

GREEN CHEMISTRY IN ELECTRONIC WASTE MANAGEMENT AND CONTROL IN AFRICA

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Abstract

Poverty and desirable consumption of ICTs have combined to impose used and inferior ICTs components on African countries in a hurry in the information milieu to address “information poverty,” bridge development gaps and minimize their exclusion and/or marginalization in the global market economy driven by globalization and powered by ICTs. The inferior and used ICTs components soon become unserviceable and improperly discarded, thus contributing to health and environmental hazards. The

concept of Green or Sustainable Chemistry, which has the principles for management and control of the mounting e-waste generated as a result of increasing ICTs diffusion, is still at its infancy in Africa. Highlighting the crucial and diverse roles of Green Chemistry in e-waste management and control, the paper recommends a number of measures to enhance them.

Introduction

The activities of people and nations conquer and wreck the world in their quest for economic development, which seeks to increase the quantum of economic output without caring about the short- and long-term short-changes of human and material resources arising from the processes.^[2] One major area of human activities that generate serious quantum of waste has to do with the information communications technologies (ICTs). Globalisation now defines development, and is powered by ICTs.

For decades running, developing countries lag behind the rest of the world in terms of development.^[3] Africa's chances of meeting the Millennium Development Goals (MDGs) targets are most doubtful.^[4] The African Development Bank (ADB) has 32 of

its regional member countries belonging to low income countries (LICs) with \$785 or less per capita income, 14 belonging to the low middle income countries (LMCs) with per capita income range of \$786-\$3,115, and only 6 belonging to the upper middle income countries (UMCs) with per capita income range of \$3,116-\$9,636 (see Table 1).^[5]

Enlarging the development despondency of the developing countries is their “information-poverty,” which enhances the chances of marginalization and/or exclusion of the “information-haves-not” developing countries from the global market system by the “information-rich” or “information-haves” developed countries. The compelling nature of ICTs is such that the “the computer has succeeded in traversing every facet of human endeavour. It is this infusion of the computer into human activity, plus advances in the telecommunications arena, especially digitization, that characterizes the information revolution. This present revolution has transformed the world into a global, knowledge-based society, referred to as the information society”.^[6]

Table 1: ADB Member Countries by Gross National Income per Capita

Low Income Countries (LICs): ≤\$785	Low Income Countries (LICs): ≤\$785 (Cont'd)	Low Income Countries (LMCs): \$3,115	Middle Income Countries \$786-\$3,115	(UMCs): \$3,116-\$9,636
Benin	Malawi	Algeria		Botswana
Burkina Faso	Mali	Angola		Gabon
Burundi	Mauritania	Cameroon		Libya
Cent. Afr. Rep.	Mozambique	Cape Verde		Mauritius
Chad	Niger	Congo		Seychelles
Comoros	Nigeria	Cote d'Ivoire		South Africa
Congo (DRC)	Rwanda	Djibouti		
Eritrea	Sao T. & Principe	Egypt		
Ethiopia	Senegal	Equatorial Guinea		
Gambia	Sierra Leone	Lesotho		
Ghana	Sudan	Morocco		
Guinea	Tanzania	Namibia		
Guinea Bissau	Togo	Swaziland		
Kenya	Uganda	Tunisia		
Liberia	Zambia			
Madagascar	Zimbabwe			

Source: ADB, 2007

In the bid to bridge the unfavourable development gap being widened by information poverty, Nigeria and many other developing countries are promoting vigorous and rapid adoption and integration of ICTs (any communication device or application, encompassing radio, television, cellular phones, computer and network hardware and software, satellite systems, etc.), the consumption of which has become both desirable and imposed choice on developing countries, especially as ICTs have been recognized as primary wealth creating assets ^[7-10], and could provide the tool for the region to experience some kind of leapfrogging in her developmental trajectory.^[11-13] This is consistent with the long held orthodoxy that “one of the key catalysts in the attainment of MDGs is inclusive access to and effective use of ICTs by the entire populace of every country on the globe”.^[14]

The aggravated and indiscriminate adoption and usage of ICTs by some developing countries is a strategy to address the development challenges of marginalisation and exclusion from the competitive global market system driven by globalization and powered by the ICTs. This informs reported rise in the

consumption of ICTs in developing countries.^[15] The digital divide and the concomitant widening gap in development between the developed nations (“information haves”) and the developing countries (“information haves-not”) had to be addressed.^[16-21]

Some developing countries in Africa appear to be in a haste to provide public access to ICTs in the belief that it will contribute in instigating social and economic development or in narrowing the digital divide.^[22] The 2006 global e-readiness rankings of countries by the Economist Intelligence Unit ranked some African countries - South Africa 35th, Egypt 55th, Nigeria 60th and Algeria 63rd ^[14] - an indication that Africa is waking up to the broadband race.

