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CHALLENGES OF ELECTRONIC WASTE IN NIGERIA: IMPLICATIONS FOR POLICY PLANNING

Dr. Mfreke Umoh J.
Department of Computer Science
Akwa Ibom State Polytechnic, Ikot Osurua. Akwa Ibom State, NIGERIA
Email: mfreke_u@yahoo.com

Pravin R. Choube
Assistant Professor, Department of Electrical Engineering,
Dr. D. Y. Patil Institute of Technology, Pune, Maharashtra, INDIA

Ekpo Edet George
Department of Electrical/Electronic Engineering Technology,
Akwa Ibom State Polytechnic, Ikot Osurua, Akwa Ibom State, NIGERIA
Email: georgeekpo@gmail.com

ABSTRACT
End-of-life electronics, otherwise known as e-waste, have steadily become a visible threat to the environment with the electronic industry fast becoming the world's largest manufacturing industry and also, arguably, the industry with the shortest life span products, it is essential that the method of disposing of the resultant e-waste has become an integral part of electronic manufacture and consumption. This study seeks to examine the challenges of electronic waste in Nigeria. The study revealed that even though health hazards are associated with the interaction with e-waste, it is evident that stakeholders in the informal management of e-waste were willing to continue in trade due to the economic benefits it offers. Though there is provision for management of hazardous waste in the national policy guidelines as well as regulations set by the National Environmental Standards and Regulations Enforcement Agency for the importation of electronic The lack of effective management systems and implementation creates a loophole for the presence of e-waste in Nigeria. It is therefore recommended that the creation of a worldwide information sharing system for hazardous chemicals in EEE and WEEE that takes into account the whole supply chain and the promotion of labelling systems to notify users of product dangers, the necessity for recycling, and the mechanisms in place for safe disposal.

Keywords: CHALLENGES; ELECTRONIC; WASTE; POLICY; PLANNING

INTRODUCTION
Electronic scrap, including computers, laptops, refrigerators and mobile phones, is often regarded as 'anything with a plug.' Refrigerators were not manufactured in bulk until the 1950ies and computers only had been available for the previous 15 years, thus e-waste is the relatively new waste stream. The range of e-waste management methods extends from open burning to automate recycling (a popular technology for China) (an expensive alternative explored in Germany).

Africa, with 80% of the world's high-tech garbage in Asia and Africa at its conclusion and an estimated 65% and 35% arriving in China and Nigeria, has been recognised as a dumping site for hazardous chemical and electronic waste from wealthy nations (Uduma, 2007). The worldwide market in electronic and electronic equipment has expanded over the last two decades, with the life cycle of these goods becoming shorter and shorter. This poses a new problem for business officers and waste management (Bhutta et al., 2001; Hilty et al., 2004; Hilty, 2005). Electronic waste (sometimes called e-waste, electronic and waste equipment) or e-scrap was defined as 'unwanted electronic or electronic equipment discarded by their original users, for example old and outdated computers, laptops, TV' and cell phones, mp3 players, telecom equipment, mouse, photocopy types, etc (PPCC, 2006; Ogbomo et al., 2012). Most e-waste includes articles which may be recovered and used for new goods even if they contain dangerous material which can

harm human health and the environment if not adequately controlled. E-waste (PPCC, 2006; Ogbomo et al., 2012). In addition to the increasing demand for electronic gadgets, there is a need to put mechanisms in place to properly exploit and manage this material which, when out of business or not, adds to the pool of e-waste in the country, as well as for information communications (ICT) to provide information technologies (IT and networking services). This article addresses the difficulties of e-waste in Nigeria in connection to health problems and soil ecosystems in Nigeria.

The explosion of technology has led to e-mail, e-commerce and e-commerce during the last two decades. More questioning separation – waste – is the most contemporary manifestation for the 'e' prefix. The newest consequences of a technology driven world are electronic and electrical trash which is generally referred to as e-waste. The report did not take into account scrap electronic messages but the actual existence of electronic components i.e. physical, touching elements which are either part of electronic, electronic or whole systems.

