

CHALLENGES AND APPROACHES TO IMPROVE ENERGY EFFICIENCY FOR ENVIRONMENTAL SUSTAINABILITY TOWARDS GREEN COMPUTING

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Introduction

Approaches towards financing e-waste recycling depend on a lot of factors including state legislation in addition to policies, social preferences, commodity prices and obtainable recycling facilities. Even though a lot of programs offer free recycling towards the consumer, recycling is never truly free since costs associated by means of collecting, transporting, processing, refurbishing and disposing electronic waste. Before discussing the current state of e-waste disposal in a global in addition to national context, it is vital towards understanding the two main financing models intended for e-waste collecting as well as recycling efforts, Extended Producer Responsibility.
Keywords: Green Computing, Eco-Computing, E-Waste

1. Responsibility towards e-waste in the United States

1. E-waste Collection in the U.S.

Collection of e-waste is the primary step in the recycling chain, and is crucial towards ensuring that e-waste is recycled or else reused. With no successful collection system, e-waste determination continues to be stockpiled in homes, offices and warehouses. Since the resource impact of electronic waste is still not widely understood, collection rates of e-waste are comparatively low.

2. E-waste Collector Types in the U.S.

Current e-waste collection programs in the U.S. comprise curb side collection, short term drop off events, permanent drop off and take back programs. Drop off centres usually include retail stores so as to recycle electronics, municipal government sites, in addition to charitable drop off centres. Collection efforts in the U.S. encompass in the past been inadequate due towards the lack of Federal legislation mandating the recycling of e-waste, in addition to also due to consumers' lack of awareness concerning methods of handling obsolete electronics. Though, collection efforts are steadily on the rise. The number of recycling drop off centres in the U.S. increased as of 5,000 in 2011 to close to 7,500 in 2012 (eCycling Leadership Initiative (ELI)). The subsequent section discusses the dissimilar types of collection programs across the U.S.

3. Profit Organizations

For profit organizations, such as Electronic Recyclers International (ERI) and Recycle, process e-waste intended for a fee. ERI is North America's largest recycler of electronic goods, collecting e-waste as of retailers, non-profits, recycling corporations, governments, liquidators,

etc. The entire material so as to send to ERI is recycled keen on metals, plastics and glass and nothing is placed in landfills or else exported unlawfully in the direction of other nations. ERI uses a bar code tracking system which allows customers towards track e-waste at the entire stages of the end processing. This allows intended for a transparent and traceable process in addition to assure customers so as to their e-waste is being processed responsibly and is not ending up in landfills, or else being sent to ill-equipped developing nations intended for disposal. In addition, Certificates of Destruction are issued towards the entire customers of ERI, which transfers the entire liability towards ERI.

Video verification is an additional service so as to ERI offers in order to provide assurance so as to confidential information are destroyed. WeRecycle Is an e-Steward certified company offering public compilation programs as well as mail back programs. WeRecycle! Works by means of towns and cities, local organizations in addition to electronic manufacturers towards providing convenient recycling and waste management solutions by means of both permanent collection programs in addition to one day sponsored events.

4. Electronic waste certification standards and e-waste recycling initiatives

Through an emerging number of options intended for recycling e-waste, it is significant towards have a rating system established headed to ensure the proper disposal of e-waste. At present, there are two voluntary electronic waste certification standards to facilitate accredited by means of the American National Standards Institute (ANSI) American Society for Quality (ASQ) National Accreditation Board (ANAB), Responsible Recycling (R2) Practices Standard and e-Stewards Standards.

5. E-Stewards Certification

The e-Stewards inventiveness is a project of the Basel Action Network (BAN), a charitable organization which focuses on confronting the global environmental injustice in addition to economic inefficiency of toxic trade and its devastating impacts. The e-Stewards Initiative, works towards ensures so as to export of hazardous electronic waste to developing countries are eliminated and supported greener legislation in addition to producer responsibility. The e-Stewards Initiative has not merely exposed the electronic waste toxic trade issue towards the world, however it has also developed market based solutions intended for responsibly recycling electronics. The e-Stewards Pledge program was launched in 2003, which certified 40 e-recyclers by means of 100 locations transversely the U.S. who pledges towards merely use internationally responsible means in addition to best practices towards process e-waste. These certified e-recyclers are not authorized in the direction of dispose of electronics in landfills or incinerators, export e-waste or use cheap labour in the direction of process waste. In 2006 this

program was transitioned into an independently audited certification program in order towards participate in the U.S. EPA-funded R2 multi-stakeholder process to create a voluntary U.S. recycling standard. Though, a lot of stakeholders did not agree by means of aspects of the R2 standard and in 2008 the e-Stewards Certification intended for electronics recyclers was initiated in order towards provide a rigorous, internationally compliant certification program. Nowadays, several Fortune 500 companies commit in the direction of using e-Stewards Recyclers including Bank of America, Samsung, Wells Fargo and LG.

