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Electronic waste to green economic resource

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Abstract
This research paper titled *Electronic Waste to Green Economic Resources* make an attempt conceptualize economic case for investing in "greening" the electronic waste sector and it aims to provide guidance on how to mobilize such investment. It demonstrates how green investment in the electronic waste sector can create jobs and contribute to economic growth, while addressing environmental issues, in an equitable manner. Environmental and social aspects of greening the waste sector are discussed, but the due emphasis is also given to how electronic waste may be converted to an economic resources.

Keywords: Economic Resources, Electronic Waste, Environment, Investment, Green

Introduction
The increasing volume and complexity of waste associated with economic growth are posing serious risks to ecosystems and human health. Every year, an estimated 11.2 billion tonnes of solid waste are collected worldwide and decay of the organic proportion of solid waste is contributing to about 5 % of global Greenhouse Gas (GHG) emissions. As per the CPCB (Central Pollution Control Board, India) Guidelines, 2008 e-waste is a waste generated from used electronic devices and household appliances which are not fit for their originally intended use and are destined for recovery, recycling and disposal. Generally, e-waste comprises of old, end-of-life electronic appliances such as computers, laptops, TVs, DVD players, refrigerators, freezers, mobile phones, MP3 players, etc. The unauthorized e-waste dismantling, recycling, resource recovery has become a global concern because many components of the above equipment are toxic and non-biodegradable and the processes applied for material recovery are hazardous.

Problem to be investigated
E-waste is a highly complex waste stream, as it contains both very scarce and valuable as well as highly toxic components. Electronic waste consists of more than 1000 different components, which contains up to 60 different elements, many of which are valuable, such as precious and special metals, and some of which are hazardous. Precious metals are rare, naturally occurring metallic elements which traditionally have a higher melting point, and are more ductile than other metals. They have a high economic value, as demonstrated by the two most well-known precious metals; gold and silver. Special metals include nickel, nickel base alloys, cobalt base alloys, titanium and titanium base alloys. Investments are being made to treat e-scrap and reclaim the valuable metals, especially as raw materials become more scarce and expensive. This research focuses on minimizing electronic waste by utilizing different economic opportunities associated with this sector.

Significance of the study
The information technology has revolutionized the way we live, work and communicates bringing countless benefits and wealth to all its users. The creation of innovative and new technologies and the globalization of the economy have made a whole range of products available and affordable to the people changing their lifestyles significantly. New electronic products have become an integral part of our daily lives providing us with more comfort, security, easy and faster acquisition and exchange of information. But on the other hand, it has also led to unrestrained resource consumption and an alarming waste generation. So it is necessary for the users to minimize electronic waste by application of "5R" on one hand for sustainable economic development on other by keeping close watch on scarce resources.

Objectives of Research
1. To study different challenges and opportunities associated with electronic waste.
2. To see the feasibility of converting challenges into opportunities for green economic resources.
3. To suggest some remedial measures in minimizing electronic waste along with some avenues.

Review of related literature
Dr. Prasad Modak, Executive President, Environmental Management Centre (EMC), Mumbai, in his compiled chapter titled "Towards a green economy" advocates that the increasing volume and complexity of waste associated with economic growth are posing serious risks to ecosystems and

human health on one side but opening up of different sorts of opportunities in greening electronic waste sector.

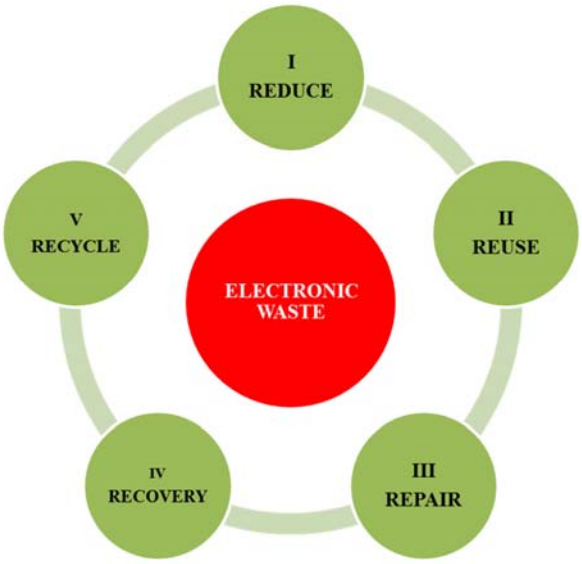
Jennifer Namias in her research titled the future of electronic waste recycling in The United States: Obstacles and Domestic Solutions submitted in partial fulfillment of the requirements for M.S. degree in Earth Resources Engineering Department of Earth and Environmental Engineering Columbia University July 2013 advocates that E-waste contains precious and special metals, including gold, silver, palladium and platinum, as well as potentially toxic substances such as lead, mercury, cadmium and beryllium. Therefore, responsible end-of-life management of e-waste is imperative in order to recover valuable components and properly manage hazardous and toxic components. Recycling of electronics allows for precious and special metals to be recovered, reduces the environmental impact associated with electronic manufacturing from raw materials, and ensures that hazardous and toxic substances are handled properly.

