



# International Journal of Innovative Research in Computer and Communication Engineering

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## A Study on Green IT – Approaches and Implications

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**ABSTRACT :** The energy consumption of software is an increasing concern as the use of mobile applications, embedded systems, and data center-based services expands. While research in green software engineering is correspondingly increasing, little is known about the current practices and perspectives of software engineers in the field. This paper focuses on the study of green IT approaches and initiatives taken by companies and organizations to realize Green IT.

**KEYWORDS:** Green IT, Carbon Footprint, Ecological footprint.

### I. INTRODUCTION

Rising energy demands and the growing environmental impact from the increased adoption of IT services are motivating the green movement in IT, which places great importance on the design and implementation of green solutions.

Green IT aims for minimal environmental impact from the design, production, and use of computers, servers, monitors, printers, storage devices, and networking and communication systems. It focuses on product and process efficiency, in terms of environmental sustainability, as well as applying IT to create energy-efficient, and sustainable business processes and practices.

Sustainable Development means to try to meet the needs of the present without compromising the chances of future generations to meet their own needs. This is because the ICT industry is responsible for nearly two percent of the CO<sub>2</sub> emissions worldwide. To quantify this: The power consumption of data centers in the world increased from 58 TW h in 2000 to 123 TW h in 2005, and is still increasing.

### II. LITERATURE REVIEW

#### 1) What is Green IT?

Green IT refers to two things which are in themselves changing rapidly. The first is our understanding of what is Green and what isn't. The second is Information Technology, which is extending its scope, techniques and social and geographical presence on a daily basis.

Green IT is a collection of strategic and tactical initiatives that directly reduces the carbon footprint of an organization's computing operation. However, Green IT is not just focused on reducing the impact of the ICT industry. It is also focused on using the services of ICT to help reduce the organization's overall carbon footprint.

#### Need of Green IT :

- Green IT refers to the study and practice of using computers and IT resources in a more efficient and environmentally responsible way.
- Computers and computing utilizes a lot of natural resources, from the raw materials needed to manufacture them, the power used to run them, and the problems of disposing them at end of life.
- All businesses are increasingly dependent on technology, and small business is no exception. We work on our PCs, notebooks and smart phones, and are connected to servers running 24/7.



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- As the technology refresh cycle is fast, these devices quickly become obsolete, and at some point — more often sooner than later — we dispose of old devices and replace them with new ones. We use massive quantities of paper and ink to print documents, many of which we promptly send to the circular file

## III. GREEN IT APPROACHES TAKEN BY COMPANIES

Green computing initiatives are taken by modern IT companies to control their own power consumptions, people, networks and hardware. Following are certain measures that can be used by companies to implement green computing in their organization.

### 2) Product longevity

The biggest contribution to green computing usually is to prolong the equipment's lifetime. Another report from Gartner recommends to "Look for product longevity, including upgradability and modularity". For instance, manufacturing a new PC makes a far bigger ecological footprint than manufacturing a new RAM module to upgrade an existing one.

### 3) Data center design

Data center facilities are heavy consumers of energy, accounting for between 1.1% and 1.5% of the world's total energy use in 2010. The U.S. Department of Energy estimates that data center facilities consume up to 100 to 200 times more energy than standard office buildings.

Energy efficient data center design should address all of the energy use aspects included in a data center: from the IT equipment to the HVAC (Heating, ventilation and air conditioning) equipment to the actual location, configuration and construction of the building.

### 4) Software and deployment optimization

#### Algorithmic efficiency

The efficiency of algorithms affects the amount of computer resources required for any given computing function and there are many efficiency trade-offs in writing programs.

#### Resource allocation

Algorithms can also be used to route data to data centers where electricity is less expensive. Larger server centers are sometimes located where energy and land are inexpensive and readily available.

#### Virtualizing

Computer virtualization refers to the abstraction of computer resources, such as the process of running two or more logical computer systems on one set of physical hardware.

#### Terminal servers

Terminal servers have also been used in green computing. When using the system, users at a terminal connect to a central server; all of the actual computing is done on the server, but the end user experiences the operating system on the terminal.

### 5) Power management

Undervolting process allow the user to manually adjust the voltages supplied to the CPU, which reduces both the amount of heat produced and electricity consumed..

#### Data center power

Data centers, which have been criticized for their extraordinarily high energy demand, are a primary focus for proponents of green computing. Data centers can potentially improve their energy and space efficiency through techniques such as storage consolidation and virtualization

#### Power supply

Desktop computer power supplies are in general 70–75% efficient, dissipating the remaining energy as heat.



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## Storage

Smaller form factor (e.g., 2.5 inch) hard disk drives often consume less power per gigabyte than physically larger drives. Unlike hard disk drives, solid-state drives store data in flash memory or DRAM. With no moving parts, power consumption may be reduced somewhat for low-capacity flash-based devices.

## Video card

Energy-efficient display options include:

- No video card – use a shared terminal, shared thin client, or desktop sharing software if display required.
- Use motherboard video output – typically low 3D performance and low power.
- Select a GPU based on low idle power, average wattage, or performance per watt.

