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## *Intangible need of Green Computing in Education*

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*Abstract: There is necessitating temperament to protect out natural world from environmental issues for current and future generations. Green Computing is a innovatory method related to the environment protection and sustainability of Information and Communication Technology (ICT) in future as well as comprise of pattern to accomplish corporate social responsibility by minimizing carbon footprints, e-waste and by conserving energy. This paper analyzes the coherent of Green computing in education and finds critical success factors for the same. This paper presents the national mission for Green India.*

### I. INTRODUCTION

Green computing is the study and pattern of environmentally sustainable computing or Information Technology. Green computing can also include designing, manufacturing, using and disposing of computers and peripheral devices efficiently and effectively with negligible or no effect on the environment.[2]

The goals of green computing are similar to green-chemistry, reduce the use of unsafe materials, maximize energy efficiently, polishing the product's lifetime and promoting recyclability or biodegradability of inoperative products and factory waste. Green computing is important for all classes of systems ranging from hand-held systems to large scale centers. Many corporate IT departments have green computing initiatives to cut down the environmental effect of their IT operations.



Figure 1.1 Concept of Green Computing [8]

In 1992, the U.S. Environmental Protection Agency launched Energy Star, A voluntary labeling program that is designed to promote and acknowledge energy-efficiency in monitors, climate control equipment, and other technologies.[1] As consequences of this the widespread adoption of sleep mode among consumer electronics took place. At the same time, the Swedish organization TCO Development launched the TCO Certification program to promote degraded magnetic and electrical emissions from CRT-based computer displays. This program was later expanded to include criteria on energy consumption ergonomics and use of unsafe materials in construction.[3][4]

**II. NEED OF GREEN COMPUTING IN EDUCATION**

Green computing is about bringing down the environmental footprints of computer or ICT in general. This is usually achieved by the following procedure:

- Making data centers and computing devices more energy efficient.
- Using more renewable energy sources.
- Using less unsafe materials in computing devices.
- Promoting devices longevity.
- Making devices better recyclable.

This means that the main benefits of green computing are:

- Reduced environmental impact (Less GHG emission, less e-waste, fewer virgin resources needed for manufacturing new devices)
- Low energy costs.
- Longer lasting computing devices.
- Reduced health risk for computing devices.
- Reduced health risk for computer workers and recyclers. [8][9]

**2.1 Requirement of Green Computing:**

The green computing concept has been on peak in conversations around the globe these days because manufacturing and consumption is becoming an environmental concern. But it's very unfortunate to see the decreasing growth which was earlier expected to have been immense. Though, continuous efforts are being made in order to win over the idea in a more simplified manner. The first thing that hits our mind is because it is the need of the hour. Global warming which has been the major illness since it came into light, poses threats for the future. We are in an era where needs and demands are growing by second of the clock. Resources are constricted and they should be managed in such a way that our future has some silver linings to it. We need to implement Green computing because of the following reasons: [6][7]

- **Heaps of Electronic waste:**

Majorly articulated E-waste, this is a leading menace that has an impact on our environment since the machinery came in. Dozens and millions of dump get collected daily around the globe in junkyards. Also, it produces some intolerable toxics that can lead to various unknown deadly disease. In order to recycle e-waste, we should move towards green technology and make use of environment-friendly products.[5]

- **Constricted Resources:**

There might be an advertise in the future that says “NO MORE RESOURCES TO PRODUCE ELECTRONICS GOODS” until manufacturers around the globe start taking this issue sincerely. Resources are constricted and should be utilized efficiently in order to save environment. Green ideas that lead to minimize the usage of these anxiety resources should be used as much as possible. Cloud computing is an practical example of it.

- **Energy cost:**

The thing that runs most of these technological activities all around the globe doesn't come at an effortless cost. Producing electrical energy these days is getting expensive and constricted. The usage and demand for energy consumption has led to

crisis situation in many countries. The difficulty can only be solved by moving to other clean and green options. Solar energy, bio gas and wind energy are great motivators towards that.[10][11]

Green computing desire to minimize negative environmental impacts through the responsible use of electronics through the creation of energy-efficient designs through the implementation of recycling programs that can re-use existing computers, and through the designing of manufacturing processes that minimize waste. One of the earliest and most accepted intentionally public initiatives for green computing was the environmental protection agency's introduction of the "Energy Star" label 1982, that is commonly seen on laptops and computer displays. This program was also adopted in Europe and Asia.