The evolution of various electronic goods and their range has been and has been through our generation. We rely so much on these electronic goods and this leads only to 'e-waste,' a new environmental problem. "Part of the wide range of new goods such as family products or domestic products for everyday use, such as refrigerators, coolers, mobile phone systems, consumer electronics and associated computers.

Electronic and electrical trash is hazardous and is being alarmingly increased as consumers exponentially abandon it. This includes hundreds of different materials that are not only deadly, but also cause hazardous pollutants if illegally disposed. These harmful substances include plastics such as mercury, lead, bromides, etc. E-waste is another explanation when many communities discard or transfer their electronic or electrical equipment to recycle and get rid of it. The procedure results

The e-waste includes: television sets, personnel gazettes, music systems, CD players, video games and other electronic equipment of the home, communication machinery, photocopying equipment, fax and mobile devices, soundtracks and audio frequencies.

Cathode ray pipes (CRTs) and personal computers are a good number of frequent kinds of waste. The toxicity, the diversity and the complexity in actual components significantly important in distinguishing these waste from any other solid waste.

All these trash categories contain extremely high and low value of hazardous and toxic elements such as cadmium, plum (Pb), mercury (Hg) and greater plastic product percentage. Besides another frequent component, e-waste including plumbing (pb) and bromine flame retardants includes imported circuit boards (PCBs) (BFRs). Not only are the aforementioned elements cancerous for people but they are also hazardous for the ecosystem.

These things are firmly labelled in the today's worldwide village idea and their quantities grow everyday rapidly, as much as the industrialised society can afford. With electronics accessible at reasonable costs, substitution rate has risen as well, providing huge features, in smaller sizes and appealing aesthetics with the pace of technical innovation and progress.

Concept of Electronic Waste

E-Waste combines a wide variety of electronic equipment such as big home appliances (coolers, air conditioners) and mobile appliances that are rapidly expanding. E-waste thus has a multitude of meanings. The interpretation of the utility of an electronic gadget varies on each concept. The OECD e-waste definition is very simple: e-waste is considered to be a device that supplies electricity with its end-of-life (OECD, 2001). Solving the problem of e-waste (StEP, solving the problem of e-waste) (StEP). On the contrary, e-waste is defined as a reverse supply chains (Draft Project Document, 2005), which gather goods no longer wanted by the customer and rehabilitate them through recyclers for other consumers.

E-waste is considered as any material or item that the holding holder disposes of or has to dispose of, in accordance with the requirements of national legislation in effect, according to the EU Waste Electrical and Electronically Equipment Directive (WEEE) (EU. Directive, 2002a). In the UK, however, the Environment Agency determines the utility of e-waste. Equipment may still have repair, sale or dispose of trash, be dispensed in return for the new equipment, donated for the purpose of charity, sent to a retailer or returned to him for refurbishment according to the return policies of the organisations. An equipment is deemed trash, however, if the aforementioned conditions are not met (Environmental Agency, 2012)

Electric trash is defined by categorisation by the US Environmental Protection Agency (EPA). It classifies non hazardous trash as e-waste, including home electronic and non-wash waste waste metals, including all recycling goods and commodities including scraping metals, circuit board and CRT (Cathode Ray Tube) glass (Tonetti, 2007). Ironically, EPA considers the discarded CRT monitors to be "hazardous domestic waste;" however it does consider the scrap materials known as a secondary scratch (copper, steel, plastics etc.) as "commodities" if not discarded, accumulated speculately or left unprotected by the w, as being for the testing or re-usable of obsolete gadgets (work and recuperable electronics) and scrap materials. Moreover, the EPO policy says that outdated electronics are not regarded to be trash unless a specific decision is taken that the use of not waste, as set forth in the above-mentioned definition, is continuously used (Tonetti, 2007).

E-waste may be called end-of-life goods as well. Products of end-of-life are regarded to be non-usable by original users. They comprise items which have and do not have tangible worth. However, end of life goods are referred to be items without a further residual value than material values by Fleischmann (2001) and Flapper, Numen and Wassenmow (2005). Yet e-waste, as any outdated equipment, is defined by Balakrishnano, Anand & Chiya (2007), to function correctly, depending on electrical currents or electronic fields including equipment for electrical power production, transmission and measurement.

