computing, EPEAT, Recycling, E-waste, Energy star.

I. Introduction

Green computing is the study and practice of using computing resources efficiently. Green computing is the environmentally responsible use of computers and related resources. Such practices include the implementation of energy-efficient central processing units (CPUs), servers and peripherals as well as reduced resource consumption and proper disposal of electronic waste (e-waste). Green computing is very much similar to movements like reducing the use of environmentally effecting hazardous materials like CFC's, promoting the use of recyclable materials, minimizing use of non-biodegradation materials, encouraging use of sustained resources. One of the spins off green computing is EPEAT-Electronics Product Environmental Assessment Tool. EPEAT products serve to increase the efficiency and life of computing products. These products tend to minimize energy expenditures, minimize the maintenance activities throughout the life of product and allow re-use of materials. Energy Star served as a kind of voluntary label awarded to computing products that succeeded in minimizing the use of energy while maximizing efficiency. Energy Star applied to products like computer monitors, television sets and temperature control device like refrigerators, air conditioners, and similar items.



Fig: 1. Green Computing

II. Green Computing History

One of the first manifestations of the green computing movement was the launch of the ENERGY STAR program back in 1992. Energy Star served as a kind of voluntary label awarded to computing products that succeeded in minimizing use of energy while maximizing efficiency. Energy Star applied to products like computer monitors, television sets and temperature control devices like refrigerators, air conditioners, and similar items. One of the first results of green computing was the Sleep mode function of computer monitors which places a consumer's electronic equipment on standby mode when a pre-set period of time passes when user activity is not detected. As the concept developed, green computing began to encompass thin client solutions, energy cost accounting, virtualization practices, etc.[1]

III. Green Computing Groups

Currently, one of the popular green computing groups is tactical incremental. This group applies and uses green computing philosophies mainly to save up on costs rather than save the environment. This green computing concept emerged naturally as businesses find themselves under pressure to maximize resources in

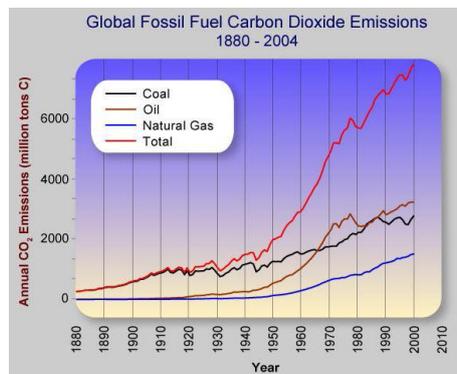
order to compete effectively in the market. This movement arose mainly from economic sentiments rather than political pressure. Strategic Leaders take into account the social and environmental impacts of new and emerging technologies. Aside from minimizing costs, this particular movement also takes into account other factors such as marketing and branding. Unlike the position held by tactical incremental, strategic leaders recognize the need to overhaul some existing policies or structural makeup of the organization. This can be seen in recent efforts to make IT personnel directly responsible for managing, minimizing and ensuring efficient energy expenditures [1]. One of the earliest initiatives toward green computing in the United States was the voluntary labeling 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. Energy Star is a joint program of the US Environmental Protection Agency and the US Department of Energy helping us all save money and protect the environment through energy efficient products and practices. [2]

IV. Why Green Computing

The three main reasons that made us realize the need for growing green are:

1. Release of harmful gases from electronics.
2. More utilization of power and money.
3. Increase of E-waste and improper disposal.

We need AC, Computers, Inverters for our comfort, we go and spend large amount of money on such things and use them continuously for hours without thinking that these machines that we are using are consuming large amount of power generated from natural resources. We fail to bother that the AC and refrigerators we are using are releasing harmful gases like CFC which is indirectly harming us. The graph shows annual emission of CO₂ in past years, the black, blue and brown lines show the rise of CO₂ due to coal, natural gas, and oil respectively, and the red line shows the total emission of CO₂ including all such factors that also includes electronics.[1]



Graph 1. Annual rise of CO₂ in air

In today's world we are using inverters in our homes. We will not worry ourselves even after knowing that the battery of inverter releases harmful chemicals like lead and will place that inverter in the central location of our house even after being very much aware of the fact that the presence of lead in the air we breathe causes various lung diseases like cancer, asthma etc [3].

Our lives are very much dependent on computers. We are using computers in almost every field of our life. Today in our hectic schedule, we can't survive without computers just because they do our work in lesser time but why do we fail to analyze that the computer which we are using daily for hours and hours is

releasing so much amount of heat and returning large amount of green house gases, some like CO₂ that is resulting in problems like global warming back to the environment, and what global warming is giving to us is visible to all of us in forms of floods, melting of glaciers, droughts, increase in temperature of earth surface etc and has contributed to almost 15% of the total deaths in last 5 years. But the fact is that we can't stop the usage of these things in our lives but the one thing we can do is to use them efficiently. Basically, the efficient use of computers and computing is what green computing is all about. Green computing strategies can help us to build a safe place for us to live in. Companies have turned to eco friendly equipments and components to be used in the machines, for example we have eco friendly ICs and eco-books making them energy efficient that consume less power and releases lesser amount of heat. Green computing promotes us to go green and along with that helps us to save green.