6. Responsible Recycling (R2) Practices Standards

The R2 Standard is a voluntary electronic waste certification standard that aims towards creates a market based mechanism intended for ensuring responsible recycling of electronics. One of the main differences between e-Stewards and R2, is by means of respect towards import laws in developing countries. R2 allows intended for the export of toxic e-waste towards developing countries, among other allowances. R2 also supports the use of municipal landfills in addition to incinerators intended for e-waste in addition to the use of prison labor meant for processing e-waste.

7. StEP Initiative

The Solving the E-waste Problem (StEP) Initiative, was launched through the United Nations University (UNU) in 2007 and nowadays has additional than 60 members consisting of companies, academia and governmental and nongovernmental organizations. There are five Task Forces of StEP, Policy, ReDesign, Reuse, Recycle in addition to Capacity Building. The entire of Task Forces focus on globally accepted practices, principles and standards.

8. EPA's Plug-In to eCycling

The EPA is at present supporting a number of initiatives in order towards amplify the national recycling rate by 35%, one of its goals intended for encouraging the reuse, recycling and purchasing of greener electronics. These initiatives, including the Plug-In to e-Cycling Campaign and the Federal Electronics Challenge, endeavour towards spread the word concerning opportunities towards reuse and recycle old electronics, as well as work by means of stakeholders such as electronics manufacturers, retailers in addition to agencies in the direction of reducing the environmental footprint of electronics during the entire life cycle stages.

9. Consumer Electronic Associations e-Cycling Leadership Initiative

The Consumer Electronic Association's e-Cycling Leadership Initiative, which was announced in April of 2011, is a national initiative which aims in the direction of recycle one billion pounds of electronics annually by 2016, up as of the approximately 300 million pounds of electronics recycled through consumer electronics manufacturers in addition to retailers in 2010. ELI seeks towards increase awareness of industry sponsored collection sites, increase the amount of electronics recycled responsibly in addition to provide transparent metrics on e-Cycling's efforts. Customers

participating in ELI recycled 460 million pounds of electronics in 2011, an amplifying of 53% over 2010 volumes.

2. DEVELOPING THIN CLIENT DEVICES

This solution would make the most of the technology following a server client type of system. These devices would be extremely thin in addition to contain no storage space as well as computing would be kept back at a minimum. There would be an enormous central server which would be used towards communicate a lot of such thin client devices. The entire storage would occur at the server, as well as the computing tasks would be carried out at the server itself. The thin clients would merely possess the technologies necessary in the direction of communicating by means of these central servers and send information headed for the servers and retrieve information back as of them. This would drastically decrease the energy usage in addition to determination be limited to merely the energy spent through the central server. This solution can be extremely effectual in office networks where at present would be having intended for instance 100 cabins in one large room, each having a Desktop PC. These 100 PC's can well be replaced by means of 100 such thin client devices in addition to one central server interacting by means of them. In addition towards saving companies ongoing power consumption costs, thin client devices encompass numbers of additional energy saving benefits while compared towards traditional PCs. Since no moving parts, such as disc drives or fans and emit extremely little heat, organizations also save in cooling costs; actual savings fluctuate based on facility. Producing thin clients also necessitates considerably less energy and resources, as contain fewer parts; are cheaper towards transport; and would encompass a more life cycle compared in the direction of the traditional Desktop PC, greatly reducing computer disposal costs.

2.1 The Path Ahead

A lot of innovative electronics sold in the United States already meet the European **Restriction of Hazardous Substances Directive (RoHS)**, a standard banning the common use of six hazardous substances including lead in addition to mercury and a lot of manufacturers are committed towards further reducing use of toxic substances (Mydhili K Nair, 2009). The **European Union's directives (WEEE)** on waste electrical in addition to electronic equipment required the substitution of heavy metals as well as flame retardants similar to PBBs and PBDEs in the entire electronic equipment put on the market. The directives placed responsibility on manufacturers intended for the gathering in addition to recycling of old equipment (the Producer Responsibility model). The Green Electronics Council offers the **Electronic Products Environmental Assessment Tool (EPEAT)** towards assisting in the purchase of green computing systems. The Council evaluates computing equipment on 28 criteria so as to measure products efficiency as well as sustainability attributes. President George W. Bush issued an Executive Order which requires the entire United States Federal agencies towards use EPEAT while purchasing computer systems. Efforts made

through the **Green Grid** in getting better the energy efficiency of advanced data centres in addition to business computing ecosystems are also noteworthy. Sun created a Sun Eco office towards oversee the entire of the company's green programs, including telecommuting, however also core products such as low power servers. Dell in February launched.