One of the weaknesses in the definitions above is that no clear agreement exists as to whether the word e-waste should apply to the renovations, re-sales and used goods or just to products which cannot be utilised for the original purpose. In particular the criteria of what should be considered e-waste do not include in the chemicals in electronic equipment such as lead or mercury in a significant manner. Therefore, because of the general nature of the word "e-waste" and the perceptions range significantly from the definitions of what e-waste should be, approaches and disposal techniques vary substantially. For example, the EPA definition for e-waste is problematic simply because it does not distinguish clearly between electronic equipment that are deemed dangerous e-waste and non-hazardous e-waste. This provides space for uncertainty, which stakes in the recycling and general management of e-waste may readily exploit. Regardless of these variations, the different definitions have a common ground that e-waste consists of electronic devices that are no longer regarded as consumer useful and may thus be thrown. E-waste is usually known as an outdated or non-usable electronic equipment for the purpose of this study.

Environmental management is now recognised as an important component of sustainable e-waste management. As Redclift (2001) puts it, the environment is mostly understood by the roles that it fulfils that are represented in human civilizations' social behaviours and commitments. In these social behaviours, such as the 'go and spend' habits that define complex contemporary cultures, the environment is often ignored. The consumer inclination is related to earnings and jobs. This also enhances trash production volume and quality. Consumption, as stated in Sachs (2001), may be addictive; it does not only grow as income levels increase, but also as needs, items that were first experienced or considered as luxuries. Recognition of consumer habits for e-waste in an environment is therefore an important component. This is regrettably ignored in certain management methods used by some companies as set forth in the above terms.

Effects of E-Waste in Nigerian Society

Lead

Lead causes damage to the central and peripheral nervous systems, blood systems, kidney and reproductive system in humans (European Union, 1999). Effects on the endocrine system have been observed and its serious negative effects on children’s brain development are well documented. Lead accumulates in the environment and has high acute and chronic effects on plants, animals and micro-organisms (Agency for Toxic Substances and Disease Registry, 1993). The main applications of lead in computers are: glass panels and gasket (frit) in computer monitors (3-8 pounds per monitor), and solder in printed circuit boards and other components.

Cadmium

Cadmium compounds are toxic with a possible risk of irreversible effects on human health, and accumulate

in the human body, particularly the kidneys (US Department of Labor, 2011). Cadmium occurs in certain components such as SMD chip resistors, infra-red detectors, and semiconductor chips. Cadmium is also a plastics stabilizer and some older cathode ray tubes contain cadmium.

Mercury

Mercury is used in the manufacture of parts of electronic devices such as thermostats, sensors, relays, switches commonly found on printed circuit boards, mobile phones and in batteries. As an alternative to cathode ray tubes, the use of mercury is likely to increase in flat panel displays. Mercury adversely affects various organs of the body including damage to the brain, fetus and kidneys. Developing fetus is highly vulnerable via maternal exposure to the prevalence of mercury in the environment. This results in miscarriages. Mercury also affects water as inorganic compounds. It forms methylated compounds in bottom sediments of water. Additionally, mercury easily accumulates in living organisms and concentrates through the food chain, particularly via fish. It is estimated that 22 % of the yearly world consumption of mercury is from electrical and electronic equipment (European Union, 1999).

Plastics including PVC

Plastics make up 13.8 pounds of an average computer. The largest volume of plastics (26%) used in electronics has been poly-vinyl-chloride (PVC). PVC is commonly present in computer and cable casings. Recently, more manufacturers are making computer moldings with somewhat more benign ABS plastics. PVC is used for its fire-retardant properties; hence when burnt under a certain temperature, it emits dioxin compounds. Dioxins can persist in the environment for years; lodging into the air, land and food chain. Health risks from dioxin consumption include infant birth defects, cancer, developmental disorders among children and sterility (Onwughara, Nnorom, Kanno, & Chukwuma, 2010)

Brominated flame retardants (BFRs)

BFRs are commonly used in the manufacture of plastic casings of electronic equipment to prevent flammability. They are also present in the circuit boards. Due to its toxic nature, BFRs have been banned from electronic devices in the EU. This directive came into force in 2006 (European Parliament and the Council, 2003).

