Technical Report on the Sustainable Management of E-Waste in Ghana

FINAL REPORT

July 2015

Acronyms

As	Arsenic
CEPS	Customs
Co	Cobalt
CSIR	Council for Scientific and Industrial Research
Cu	Copper
EEE	Electronic and Electrical Equipment
EMPA	Materials Science and Technology
EMS	Environmental Management System
EC	Energy Commission
Fe	Iron
GAEC	Ghana Atomic Energy Commission
GLSS	Ghana Living Standards Survey
GRA	Ghana Revenue Authority
ICT	Information and Communication Technology
IIR	Institute for Industrial Research
ILO	International Labour Organisation
IRS	Internal Revenue Service
IT	Information Technology
KNNRI	Kwame Nkrumah Nuclear Research Institute
LDC	Less Developed Countries
LRC	Law Reform Committee
Mn	Manganese
NGO	Non-Governmental Organisation
NNRI	Nuclear Research Institute
Pb	Lead
POPs	Persistent Organic Pollutants
PPP	Private Public Partnership
Rb	Rubidium
Sb	Antimony
SIC	Scientific Instrumentation Centre
SME	Small and Medium-sized Partnership
Sn	Tin
Sr	Strontium
Ti	Titanium
UNDP	United Nations Development Programme
WEEE	Waste Electronic and Electrical Equipment
XRF	X-Ray Fluorescence
Zn	Zinc

Executive Summary

Introduction

Discarded or waste electronic and electrical equipment (WEEE), commonly referred to as e-waste is the fastest growing stream of waste in industrialized countries. A large proportion of end-of-life equipment (e-waste) as well as near end-of-life equipment is shipped to developing countries for dumping or recycling and for use respectively. Previous studies on the e-waste situation in Ghana, particularly at Agbogbloshie, have established the dire environmental and health consequences of the informal recycling activities on the one hand, and on the other, the significant socio-economic benefits of the sector to the national economy. It is essential therefore to put in place appropriate policies and actions to deal with regulation of the sector; this will involve institution of appropriate standards and work practices as well as cleaning up of contaminated sites.

In line with this, the World Bank has received grant funds from the Global Environment Facility (GEF) to support preparatory work to respond to the issue of e-waste with the aim of designing a larger program to address environment and health risks associated with the sector. The objective of this assignment was to undertake a detailed study and prepare a technical report on management of e-waste in Ghana. The study covered an inventory of the types and quantities of EEE entering the country for the five-year period between 2009 and 2014, and an estimate of the amount of obsolete equipment recycled, using the Agbogbloshie scrap yard as the reference hotspot. Other key aspects of the study included assessment of contamination levels at Agbogbloshie, contribution of the e-waste sector to the national economy, extent of exposure of "recyclers" to health risks, an environmental management system for e-waste and an action plan to guide management of e-waste in Ghana.

Methodology

A number of methods were used for the study; comprising the purposive, quota and random sampling techniques, field surveys and site visits, review of related literature and statistical data. The study categorized EEE into five (5) groups: Large household; Small household; IT and Telecommunication Equipment; Consumer electronics; and Others (EEE parts) for import data analysis. For EEE survey, four groups were considered. These included Customs Division of GRA, EEE importers, refurbishers and recyclers.

A GPS-aided survey was conducted for the presence of various contaminants at Agbogbloshie. A Garmin Etrex GPS device was used to determine coordinates of 31 points (at the soil surface and then at a 3.6 inches depth) within the study area and the samples were analyzed using an Innov-X SYSTEMS XRF device. The ArcGIS software was used to generate topographic and image maps for the site. The Google Maps Application was also used to support the generation of maps.

