Green Computing: E-waste management through recycling

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Abstract— Green computing is the study and practice of using computing resources efficiently and eco-friendly. The goals are that is reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste. 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. This paper presents at several green initiatives currently under way in the computer industry, as well as issues that have been raised regarding these initiatives and presents a study about the green computing and e waste recycling process. Ultimately green computing focuses on ways in reducing overall environmental impact, its main purpose is to find and promote new ways of reducing pollution, discovering alternative technologies, and creating more recyclable products.

Index Terms— Energy Star, Environment, Green Computing, Recycle e-waste.

Introduction:

Green computing is the study and practice of using computing resources efficiently. The goals are reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste.

Definition - Green computing is the environmentally responsible and eco-friendly use of computers and their resources. In broader terms, it is also defined as the study of designing, manufacturing/engineering, using and disposing of computing devices in a way that reduces their environmental impact.

Many IT manufacturers and vendors are continuously investing in designing energy efficient computing devices, reducing the use of dangerous materials and encouraging the recyclability of digital devices and paper. Green computing practices came into being in 1992, when the Environmental Protection Agency (EPA) launched the Energy Star program.

Green computing is also known as green information technology (green IT).

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History of Green computing

The idea of green computing has been around a good time, the government themselves play a role in it. For example the Environmental Protection Agency (EPA) launched the 'energy star' program in the 90s, to promote energy efficient methods.

The EPA today still plays an active role by providing not only energy effective methods, but also cost effective methods for the consumers. In 2006 the EPA established a way to save U.S. households and businesses money; "With an eye to saving U.S. households and businesses more than $1.8 billion in energy costs over the next 5 years, today EPA announced new Energy Star specifications for computers and related equipment. These new modifications are also expected to prevent greenhouse gas emissions equal to the annual emissions of 2.7 million cars."(Jones, 2006) Though the EPA is a recognizable agency, they are not the only ones who promoting new ways of going green in the technological aspect. Organizations such as European Union and TCO Certification are one of the leading groups in green computing.

Concept of Green Computing

Green computing, or green IT, aims to attain economic viability and improve the way computing devices are used. Green IT practices include the development of environmentally sustainable production practices, energy efficient computers and improved disposal and recycling procedures.

To promote green computing concepts at all possible levels, the following four complementary approaches are employed:

- **Green use**: Minimizing the electricity consumption of computers and their peripheral devices and using them in an eco-friendly manner
- **Green disposal**: Re-making an existing computer or appropriately disposing of, or recycling, unwanted electronic equipment
- **Green design**: Designing energy-efficient computers, servers, printers, projectors and other digital devices
- **Green manufacturing**: Minimizing waste during the manufacturing of computers and other subsystems to reduce the environmental impact of these activities

Government regulatory authorities also actively work to promote green computing concepts by introducing several voluntary programs and regulations for their enforcement. Average computer users can employ the following general tactics to make their computing usage

Advantages and Disadvantages of Green Computing

Advantages:
- Energy saving
- Environmentally Friendly
- Cost-effective (pays over time)
- Save more money per year
- can give you a tax right off

Disadvantages:
- High start up cost
- Not readily available
- Still in experimental stages
- Sacrafice performance for battery life
- Not for everyone

Potential Benefit

The ever rapid growth of technologies and innovations brings forth many ways on how green computing will have a positive impact, along with great benefits. The benefits of green computing are large, not only from just the consumer, or business, or country's standpoint, but a global benefit. Green computing helps reduce energy demands, waste, and money of how we use technology which positively effects the environment, and our costs. Overall the benefits of green computing will result in saving money, reducing costs, and conserving energy, along with helping the environment

E-waste management and Recycling

E-Waste Definition

E-Waste for short - or Waste Electrical and Electronic Equipment - is the term used to describe old, end-of-life or discarded appliances using electricity. It includes computers, consumer electronics, fridges etc which have been disposed of by their original users.

"e-waste" is used as a generic term embracing all types of waste containing electrically powered components. e-Waste contains both valuable materials as well as hazardous materials which require special handling and recycling methods. This guide covers all categories of e-waste but emphasizes categories which contain problematic, scarce and valuable or otherwise interesting materials.

Examples: Computers, LCD / CRT screens, cooling appliances, mobile phones, etc., contain precious metals, flame retarded plastics, CFC foams and many other substances.

Categories of e-waste

Large Household Appliances
Washing machines, Dryers, Refrigerators, Air-conditioners, etc.

Small Household Appliances
Vacuum cleaners, Coffee Machines, Irons, Toasters, etc

Office, Information & Communication Equipment
PCs, Latops, Mobiles, Telephones, Fax Machines, Copiers, Printers etc.