Barium

Barium is a soft silvery-white metal that is used in computers in the front panel of a CRT, to protect users from radiation. Studies have shown that short-term exposure to barium has caused brain swelling, muscle weakness, damage to the heart, liver, and spleen (ATSDR, 2011). There is still a lack of data on the effects of chronic barium exposures to humans. Animal studies however, reveal increased blood pressure and changes in the heart from ingesting barium over a long period of time

Beryllium

Beryllium is a steel-grey metal that is non-magnetic, a good conductor of electricity and heat and extremely lightweight. These properties make beryllium a preferred material for the manufacture of electronic applications such as computers. In computers, beryllium is commonly found on mother-boards and “finger clips” as a copper beryllium alloy used to strengthen the tensile strength of connectors and tiny plugs while maintaining electrical conductivity (Puckett, 2002).

Beryllium has recently been classified as a human carcinogen as exposure to it can cause lung cancer (US Department of Labor, 2011). The primary health concern is inhalation of beryllium dust, fume or mist. Workers who are constantly exposed to beryllium, even in small amounts, and who become sensitized to it can develop what is known as Chronic Beryllium Disease (beryllicosis), a disease which primarily affects the lungs (ibid). Exposure to beryllium also causes a form of skin disease that is characterized by poor wound healing and wart-like bumps (ATSDR, 2011). Studies have shown that people can still develop beryllium disease after many years following the last exposure (Puckett, 2002).

Toners

The plastic printer cartridge especially those containing black and color toners, is one of the most popular

item of e-waste. The black toner contains a pigment commonly referred to as carbon black. Carbon black is also a general term used to describe the commercial powder form of carbon. It may also be known as furnace black, acetylene black or thermal black.

Phosphor and additives

Phosphor is an inorganic chemical compound that is applied as a coat on the interior of the CRT faceplate. Phosphor is used in the electronic industries to facilitate the display resolution and luminance of the images that is seen for example in computer monitors. Even though the effects of phosphor in CRTs is not well known or reported, the U.S. Navy has made it clear about the hazards involved in improper handling of CRTs as stated in their guidelines: "*NEVER touch a CRT's phosphor coating: it is extremely toxic. If you break a CRT, clean up the glass fragments very carefully. If you touch the phosphor, seek medical attention immediately*" (Information Systems Security, 1993).

International E-Waste Regulatory Policies

From a scientific standpoint, e-waste is undeniably hazardous to both the environment and people; nevertheless, it is clearly cruel to bring elements contained in e-waste into communities only for the purpose of earning fast money and evading responsibility. However, from a legal perspective, the problem has grown unclear, and it is reliant on how seriously a government plans to deal with the risks and their consequences. Domestically, e-waste laws vary per country. Internationally, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, also known as BAN (Basel Action Network), appears to be the only internationally recognised body in charge of hazardous waste management, aside from the Bamako Convention, which is a treaty of African nations prohibiting the importation of any hazardous waste (including radioactive waste).

The Basel Convention

As a consequence of hazardous deposits in Africa and other developing nations, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (hereafter referred to as "the Basel Convention") was established in 1989. This effort, precipitated by industrialised nations' increasing awareness of the long-term consequences of incorrect hazardous waste disposal, led in stringent restrictions on hazardous waste disposal. As a result, disposal prices will rise as well. Seeking alternate routes for the growing e-waste buildup, businesses and operators alike sought low-cost disposal alternatives in Eastern Europe and emerging countries where environmental awareness was low and strict laws and enforcement were absent (Basel Convention, 2011).

This desire to avoid stringent regulations in one's own country has resulted in an apparently unrestricted traffic of e-waste across international boundaries, particularly to poor countries. In 1992, the Basel Convention went into full force against this backdrop (ibid). The Basel Convention is the first worldwide intergovernmental agreement designed to limit the transportation of hazardous waste between countries. The transfer of poisonous or hazardous waste from rich or industrialised countries to less developed or developing ones receives special attention. The Basel Convention seeks to guarantee environmental accountability for waste generated by the nation of origin, as well as to urge signatory countries to decrease waste production and toxicity. It also guarantees that hazardous waste management or trans-boundary transportation is compatible with the protection of human health and the environment where it is disposed of. The agreement also encourages developing countries to practise good environmental waste management (Basel Convention, 2011).