Some of the regular activities that can be employed by the home electronic or computer use to support green computing include the use of the sleep or hibernate function when not actively using a unit powering computers completely off overnight, considering the purchase of refurbished units as opposing to new ones, and complying with local guidelines for the safe and amenable disposal of waste equipment.[12]

Information technology industry is increasing every day and there is more demand for computing and communication as it continues to advance. Servers, networks and data centers will consume more and more energy. The computers emit carbon dioxide and other harmful gases and the energy consumption by various computing devices also play a major role towards our harmful schools environment. The data center of some educational institutes in United States as of 2015 were said to have 1.5 percent of total energy consumed and at a cost of \$4.5 billion.

When the organization purchases a new set of computer or laptop of electronic devices, what happens to the old one? No organization seems to know what to do with the obsolete computers, electronic phones etc and it has been estimated that out of all computer equipment taken out of service annually, only 35 percent is recycled. Making this transition to green computing in schools can reduce their energy consumption save on their power bill, extend their budget and help to save the environment. The e-waste contains so many substances that are very noxious to our health e.g. the mercury, lead cadmium etc.[15]

## **2.2 Effects of Electricity on Environment:**

The electric power produces much pollution to environment. They are Air pollution, Water pollution. Land pollution. Fossil fuel power plants release air pollution and require lot of water. Nuclear power plants releases lots of radio active energy and unsafe waste. Even renewable energy sources affecting water and wild life and even disturbing the food chain too.[14]

Air pollution affects on climate change, acid rain, ozone, air toxic. Water pollution affects on ingestion of water resources, polluting water bodies. Land pollution impacts on degrade and devalue the land, impacting ecosystem and aesthetics. The computer crowding our landfills contains lead, mercury and cadmium into air and ashes. Even recycling the electronics can harm the workers and the environment surrounding them. So we are putting clean discoloration on the environment. We can't stop using computers and we can't stop using electricity, those are more important parts of our lives and economy. But we can do few things to make the environment healthy.[13] There are multiple ways to alter energy use with computers such as:

- Power Management:

Power management helps to manage the power supply to a desktop computer so that it minimizes the power consumption of the computer without affecting the quantity of work completed.

- Email Practices and Policies:

Computer users can use email to cut down energy consumption by sending email memos instead of paper.

- Digital Learning:

Online learning options using learning management and web/videoconferencing can cut back on the need for traditional physical classrooms (and other infrastructure) while also reducing travel cost and associated energy consumed.

**2.3 Effects on Economy in absence of Green Computing:**

City, State	20 Mega Watt (in million \$)	40 Mega Watt (in million \$)
Lee, AL	4	9.55
Shelby, AL	4.03	10.37
Saline, AR	4.85	11.44
Union, AR	5.02	10.91
Clay, FL	3.69	9.46
Leaon, FL	4.52	10.57
Santa Rosa, FL	4.7	11.23
Cowera, GA	2.36	6.13
Murray, GA	3.7	8.7
Union, GA	4.76	11.64
Trimble, KY	3.36	8.77
DeSoto, MS	3.56	9.8
Le Flore, OK	5.88	12.97
Oconee, SC	4.08	10.3
<b>Total (Average)</b>	<b>58.52 (4.18)</b>	<b>141.84 (10.13)</b>

Table 1. Biomass Fuel Costs for 20 and 40 Mega Watt power plants in selected US Cities without Green Computing.