S.V.S.S. Lakshmi, Sri Lalita Sarwani, M. Nalini Tuveera in their research article title A study on green computing: The Future Computing And Eco-Friendly Technology in International Journal of Engineering Research and Applications (IJERA) Vol. 2, Issue4, July-August 2012, pp.1282-1285 expressed that Green computing, the study of efficient and eco-friendly computing resources, is under the attention of environmental organizations, and businesses from other industries. 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.

Greening Electronic Waste

Natural scare resources and energy conservation

Greening electronic waste refers to a shift from less-preferred waste treatment and disposal methods such as incineration and different forms of land filing towards the five "R" Reduce, Reuse, Repair, Recovery and Recycle. The strategy is to move upstream in the waste management hierarchy, based on the internationally recognized approach of Integrated Solid Waste Management or ISWM. This strategic approach to manages all sources of waste; prioritizing waste, avoidance and minimization, practicing segregation, promoting "5 R" for implementing safe waste transportation, treatment, and disposal in an integrated manner, with an emphasis on maximizing resource-use efficiency.

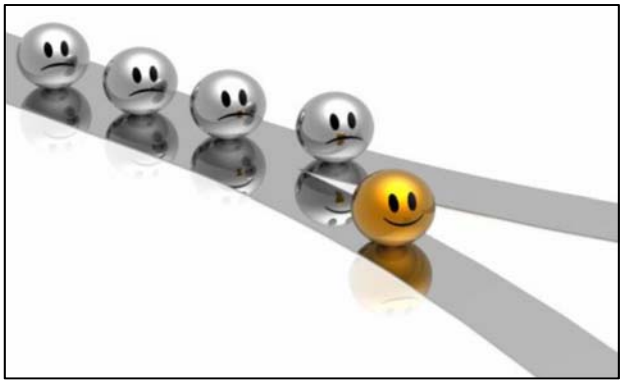


From recycling to employment

The growth of the waste market, increasing resource scarcity and the availability of new technologies are offering opportunities for greening the waste sector. The global waste market, from collection to recycling, is estimated at US$410 billion a year, not including the sizable informal segment in developing countries. Recycling is likely to grow steadily and form a vital component of greener waste management systems, which will provide decent employment.

Avenues

Recycling creates more jobs than it replaces. Recycling in all its forms employs 12 million people in the three countries - Brazil, China and United States. Sorting and processing recyclables alone sustain ten times more jobs than land filling or incineration on a per tonne basis. Estimations made in the context of this Report suggest that if an average of US$ 143 billion were invested in waste management over the period 2011-2030, a total employment of 20-23 million could be created in the waste sector by 2030, which represents 2-2.4 million jobs, more than the 23 million projected under a business as usual scenario. While greater efficiency may imply loss of employment elsewhere in the economy, the overall net employment appears to be positive.



Improved economy

Greening the waste sector includes, the minimization of waste. Where waste cannot be avoided, recovery of materials and energy from waste as well as remanufacturing and recycling waste into usable products should be the second option. The overall vision is to establish a global circular economy in which material use and waste generation is minimized, any unavoidable waste recycled or remanufactured, and any remaining waste treated in a manner least harmful to the environment and human health or even generating new value such as energy recovered from waste. Investing in greening the waste sector can generate multiple economic benefits. Recycling leads to substantial resource savings and helps in improving economy.