Entertainment & Consumer Electronics
Televisions, VCR/DVD/CD players, Hi-Fi sets, Radios, etc

Lighting Equipment
Fluorescent tubes, sodium lamps etc. (Except: Bulbs, Halogen Bulbs)

Electric and Electronic Tools
Drills, Electric saws, Sewing Machines, Lawn Mowers etc. (Except: large stationary tools/machines)

Toys, Leisure, Sports and Recreational Equipment
Electric train sets, coin slot machines, treadmills etc.

Medical Instruments and Equipment

Surveillance and Control Equipment

Automatic Issuing Machines

Recycling Technologies

e-Waste management practices comprise of various means of final disposal of end-of-life equipment which have different impacts on human health and the environment. It can be distinguished between state-of-the-arte recycling technologies, which comply with high environmental and occupational health standards and hazardous technologies that bear a great risk for both health and the environment and are often applied in countries, where no strict standards exist.

Hazardous Technologies

Incineration: Incineration is the process of destroying waste through burning. Because of the variety of substances found in e-waste, incineration is associated with a major risk of generating and dispersing contaminants and toxic substances.

Open Burning: Since open fires burn at relatively low temperatures, they release many more pollutants than in a controlled incineration process at an MSWI-plant. Inhalation of open fire emissions can trigger asthma attacks, respiratory infections, and cause other problems such as coughing, wheezing, chest pain, and eye irritation. Often open fires burn with a lack of oxygen, forming carbon monoxide, which poisons the blood when inhaled.

Land filling: Land filling is one of the most widely used methods of waste disposal. However, it is common knowledge that all landfills leak. The leach ate often contains heavy metals and other toxic substances which can contaminate ground and water resources.

State-of-the-art Recycling Technologies

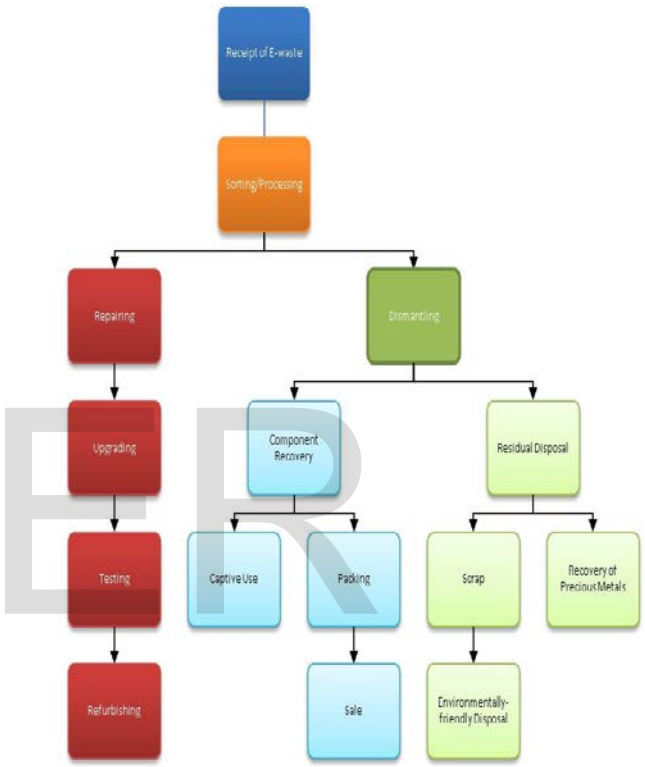
The state-of-the-art recycling of e-waste comprises three steps

Detoxication The first step in the recycling process is the removal of critical components from the e-waste in order to avoid dilution of and / or contamination with toxic substances during the downstream processes. Critical components include, e.g., lead glass from CRT screens, CFC gases from refrigerators, light bulbs and batteries.

Shredding Mechanical processing is the next step in e-waste treatment, normally an industrial large scale operation to obtain concentrates of recyclable materials in a dedicated fraction and also to further separate hazardous materials.

Refining The third step of e-waste recycling is refining. Refining of resources in e-waste is possible and the technical solutions exist to get back raw with minimal environmental impact. Most of the fractions need to be refined or conditioned in order to be sold as secondary raw materials or to be disposed of in a final disposal site, respectively. During the refining process, to three flows of materials is paid attention: Metals, plastics and glass.

E-waste Management – Six Steps



Benefits of recycling

Recycling raw materials from end-of-life electronics is the most effective solution to the growing e-waste problem. Most electronic devices contain a variety of materials, including metals that can be recovered for future uses. By dismantling and providing reuse possibilities, intact natural resources are conserved and air and water pollution caused by hazardous disposal is avoided. Additionally, recycling reduces the amount of greenhouse gas emissions caused by the manufacturing of new products.

Conclusion

Overall the effects of green computing with its benefits, practicality, and uses are all positives. All which are great for not only the individual, but also all around the globe. By going "green" in technology we help promote an eco-friendly and cleaner environment, along with our own

benefits by reducing costs, conserving energy, cutting down on waste. Green computing has definitely come a long way, but with so many new innovations coming along in regards of preserving the environment, it is safe to say that green computing is a great development.
Finally follow the ecology and economy system.

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