The Basel Convention accord focuses on both worldwide manufacturers and recyclers of electronic waste. As stated in earlier sections, electronic waste includes toxic substances that endanger human health and the environment in the long and short term. As a result, the BAN (Basel Action Network) convention has an impact on the worldwide electronic sector. Signatories to the BAN convention are essentially obligated to guarantee that e-waste production and other hazardous waste are kept to a minimal minimum. The agreement also guarantees that member nations have enough disposal facilities to handle e-waste and other hazardous waste produced. It places a special focus on ensuring that waste management extends all the way to the point of disposal.

It seems probable that a country like the United States would be able and willing to meet and execute this demand for national waste management self-sufficiency. Unfortunately, the United States is the only industrialized nation that has yet to ratify the Basel Convention. According to Puckett (2002), US officials deliberately sought to oppose, and then undermine, the Basel waste export prohibition. The policies of the United States government seemed to be intended to promote the exporting of their trash to other nations that would accept it. Not only has the United States failed to ratify the Basel Convention, but it seems to have purposefully exempted e-waste from the few regulations that do exist (requiring prior notice of hazardous waste exports) to protect importing nations (ibid). According to reports, officials at the United States Environmental Protection Agency (EPA) have admitted under questioning that export is an important part of the United States' e-waste disposal strategy, and the only concern for the United States may be how to ensure minimal environmental standards abroad (Puckett, et al., 2002).

The Bamako Convention

The Bamako Convention, also known as the Bamako Convention on the Ban on the Importation into Africa and the Control of Trans-Boundary Movement and Management of Hazardous Wastes Within Africa, is an African convention that prohibits the importation of any hazardous waste (including radioactive waste). Twelve African countries negotiated the Convention in January 1991 at the Organization of African Unity in Bamako, Mali. It became effective in 1998 (Organization of African Unity (OAU), 1991).

The Bamako Convention arose from the awareness that wealthy nations were shipping toxic wastes to Africa, as well as the failure of the Basel Convention to effectively ban the transfer of hazardous waste to developing countries. The Bamako Convention is similar in structure and language usage to the Basel Convention, but it is more adamant in banning any imports carrying hazardous waste, with no exclusions (such as radioactive materials) permitted by the Basel Convention. Nigeria accepted the Basel Convention on May 24, 2004, banning the importation of hazardous waste into its borders, but has yet to ratify the Bamako Convention.

Nigeria’s National Policies on E-waste

The Nigerian Government enacted the Harmful Wastes Decree in response to the unlawful dumping of toxic wastes at Koko, old Bendel State, in 1987. This decree establishes a legislative framework for the efficient regulation of the discharge of toxic and hazardous waste into any environment within Nigeria's borders. In 1988, the Federal Environmental Protection Agency (FEPA) was established as a regulating agency. FEPA is in charge of preserving and improving Nigeria's environment. A National Policy on the Environment was created to assist this process, making it a standard working document for the preservation and protection of the Nigerian environment. Administratively, states and local government councils created their own environmental regulating agencies to ensure excellent environmental quality in their own terrain (NESREA, 2011).

The Environmental Impact Assessment Decree No. 86 of 1992 is an extra document aimed at preserving the Nigerian environment. However, it is primarily aimed at controlling the industrialisation process in terms of the environment. This Decree states that no industrial plan/development/activity on the FEPA's obligatory list may be carried out without first considering the environmental implications of such a planned action in the form of an environmental impact assessment. 1992 (Federal Republic of Nigeria)

National Policy on Environment

Section 6.2 of Nigeria's National Policy on Environment expressly specifies the roles and duties of relevant authorities in the administration and management of hazardous and radioactive substances. E-waste is classified as hazardous waste. According to an excerpt from the policy document, “...appropriate governmental agencies shall therefore establish regional framework and standards for "DUMP WATCH" against trans-boundary movement of toxic, hazardous, and radioactive wastes and for the achievement of environmentally sound hazardous substance management;” (National Policy on the Environment, p41, 1998).

