

Green Computing and Energy Consumption Issues in the Modern Age

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Abstract: Green computing concept is to improve environmental condition. The main aim of green computing is to reduce toxic materials. We systematically analyze its energy consumption which is based on types of services and obtain the conditions to facilitate green cloud computing to save overall energy consumption in this system. Today it is the major issue to prepare such equipments by which we achieve efficient energy and to minimize of e-waste and use of non toxic chemicals/materials in preparation of e-equipments. We can implement green computing in computer's fields as CPU servers and other peripheral devices (mobile devices). By using green computing we can reduce resources consumption and disposal of electric waste (e-waste). It has been seen that computers and other electronics devices are increasing day by day, so the amount of electricity consumed by them is also increasing. In this way the percentage of CO₂ in the atmosphere is also increasing. The other toxic materials which are used in computer/electronics industry are also harmful for environment. In this paper, we will elaborate comprehensively survey the concepts and architecture of green computing, as well as its heat and energy consumption issues. Their pros and cons are discussed for each green computing strategy with its friendly approach towards atmosphere. Green computing can facilitate us to safe, secure place and healthy environment all over in the world. This paper will help us to take some initiatives currently under in the field of computers/electronics industry and new ways to save vast amounts of energy which is wasted in very large scale.

Keywords: Green Computing, toxic material, e-waste, e-equipments, peripheral devices

I. Introduction

The green computing technologies can reduce energy consumption. The temperature of global world is increasing very quickly. There are many factors but computers/electronics industry causes over emission of green house gas and use much energy consumption which is the main root cause of current global warming. The energy consumption may be reduced by introduction of green computing. We can prepare and manufacture such devices which take low energy, give out low heat and gases. Air stream, weather, medicine, transportation, agriculture uses machines which take much amount of power, money and consumption of energy. It has been seen that there are three main areas which affect our daily life, air which we breathe, water which we drink and food which we eat and the soil on which we live. The data centers use a large amount of power/energy and release a lot of amount of heat and gases. In our daily life we use AC's. Refrigerators, inverters, UPS and computers. These items take a large amount of energy and evolve heat and gases. These gases are very harmful our lives. It has been seen that AC and refrigerators release CFC type gases. The battery of inverters release also harmful chemicals like lead. It causes lungs type diseases like cancers, asthma. The large amount of heat destroy green houses gases like CO₂ which create global warming. A large amount of heat create floods, melting of glaciers, drought and increase the temperature of the earth. Many companies are trying to resolve these problems. Companies are trying to establish such devices which can take low consumption of energy and release low amount of heat.[1]

II. Main Problem and issues

As we know that today the main issue is that the manufactures are preparing such devices which are however more efficient and accurate but they use more energy and evolve very toxics, dangerous gases and chemicals. Many electronics companies especially in computer use lead, mercury, cadmium and other toxics chemicals. It has been calculated that during manufacturing of computers can 4 to 8 pounds of lead alone. According to a new research it is estimated that computers and other electronics devices make up two-fifth of all lead in land-fills on the earth. Due to this reason pollution is increasing very rapidly. Data center servers use 50 times more the energy per square foot as in office. Data centers are the main energy consumption sources. In a survey in America energy consumed by data center in USA and all over the world will be doubled in next few years.

III. Existing works in Green computing

Today all manufactures companies are trying to establish such data center which are cheap and use low energy/power.

In America in 1992 introduced a energy star program. Its main aim was given awarded to those computing products which use minimum energy and give maximum efficiency in its working. In Energy star program were included such product as computer monitor, television sets, refrigerator ,air conditioning and other electronics devices. All these products may be friendly green computing.[2]