A World Bank publication has it that “the digital divide” between rich and poor nations is narrowing fast ..., telecommunications services to poor countries were growing at an explosive rate and the digital divide was rapidly closing. The Report was based on the premise that people in the developing world were getting more access, especially to cell phone communications, far faster than they got access to new technologies in the past”. However, such reported growth has not

captured “quality of access, adequacy of content, effective usage and affordability of access”^[14]. Arguably, the gap between the developed and developing countries in terms of quality of access to service and access to quality ICTs products is widening. For instance, the Infostate gap between countries varies from 8 to 225, with sub-Saharan Africa (SSA) occupying the lower rung.^[23]

As a result of poverty and low level of development in SSA, the consumption of ICTs in the region is concentrated on the inferior and used components, which have become ubiquitous in the region. Given the economic status of the region, virtually all the used ICTs components that escape recycling and incineration in the developed countries find their final resting place in SSA. These shortly become unserviceable and abandoned, thus contributing to environmental hazard. These inferior and used components are supplied from China - facilitated by the increasing trade between China and Africa. The flourishing trade relations subsisting between Chinese and Nigerian informal exporters and importers provide vibrant platform through which inferior and used ICTs are shipped into most parts of SSA countries.^[24-5]

Besides used and inferior ICTs components, outright e-waste from developed countries is also dumped in Africa. For example, in 1987, metric tonnes of toxic e-waste were dumped in Koko, Delta State, Nigeria by a foreign firm in collusion with Nigerian businessmen. Koko is a town and a port, lying along the Benin River in the western Niger River delta.^[26]

Definition of e-waste

Electronic waste, or E-waste for short, is also known as “e-scrap” or “waste electrical and electronic equipment” (WEEE). E-waste refers to loosely discarded surplus, obsolete, broken electrical or electronic devices.^[1] It is composed of secondary computers, entertainment devices, electronics, mobile phones, and other items, like television sets, refrigerators, cathode ray tube (CRT), VCRs, stereos, copiers, and fax machines nearing the end of their useful life. It could be sold, donated or discarded by its original owner and destined for reuse, resale, salvage, refurbishing, recycling or disposal.

Environmental Sustainability Challenges of E-waste

Rapid technology change, low initial cost and even planned obsolescence have resulted in a fast growing problem of increasing e-waste generation around the globe. The United Nations Environment Programme (UNEP) estimates that as much as 50 million tonnes of e-wastes are generated worldwide each year. Increasing at a rate of 3-5% per year (faster than any other category of waste), the global volume of e-wastes produced annually is soon expected to double.^[27] Although, the majority of e-waste is generated in the industrialized countries, much of it is transferred to Africa, where environmental regulations and treatment capacity is significantly weaker to manage and control it in an environmentally sustainable manner.^[15]

In developing countries, e-wastes containing plastics are commonly littered, at best in collection points. Plastics in electronics easily leach off in hot weather, especially when left outside. The record levels were “93 times higher than soil without contact with e-wastes”^[28]. The uncontrolled burning, disassembly, and disposal of e-wastes can cause a variety of environmental problems, such as ground water contamination, atmospheric pollution, and water pollution either by immediate

discharge or due to surface run-off (especially near coastal areas). In some cases, the e-waste items are used in filling construction pits and land reclamation sites. This would appear to be most economical and convenient in the short run, but poses serious health and environmental danger in the long run, both on the people and the environment because “toxic chemicals in (ICT) electronic products can leach into the land over time or are released in the atmosphere, impacting nearby communities and the environment”^[29].

