

Green Computing: Ways Our Information Technology Can Go Greener.

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Abstract

As computing is increasing pervasively, the energy consumption attributable to computing is climbing, despite the clarion call to action to reduce consumption and reverse greenhouse effects. Green computing can be defined as the study of designing, engineering, and manufacturing, using and disposing of computing devices in a way that reduces their environmental impact. The topic of this paper, Green Computing is especially important in this regard. Green computing is a very hot topic these days, not only because of rising energy costs and potential savings, but also due to its impact on the environment. This paper outlines the goals, reasons, approaches, methodologies and emphasizes the importance of green computing for sustainable development.

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I. Introduction

After years of token recognition, green Information and Communication Technology (ICT) or green computing is beginning to gain significant traction. In fact, the association of 'greenness' with technology has become so fashionable that companies are now trying to 'out-green' each other. The main catalyst for this change is the realization that energy consumption is growing at a staggering rate, far beyond that for which we have prepared. Energy to manufacture, store, operate, and cool computing systems has grown significantly in the recent years, primarily due to the volume of systems and computing that companies now heavily rely upon. The corollary for ICT is that as an industry, it is responsible for significant environmental impact.

Green technology focuses more on reducing the environmental impact of industrial processes and innovative technologies caused by the Earth's growing population such as reducing the use of hazardous materials; maximize energy efficiency during the product's lifetime; and promote recyclability or biodegradability of defunct products and factory waste. Modern IT systems rely upon a complicated mix of people, networks and hardware; as such, a green computing initiative must be systemic in nature, and address increasingly sophisticated problems.

It has taken upon itself the goal to provide society's needs in ways that do not damage the natural resources. This means creating fully recyclable products, reducing pollution, proposing alternative technologies in various fields, and creating a center of economic activity around technologies that benefit the environment. The huge amount of computing manufactured worldwide has a direct impact on environment issues, and since then scientists have been conducting numerous studies in order to reduce the negative impact of computing technology on our natural resources. A central point of research is testing and applying alternative nonhazardous materials in the products' manufacturing process

Green computing is the study and practice of using computing resources efficiently. The primary objective of such a program is to account for the triple bottom line (or "People, Planet, Profit").

ORIGIN OF GREEN COMPUTING

In 1992, the U.S. Environmental Protection Agency labeling program which is designed to promote and recognize energy-efficiency in monitors, climate control equipment, and other technologies. This resulted in the widespread adoption of sleep mode among consumer electronics. The term "green computing" was probably coined shortly after the Energy Star program began; For a PC disposal, it is necessary to know everything there is to know in order to be involved in green computing. Basically, the whole green aspect came about quite a few years back when the news that the environment was not a renewable resource really hit home and people started realizing that they had to do their part to protect the environment. Basically, the efficient use of computers and computing is what green computing is all about. The triple bottom line is what is important when it comes to anything green and the same goes for green computing. This considers social responsibility, economic viability and the impact on the environment. Many businesses simply focus on a bottom line, rather than a green triple bottom line, of economic viability when it comes to computers. The idea is to make the whole process surrounding computers friendlier to the environment, economy, and society. This means manufacturers create computers in a way that reflects the triple bottom line positively. Once computers are sold businesses or people

use them in a green way by reducing power usage and disposing of them properly or recycling them. The idea is to make computers from beginning to end a green product.

II. Background

1. Governments go green

Figure 1 : Energy Star

Many governments worldwide have initiated energy-management programs, such as Energy Star, an international standard for energy-efficient electronic equipment that was created by the United States Environmental Protection Agency in 1992 and has now been adopted by several other

IMPORTANCE OF GREEN COMPUTING

Green computing minimizes the use of electricity as well as energy and reduce environmental dissipate when we are using a computer. The green computing has the same goals with green chemistry, which is longer the life time of the product and makes the product more efficiency of energy; advance the discarded products and factory waste to be more easily recycled and biodegradable, use of the less hazardous materials.

It also strives to get economic achievability and better system performance and use due to abide your social and ethical responsibilities in the economic sense, it has efficiency energy, a safe a total cost of ownership, which include the cost of disposal and recycling. Therefore it is the study and practice of using computing devices efficiently.

Enterprises with the technology and vision to produce products and services that address environmental issues enjoy a competitive edge because many customers when making purchasing, leasing, or outsourcing decisions, have started to consider the service providers' environmental records and initiatives.

Organizations face lower energy costs and even save a lot on government taxes when they follow government policies on environment and produce goods following strict environment norms.