Legal, Regulatory and Policy Framework on E-Waste

The policies, legal and institutional frameworks relevant to issues on EEE and the WEEE (e-waste) sector and their gaps, particularly to the recycling of WEEE, were reviewed include broadly the following:

1. The 1992 Constitution of the Republic of Ghana
2. National policies
    a. Ghana ICT for Accelerated Development (ICTAD) Policy;
    b. National Policy on Public Private Partnership;
    c. National Environmental Policy;
    d. Occupational Safety and Health Policy of Ghana (Draft 2004);
    e. National Energy Policy; and
    f. Environmental Sanitation Policy
3. National laws and regulations
    a. Environmental Protection Agency Act;
    b. Environmental Assessment Regulations;
    c. Draft National Hazardous Waste Bill;
    d. Factories, Offices and Shops Act;
    e. Energy Commission Act;
    f. Energy Efficiency Regulations
    g. Local Government Act.
    h. Mercury Law;
    i. Ghana Standards Authority Decree;
    j. Export and Import Act;
    k. Ghana Revenue Authority Act
4. Other key national institutions relevant to WEEE management
    a. Ministry of Environment, Science Technology and Innovation;
    b. Ministry of Trade and Industry;
    c. Atomic Energy Commission;
    d. GRATIS Foundation; and
    e. Institute for Industrial Research (CSIR-IIR)
5. International and multilateral environmental agreements (The Basel Convention, The Vienna Convention, The Vienna Convention and ILO Convention on the Safety of Chemicals at the Workplace).

EEE Country Context

The country context is to provide understanding of the annual imports of EEE into the country over the past 5 years; estimates of WEEE generation; as well as the contribution of the sector to the national economy (income levels and employment). This was based on a comparison of import data 2010 – 2014) as well as surveys of selected refurbishers, importers and recyclers with existing data on the sector primarily from the population and housing census data on the sector.

Import data gathered indicated the following categories and their quantities over the 5-year period of the study:

- ICT Equipment, Components and Parts 18,034,983
- Consumer Electronics 3,633,568
- Small Household Appliances 7,003,948
- Large Household Appliances 5,407,666

Field surveys conducted suggest that the refurbishing and e-waste recycling sectors employ an estimated 12,000 to 17,000 people in Accra and Tema and possibly sustain about 46,800 to 66,200 people in the Greater Accra Region. Deductions from expert opinion further suggest that about 20,000 to 42,500 people are employed in the refurbishing and e-waste recycling sector in Ghana, constituting about 0.2% to 0.4% of the total labour force in Ghana (PHC, 2010). Employers and managerial staff earned between GH¢ 2,000 and GH¢5,000 while employees earned between GH¢ 500 and GH¢1,000 monthly.

Contamination Profile of Agbogbloshie

The Agbogbloshie scrapyard has become a major dumping ground for old electrical and electronic products with people dealing in all kinds of scrap. The area is about 1km from Obetsebi Lamptey Circle (to the north-east) and 2.5km from the Gulf of Guinea (to the south-east). It is bordered to the north by the Onion market and the Abosey Okai Road, to the east by Galaway, Old Fadama (Sodom and Gomorrah) and the Odaw Channel.

Soil analyses, which were done with a XRF Analyzer (and subsequently confirmed at CSIR laboratory) identified Zinc (Zn), Lead (Pb), Rubidium (Rb), Strontium (Sr), Zirconium (Zr), Iron (Fe), Copper (Cu), Titanium (Ti), Manganese (Mn), Arsenic (As), Antimony (Sb), Tin (Sn) and Cobalt (Co) as the main contaminants. Zn, Pb, Rb, Sr, Zr and Fe, the major contaminants, were found at between 90% – 100% of the sampled spots. A comparison of concentration levels of some of the toxic heavy metals identified at the site, such as Zn, Pb, Cu and As with set limits from three geographic locations and that of the World Health Organisation (WHO) guidelines indicated that their mean concentration levels were higher for the site.

Potential impacts of contaminants on soil, surface and ground water indicated the following:

- Impacts on soil could result from potential release of heavy metals such as Zn, Pb, Fe, Cu into the soil and its effect on soil organisms and nutrients;
- Impacts on surface water resulting from run-offs from the contaminated sites to nearby Korle Lagoon and Odaw River, which can impact the health of lower food chain organisms and, consequently, the availability of the food; and
- Impacts on ground water resulting from leaching of heavy metal contaminants to ground water often leading to diarrhea and stomach irritation, which can lead to more severe health effects.

Action Plan for E-Waste Management

The Action Plan for managing e-waste focused on enforcement and amendment of existing legislation, drafting and EMS for WEEE recycling at Agbogbloshie with an estimated cost of implementation at nine million, four hundred and forty Ghana Cedis (GHS 9,440,000) for a period of three years.