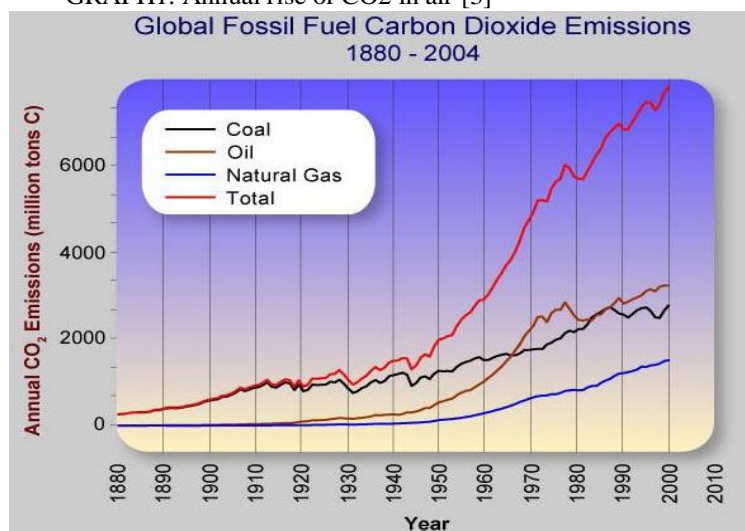
EPEAT (Electronic Products Environmental Assessment Tool) check the product's standard. All product which are registered are better to protect human health and these item can be easily upgraded and recycled. These products have reduced the percentage of lead, mercury and cadmium. These products are more efficient in energy and reduce the environmental impact.

IBM also has also contributed these issues.IBM has helped the clients to purchase the products according to green computing. According to the research of the IBM in 1990, He saved 4.6 billion KWh of electricity and also prevented3 million metric tones of CO₂ emission.

Google is trying to establish its data centre building on Oregon's Columbia River to tap hydroelectric power.

Microsoft company is also trying to establish its data centre building near Washington for hydroelectric power. Financial services company (HSBC) is preparing its building of data centre near Niagra falls for cooling and low energy consumption. In data center the servers evolve a large amount of heat so for their cooling company establish fully air conditioning equipments. The more powerful equipment of servers and then more cooling is required from overheating and secure working accurately. According to the report of staff scientists Jonathan Koomey of Lawrence Berkely National Laboratory and AMD which was released in 2005 to cool and power the servers 1.2% of total USA electricity is required. In 2010 according to Gartner the 2000 Global companies will spend more energy on data centers on servers than hardware's of the computers. Kumar says that energy costs is now 10% of the average IT budget of the world will increase 50% in next few years. The percentage of CO₂ is increasing very quickly. The annual rise of the CO₂ in air is given in graph,

GRAPH1. Annual rise of CO₂ in air [3]



The graph shows that annual emission of CO₂ in past years , the black, blue and brown lines show the rise of CO₂ due to coal, natural gas and oil respectively and the red line shows the total emission of CO₂ including all such factors that also includes electronics.

If we see the energy consumption during the actual use of the product and during the stand by mode we observe that during the standby mode the energy consumption ratio is more. e.g. Ink jet printer use 12 watts during use while printing and take 5 watt during idle state. The given below table shows the facts and figure clearly.

Appliance	Hours per day	Watt when on	Annual cost of use	Watts on stand by	Annual cost on standby	% wasted
TV	2	75	\$7.12	14	\$14.61	67%
VCR	1	15	\$0.07	8	\$9.07	99%
Computer	2	60	\$5.69	13	\$13.57	70%
Micro wave	25	1700	\$20.17	24	\$27.05	57%
Battery charger	6	12	\$3.41	10	\$3.79	53%
Total cost			\$49.36		\$104.50	

Table 1 The annual power wastage and cost [3]

Different electronics products use different energy consumption. In this table it is seen that if we switch off the product after using, we can save a large amount of energy which can be utilized other purposes. By this way we can decrease our budget annually and provide better environment to the world.

Intel Published a report about green computing in which they showed that components of computer use energy especially monitor or display consume a large amount of energy.

If we switch off of the laptop when it is idle state. We can save energy and money. The computer architecture are trying to set up such design in which display unit consume less energy/power. In the figure 2 it has been seen that in laptop all parts consume energy but display unit consume much energy which is one third (1/3) of the total energy consumed by a laptop. Most part of the energy is wasted during processing in the form of heat which is the loss of energy and sources.

