

## Green Computing-New Approaches of Energy Conservation and E- Waste Minimization

Mr.N.P.Jadhav<sup>1</sup>, Mr. R.S. Kamble<sup>2</sup>,Mr.S.V.Kamble<sup>3</sup>

<sup>1</sup>(Dept. of CSE,Dr.J.J.Magdum College of Engg.,Jaysingpur,Maharashtra,India)

<sup>2</sup>(Dept. of CSE,Dr.J.J.Magdum College of Engg.,Jaysingpur,Maharashtra,India)

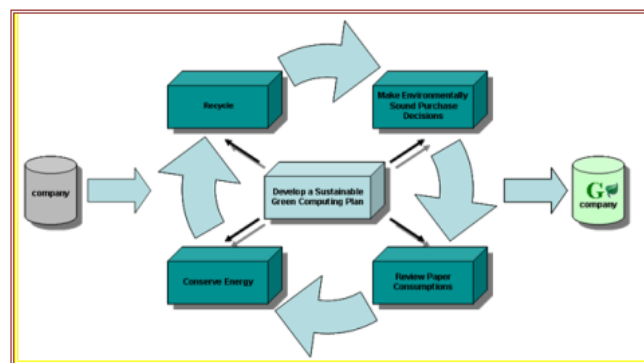
<sup>3</sup>(Dept. of CSE,Dr.J.J.Magdum College of Engg.,Jaysingpur,Maharashtra,India)

**Abstract**-Thrust of computing was initially on faster analysis and speedier calculation and solving of more complex problems. But in the recent past another focus has got immense importance and that is achievement of energy conservation of e-equipments. Green Computing is now under the attention of not only environmental organizations, but also businesses from other industries. It has also given utmost attention to minimization of e-waste and use of non-toxic materials in preparation of e-equipments. In recent years, companies in the computer industry have come to realize that going green is in their best interest, both in terms of public relations and reduced costs.

**Keywords**- Carbon, Conservation, E-waste, Environment, Efficiency.

### 1.INTRODUCTION

Green Computing is a recent trend towards designing, building, and operating computer systems to be energy efficient. The goals are to maximize energy efficiency during the product's lifetime, reduce the use of hazardous materials, and promote recyclability or biodegradability of defunct products and factory waste [7]. Such approaches include the implementation of energy-conserving central processing units (CPUs), servers and peripherals as well as reduced resource consumption and proper disposal of electronic waste (e-waste). In 1992, the U.S. Environmental Protection Agency launched Energy Star, a voluntary labeling program which is designed to promote and recognize energy-efficiency in monitors, climate control equipment, and other technologies. Companies in every industry, from nonprofits to consumer goods, are paying much closer attention to their power bills, as the amount spent on data center power has doubled in the past six years. The good news is that computer companies are talking about greenness and are touting green programs nowadays [1]. Even consumers are now becoming increasingly aware of green technologies and are starting to demand more environmentally friendly products in their homes and workplaces. In addition to saving companies in ongoing power consumption costs, thin client devices have a number of additional energy saving benefits when compared to traditional PCs. Because they have no moving parts, such as disc drives or fans, and emit very little heat, organizations also save in cooling costs; actual savings vary based on facility. Producing thin clients also requires significantly less energy and resources, as they contain fewer parts; are cheaper to transport because they are approximately 40 percent lighter; and last 50 percent longer, greatly reducing computer disposing cost.



(Fig 1: Green Computing migration framework)

This approach also encompasses the vehicle market. Automakers have been listening to the feedback and addressing consumer needs through cars that have better fuel economy, have lower emissions, and include natural materials.

### 2. NEED FOR GREEN COMPUTING

The following points would clear why should a company promote green, or energy efficient computing?

- 2.1 Green computing can lead to serious cost savings over time. Reductions in energy costs from servers, cooling, and lighting are generating serious savings for many corporations..
- 2.2 As energy demands in the world go up, energy supply is declining or flat. Energy efficient systems helps ensure healthy power.
- 2.3 Computing Power Consumption has Reached a Critical Point: Data centers have run out of usable power and cooling due to high densities.