Key legislative recommendations were on enforcement and amendments of the following existing provisions:

- Environmental Protection Agency Act, 1994 (Act 490);
- Environmental Assessment Regulations, 1999 (LI 1652);
- Energy Efficiency Regulations, 2008 (LI 1932);
- National Environmental Policy (2012);
- The Ghana ICT for Accelerated Development Policy (ICT4AD);
- Occupational Safety and Health Policy of Ghana (Draft 2004);
- Mercury Law, 1989 (PNDC 217); and
- Local Government Act (1994) Act 462.

Other suggestions on the need for new legislation were considered for the following areas:

- Adoption of EU WEEE guidelines;
- Domestication of chemicals and waste related conventions; and
- Extended producer/ importer responsibility.

The EMS for Agbogbloshie focused on the following key areas:

- Environmental Policy
- Relevant Legal and Other Requirements
- Environmental Aspects and Impacts
- Mitigation and Enhancement Measures
- Action Plan Implementation
- Capacity Building
- Implementation Timelines and Budget

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CHAPTER ONE

INTRODUCTION

- **Background**
- **Purpose of the Study**
- **Main Areas of the Study**
- **Report Organisation**

1.0 INTRODUCTION

1.1 Background

Discarded or waste electronic and electrical equipment (WEEE), popularly referred to as e-waste is the fastest growing stream of waste in industrialized countries. This perhaps reflects the developing trend that the electronics industry is the fastest growing manufacturing industry, producing cellular phones, personal stereos, air conditioners, consumer electronics and computers, etc. A large proportion of end-of-life equipment (e-waste) as well as near end-of-life equipment is shipped to developing countries for dumping or recycling and for use respectively. The near end-of-life equipment no sooner joins the e-waste stream.

Much e-waste recycling occurs in the informal sector, where the youth and also women are engaged in hazardous recycling practices without the benefit or the knowledge of exposure-minimizing technology or protective equipment. High levels of environmental contaminants are generated from e-waste recycling, that put residents and the general population in surrounding areas at risk of health and ecological exposure via inhalation or ingestion of contaminated water, air, and food sources. In addition to risks of injury, potential exposure includes the original constituents of the equipment, substances added during the recovery process, and substances formed as a result of the often crude recycling process. Thus, although the potential toxicity of the original components might be known, workers and residents are likely to be exposed to complex mixtures of unknown toxicity.

Previous studies on the e-waste situation in Ghana, particularly at Agbogbloshie have established the dire environmental and health consequences of the informal recycling activities on the one hand, and on the other, the significant socio-economic benefits of the sector to the national economy. Among the key studies are the:

- Assessment of Health Status and Effects of Exposure to Chemicals at Agbogbloshie E-Waste;
- Recycling and Dump Site – Accra, Ghana;
- Heavy Metal Polluted Soils; Effects on Plants and Bioremediation Methods;
- Soil and Water Pollution Levels in and around Urban Scrapyards;
- Ghana E-waste Country Assessment; and
- Socio-economic Assessment and feasibility study on sustainable e-waste management in Ghana.

The management of hazardous and toxic pollutants from the informal e-waste recycling sector is an emerging challenge for Ghana. The resulting grave environmental and public health concerns are felt mostly in the urban areas, but rapidly becoming common in rural areas also. It is a complex issue that requires to be addressed in a holistic manner. However, institutional capacity (technical, financial and administrative) to regulate, monitor and enforce good practices, and also manage the health and environmental consequences is limited. It is essential therefore to put in place appropriate policies and actions to deal with regulation of the sector, institution of appropriate standards and work practices, cleaning up of contaminated sites, monitoring of exposure and effects, implementation of cleaner technologies and building capacity and raising awareness.

1.2 Purpose of the Study

The World Bank received grant funds from the Global Environment Facility (GEF) to support preparatory work to respond to the issue of e-waste with the aim of designing a larger program to address environment and health risks associated with harmful chemicals, such as Mercury and other heavy metals from e-waste

recycling and disposal of toxic and hazardous fractions. The objective of this assignment was to undertake a detailed study and prepare a technical report on management of e-waste in Ghana. The study therefore set out to:

- Review the quantum and trends of electrical and electronic equipment (EEE) importation and e-waste generation in Ghana;
- Review the policies and regulatory environment in Ghana guiding the importation of new and old (used) EEE, and the handling and disposal of WEEE;
- Improve understanding of the environmental health implications of e-waste handling and informal recycling in Ghana and of options for risk management.
- Develop a program of action for e-waste management in Ghana.