Investors and consumers are beginning to demand more disclosures from companies with regard to their carbon footprint as well as their environmental initiatives and achievements, and they have started discounting share prices of companies that poorly address the environmental problems they create. As a result of which, many businesses have begun showing their environmental credentials. For instance, the Carbon Disclosure Project is a recent initiative to request global companies to disclose their carbon emissions.

2. Ways of making our IT Green

It is extremely ironic that all the helpful modern technology in the home and office which was meant to make our lives easier really has not. We have now increased humanity's environmental concerns over climate change and global warming with the new technologies. Good computing and network systems were meant to be enable the "paperless office". This might have meant fewer forests had to be sacrificed so that superfluous paper messages were required to be typed out. Perhaps more videoconferencing might have meant less business travel on jets around the world. Unfortunately, with the ever-increasing requirement of computers and electrical wizardry these very devices have succeeded in heating up the planet. It is estimated that 60 per cent of ambient office temperature is caused by technology such as computers and printers, heat that needs to be cooled using air conditioners that use even more power. It is also estimated that 60 per cent of computers are left on when the office is closed. Power wastage that could easily be reduced.

Making your Information Technology "Green" has recently become fashionable and has had major interest from the search engine company Google and computer chip manufacturer Intel. A senior executive at Google has said: "The average desktop PC wastes nearly half of its power, and the average server wastes one-third of its power. Ways of making our information technology greener are;

- Reuse and repair of information technology equipment, too much e-waste is thrown away in landfill sites and is hard to recycle.
- Print out fewer documents, read off the screen. Save paper and ink. Establish a code of practice designed to minimise unnecessary printing.
- Ensure unused equipment is turned off when it is not being used and that if the computer has to be left on that there is capacity for the computer to hibernate. Identify computer management practices that reduce power consumption. Educate staff to the benefits of saving energy and recycling. IT departments can also configure PCs to shut down after a period of inactivity
- When purchasing new computer equipment, choose energy-saving devices that have been manufactured in an environmentally-conscious fashion.
- Find out how much energy your computer and technology systems use and monitor ongoing consumption levels.
- Consider carefully about whether you really need a new computer or gadget. Could upgrading your existing computer or device serve the same purpose?

- Upgrade the computer memory or hard disk space as much as possible as an alternative to purchasing new devices.
- Many small offices now have networks, which store documents. They can also be used to share applications, so that the computer on your desk doesn't need as much computing power;
- Strip your software down to the essentials and do not use valuable space or processor memory on programmes and files you do not use.
- Although Microsoft Office may slow to a crawl on your computer perhaps, smaller more specialist programmes will not.
- Keep your computer well-tuned. You are more likely to want to keep a computer longer if it runs better.
- When computers need to be recycled that they are safely disposed of and recycled if possible. Dispose of old hardware responsibly; send old computers to be reconditioned and recycled.
- Computer plastics removed from computer equipment can be processed into chip form for re-use in new products
- Computer circuit boards when removed and separated for refining. This provides the only safe method for heavy and precious metal extraction, whilst at the same time removing hazardous chemical products.
- Computer cases, drive chassis, heat sinks and faraday cages can be stripped for processing of ferrous and non-ferrous metals.
- Cables can be removed and melted down for metal extraction. A percentage of cables can be re-used.
- Computer hard drive casing and data storage platters are crushed and melted down as scrap metal.
- The implementation of the Landfill Regulations, Hazardous Waste Regulations and the WEEE Regulations resulted in computer monitors and flat screens (with their Mercury cold cathode tubes) being officially classified as hazardous waste, and therefore not suitable for disposal in the general waste stream. UK legislation now does not permit the disposal of computer screens in Landfill and the Environment Agency classes these units as hazardous waste. Monitors must now be recycled or disposed of at special disposal centres.
- You may consider recycling your computer to a computer community-recycling agency such as Community Computers <http://www.communitycomputers.org/> or Oxfam <http://www.oxfam.org/> Most of these organizations have a minimum specification for accepting a working computer. You would need to ensure that any data on your computer's hard drive had been safely deleted or the hard disc physically destroyed (especially if it contained patient data). The hard disc can be destroyed by removing it and smashing it with a large hammer!
- IT departments can also configure PCs to shut down after a period of inactivity

Instead of having one computer for each service or set of services, you can instead consolidate each server onto a larger virtualized system that uses its resources to the fullest, and has a much smaller energy footprint. It consists of virtualised servers, grid computing, data centre automation and provisioning, and virtual networking and telecommuting. This benefits the system in several ways:

- It reduces the total amount of hardware used in your environment
- Idle Virtual servers can be powered off
- The virtualized server will have much less idle time and waste less
- The total volume of space, air, and rent will be reduced. Data centres can use up to 100 times the energy per square foot of typical office space.
- Some power companies pay rebates for conversion to virtualized systems.

