



Green Computing: Protect Environment from Computers.

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Abstract:

The study and practise of resource-aware computing is known as "green computing." The goals are to decrease the use of hazardous materials, boost energy efficiency over the course of the product, and encourage recycling of manufacturing waste. Everyone needs a computer and uses one for their own purposes, yet nobody is aware of the negative effects that computer use has on the environment and the gadgets that it affects. It is now up to the end user community to abide by several key guidelines in order to reap the rewards of green computing. It's crucial to talk about how we can safeguard the environment by comparing how eco-friendly and conventional computing equipment affect one another. The comparison analysis suggests that we may save money, create a greener environment, and use less electricity.

Keywords: Carbon Dioxide (CO₂); Environment; Eco-friendly Devices; Green IT; Green Computing; Solar Computing.

I. INTRODUCTION

Resource-conserving computing is referred to as "green computing". Using computer resources to ensure social duties, maximise economic viability, and reduce environmental harm is the main motive behind green computing. It is the investigation and use of green IT. San Murugesan claims that this may be accomplished with minimal to no environmental damage by developing, using, and discarding computers, servers, and related subsystems including displays, printers, storage devices, networking, and communications systems. Similar to green chemistry, green computing attempts to reduce the use of dangerous chemicals, increase energy efficiency over the course of the product, and promote recyclable or biodegradable production waste and standard items. Green computing initiatives are being undertaken by various corporate IT departments in an effort to reduce the environmental impact of their IT operations. It takes into account issues of environmental sustainability, energy economics, disposal and recycling costs, and also aims to improve system efficiency and utilisation while upholding our social and ethical obligations. Understanding the need of studying green computing is vital. It may be used as a tool to control and slow down global warming.

The concept of "green computing" has been around for a while, and the government is highly involved. To promote energy-efficient practises, the Environmental Protection Agency (EPA) for instance introduced the "energy star" programme in the 1990s. The EPA continues to play a vital role in the modern world by offering customers techniques that are both energy and financially advantageous. "With an eye to saving U.S. households and businesses more than \$1.8 billion in energy costs over the next five years, today EPA announced new Energy Star specifications for computers and related equipment," stated the EPA in 2006.

Additionally, it is anticipated that these additional changes will stop greenhouse gas emissions equivalent to the yearly emissions of 2.7 million autos (Jones, 2006) Although the EPA is a well-known organisation, they are the only ones that advocate for innovative technical approaches to become green. One of the most influential groups in green computing are organisations like the European Union and TCO Certification.

Computers' sleep mode feature was one of the earliest attempts at green computing. Computers can be put in standby mode using the sleep mode feature for a predetermined amount of time. The whole "green" movement began quite a few years ago, when people began to understand that they needed to do their part to safeguard the environment after learning that the ecosystem was not made of renewable resources. Green computing basically focuses on using computers and computing resources efficiently.

The triple bottom line is critical to everything green, including green computing. This takes into account environmental effect, economic viability, and social responsibility. When it comes to computers, many firms merely concentrate on the bottom line rather than a green triple bottom line of economic viability. The goal is to make the entire computer industry more beneficial to society, the economy, and the environment. This indicates that manufacturers design their computers in a way that benefits the triple bottom line.

This essay is divided into sections that cover the need for green computing, how it affects the environment, different green computing technologies, how researchers have worked hard to create safe environments, and how technology may benefit the environment. In one of the parts, as well as the paper's independent conclusion, a comparison of computing equipment is also made.

II. WHY GREEN COMPUTING REQUIRED?

Technology and ecology are now converged in novel ways thanks to green computing. Many businesses and sectors have recently focused on being "green" as a way to improve public relations, cut costs, and reduce global emissions from industrial manufacturing. Though the term "green computing" refers to a wide range of practises, including everything from energy conservation measures to the analysis of materials used in daily life, it ultimately boils down to finding ways to avoid destroying or using up all of the earth's natural resources. In the process of making computers and their components, hazardous chemicals are utilised, which might end up in the water supply and food chain. It has been noted that most computer energy is frequently wasted and that most individuals are ignorant of the repercussions of improper management. We do this even when we are not using the computer by leaving it on. Even when the system is not in use, the CPU, fan, and screen savers all utilise energy. Energy loss can also be caused by insufficient cooling and power capabilities. It has been noted that the majority of data centres don't have enough cooling capacity. Pollution of the environment stems from this. This could be as a result of flaws in manufacturing processes, packing, and component and computer disposal. One source asserts that "Data centres emit over 150 metric tonnes of Carbon-dioxide per year, and the volume is rapidly increasing," and that "Information Technology energy demand is growing twelve times faster than the overall demand for energy." Public awareness of ICT usage that is environmentally friendly is urgently needed. Numerous organisations have been established in order to promote these concepts and provide standards and laws. In order to fulfil their objectives of being greener, many technology businesses really participate in multiple of these. Several of these green businesses include:

1. The U.S. Environmental Agency is a federal organisation established to defend the environment and human health. Together with U.S. EPA and U.S. Department of Energy, this agency also developed the Energy Star programme. The ENERGY STAR designation was created with two goals in mind: to reduce greenhouse gas emissions and other pollutants brought on by the wasteful use of energy, as well as to make it simple for customers to do so.
2. To increase energy efficiency in data centres and corporate computing ecosystems globally, a group of IT businesses and experts has formed The Green Grid. Microsoft, EMC, AMD, HP, Dell, Intel, and Oracle are all members of The Green Grid's board of directors.

III. SOME IMPORTANT FACTS:

How Computers affect the Environment?

- An average desktop computer requires 85 watts just to idle, even with the monitor off. If that computer were in use or idling for only 40 hours a week instead of a full 168, over \$40 in energy costs would be saved annually.
- One computer left on 24 hours a day costs you between \$115 and \$160 in electricity costs annually while dumping 1,500 pounds of CO₂ into the atmosphere.
- A tree absorbs between 3 and 15 pounds of CO₂ each year. That means up to 500 trees are needed to offset annual emissions of one computer left on all the time.
- If each household in a region the size of the metro Boston area turned off its computer for just one additional hour per day, it would save \$3.2 million in electricity costs and prevent 19,000 tons of CO₂ from heating the atmosphere.
- Electricity production is the largest source of green-house gas emissions in the United States, ahead of transportation.

IV. TECHNOLOGIES OF GREEN COMPUTING

In 2001, one of the businesses that makes motherboard chipsets, CPUs, and other computer hardware unveiled its "green computing" programme. The company put a lot of effort into the product's design and manufacturing process to maximise power

efficiency. The business tries to inform people about the benefits of green computing for the environment, productivity, and all-around user experience. It uses a range of clean-computing approaches to generate its ecologically beneficial goods.

1. Solar Computing:

An important component of green computing initiatives is the solar computing effort. VIA collaborated on this project with MTech Industries, one of the biggest solar cell manufacturers in the world. The power-efficient silicon, platform, and system technologies from VIA are compatible with solar cells, enabling the business to develop fully solar-powered gadgets that are quiet, incredibly reliable, and non-polluting. Solar cells provide power for free after the original installation expenses are recouped and require practically no upkeep during their lifespan. The output of solar cells has increased significantly globally during the last several years. Costs should continue to decline as more governments become aware of the benefits of solar energy and photovoltaic technology. As part of its "pc-1" initiative, VIA built the first cyber community centre in the South Pacific to be powered by solar energy.

2. Carbon-Free Computing

Lessening the "Carbon Footprint" of users, which is the amount of greenhouse gases emitted and quantified in carbon dioxide (CO₂) units, is one of VIA Technologies' principles. Because of the greenhouse gases that naturally surround the globe, its temperature remains almost constant. It is thought that carbon-dioxide, nitrous-oxide, methane and fluoro-carbons are responsible for the earth's rising temperature, which may cause floods and droughts, rising sea levels, and other environmental factors that have an impact on both human existence and the global economy. VIA strives to offer the first "PC" items in the world that are certified Carbon Free by taking ownership of the amount of CO₂ they create. The ecologically concerned corporation plans to monitor the gadget's power usage over the course of three years. This information may be used to estimate how much carbon-dioxide machine can release into the air while it is in operation.

3. Energy-Efficient Computing

The creation of energy-efficient platforms for low-power small form factor (SFF) computing devices is one of the key objectives of VIA's green computing effort. The company introduced the VIA C7-M and VIA C7 CPUs in 2005, which had a 1W maximum power consumption. These carbon-reduction processors, which are easily incorporated into solar-powered devices, produced almost four times less carbon while in use. Other companies besides VIA deal with environmental concerns. At a convention in London, Intel, the largest semiconductor maker in the world, recently introduced a green product. The company uses virtualization software, an Intel technique for condensing several physical systems into a single, power-efficient virtual computer, which significantly reduces power usage. Intel joined Google, Microsoft, and other businesses in agreeing to follow the Energy Star requirements for energy-efficient equipment as part of the climate saves computing initiative, which was launched earlier this year.