While this legislation is effective in and of itself, there are no direct regulations banning the importation of e-waste disguised as “second hand” products as of this writing. There are no regulations governing the

health or quality of "second hand" products imported. In hindsight, the policy on trans-border movement of hazardous waste has been ignored far too often because outdated electronic gadgets flood into the country disguised as "second-hand" products and "charity" contributions. Even though e-waste is classified as hazardous trash, imported electronic equipment are deemed valuable only until they are found to be e-waste. It is impossible to determine the health of imported products into the nation while they are still off shore; only after they dock will the port authorities check their contents.

The Lagos State Garbage Management Authority is exclusively responsible for handling waste produced inside the state at the state level. Because there are no previous regulations requiring trash sorting at the source, waste is often intermingled during collection. Other waste management agencies include the Ministry of Environment, which serves as a policy regulator, the Local Government functions attributed to them by virtue of their constitutional roles, and the Private Sector Participant (PSP operators) tasked with waste collection, transportation, and disposal. Informal waste management practitioners, such as e-waste recyclers and e-waste collectors, also actively engage in trash collecting across the state.

Guide for Importers of Used Electrical and Electronic Equipment into Nigeria

Despite the fact that there are no explicit regulations banning the importing of outdated electronic equipment, the National Environmental Standards and Regulations Enforcements Agency (NESREA) regulates the shipping and importation of electronic devices into the nation. The organisation issued a set of recommendations in 2011 as a means of enforcing regulations. Importers are encouraged to register with NESREA, inform, and adhere to the restrictions outlined in the paper. An example:

• Your (importer) shipment may be classified as '' Waste '' by NESREA and thus treated as an illegal waste shipment. • Only functional Used Electronic and Electrical Equipment (UEEE) that meet the requirements of the guidance contained in this document and relevant NESREA Regulations can be legally imported into Nigeria. Publications and Articles, NESREA, 2011.

The paper also emphasises certain guiding principles that will assist importers, including businesses, private individuals, organisations, and shipping firms, in distinguishing between e-waste and 'second hand' electronic equipment. This guideline is not intended to replace the Harmful Waste (Special Criminal Provisions, etc.) Act, Cap H1 LFN 2004, which prohibits the dumping, carrying, transportation, and importation of any harmful waste (including e-waste) into the country (which is still enforced in Nigeria), but rather to supplement the law by addressing the country's rising e-waste trend.

CONCLUSION

This research looked at the impact of electronic trash on ground water quality. This was done to illustrate the hazardous chemicals present in electrical west, as well as the ease with which these toxic substances may contaminate the soil and ground water in nearby regions. As a consequence, the findings of this research offer varying information on the leachability of heavy metals, particularly lead, from electronic trash at waste disposal sites into the area's soil and groundwater. The heavy metal concentration of the soil inside and surrounding the dumpsite exceeds the established lead, cadmium, and zinc limitations. As a result, the hazardous chemicals contained in electronic trash should be carefully handled. Although some of the parameters were found to be within the World Health Organization (WHO) and NSDWQ's defined ranges, they may surpass these limits if corrective actions are not implemented.

The problem of e-waste is not just a worldwide one, but it also has environmental and health implications in Nigeria. Protocols and treaties on transboundary e-waste transportation should be enforced by both developed and developing nations. Nigeria must implement and enforce e-waste management laws, in addition to conventional recycling choices, recovery, and reuse of so-called valuable components. Non-tolerance of ewaste by Nigerians would help to reduce e-waste transboundary commerce and maintain a healthy soil environment, since studies in Nigeria and elsewhere show that ewaste presents a major danger to soil biota, soil quality, and soil water resources, including surface and subterranean water.

RECOMMENDATIONS

• Intense public awareness campaign on hazardous chemicals in EEE, UEEE, and WEEE, as well as the

necessity for national, regional, and global control measures for all stakeholders, including policymakers, legislators, regulatory agencies, Customs, women and youths, and the press.