There is a strong connection between virtualization, capacity planning, and performance management because of the extreme performance requirements that are placed on virtual servers. Once in place, virtual systems have a unique power flexibility that allows for power consolidation, efficiency, and ability to power-off unused systems.

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Cooling the tremendous amounts of heat generated by computers is essential in order to keep the equipment and the software stable. This cooling in turn requires a significant amount of energy which can be estimated at between 30% to 50% of the energy used to power the hardware. This means that for each 100 kilowatt-hours used to power a system, 50 kilowatt-hours could be required to cool it.

Energy consumption can be reduced by concentrating on the initial source of the energy burned in the computer. Energy efficient fans, CPUs, power supplies, disks, and related components can make a big difference that pays huge dividends. Other ways to effect efficient cooling

1. System design and load matching
2. Use of efficient power equipment which exist today
3. Floor layout and vent layout design
4. Coupled cooling systems that directly cool and exhaust.

- The number one fallacy that many companies have is that throwing more hardware at a problem will solve every computing problem known to man. Adding more hardware does not always imply better performance. Complex systems react very differently to the numbers of servers you have.

You might be overloading the network, database, or other resources.

Design to Fit (or sizing) means that the computing system is designed and built to accommodate only what the computing requirements plus some “reasonable” surplus capacity. Design to Fit is a very effective way to insure performance without overspending on energy and hardware. Make sure you spend sufficient resources to determine your overall needs, and design that into your systems and infrastructure.

- Another mistake you see floating around is that you need to have all the capacity you’ll ever need right now. This can lead again to over-built systems that sit idle for years until they see some action or the scrap heap. A more sensible plan is to use capacity planning techniques to limit and build out your systems as you need them. After all, newer systems use less energy and give you better performance.

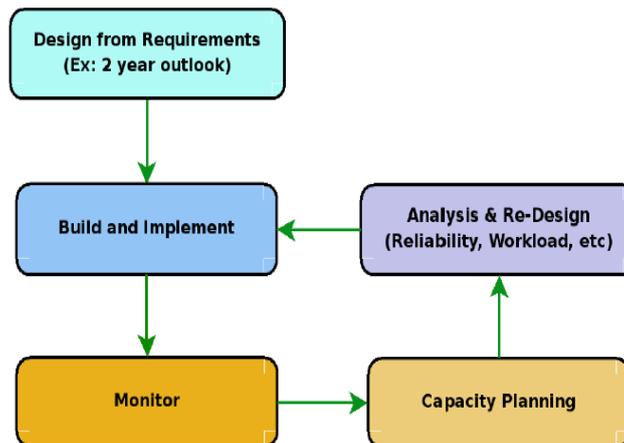


Figure 1. The DIT process [1]

Having capacity planning management in place allows you to grow your environment as you need it, just like the just in time (JIT) processes used in manufacturing. It allows you to grow your IT as needed, save energy with fewer components, and purchase more power efficient systems later in the purchase cycle. Just In Time (JIT) is an inventory strategy implemented in manufacturing proven to save millions by reducing in-process inventory and its associated storage and energy costs. The same techniques can be used by IT.

III. Conclusion And Recommendation

Green computing minimizes the energy consumption of the organization. Appropriate legislations, regulations, user education and awareness and recycling are some of the solutions to reduce power consumption and minimize environmental waste. Government can discourage the irresponsible disposal of computer hardware that generally lack biodegradability by putting in place a proper ICT waste management body and also giving low tax incentives to industries that do not practice Green computing.

It is estimated that out of \$250 billion per year spent on powering computers worldwide only about 15% of that power is spent computing- the rest is wasted idling. In enterprises, we must be smarter about the technology tools we choose to use. This requires for all of us to understand the possible adverse impacts of the tools and understand how to reduce these impacts, taking action to implement justifiable efforts in practice. Presently, with a greater concern for the environment, green computing is well practiced in most institutions and industries, and has contributed substantially to reducing carbon emissions and conserving the environment. Office staff, managers and all other stake holders can start by making small contributions towards sustainability implementing at least the concepts and guidelines discussed here. Such small contribution can lead to a substantial improvement in energy efficient and environment friendly enterprise structures and save time, money and resource on maintenance.

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