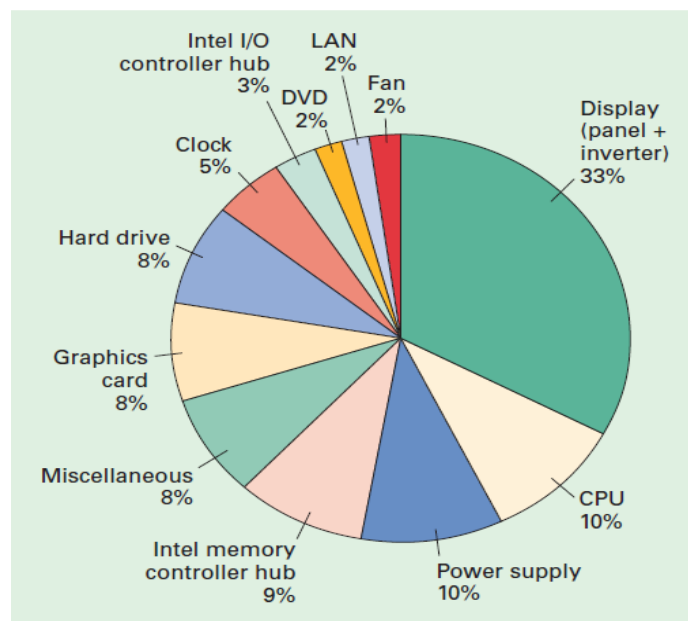


Fig.2.Power Consumption of average lap top [4]

In the above figure it is cleared that display unit of the laptop is consuming much energy that is 33% of the total energy consumed by a laptop. It has been that the laptop is very beautiful but its battery charging efficiency is not good. The performance of the CPU depends upon the battery of the laptop.

IV. Work in Green Computing

Today computers play very important role in our lives. Computers are the wealth of knowledge of internet. It is very fast in communication and to share other peoples. These are its good qualities but it takes a lot of energy to create, package, store and move data from one place to other When technology changes then the computer are dumped in a landfill. It is a major problem and it create pollution. When manufacturer company prepare computers, then these use lead, cadmium, mercury and other toxic materials. It has been estimated that 4 to 8 pounds of lead alone is used in a single computer. Computers and other electronics make two fifth (2/5) of all lead in landfill. Owing to this reason it is realizing that green computer should introduce. In the beginning in computers it was given attention their speed, price and cost. But now it is tried that these devices use less and less energy. Now such material is developed which is more green and toxic material is replacing by them.

It has been guessed that CO₂ emission, global warming and climate changes are getting hotter to hotter. It is estimated that out \$250 billion power per year is spent in which 15% of that power is spent on computing. Faster processor use more energy and slower or inefficient processor may also use double power which is the

wastage of energy in form of heat which create pollution in our environment. The waste heat also cause reliability problems in CPU as it may crash due to much temperature. Similarly the power supply which are used in computer are inefficient. It

has been estimated that these are 47% of total supply. But now power supply technology has been changed, because it is accepted that all parts of computer depend on power supply. so the efficient and low energy consumption are introduced. Now 80% supply are more efficient. Software which manage power are also help the computers to sleep or log of or hibernate when computer is not in use.

V. Green computing, issues and Benefits

1. In computer technology virtualization is very important effective tools. It is cost effective, green energy and efficient computing. In this tool the main server is divided into multiple virtual machines that help the server to run different applications. By using this technique companies can enhance their server utilization rates.
2. The companies should manufacture such processors which use low energy. Intel, Sun and Advance Micro Devices (AMD) are now trying to manufacture such processor. Sun has designed multicore processors which are very efficient relating to fuel.
3. In computers power option setting is also helpful, in which sleep mode is active, when the system is not working. It is a good practice. This option can be set through PC's control panel. It takes PC's in standby mode and turn off the monitor, when PC is in idle mode.



Fig.3.a Log off mode



Fig.3 b Stand by mode



Fig 3.c Turn off mode

4. It is also observed that flat monitor use less energy than cathode ray tube (CRT) monitor. Liquid crystal display (LCD) use very low energy than conventional monitor.
5. Hard disk drives take less power than other physical parts of computer. Now solid state drives as flash memory or DRAM are used to store data. They take less energy because they have no moving part, so the energy consumption may be reduced as compared to the hard disk.
6. We should use print paper only when we need. We can read soft copy. If we want hard copy (print copy), we should use such type of printers which have the capacity to print the paper both side. It reduces paper consumption and energy consumption. Recycled used ink in powder form and toner of the printer can be used again.
7. Screen savers are active when system is in idle state, if we allow the monitor to go to standby mode during idle state of the computer. It will also decrease energy consumption.
8. Computer manufacturer should designed such type of computer which can be powered from non conventional sources of energy like Sun energy, air energy, pedaling a bike, turning a hand crank etc.
9. In computer some devices are also important. Video card, graphic card, 3D performance software take a very large amount of energy. If we use older video card, these card use little power. In these cards there are no heat sink and fan.