1.3 Main Areas of the Study

The study covered an inventory of the types and quantities of EEE entering the country for the five-year period between 2009 and 2014), and an estimate of the amount of obsolete equipment recycled, using the Agbogbloshie scrap yard as the reference hotspot. The other key aspects of the study included:

- Exposure of persons involved in e-waste recycling to health risks;
- Contamination levels at the recycling site; and
- Contribution of the sector to the national economy.

An action plan was developed to guide the sound management of e-waste in the country, covering policy, regulatory and standards requirements, consistent with internationally accepted best practices for WEEE recycling. The action plan covered the following broad areas:

- Recommended policies and guidelines to manage the import of e-waste, employee and work standards for recycling, refurbishment and end disposal;
- Environment management systems, including investments for infrastructure and technology needed for clean recycling of various components, disposal of end products, and occupational and health safety standards;
- Clean-up plan for the contaminated sites;
- Systematic monitoring of occupational health and exposure of workers;
- Proposed systems to formalize collection and transportation of e-waste;
- Capacity building and awareness creation;
- Private Public Partnership (PPP) initiatives and involvement of producers of EEE goods to improve production and buy-back systems;
- Systems for monitoring and enforcement; and
- Timeline and budget for implementation of the Action Plan.

1.4 Report Organization

The report contains six (6) main chapters, an executive summary, references and appendices. The main chapters are as follows:

- Chapter One – General introduction;

- Chapter Two – Methodology;
- Chapter Three – Legal, regulatory and policy framework on e-waste;
- Chapter Four – Ghana e-waste inventory;
- Chapter Five – Contamination profile of the Agbogbloshie scrap yard; and
- Chapter Six – Action plan for e-waste management.

CHAPTER TWO

METHODOLOGY

- **Categorization of EEE**
- **Sampling Techniques**
- **Review of Related Literature**
- **EEE Import and WEEE Survey**
- **Contamination Study and Base map**
- **Limitations**

2.0 METHODOLOGY

2.1 Categorization of EEE

For the purpose of the study, EEE were put into five (5) groups: large household; small household; IT and telecommunication equipment; consumer electronics; and others (EEE parts). Details of the equipment type in these categories are given in Table 2.1

Table 2. 1 Categories of EEE

No.	Category	Equipment	
1	Large household	• Fridge • Freezer • Air conditioner • Washing machine	• Electric heater • Electric/Gas stove • Dishwasher • Griller
2	Small household	• Iron • Kettle • Hand dryer • Fan • Toaster	• Blender • Microwave • Toaster • Vacuum cleaner • Coffee maker
3	IT and Telecommunication	• Fax machine • Phone (landline) • LCD monitor • CRT monitor • Router	• Printer • Photocopier • Scanner • Modem
4	Consumer electronics	• Laptop/notebook • TV (LCD/LED) • TV (CRT) • DVD player • Sound system	• Projector • Digital camera • Calculator • VCR
5	Others (EEE parts)	• Mobile phone screens • TV screens • Laptop batteries	• CD-ROMs • External hard drives • Mobile phone batteries • Pen drives

2.2 Sampling Techniques

Three (3) key sampling techniques - purposive, quota and random sampling outlined below - were used, each of which was applied at various levels in the sampling process.

2.2.1 Purposive Sampling

The Greater Accra Region was purposively selected for the study owing to the following reasons:

- It has a high level of economic and social activity likely to translate into high use rate of EEE and high rate of generation of WEEE;
- It houses the Agbogbloshie e-waste recycling site, which is a key focus in this study;
- It has been determined, from previous studies, to have the largest scale of informal WEEE activities; and
- It houses the main port of entry of EEE and WEEE.