Fig: 2. Green Computing

V. What Can We Do To Go Green

1. Turn off your computer at night so it runs only eight hours a day—you'll reduce your energy use by 810 kWh per year and net a 67 percent annual savings.
2. Purchase flat screen monitors—they use significantly less energy and are not as hard on your eyes as CRTs.



Fig:3. Green Computing Environment

3. Unplug the electronics if not in use:
All the electronics equipment must be turned off when not in use. This will save energy as well as our electricity bill.

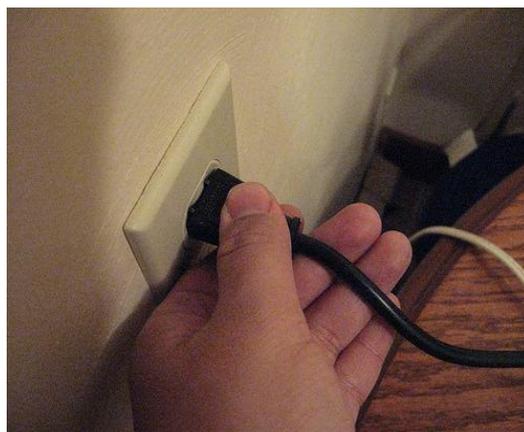


Fig: 4. Unplug the electronics if not in use

4. Enable the standby/sleep mode and power management settings on your computer.



Fig: 5. Stand By mode

5. Power off your monitor when you are not using it instead of using screen savers.

6. Buy vegetable or non-petroleum-based inks—they are made from renewable resources require hazardous solvent.

7. Recycling - Electronics Waste can be recycled. Recycling can be defined as the process of used materials processing into new useful materials with the aim to reduce environmental pollution. The recycling process is more environmentally friendly than the process of making new stuff because it can reduce the use of new raw materials, land degradation, pollution, and energy usage and also can reduce greenhouse gases [3]. Computing supplies, such as printer cartridges, paper, and batteries may be recycled.



Fig: 6. Recycle E-waste

8. By make use of more efficient components like:

8.1 Power supply

Desktop computer power supplies (PSUs) are 70–75% efficient, dissipating the remaining energy as heat. As of 20 July 2007, all new Energy Star 4.0-certified desktop PSUs must be at least 80% efficient.

8.2 Display

LCD monitors typically use a cold-cathode fluorescent bulb to provide light for the display. Some newer displays use an array of light-emitting diodes (LEDs) in place of the fluorescent bulb, which reduces the amount of electricity used by the display.

VI. Benefits of Green Computing

1. 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.
2. Conserving resources means less energy is required to produce, use, and dispose of products.
3. Saving energy and resources saves money.
4. Green computing even includes changing government policy to encourage recycling and lowering energy use by individuals and businesses.
5. Reduce the risk existing in the laptops such as chemical known to cause cancer, nerve damage and immune reactions in humans.

VII. Conclusion

Overall the effects of green computing with its benefits, practicality, and uses are all positives. All which are great for not only the individual, but also all around the globe. By going "green" in technology we

help promote an eco friendly and cleaner environment, along with our own benefits by reducing costs, conserving energy, cutting down on waste and greenhouse gases. Green computing has definitely come a long way, but with so many new innovations coming along in regards of preserving the environment, it is safe to say that green computing is a great development. The need to educate people about green computing is a necessity in order to fully maximize the people's awareness regarding the study on how they can save computing resources for their computing activities.

VIII. Further Required Research

Advancements in green computing have become vast. There are so many new ways of combining ecology with technology that we practically are trying a bit of everything. Such as using solar technology, solar technology now is being used on keyboards and mice now to reduce energy costs. Another green computing method is eliminating certain materials that are hazardous to the environment, and replacing them with cleaner and efficient materials which are biodegradable and eco-friendly. Even now certain computer components such as processor units have reduced heat emissions, and monitors as well with their advancement of flat screens. Ultimately this reduces the need of businesses to have purchase more computers, which can emit greenhouse gases when left on. The practice of green computing has essentially branched off to every form of technology out there. Cars being a great example, now with hybrids becoming main stream, people are able to save on gas, money, and also cutting on carbon monoxide and other various dangerous gases to the atmosphere. Green computing has also grasped how industries market themselves, and many realize how going green in their technologies can aid them. Not only have they implemented ways in being more eco-friendly by removing hazardous materials in their computers and products, but their manufacturing and delivering their goods has also been altered to help the environment.

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