• Creation of a worldwide information sharing system for hazardous chemicals in EEE and WEEE that takes into account the whole supply chain.

• Promotion of labelling systems to notify users of product dangers, the necessity for recycling, and the mechanisms in place for safe disposal.

• Strengthening the Basel and Bamako Conventions, as well as EU enforcement responsibilities to rigorously execute relevant EU directives

• E-waste inventories at the national and regional levels are needed for meaningful planning, and a national/regional database on EEE, UEEE, and WEEE should be created for monitoring and information sharing on import and export statistics in order to prevent and regulate illicit traffic.

REFERENCES

1) ATSDR, (2011). ATSDR. Retrieved December 5, 2011, from Toxics Substances Portal - Barium: http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=326&tid=57
2) Balakrishnan, F., Anand, J., & Chiya, L., (2007). Electrical and electronic waste: a global environmental problem. Journal of Waste Management and Research, vol. 25, pp. 307- 317.
3) Basel Convention, 2011). Basel Convention on the Control of Transboundary Movements of Hazardous Waste. Switzerland: UNEP.
4) Environmental Agency, (2012). Waste electrical and electronic equipment (WEEE). Retrieved January 31, 2012, from Environmental Agency: http://www.environment- agency. gov.uk /business/ topics/waste/32084.aspx
5) EU. (2010). Being wise with waste: The EU's approach to waste management. Luxembourg: Publications Office of the European Union.
6) EU. Directive. (2002a). 2002/96/EC of the European parliament and of the council of 27 January 2003 on waste electrical and electronic equipment (WEEE) — joint declaration of the European parliament, the council and the commission relating to article 9. Official Journal, L037:0024-39.
7) European Union. (1999). Waste from Electrical and Electronic Equipment. Explanatory Memorandum (3rd Draft). Brussles.
8) Flapper, I., Numen, W., & Wassenmow, L., (2005). Managing Closed – Loop Supply Chain. In D. Flapper S, V. J. Numen, & V. L. Wassenmow, Managing Closed – Loop Supply Chain (p. 200). Germany: Springer Verlag Heidel Berg.
9) Fleischmann, O., (2001). Quantitative modes for Reverse Logistics. In M. Fleischmann,
10) Quantitative modes for Reverse Logistics (p. 200). Berlin: Springer verlag.
11) NESREA, 2011). NESREA. Retrieved December 14, 2011, from NESREA: http://www.nesrea.org/about.php
12) Organisation of African Unity OAU), 1991). Bamako Convention. Retrieved July 25, 2012, from Bamako Convention on the BAN of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa: http://www.cetim.ch/en/documents/conv-bamako-ang.pdf
13) Onwughara, T., Nnorom, K., Kanno, A., & Chukwuma, I., (2010). Disposal Methods and heavy Metals Released from Electrical and Electronic Equipment Wastes in Nigeria: Adoption of Environmental Sound Recycling System. International Journal of Environmental Science and Development, Vol. 1, 4.
14) Puckett (2002). Exporting Harm: The High-Tech Trashing of Asia. Seattle: The Basel Action Network (BAN) Silicon Valley Toxics Coalition (SVTC).
15) Puckett, D., (2002). The Digital Dump:Exporting Re-use and Abuse to Africa. Seattle: The Basel Action Network.
16) Redclift, W., (2001). Wasted: Counting The Costs of Global Consumption. Sterling: Earthscan Publications Limited.
17) Sachs, C., (2001). Wasted: Counting The Costs of Global Consumption. In M. Redclift, 'Can the North Stop Consumption growth? Escaping the Cycyle of Work and Spend' (p. 7). Sterling: Earthscan

Publications Limited.

18) Sangarika, et al., 2010) . e-Junk Explosion. Retrieved December 4, 2010, from Environmental Health Perspective: http://dx.doi.org/10.1289/ehp.110-a188
19) Tonetti, O., (2007). US EPA's Regulatory Framework for "E-Waste". Electronics Waste and Spent Lead Acid Batteries Capacity Building Workshop, 1-4.