Despite the potentials of ICTs wastes in destroying the environment, efforts to encourage development in developing countries are mostly directed at such dominant areas as poverty, malaria, HIV/AIDS, wars and the like, and the traditionally known causes of environmental degradation, such as erosion and desert encroachment, as if they are the only sources of underdevelopment in these countries.^[15] Limited attention is directed at the management and control of the environmental hazards posed by increased ICTs consumption on the largely “unprotected” African countries. The attendant unsustainability challenges represent development without sustainability, which is short-sighted and

absurd. After all, “the notion of sustainability is also related to wellbeing, (as) sustainability entails growth beyond economic efficiency and wealth but within social and environmentally friendly perspectives that may impact the ability of a community to be free from crime and enjoy civil liberties”,^[30] and enjoyment of right to clean environment.

With the increasing ICTs consumption and increasing rise in the realization of the impact of e-waste on the environment, the need to address e-wastes issues in Africa has become urgent and apt. Researches need to be directed at the environmental hazards of various dimensions caused by growing volume of e-waste items defacing African landscape and negating sustainable development.

This review paper examines the crucial and diverse role of Green or Sustainable Chemistry in e-waste management and control in Africa, and recommends measures to enhance the study and practice of Sustainable Chemistry.

Green Chemistry in E-waste Management and Control

In spite of the development potency of ICTs, the disposal of their hazardous e-wastes poses serious sustainability challenge,^[30] especially as e-waste can become toxic if discarded improperly. Waste management and control hierarchy are^[31]:

1. *source reduction or avoidance*;
2. *waste recycling*, that is, reuse or reclaiming of as much waste as possible;
3. *waste treatment*, that is, treatment of the waste that cannot be reclaimed; and
4. *waste disposal*, that is, disposal of waste residues to air, water or land.

Each component of the hierarchy begs Chemistry (which can be employed to avoid or reduce waste source, recycle waste, treat and dispose waste). Besides Environmental Chemistry - the chemistry of the natural environment, and of pollutant chemicals in nature -

Green Chemistry or Sustainable Chemistry seeks to reduce and prevent pollution. Sustainable Chemistry is a philosophy of chemical research and engineering that encourages the design of products and processes that minimize the use and generation of hazardous substances.^[32-3]

Sustainable chemistry consists of chemicals and chemical processes designed to reduce or eliminate negative environmental impacts. The use and production of these chemicals may involve reduced waste products, non-toxic components, and improved efficiency.^[33]

Green chemistry is a highly effective approach to pollution prevention because it applies innovative scientific solutions to real-world environmental situations. It promotes designing chemical products and processes to the highest level of this hierarchy and for cost-competitiveness in the market.^[33]

Green Chemistry deals with source reduction/prevention of chemical hazards; design of chemical products to be less hazardous to human health and the environment; use of feedstock and reagents that are less hazardous to human health and the environment; design of syntheses and other processes to be less

energy and materials intensive (high atom economy, low e-factor); use of feedstock derived from annually renewable resources or from abundant waste; design of chemical products for increased, more facile reuse or recycling; reuse or recycle chemicals; treatment of chemicals to render them less hazardous; proper disposal of chemicals; chemicals that are less hazardous to human health and the environment and are less toxic to organisms and ecosystems, not persistent or bio-accumulative in organisms or the environment, and inherently safer with respect to handling and use.^[33]

Conclusion and Recommendations

In the information milieu, many developing countries are in a hurry to address “information poverty,” bridge development gaps and minimize their exclusion and/or marginalization in the global market economy driven by globalization and powered by ICTs. Understandably, poverty and desirable consumption of ICTs have combined to impose used and inferior ICTs components on them. The inferior and used ICTs components soon become unserviceable and abandoned, thus contributing to environmental

hazard. They are ubiquitous and improperly discarded in these countries with technological backwardness and weak legal environment to manage and control e-waste.

Green or Sustainable Chemistry has the principles for management and control of the mounting e-waste generated as a result of increasing ICTs diffusion in developing countries. But, the concept of Green Chemistry and Sustainability is still at its infancy in most of these countries. Considering the crucial and diverse roles of Sustainable Chemistry in e-waste management and control, which is a milestone in the new global paradigm of sustainable development, it is, therefore, recommended that:

1. the concept of Green Chemistry and Sustainability be introduced in the education system in developing countries,
2. policy be put in place for the study of Sustainable Chemistry in schools in developing countries,
3. legal framework be put in place for the practice of Sustainable Chemistry in the industry in developing countries,

4. more serious measures should be taken at national and international levels to encourage the study of Chemistry and to enhance the regulation of its practice in order to maximize the services of the Chemist in environmental sustainability, which includes e-waste management and control.

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