Green Computing can help us to secure and safe place for us in the world. If each person try to safe the environment then our mother earth will healthy and happy for survival. Here are given some benefits of green computing,

It helps us to reduce the amount of pollution in air or surrounding.

It saves the power consumption and decreases the amount of heat which evolved the products.

It also reduces the pressure on paper industry which is a main issue.

Renewable resources are encouraged to use again.

Green computing help to promote the effective utilization of natural resources.

It also promotes us to avoid such products which destroy Green computing.

VI. Green Computing Eco friendly

It was realized that the conventional computers take much energy and produce heat. So the manufacturer of the computer designed laptop, desktop and note book type computers. The main aim of the manufacturer is to reduce the e-waste in the environment. In these computers hazardous material such as PVC's Brominated flame-retardants and heavy metals such as Cadmium, Mercury and Lead are not used like commonly used computers. In laptop computers and other electronics industry Lead-Tin solder is used. It has some qualities i.e. ideal shock absorber. Now its replacement is being taken the alloy of the Tin/Copper/ Silver. Some precautions may be taken to make future computers more eco friendly.[4]

- Computer Company manufactures such parts of computers which use low energy consumption.
- Petroleum filled plastic may be replaced by Bioplastic (plant based polymers) which require less oil and energy. Bioplastic materials made computer are more secure and cool.
- E-waste is also a big problem; it can be controlled by avoiding discarding the computer. Replacement and upgrading their devices is also helpful. In this way we can save energy, pollution and materials for dumping.
- Traditional monitors are also power sucking displays. These monitors can be replaced with green light display made of OLED or Organic light emitting diodes or LCD or Liquid crystal display.
- Lead is a toxic material, (it is expensive and time consuming) which is used in computer may be replaced by silver and copper making devices of computers.
- Use smaller monitor/LCD- a 14-inch display uses 40 percent less energy than a 17-inch one.
- When you are not using monitor, power off it.
- Remote control is used on/off the products. During off in remote control. The product is still consuming energy. So it is advised to plug off the switch.

VII. Carbon free computing

It has been estimated that the concentration of CO₂ is increasing day to day very quickly. The other gases which affect the greenhouse are methane (CH₄), nitrous oxide (NO₂) and fluorocarbons (CCl₄). These gases are able to increase the temperature of the earth, which causes to lead the drought and floods and rising the sea level. These also affect the life on earth. In 1997 Kyoto in USA tried to reduce the emission of CO₂ from electronic devices and other devices. These devices are manufactured in such way that they take less energy.

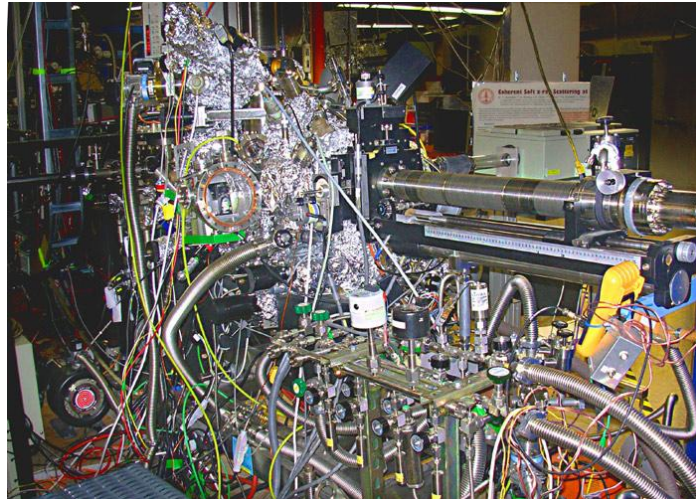


Fig:4 Emission of CO₂ in a lab. [5]

It has been estimated that it is to see that these devices how much energy consume and how much heat is evolved. To reduce the percentage of CO₂ in atmosphere to grow a plant to against each product after manufactured. It has been estimated that 4 to 6% are of planted tree can absorb 20 to 25 % area CO₂. Different companies are now working on this issue very keenly. Dell is working on worldwide product-recycling program. In this program Dell company allows to customers to pay an extra \$2 to \$4, for grow a plant against each product AMD, a global microprocessor manufacturer, is also working toward to reduce energy consumption in its products without toxic material and echo free product.[6]

VIII. Solar energy Computing

Solar energy is also playing important role in green computing. In this technology the emission of heat and different gases especially CO₂ during producing energy is very low. In solar computing cells are used in large panel. Solar cells require very little maintenance throughout the life after installation. There is no further cost many years. So such solar powered devices are manufactured that are totally non polluted, efficient, silent and highly reliable.