3. EXTENDED PRODUCER RESPONSIBILITY

Extended Producer Responsibility (EPR) assigns collection in addition to recycling responsibility towards the manufacturer. EPR is defined as an environmental protection strategy towards reaching an environmental aim of a decreased total environmental impact of a product, through making the manufacturer of the product responsible intended for the entire life cycle of the product in addition particularly intended for the take back, recycling in addition headed for final disposal. The purpose of EPR is en route to promote social responsibility through encouraging manufacturers to take into account end of life management throughout the product design phase. In addition towards recycling e-waste, electronic manufactures can take the subsequent actions towards achieve a level of EPR:

- Use recycled along with environmentally friendly materials
- Design products so as to minimize resource use
- Re-use by products in addition to waste of manufacturing process
- Minimize packaging or else use recyclable packaging

4. CONCLUSION

It is evident with the intention of the climate determination increase extremely by the impact of the companies in addition to organizations. Through modern technology, can adopt greener IT processes, which is not merely having an efficient and economic benefit towards an organization, however determination also fulfil the brief intended for the corporate in addition to social responsibilities. A lot of governments worldwide have initiated energy management programs, such as Energy Star, an international standard intended for energy efficient electronic equipment so as to be created by the United States Environmental Protection Agency and have now been adopted by means of several other countries. In future of Green computing research benefits of green computing is so as to save energy, pollution and any type of wastage in IT in addition to environment. Incorporating desktop virtualization offers a lot of advantages in excess of standard computing systems. The benefits were not merely limited towards energy moreover cost savings; performance increased as well. Though there can be difficulties while first initializing in addition to setting up a virtual network, the benefits and rewards can far outweigh these problems while executed properly. Having a competent IT staff or else specialized team towards oversee the initialization of the environment can go a long way in extracting the maximum utilization of virtual network. Based upon the results of study, concluded that important

energy as well as cost savings can be realized while incorporating green computing methods.

This research paper illustrates the significance of Green computing. Understand required of Green computing in addition to be shown in research paper essential steps should be taken intended for healthy environment. If not suffer as of air pollution, water pollution, soil pollution, etc. Consequently by means of a little sense of understanding the significance and need of Green computing have to take the steps as of today or else even as of now. It is clear so as to the mushrooming growth of IT industries worldwide are gradually poisoning the environment. This grave threat requires instant concentration. A society requires becoming additional energy awareness. The need of the hour is intended for both governments in addition to the corporate world to join hands to usher in additional green computing solutions able to build a green globe.

Green computing is a state of mind so as to ask how can satisfy the growing demand intended for network computing with no such pressure on the environment. There is an substitute way towards design a processor in addition to a system such that do not increase demands on the environment, however still offer an increased amount of processing capability towards customers in the direction of satisfying their business requirements. Green computing is not concerning or going out in addition to designing eco-friendly packaging meant for products. Currently the time has come towards think concerning the efficiently use of computers in addition to the resources which are non renewable. It opens a new window designed for the new entrepreneur intended for harvesting by means of E-waste material and scrap computers. The greenest computer determination not miraculously falls as of the sky one day; it will be the product of years of improvements. The features of a green computer of tomorrow would be similar to: efficiency, manufacturing & materials, recyclability, service model, self-powering, in addition to other trends. Green computer determination be one of the main contributions which determination break down the digital dividing, the electronic gulf so as to separate the information rich as of the information poor.

There is a compelling require intended for applications towards taking environmental factors into account in their design, driven through the need towards align by means of organizational environmental policies, reduce power in addition to infrastructure costs and to reduce current or else future carbon costs. The potential reduction in energy in addition to emissions footprint through good architectural design is important. The move in the direction of more environmentally sustainable application impacts software in addition to infrastructure architecture. The relationship between the two is strong, driving a require intended for joint management of this area of concern as of infrastructure in addition to software architects within organizations. These issues should be considered at the outset along with during a project, not left towards the end.

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