V. HOW CAN WE CREATE GREEN ENVIRONMENT?

Green computing is a responsible technique to reduce energy consumption and protect the environment from the negative effects of computers and related technology. Everyone uses computers for their convenience, and they are utilised everywhere. However, no one is aware of the negative effects that computer use has on the environment. The direction of green computing's current tendencies is towards resource efficiency. The primary resource is thought to be energy, and the ecosystem is thought to be mostly affected by carbon footprints. Therefore, the focus is on lowering energy use, reducing carbon footprints, and improving computer performance. Researchers are working hard in a number of areas to produce secure environment solutions.

1. Energy Consumption

Companies are becoming more and more aware of how much their energy usage, both in terms of quantity and source, contributes to greenhouse gas emissions. The appropriate architectural paradigm, then, is to adopt fewer, more energy-efficient systems while refactoring the application environment to make greatest use of physical resources. Environmental Protection Agency estimates that between 30% and 40% of personal computers are left "ON" during work hours, on the weekends, and even while 90% of those machines aren't in use.

2. Virtualization

The virtualization of computing resources is one of the primary themes in green computing. The abstraction of computer resources, such as running two or more logical computer systems on a single physical hardware configuration, is known as virtualization. Virtualization is a green computing trend. In addition to virtualization software, it offers management solutions for virtualized settings. One of the best ways to go green and save enough space, enough resources, and the environment is through virtualization, which increases efficiency. This kind of environmentally friendly computing will improve computer security and lead to service consolidation. The ability to fully utilise a computer's resources is made feasible by virtualization, which also reduces the total amount of hardware required, saves energy and resources by shutting off idle virtual servers, and lowers the overall amount of space, air, and rent required, all of which reduce costs.

3. IT products and Eco- Labeling

Introducing policies all around the world to encourage businesses to design their goods to earn the eco-label is another strategy for promoting green computing and protecting the environment. Worldwide, a number of organisations advocate "Eco-Label" IT goods. These organisations award certifications to IT goods based on criteria including recycling design, recycling system, noise level, energy usage, etc.

VI HOW TECHNOLOGY CAN HELP THE ENVIRONMENT

Despite some regrettable negative effects, computers and the Internet have largely had good effects as well. Here are just a few examples of how technology is enhancing the environment:

- It aids in the creation of environmentally friendly, sustainable materials and technology so that we may finally quit utilising those that hurt the environment.
- It enables us to observe and research our surroundings in order to comprehend how it functions and the effects of our activities on it.
- It enables the development of more intelligent devices, such as lights that can detect when no one is around and switch off automatically, that adapt to how we use them and lessen their environmental effect.
- It enables us to create a global virtual laboratory where specialists from many disciplines may exchange research, knowledge, and ideas in order to develop better, more ingenious solutions. This not only makes it possible for individuals who live far apart to collaborate, but it also lessens the environmental damage that people would often incur by travelling to meet.
- It enables paperless communication such as email and online bill payment to lessen the number of trees felled.
- It enables businesses to reach a larger audience and lessen the burden of shipping and production.

VII. STUDY OF COMPUTER DEVICES

1. Mobile vs. Computer

Green computing says that mobile devices are superior to computers. Computers are typically utilised for slower tasks like conversation and internet browsing. Whereas Mobile devices are used for viewing your photographs and videos, playing video games, social networking, downloading, and utilising desktop applications to write papers, create spreadsheets, or give presentations. Modern cell phones are able to perform any task, often even better than earlier generations. They have faster CPUs, quicker wireless internet access, and more RAM. Mobile gadgets need very little power.

2. LCD Vs. CRT Monitor

Reduced power consumption can greatly benefit from the deployment of innovative technologies. The Cathode Ray Tube (CRT) monitor is outperformed in terms of power usage by the Liquid Crystal Display (LCD). Therefore, using LCDs rather than CRTs is the only way to protect the environment from the effects of carbon dioxide emission.

3. Laptop vs. Desktop

Although desktop PCs are excellent for use in the home or office, they can consume up to six times as much power as a laptop. On a desktop, you can save energy by utilising the right power management settings, but not by nearly as much as you would if you were using a laptop. As much as 80% less energy is used by laptops than by desktop computers because of design. Naturally, there is one more benefit: computers are portable. For usage at home or at the office, many laptops may be connected to a separate full-size display and keyboard.