Fig:4 Solar Panel Power computing [7]

Solar energy is echo friendly during the production of this energy no toxic material or gases are evolved which harm atmosphere.

IX. Data centers

In data centers (in wireless sensors networks) many devices are used which are servers, laptops, desktops, printers, wireless APs, fax machines, routers, switches and other electronics devices. These all devices emit heat and CO₂.Here we see only two devices laptop and desktop. It has been estimated that desktop computer take 100 watts and laptop take only 17 watt. The ratio is about 6:1.It is estimated that data centers use a large amount of energy and emit a very huge amount of heat. It is shown in the given below table in which different peripheral are attached with one another.

Category	Power drawn
Computing	588 KW
UPS and distribution losses	72 KW
cooling for computing and UPS losses	420 KW
MV transformers/other	38 KW
Total	1127 W

Table 2 Energy usage of 5,000 sq-ft data center[8]

Owing to this reason we can easily compare the efficiency and energy consumption.

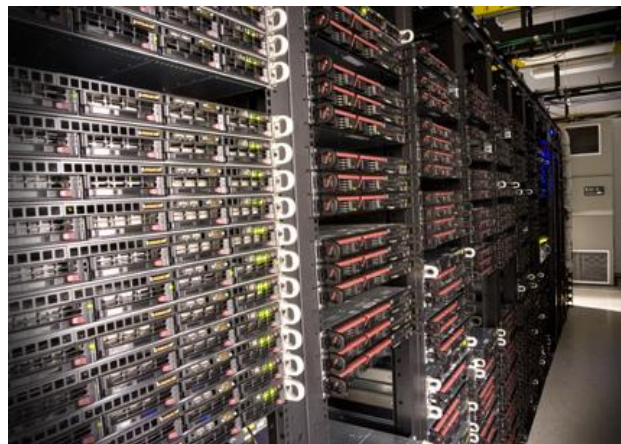


Fig:4 Host upon Network and Data center USA [9]

The efficiency of the laptop may be observed as the following key points,[10]

9.1 Energy Cost

Laptop use very low energy and reduce energy costs.

9.2 Save Energy

However the laptops has more price than desktop, but due to low consumption of energy laptop compensate its high price in a year.

9.3 Software

Software also play a vital role in energy consumption. Such software should be developed which can take low energy in their booting process and data consolidation.

9.4 Computer Hardware

Other peripherals devices such as networks, LCD screen and computer cluster should focus in energy consumption and emission of CO₂.

10. Conclusions and Future Work

Green computing techniques and issues which were discussed in this paper help us to reduce power consumption and heat which is evolved during processing. Power consumption in computer can be managed such as the sleep mode, hibernate mode, standby mode are very effective in it because computers may be automatically go into low power states,, when a computer is in an idle state without human interest or interfere.

Techniques such as unplugging a computer, using LCD and using of flash drives may be adopted to reduce energy consumption. Likewise control panel play important role to control the computer as shut down stand by or hibernate. In the future such devices or parts of computer will be designed and manufacture which take very low energy and give out very low heat. Many governments have now tried to take initiative steps in energy management programs like Energy Star. Now it is realized that such standards should be adopted for energy efficient electronic equipments. In USA the United States Environmental Protection Agency [11] and other countries these standards has been adopted and implemented. There are lot of techniques in green computing. The techniques which were suggested in this paper will be applied in future in real world. By using these techniques we can save energy, emission of CO₂, air pollution and toxic materials. Green computing is not about going out but designing new products in this way to reduce energy consumption. Green computing in future will also help in recycling E-waste and scrap computers..

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Research Interests: We present a simple image-based method of generating novel visual appearance in which new image is synthesized by stitching together small patches of existing images. We call this process image quilting. First, we use quilting as new, fast, yet very simple texture synthesis algorithm which produces surprisingly good results for a wide range of textures. Second, we extend the algorithm to perform texture transfer {rendering an object with a texture taken from a direct object. More generally, we demonstrate how an entire image can be re-rendered in the style of a direct image. The method works directly on the images and does not require 3D information. My current interests are focused to create/use new technologies of image enhancement, image information gathering. Decision support system based on image processing.