### **3. EXISTING WORK**

According to the company sources, IBM in 1990 saved around 4.6 billion kWh of electricity and prevented almost 3 million metric tons of CO<sub>2</sub> emissions [8]. So, essentially a reduction in wastage and recycling of the used materials is what is required to ensure green IT. There have been multiple approaches to green computing [2]. "Data center servers use 50 times the energy per square foot as an office [does]," says Mark Bramfitt, principal program manager at PG&E [9]. Data centers are the main reason behind energy consumption, Energy consumed by data centers in the United States and worldwide doubled from 2000 to 2005, according to Jonathan Koomey, a consulting professor at Stanford University and staff scientist at Lawrence Berkeley National Lab. As a result, some companies are chasing cheaper data center power. Google is building a data center on Oregon's Columbia River to tap hydroelectric power, while Microsoft builds nearby in Washington for the same reason. One of the VIA Technologies' ideas is to reduce the "carbon footprint" of users — the amount of greenhouse gases produced, measured in units of carbon dioxide (CO<sub>2</sub>). [5] Greenhouse gases naturally blanket the Earth and are responsible for its more or less stable temperature. An increase in the concentration of the main greenhouse gases — carbon dioxide, methane, nitrous oxide, and fluorocarbons — is believed to be responsible for Earth's increasing temperature, which could lead to severe floods and droughts, rising sea levels, and other environmental effects, affecting both life and the world's economy. To keep servers at the right temperature, companies mainly rely on air-conditioning equipments. The more powerful the machine, the more cool air needed to keep it from overheating. By 2005, the energy required to power and cool servers accounted for about 1.2% of total U.S. electricity consumption, according to a report released in February by staff scientist Jonathan Koomey of Lawrence Berkeley National Laboratory and sponsored by chip manufacturer AMD (AMD). The Energy Star program encourages manufactures to create energy-efficient devices that require little power are not in use. For example, many devices switch to standby mode after a specified number of inactive minutes. Personal computers, monitors and printers should comply with the ENERGY STAR program, which was developed by the United States Department of Energy (DOE) and the United States Environmental Agency (EPA). Therefore, computers and devices that meet ENERGY STAR guidelines display an ENERGY STAR label [3]. According to SUN, Today's modern network economics have more and more businesses requiring high computing capability whether it be for searches, Web services, e-commerce, traffic control, or supply chain management. The bottom line is that they all require computing with significant capacity SUN approached the problem by pushing the physical technology of the CPU frequency — namely, the number of cycles that a piece of silicon can do. But you quickly run into the law of physics that says that when you force the transistors to switch as quickly as possible, there is a corresponding amount of power consumption and the heat generated by the transistors grows proportionally. Faster processors use more power, because they use too much power and their waste heat increases temperature for which air conditioning necessary, especially in server farms--between the computers and the HVAC. The waste heat also causes reliability problems, as CPU's crash much more often at higher temperatures.

### **4. PROPOSED WORK**

So far, consumers haven't cared about ecological impact when buying computers, they've cared only about speed and price. But as Moore's Law marches on and computers commodities, consumers will become pickier about being green. Devices use less and less power while renewable energy gets more and more portable and effective. New green materials are developed every year, and many toxic ones are already being replaced by them. The greenest computer will not miraculously fall from the sky one day, it'll be the product of years of improvements. The features of a green computer of tomorrow would be like: efficiency, manufacturing & materials, recyclables, service model, self-powering, and other trends. Green computer will be one of the major contributions, which will break down the 'digital divide', the electronic gulf that separates the information rich from the information poor. A green computer or green IT system is one where the entire process from design, manufacture, use, and disposal involves as little environmental impact as possible. In other words, a green initiative is taken in consideration of all facets of a computer's life, from design to disposal. A green computer will also take into account how it impacts the environment during its life. One way to make a green computer reduce its usage impact is to extend its longevity. The longer the computer lasts, the less impact it will have on the environment because disposal, normally the most significant green influence of the computer's cycle, will be

delayed for a longer period of time. As 21st century belongs to computers, gizmos and electronic items, energy issues will get a serious ring in the coming days, as the public debate on carbon emissions, global warming and climate change gets hotter. If we think computers are nonpolluting and consume very little energy we need to think again. 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. Thus, energy saved on computer hardware and computing will equate tons of carbon emissions saved per year. Taking into consideration the popular use of information technology industry, it has to lead a revolution of sorts by turning green in a manner no industry has ever done before. It is worth emphasizing that this “green technology” should not be just about sound bytes to impress activists but concrete action and organizational policy [6]. Manufacturing computers means the use of lead, cadmium, mercury, and other toxics in general and laptop in particular. Normally, computers can contain 4 to 8 pounds of lead alone, according to green experts. It's no wonder that computers and other electronics make up two fifths of all lead in landfills. To counter this growing pollution threat all over the world due to the growing use of electronic device in general and computers in particular a need to look for a green computer. Opportunities lie in green technology like never before in history and organizations are seeing it as a way to create new profit centers while trying to help the environmental cause.