City, State	20 Mega Watt (in million \$)	40 Mega Watt (in million \$)
Lee, AL	2	4.55
Shelby, AL	2.03	5.37
Saline, AR	2.85	5.44
Union, AR	3.02	5.91
Clay, FL	1.69	4.46
Leaon, FL	2.52	5.57
Santa Rosa, FL	2.7	5.23
Cowera, GA	1.06	3.13
Murray, GA	1.7	4.7
Union, GA	2.76	5.64
Trimble, KY	1.36	4.77
DeSoto, MS	1.56	4.8
Le Flore, OK	3.88	6.97
Oconee, SC	3.08	5.3
<b>Total (Average)</b>	<b>32.21 (2.30)</b>	<b>71.84 (5.13)</b>

Table 2. Biomass Fuel Costs for 20 and 40 Mega Watt power plants in selected US Cities with Green Computing.

**2.4 Existing education model adapted Green Computing:**

When the green computing is implemented in schools, it is not only the electricity bills that will go down but the institute will cut down the amount of CO<sub>2</sub> emanation which is the greatest environmental situation today and is responsible for global warming. Example, Georgetown University in United States said that since they invested in green computing, they had been able to cut down CO<sub>2</sub> emission over 20% through a combination of demand reduction, efficiency and use of cleaner fuels.

In the spring of 2015 Georgetown launched a new on-site renewable energy project through a collaborative student-staff initiative, installing 18 KW of solar panels on a block of historic university owned row housed which was the first campus project in Washington DV. It has been estimated that the project is expected to provide 19711 KW each year and thereby reduce more than 600,000 pounds of carbon pollution over the 20 year life of the project.[16]

If we talk about India, India actively promotes the use of information and communication technologies in education sector. Higher education in India has witnessed and impressive growth over the years. The number of higher education institutions (HEIs) has increased from about 30 universities and 695 colleges in 1950-51 to about 700 universities and 35000 colleges as per a recent University grant commission report. India is now the world's third biggest emitter of carbon dioxide. The global E-waste generation is growing annually at 4- million tones and in next 10 years India's e-waster is like to grow by 18 times. Concerning higher education institutions, the learners and academicians have extended the use of ICT s a part of their consistent life. Each living individual should come to be Green pioneer for social change and saving mankind from natural defilement. Green ICT helps education organizations to realize social profits like enhanced image, higher reputation and trustworthiness among all stakeholders. India's spending on green IT and sustainability initiatives will double from \$55 billion in 2018 to \$100 billion in 2020, according to a report by research and advisory firm Gartner.[16]

### III. SERVICES AVAILABLE IN GREEN COMPUTING/EDUCATION/REVIEW OF LITERATURE

Computer virtualization refers to the abstraction of computer resources. With virtualization, a system administrator could combine several physical systems into virtual machines on one single, powerful system thereby unplugging the original hardware and reducing the power and cooling consumption. Several commercial; companies and open-source projects now offer software packages to enable transition to virtual computing. Intel Corporation and AMD have also built proprietary virtualization enhancements to the x86 instruction set into each of their CPU product lines, in order to facilitate virtualized computing.[17][18]

#### **Terminal Servers:**

Terminal servers have also been used in green computing methods. Terminal services for Windows and the Aqua connect terminal server for Mac, both deliver operating systems to end users. Using this method user's terminal into a central server. Using this method user's terminal into a central server. All of the computing is done at the server level but the end user experiences the operating system. There has been an increase in using terminal services with thin clients to create virtual labs. Thin clients use up to 1/8 the amount of energy of a normal workstation. Using thin clients with a terminal server delivers the Windows or Mac operating system to end users while also decreasing energy cost and consumption.

#### **Power Management:**

The advance configuration and power interface(ACPI), an open industry standard allows an operating system to directly control the power saving aspects of its underlying hardware. This allows a system to automatically turn off components such as monitors and hard drives after set periods of inactivity. In addition a system may hibernated, where most components are turned off. ACPI is a successor to an earlier Intel Microsoft standard called Advanced Power Management, which allows a computer's BIOS to control power management functions.

#### **Power Supply:**

Desktop Computer Power Supplies(PSUs) are generally 70-75% efficient dissipating the remaining energy as heat. An industry initiative called 80 PLSU certifies PSUs that are at least 80% efficient; typically these models are drop-in replacements for older, less efficient PSUs of the same form factor. As of July 20, 2007 all new Energy Star 4.0 certified desktops PSUs must be at least 80% efficient.

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