Nine locations within the region were also selected purposively based on the prevalence of EEE-related activities relevant to the study. The locations are as follows:

- Kwame Nkrumah Circle
- Abeka Lapaz
- Nyamekye
- Darkuman
- Odorkor
- East Legon
- Spintex Road
- Agbogbloshie

2.2.2 Random Sampling

Electronic and electrical equipment repairers were randomly selected from seven (7) of the locations mentioned earlier. Selection of sampling points for contamination study at Agbogbloshie and interactions with recyclers was also done randomly.

2.3 Review of Related Literature and Statistical Data

A number of publications, research work and statistical data related to this study were relied on for comparison, confirmation and complementary purposes. References were made to work done by Green Advocacy Ghana (GreenAd), Ghana Health Service and the Blacksmith Institute (now Pure Earth) of the USA; and also GreenAd, EMPA, and the Oko Institute of Germany under the auspices of the E-Waste Africa Project of the Secretariat of the Basel Convention, and coordinated by the Environmental Protection Agency of Ghana. Information was also culled from government websites and other sources such as the Ghana Living Standards Survey (GLSS), and statistical data from the National Census Bureau and Statistical Service. A full list of the various resources used is at the References section.

2.4 EEE Import and WEEE Survey Methodology

The four main actors involved in EEE and WEEE activities were considered; and data sought on various aspects, such as dealership, employee numbers, income levels, quantities of imports and refurbishment and recycling, etc. Data collection primarily involved guided questionnaire administered to the various groups (Appendices 1A, 1B, 1C and 1D). The groups consulted are:

- Customs Division of GRA;
- Importers of EEE;
- Refurbishers of EEE; and
- Recyclers of WEEE.

2.4.1 Customs Division of GRA

The Customs Division is the government body with the mandate to monitor, screen and record all goods entering and leaving the country for purposes of export and import and export duty and import excise and as such have custody of official records on EEE entering Ghana. A previous study; E-Waste Country Assessment covering the period 2004-2008 relied on this same source for EEE import data, and this was therefore to ensure consistency and for ease of comparison. An official request was made to the Division for data covering a 5-year period (from 2009 to 2014), which was duly provided. The format for the data extract is given in Appendix 1D. This covered the type of EEE, country of origin (export), quantity, the year and whether new EEE or used (old) equipment.

2.4.2 Importers of EEE

Five major EEE importers/dealers in Ghana, namely: CompuGhana Ltd., Zepto Ghana Ltd., Next Computers, SETMAT Ghana Ltd and Hisense Ghana Ltd, were selected from four (4) locations within Accra (i.e. Spintex Road, Kwame Nkrumah Circle, East Legon and Osu). Selection of these locations was based on the strong presence of the EEE industry in these areas. A guided questionnaire (Appendix 1A) was administered to elicit responses with regards to the types of EEE, number of employees, range of income, etc. The information obtained was to help determine the study objectives of employment of generated by the sector, contribution of the sector to the national economy, etc.

2.4.3 Refurbishers of EEE

Refurbishers, in the context of the study, refer to those involved in the repair and/or resale of EEE in the 'informal sector'. The group comprised small-to-medium sized repair or resale shops selected randomly from seven (7) locations within Accra considered to be major areas of operation for refurbishers. Interaction involved administering of a questionnaire (Appendix 1B). A total of sixty-nine (69) entities from the Spintex Road, Kwame Nkrumah Circle, Odorkor, Abeka-Lapaz, Nyamekye, Darkuman and East Legon were involved in the study.

2.4.4 Recyclers of WEEE

This category comprised people involved in the dismantling and recycling of e-waste. The sample population was entirely derived from Agbogbloshie, which is the hub of e-waste recycling within the Greater Accra Region. A sample size of sixty-seven (67) was selected made up of persons involved in various activities including collection and transporting and dismantling of e-waste. Interaction involved administering of a questionnaire (Appendix 1C).

2.5 Methodology for Contamination Study and Base Map Generation

A GPS-aided survey was conducted for the presence of various contaminants at Agbogbloshie. A Garmin Etrex GPS device was used to determine coordinates at 30 randomly selected points within the study area. Two types of analysis were done at each point:

- The presence and levels of contaminants in the soil was determined in-situ using an Innov-X SYSTEMS XRF device at the soil surface and then at a 3.6- inch depth. Figure 2.1 shows the XRF in use on site; and
- Soil samples were taken at 4 of the 30 in-situ sampling points for chemical analysis (for control purposes). The samples were analyzed at the Laboratory of the Water Research Institute of CSIR.