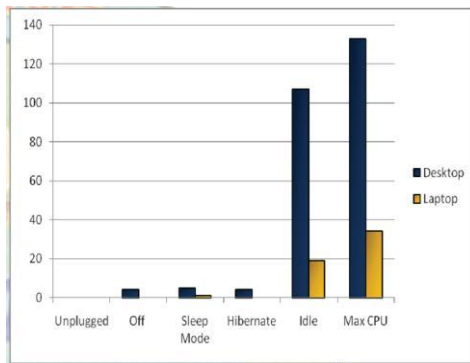


Figure: Laptop & Desktop Consumption in watts

4. Laser Jet vs. Ink Jet Printer

High-end ink jet printers are speedier and provide better results even though they are much more expensive and consume 90% less energy than laser jet printers. While ink jet printers can't match lasers in speed, more current models have better print quality. As ink jet printers print well on used paper, you may print sketches on the back of prior work. Coloured copies are more affordable when using ink jet printers; search for a printer with a duplexing mode that prints on both sides of the paper. If you do decide to purchase a laser printer, upgrading to an inkjet type will drastically cut down on energy use.

VIII. STEPS TO GREEN COMPUTING

Here are five essential steps we can take to move towards green computing: -

1. Develop Sustainable plan

Strategies, such as organisational policies and checklists, should be discussed with your business executives. Such a strategy should include recycling regulations, advice on how to get rid of old technology, legal requirements, and suggestions for buying environmentally friendly computer hardware. Green computing best practises and standards should include electricity utilisation, a decrease in paper usage, suggestions for new equipment, and the recycling of outdated technology. Implementation and communication should be included in organisational policies.

2. Recycle

Electronics should be disposed of in a convenient and ecologically friendly way. Metals and contaminants found in computers can release dangerous emissions into the environment. Never dump electronics in a landfill. Instead, recycle them via local recycling centres or manufacturer programmes like HP's Planet Partners recycling service. Alternately, give functional computers to a charitable organisation.

3. Make environmentally sound purchase decisions

Buy items that have been registered with the Electronic Product Environmental Assessment Tool. The charity Green Electronics Council is promoting EPEAT as a procurement tool to assist institutional buyers in comparing, evaluating, and choosing desktop, laptop, and monitor options based on environmental factors. Establish a set of performance standards for product design that are precise and consistent. Recognise manufacturers' efforts to lessen the impact of their products on the environment by removing or decreasing ecologically hazardous materials, engineering for durability, and using less packaging. For the purpose of reducing emissions of greenhouse gases that contribute to global warming, all items that have been certified by EPEAT must exceed minimum standards in eight different categories of environmental impact. Manufacturers are required to provide secure end-of-life management and recycling solutions when items become unsuitable in order to demonstrate corporate social and environmental

performance. According to Jeri Callaway, vice president and general manager of HP's Americas Commercial Solutions, Personal Systems Group, "The design and engineering teams at HP have traditionally placed a high premium on creating environmentally friendly products". We take special pride in the fact that our business-class products already surpass the fundamental EPEAT criteria without requiring any design changes.

4. Reduce Paper Consumption

E-mail, electronic archiving, and using the "track changes" option in e-documents instead of redlining rectifications on hard paper are just a few simple, apparent ways to minimise the amount of paper used. Use both sides of the paper when printing papers, recycle frequently, use typefaces and margins that are narrower, and only print the necessary pages.

5. Conserve energy

When you know you won't be using your computer for a while, turn it off. When inactive for shorter amounts of time, activate power management measures. When not in use, displays and PCs can enter low-power modes thanks to power management. The computer or displays wake up from their low power sleep state in a matter of seconds by merely pressing a key on the keyboard or moving the mouse. Techniques for power management can conserve energy and aid in environmental protection.

IX. CONCLUSION

We have addressed ways to conserve energy and contribute to environmental protection in this essay, including: enabling power management features for shorter amounts of time. Monitors and computers may go into low-power modes while not in use thanks to power management. Techniques for power management can conserve energy and aid in environmental protection. When not in use for an extended amount of time, turn your computer off. The computers or displays come up from their low power sleep state in a matter of seconds by merely pressing a key on the keyboard or moving the mouse. We have also spoken about environmentally friendly computers and smartphones. As a consequence, we discovered that a mobile device is superior to a PC since it uses less electricity. In a comparison of LCD vs CRT displays, the LCD offers superior performance over the CRT monitor because to its lower power usage and cheaper pricing. Similar to how much less energy laptops use than desktop PCs. The current study is being conducted in order to further explore and create concepts for massive energy and cost savings. We can also conserve our environment with the aid of this study.

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