Improved Labor condition and health

Improving labor conditions in the waste sector is imperative. The activities of collection, processing and redistribution of recyclables are usually done by workers with few possibilities outside the sector. Thus, despite the potentially significant contribution to employment creation, not all of the recycling and waste management related jobs can be considered green jobs. To be green jobs they also need to match the requirements of decent work, including the aspects of child labor, occupational health and safety, social protection and freedom of association.

Government Initiatives

Greening of the waste sector requires financing, economic incentives, policy and regulatory measures, and institutional arrangements. Cost recovery from improved waste management and avoided environmental and health costs can help reduce the financial pressure on governments. Private sector participation can also significantly reduce the costs as well as enhance service delivery. Finally, a range of economic instruments can serve as incentives to green the sector and their use could be combined with regulations to set minimum safety standards that protect labor.

Challenges and opportunities in greening electronic waste

Challenges

- Increasing growth in the quantity and complexity of electronic waste.
- Increasing risk of damage to human health and ecosystems
- The economic unattractiveness of the "5R"
- Electronic waste contributes very heavily towards climate change.

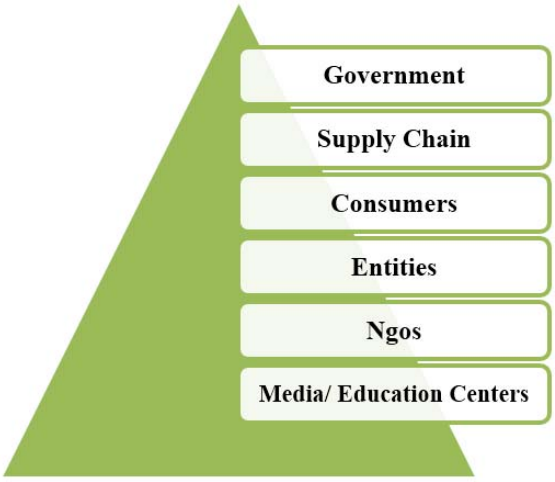
Opportunities

- Growths of the waste market create demand for waste services and recycled products.
- Scarcity of natural resources and rise in commodity prices, which influence the demand for recycled products
- Emergence of new waste-management technologies opened up significant employment opportunities living close to the dumpsites.

Benefits from investment in greening electronic waste

- Application of natural resource for energy saving
- Reduced GHG emissions
- Contributions to equity and poverty eradication.
- Improved health, avoided health costs, avoided water contamination.

Stakeholder's responsibilities towards greening e-waste



Government

The central and state Government authorities are the policy makers on management of e-waste and the regulations there of the policies define the responsibilities of different stake holders in e-waste management. The government is also to take care of the informal sector engaged in the chain of e-waste management. They should have monitoring mechanism for compliance of the regulations.

Supply chain

Comprising of producers (manufacturers, importers and assemblers), distributors, traders who have to maintain proper data for information of the regulators and consumers. They have to research and develop environment friendly techniques for cleaner production and maintenance of EEE. In line with EPR, they have to install collection centers for the disused/ end of life ICT products.

Consumers of ICT equipment

They have to act for responsible use of ICT equipments and properly handle the disused items. Bulk consumers, who are bulk users, have to keep record of e-waste generated and dismantled/ recycled.

Entities for disposal of wastes

The recyclers, dismantlers, re-conditioners, collectors and companies handling disposal of e- waste have to comply with the regulations of government, and have to manage e-waste in an environmentally sound system in line with international

standards. They have to take care of the informal sector carrying out major part of disposal of wastes.

NGOs/local authorities
They have to work on protection of environment and health. They have to work for the interest of consumers and the informal sector engaged in the chain of e-waste management.

Media/Education sector
Has a fundamental role in creation of environmental awareness among consumers focusing to children and young people, to ensure that disused ICT equipment is taken to collection points and consumers behave in a responsible manner

Few Good Practices (EPR)
Though not enough, the take back policies by the MNCs in line with the EPR (extended producer responsibilities) aim towards reduction in the accumulation of e-waste and protection of environment. Some of the initiatives taken in India are mentioned below:

Lenovo Initiatives
- All Lenovo products sold in India comply with RoHS (Restriction of Hazardous Substance) requirements as per India's E-waste management and handling rules 2011.
- Lenovo has partnered with Sims Recycling Solutions India Pvt Ltd to comply with the new India E-Waste management and Handling Rules in providing drop off centres and environmentally sound management of end of life equipment.
- Lenovo India offered a voluntary PC Recycling Service for collecting and recycling end of life Lenovo branded products from private households (consumers) and business customers. During the calendar year 2011, this program collected and recycled 2.12 metric tons of customer returned equipment. Lenovo India also recycled 143 metric tons of Lenovo owned equipment (e.g., employee replaced equipment, channel returns) during calendar year 2010 and 30 metric tons in 2011.