Figure 2. 1 In-Situ Determination of Contaminants

The GPS coordinates were recorded as points using ArcGIS software; a database was generated for each of the points indicating the type of element encountered and the magnitude. A map of the distribution of elements on the site is shown in Figure 2.2. The full results for the in-situ and laboratory analysis are provided in Appendices 3B and 3C respectively. The ArcGIS software was used to generate topographic and image maps for the site. Google maps were also used for illustration. Full details of the maps are given in Chapter Five.

2.6 Limitations of the Study Methodology

The following are some limitations of the study methodologies:

1. Narrow scope of study - limiting the study to the Accra Metropolis;
2. Extensive use of correction or reduction factors, adjustments and assumptions;
3. Absence or limited business documentation and unreliable responses from the informal operators;
4. Potential skewed results from one-time contamination study (soil analysis) in the rainy season; and
5. Absence of information and non-inclusion of locally assembled EEE.

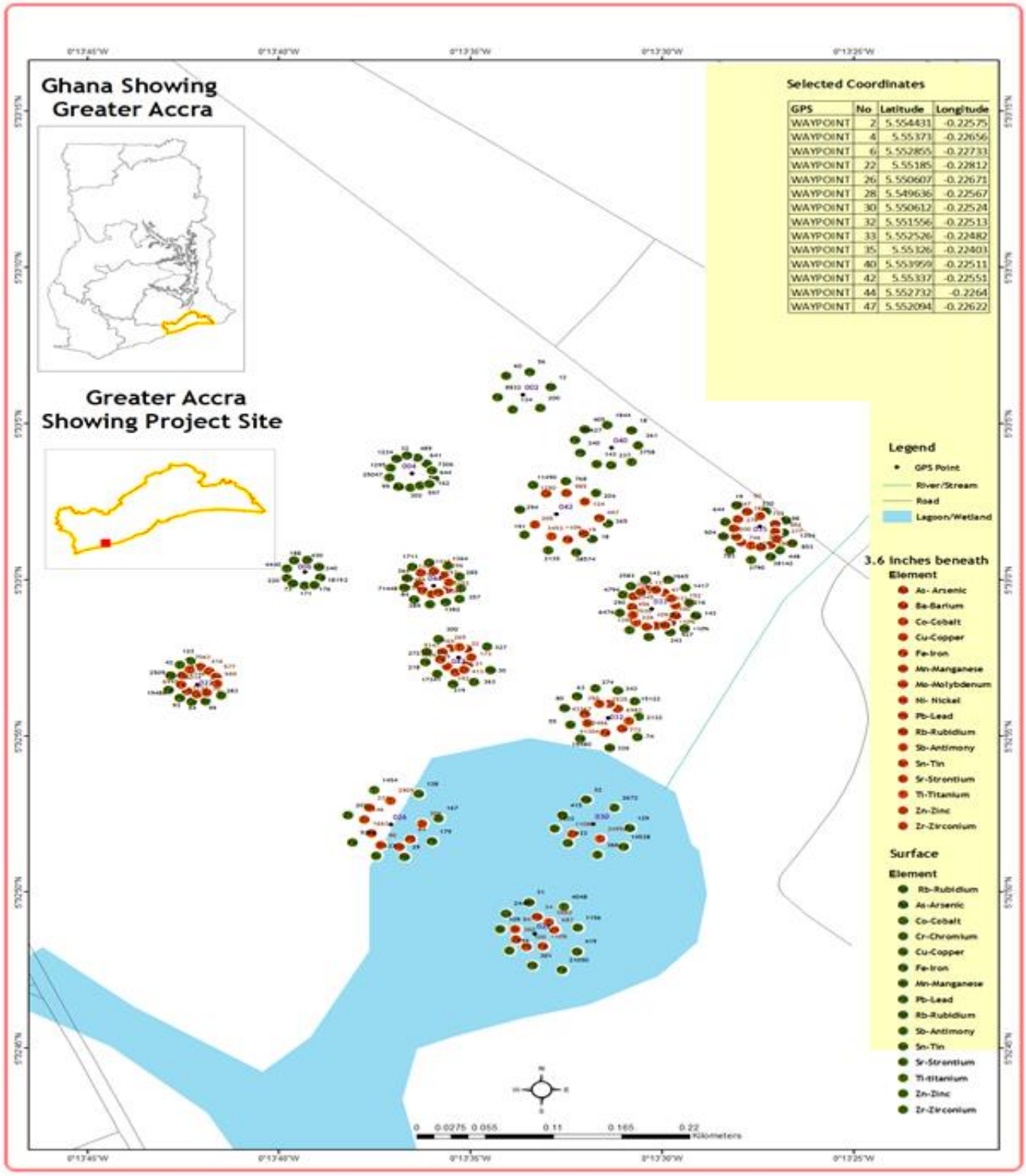


Figure 2. 2 Map of Scrap Yard showing Sampling Points

CHAPTER THREE

LEGAL, REGULATORY AND POLICY FRAMEWORK ON E-WASTE

- **National Policies**
- **National Laws and Regulations**
- **Key National Institutions**
- **International and Multilateral Agreements**
- **Identified Gaps and Recommendations**

3.0 LEGAL, REGULATORY AND POLICY FRAMEWORK ON E-WASTE

The relevant policies, legal and institutional frameworks to issues on EEE and the WEEE (e-waste) sector, particularly to the recycling of WEEE reviewed include broadly the following:

6. The 1992 Constitution of the Republic of Ghana;
7. National policies;
8. National laws and regulations;
9. Other key national Institutions; and
10. International and multilateral environmental agreements.

3.1 The 1992 Constitution of Ghana

The 1992 Constitution of Ghana provides the broad policy for the protection of the environment in general. The relevant sections include the following:

- Economic Development - Article 36 (9): The State shall take appropriate measures needed to protect and safeguard the national environment for posterity; and shall seek co-operation with other states and bodies for the purposes of protecting the wider international environment for mankind.