## Display

CRT monitors typically use more power than LCD monitors. They also contain significant amounts of lead. 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.

## 6) Materials recycling

Recycling computing equipment can keep harmful materials such as lead, mercury, and hexavalent chromium out of landfills, and can also replace equipment that otherwise would need to be manufactured, saving further energy and emissions. Computer systems that have outlived their particular function can be re-purposed, or donated to various charities and non-profit organizations. Computing supplies, such as printer cartridges, paper, and batteries may be recycled as well.

The recycling of old computers raises an important privacy issue. The old storage devices still hold private information, such as emails, passwords, and credit card numbers, which can be recovered simply by someone's using software available freely on the Internet. Deletion of a file does not actually remove the file from the hard drive. Before recycling a computer, users should remove the hard drive, or hard drives if there is more than one, and physically destroy it or store it somewhere safe. There are some authorized hardware recycling companies to whom the computer may be given for recycling, and they typically sign a non-disclosure agreement.

## 7) Cloud computing

Cloud computing addresses two major ICT challenges related to Green computing – energy usage and resource consumption. Virtualization, Dynamic provisioning environment, multi-tenancy, green data center approaches are enabling cloud computing to lower carbon emissions and energy usage up to a great extent.

## 8) Telecommuting

Teleconferencing and telepresence technologies are often implemented in green computing initiatives. The advantages are many; increased worker satisfaction, reduction of greenhouse gas emissions related to travel, and increased profit margins as a result of lower overhead costs for office space, heat, lighting, etc.

## 9) Supercomputers

Today a new supercomputer, L-CSC from the GSI Helmholtz Center, Made in Germany emerged as the most energy-efficient (or greenest) supercomputer in the world. The L-CSC cluster was the first and only supercomputer on the list to surpass 5 gigaflops/watt (billions of operations per second per watt).



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## 10) Practical Tips to Achieve Sustainable business

Following practical tips can be followed to get sustainable business and move towards green IT,

### 1. Novice:

- *Eliminate paper, printer and packaging waste.* We can use tools such as Green Print to make people “think before they print” and automatically eliminate things such as printing that extra page.
- Reduce power consumption. The use of “Set it and forget” tools, such smart power strips, which automatically turn off peripheral devices when you turn off the main device.
- Recycle old equipment. The U.S. Environmental Protection Agency estimates that only 18 percent of electronic waste was collected for recycling in 2007—while 82 percent, or 1.84 million tons, was disposed of, primarily in landfills. But it’s easy to recycle: At Gazelle you can sell and/or recycle all kinds of electronic devices, from mobile phones to printers. Through Dell and Goodwill’s Reconnect Partnership, you can donate unwanted devices.

### 2. Intermediate:

- Use Web conferencing instead of traveling to meetings. Web conferencing is a great way to go green — and save huge amounts of time and money.
- Transition from paper-based to digital processes. Paper-based marketing, forms and faxes add a lot of trash to landfills. E-mail marketing solutions are greener and more affordable, flexible and interactive than direct mail.
- Use cloud computing and software-as-a-service solutions (SaaS) instead of new, in-house applications. With cloud computing, multiple organizations share the same computing resources, and that increases utilization by making more efficient use of hardware resources.

### 3. Advanced:

- *Enable staff to telecommute.* While it may not work for every employee or business, technologies such as virtual private networks and collaboration tools such as HyperOffice and IBM LotusLive help employees work together from different locations.
- Server and storage virtualization. Because hardware itself is relatively inexpensive, many mid-size and even small companies are facing server and storage sprawl. Meanwhile, surveys show that up to 85 percent of system capacity goes unused. While you will have to invest in initial start-up costs, virtualization can help you improve resource utilization, reduce energy costs and simplify maintenance. Dell, HP and IBM each offer a range of comprehensive server and storage virtualization solutions and services.
- Develop a thin-client strategy. Netbooks and other thin clients use about half the power of a traditional desktop PC. They are smaller, cheaper and simpler for manufacturers to build than traditional PCs or notebooks — and cheaper for you to buy and operate.

## V. GREEN IT ACTIVITIES





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There are three aspects of the relation between end users and Green IT activities:

- The Hardware side: Thinking of Green IT mostly advices like using energy-saving modes or printing duplex come to mind. Many checklists are available and the industry is promoting green hardware.
- The Software side : The user is independent in his choice of IT tools and software. Even though the energy management of the operating system is probably the predominant driver for the resulting energy consumption, we think that the software side also influences the carbon footprint of the IT.
- Information systems for the end user: The users need to be aware that there is for example more than just one software-option to choose.

## V. CONCLUSION

- Green IT is applicable to a range of high-tech domains, including datacenters, mobile computing, and embedded systems
- Several efforts are being taken to highlight the importance of including green aspects within software engineering .
- From this study we can conclude that there is a need to raise awareness among software developers as well as users, who hold in their hands the responsibility of choosing and demanding a software that is more respectful of the environment.
- If we achieve this, the whole software development ecosystem will be forced to adopt greener software processes and produce greener software products if they want to remain competitive.

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