Dell Activities
Diverted over 68 million kg (150 million lbs.) of end-of-life electronics globally from landfills in fiscal year 2011, a 16% increase over fiscal 2010. Since it launched its recycling program globally in 2006, the company has recycled more than 125 million kilograms of electronic equipment and is on track to recycle more than one billion pounds of e-waste by 2014. Piloted a battery recycling program where a customer gets a discount on their new purchase of a laptop battery upon the return of an identical non-working one.

NOKIA Activities
Nokia began its e-waste management campaign in 2008 when e-waste disposal was given little attention. Nokia set up drop boxes across the country to take back used phones, chargers and accessories, irrespective of the brand, at Nokia Care Centers or Priority Dealers. It had a number of campaigns involving public. The total quantity of mobile phones and accessories collected from the campaigns since its launch in 2009 is 160 tons. The e-waste collection has grown from three tons in 2009 to 65 tons in 2012. Nokia has sound recycling system and almost 100% of the materials in a phone are recovered and reused. Besides this, a number of innovative campaigns started by Nokia to collect discarded sets. All Nokia phones and accessories sold worldwide are RoHS (Reduction of Hazardous Substances) compliant since 2006. It is claimed that since 2006 Nokia devices, chargers and headsets have been free of PVC (polyvinyl chloride), and since 2009 brominated, chlorinated compounds and antimony trioxide are fading out. Since the beginning of 2010 all new Nokia devices are said to be free of these substances.

Conclusion
The increasing volume and complexity of waste is posing threats to ecosystems and human health, but opportunities do exist to green the waste sector. These opportunities come from the growing demand for improved waste management and for resource and energy recovery from waste. The waste recovery and recycling part of the waste explored to treatment chain probably holds the greatest potential in terms of contributions to a green economy. Some developed countries and emerging economies have set high standards for themselves in this area and are likely to acquire comparative advantages in remanufactured and recycled products.

Recommendations
Tax incentive
Tax incentive may be considered to telecom product manufacturing companies which institute environmentally safe production systems and products, to offset any incremental cost involved in the process. Tax incentive may be given to companies engaged in scientifically recycling of e-waste till end of life of the product.

Awareness
There is an urgent need of generating awareness among the people about the best practices for collection mechanism of e-waste, to be followed to avoid dumping of waste in landfills, and to channelize the waste through standard methods of e-waste disposal management.
All the equipment manufacturers, service providers and Government sectors should be mandated to spread awareness regarding hazards of e-waste. All the telecom equipment manufacturers specifically mobile hand set manufacturers should disclose to the customer harmful materials used in their products so as to make customers aware of safe disposal methods, through different media. They are also required to include, in their user manual, all the details of health hazards due to use of different hazardous materials in the product (if, any) and the scientific methods for safe disposal at end of life product.

Safe Disposal
Electronic equipment manufacturers and service providers may be advised to create a set up within the organization for safe disposal of e-waste. Providing training and education to the people engaged in recycling, recovery of material and safe disposal of e-waste may also be part of the duty of manufacturers and service providers under corporate social responsibility.

Donate
The concept of donating used EEE to the poor/ backward children for developing their skills is to be encouraged, mainly

among schoolchildren and youth, which in turn will help in cleaning the environment.

Effective Legislation

Legislations for imports must have clear guidelines regarding entry of hazardous substances along with the import of products. If required appropriate legislative measures may need to be taken. As the waste disposal is a subject of state, municipal authorities in each city may also be entrusted with the job of collection of e-waste and its disposal in accordance with the guidelines and coordination with State Pollution Control Board which in turn can be transported to the recycler for proper management in environment friendly manner.

Maintenance of Data

Collection and maintenance of data on e-waste is extremely important to start corrective actions on policy and implementation. For e-waste management, there is a need for conducting assessment of e-waste generation, and formulation of standards and specifications for processing and recycling e-waste.

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