- Economic Development - Article 36 (10): The State shall safeguard the health, safety and welfare of all persons in employment, and shall establish the basis for the full deployment of the creative potential of all Ghanaians.
- Duties of a Citizen - Article 41 (k): The exercise and enjoyment of rights and freedoms is inseparable from the performance of duties and obligations, and accordingly, it shall be the duty of every citizen to protect and safeguard the environment.

3.2 National Policies

The key policies related to the sector are:

1. Ghana ICT for Accelerated Development (ICTAD) Policy;
2. National Policy on Public Private Partnership;
3. National Environmental Policy;
4. Climate change policy;
5. Occupational Safety and Health Policy of Ghana (Draft 2004);
6. National Energy Policy; and
7. Environmental Sanitation Policy.

3.2.1 The Ghana ICT for Accelerated Development Policy (ICT4AD)

Information and Communications Technology (ICT) is an umbrella term that includes any communication device - radios, televisions, mobile phones, desktop computers, laptops and network hardware, software, satellite systems as well as the various services and applications associated with them. The ICT4AD Policy of Ghana was designed to address the nation's developmental challenges and accelerate socio economic development to improve the well-being of its people through deployment and exploitation of ICTs within the society and economy.

The overall objective of the policy is to engineer an ICT led socio-economic development process to transform Ghana into a middle income, information rich, knowledge based and technology driven economy. Included in the policy are the priority focus areas - the 14 ICT4AD Pillars, which include:

- Promoting ICTs in education – deployment and exploitation of ICTs in education;
- Facilitating administration and service delivery – electronic government and governance;
- Developing an export-oriented ICT products and services industry;
- Developing a globally competitive and value added services sector;
- Deploying and spreading ICTs in the community;
- Rapid ICT and enabling physical infrastructure development;
- Research and development (R&D), scientific and industrial research capacity development;
- Legal, regulatory and institutional framework provisions; and
- Promoting local and foreign direct investment drive in ICTs.