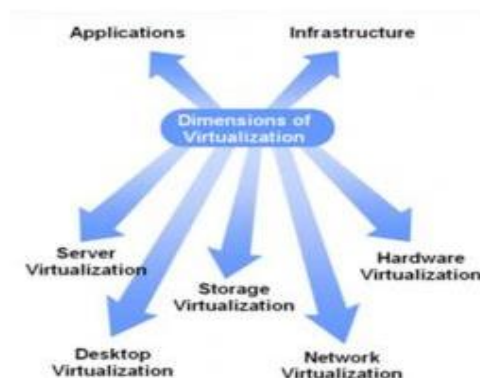
The plan towards green IT should include new electronic products and services with optimum efficiency and all possible options towards energy savings. Faster processors historically use more power. Inefficient CPU's are a double hit because they both use too much power themselves and their waste heat increases air conditioning needs, especially in server farms--between the computers and the HVAC. The waste heat also causes reliability problems, as CPU's crash much more often at higher temperatures. Many people have been working for years to slice this inefficiency out of computers. Similarly, power supplies are notoriously bad, generally as little as 47% efficient. And since everything in a computer runs off the power supply, nothing can be efficient without a good power supply. Recent inventions of power supply are helping fix this by running at 80% efficiency or better. Power management soft-wares also help the computers to sleep or hibernate when not in use. On the far horizon, reversible computing (which also includes quantum computing) promises to reduce power consumption by a factor of several thousand, but such systems are still very much in the laboratories. The best way to recycle a computer, however, is to keep it and upgrade it. Further, it is important to design computers which can be powered with low power obtained from non-conventional energy sources like solar energy, pedaling a bike, turning a hand-crank etc.

## **5. ANALYSIS OF PROPOSED WORK**

Electronics giants are about to roll out eco-friendly range of computers (like desktops and laptops) that aim at reducing the e-waste in the environment. Besides desktops and laptops, other electronic hardware products should also be strictly adhering to the restricted use of hazardous substances. In other words, they should be free of hazardous materials such as brominated flame retardants, PVCs and heavy metals such as lead, cadmium and mercury, which are commonly used in computer manufacturing. Reliability about the use of green materials in computer is perhaps the biggest single challenge facing the electronics industry. Lead-tin solder in use today is very malleable making it an ideal shock absorber. So far, more brittle replacement solders have yet to show the same reliability in arduous real-world applications. Replacements like the front runner, a tin/copper/silver alloy, also require higher melting temperatures, which can affect chip life. The work habits of computer users and businesses can be modified to minimize adverse impact on the global environment. Here are some steps that can be taken:

- It is better to do computer-related tasks during contiguous, intensive blocks of time, leaving hardware off at other times.
- Designers plan to make future computer more eco-friendly across its entire life span, from manufacture to recycling.
- Avoidance of the use of screen savers contributes to energy savings by allowing a monitor to enter in stand-by mode.
- Replacing petroleum-filled plastic with bioplastics—plant-based polymers—require less oil and energy to produce than traditional plastics with a challenge to keep these bioplastic computers cool so that electronics won't melt them landfills can be controlled by making best use of the device by upgrading and repairing in time with a need to make such processes (i.e., up gradation and repairing) easier and cheaper.
- Use of toxic materials like lead can be replaced by silver and copper making recycling of computers (which is expensive and time consuming at present) more effective by recycling computer parts separately with a option of reuse or resale.
- Print only what we need and use of recycled content paper whenever possible is another good practice. Most printers today have a two-sided printing option which can dramatically reduce paper consumption. Recycled used ink and toner cartridges may also be used.

- It is important to design computers which can be powered with low power obtained from nonconventional energy sources like solar energy, pedaling a bike, turning a hand-crank etc
- Energy efficient display options include:
  - No video card or use of shared terminal, shared thin client, or desktop sharing software if display required.
  - Use motherboard video output - typically low 3D performance and low power.
  - Reuse of older video card that uses little power; many of which do not require heat sinks or fans
- IT vendors also are applying green standards to their own operations. The reasons are ::
  - New revenue opportunities
  - Fear of a customer backlash
  - Desire to act like good corporate citizens
- 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.[4]
- This benefits 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 centers 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.



(Fig 3: Virtualization : The key to Green Computing)

The awareness programme may include the following major issues:

- Green computing minimizes the energy consumption of the organization i.e. minimizes the power bill.
- Use of non-toxic material in the equipment makes the worker safe from health problem and occupational hazards.
- It saves the resource of the country as a whole.
  - In the long term these green equipment will be less costly without any hidden cost of waste and enhanced resource consumption without any detrimental effect of accuracy, performance and longevity.



(Fig 2: The Green Computing revolution cycle)

Sun created a Sun Eco office to oversee all of the company's green programs, including telecommuting but also core products such as low-power servers.

One more vital step can be taken in Green Computing is that hardware design the machines to conserve energy & minimize the E- waste disposal, which will be our future work naming as 'Green Computer: green revolution in computing'.

## **6. CONCLUSION**

Green computing is a mindset that asks how we can satisfy the growing demand for network computing without putting such pressure on the environment. There is an alternative way to design a processor and a system such that we don't increase demands on the environment, but still provide an increased amount of processing capability to customers to satisfy their business needs. Green computing is not about going out and designing biodegradable packaging for products. Now the time came to think about the efficient use of computers and the resources which are non renewable. It opens a new window for the new entrepreneur for harvesting with E-waste material and scrap computers. Green Computing or Green IT, refers to environmentally sustainable computing or IT systems and activities. The main duty of Green Computing is to design, manufacture, use, and dispose of computing systems and accessories in environment respective way. In the context of TCSC, the technical area of Green Computing aims to carry on the research to design, develop and implement environment-respect algorithms, hardware/software and computing systems.

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