3.2.2 National Policy on Public Private Partnership

A Public Private Partnership (PPP) is a contractual arrangement between a public entity and a private sector party, with clear agreement on shared objectives for the provision of public infrastructure and services traditionally provided by the public sector. Usually in a PPP arrangement, the private sector party performs part or all of the government's service delivery functions, and assumes the associated risks for a significant period of time. In return, the private sector party receives a benefit/financial remuneration (according to predefined performance criteria), which may be derived entirely from service tariffs (user charges), Government budgets, periodic payments (annuities) and contingent, or a combination of the above.

The key objectives of this policy are to:

- Leverage public assets and funds with private sector resources to accelerate needed investments in infrastructure and services;
- Encourage and facilitate investment by the private sector by creating enabling environment for PPPs;
- Ensure attainment of required and acceptable local and international social and environmental standards;
- Protect the interests of all stakeholders including end users, affected people, etc.; and
- Encourage and promote indigenous Ghanaian private sector participation in delivery of public infrastructure and services.

The benefits of PPPs include the following:

- Accelerated delivery of needed infrastructure and public services on within budget;
- Encouraging the private sector to provide innovative design, technology and funding;
- Increased international and domestic investment;
- Ensuring good quality public services and their wider availability;
- Economic growth and increased and wider employment possibilities;
- Technology transfer and capacity building; and
- Improved operation and maintenance of public infrastructure.

All PPP arrangements in Ghana are guided by the principles of:

- Value for money;
- Risk allocation;
- Ability to pay;
- Local content and technology transfer;
- Safeguard public interest and consumer rights; and
- Environmental, climate and social safeguards.

3.2.3 National Environmental Policy (2012)

The National Environmental Policy (NEP) adopted in 1991 evolved from the National Environmental Action Plan (NEAP) process. The plan provides a broad framework for the integration of environmental issues into development strategies and actions. The ultimate aim of the NEP was to improve the surroundings, living conditions and the quality of life for the entire citizenry, both present and future. It sought to ensure reconciliation between economic development and natural resource conservation, making high quality environment a key element to country's economic and social development. It also aimed at ensuring that a preventive approach was adopted in the pursuit of sound environmental management. The adoption of the NEAP led to the enactment of the EPA Act 1994 (Act 490); and subsequently the passing of the Ghana EIA Procedures into the EA Regulations, 1999 (LI 1652).

The policy statement on the environment requires the State to "take appropriate measures, irrespective of the existing levels of environmental pollution and extent of degradation, to control pollution and the importation and use of potentially toxic chemicals". This expectation from the State requires a more comprehensive policy on toxic substances (including e-waste) for the country.

The revised NEP list among other environmental issues, e-waste as one of the emerging environmental challenges that has gained prominence in the country. The policy describes e-waste as used equipment in the form of computers, copying machines, television sets, mobile phones and electronic equipment, imported into Ghana without regard to their age and degree of usefulness. It acknowledges that the burning of components of e-waste to retrieve useful parts releases emissions and toxins that cause detrimental impacts on human health and the environment.

3.2.4 National Climate Change Policy

The National Climate Change Policy (NCCP) was developed from the National Climate Change Policy Framework (NCCPF). The Government of Ghana sees response to climate change as part of its development agenda, recognizing that climate change must be mainstreamed into policies and all sectorial activities in order to achieve sustainable national growth. Three objectives of the NCCP are Effective adaptation, Social development and Mitigation. In order to achieve these objective appropriate systems must be put in place to ensure success. These are outlined in the following systemic pillars:

- Governance and Coordination;
- Capacity-building;
- Science, Technology and Innovation;
- Finance;
- International Cooperation;

- Information, Communication and Education; and
- Monitoring and Reporting.

3.2.5 Occupational Safety and Health Policy of Ghana (Draft 2004)

The policy statement of the OSH Policy (draft 2004) is: 'to prevent accidents and injuries arising out of or linked with or occurring in the course of work, by minimizing as far as reasonably practicable the cause of the hazards in the working environment and, therefore the risk to which employees and the public may be exposed'. The policy is derived from provisions of the International Labour Organization (ILO) Conventions 155 and 161. The policy document has specific sections on objectives, scope, strategies, activities promotion and awareness creation which ensure that workers are protected.

3.2.6 National Energy Policy

The National Energy Policy of Ghana seeks to address the challenge of increasing energy supply and also expanding energy infrastructure in the country in a way that is sustainable. The Policy objective is to increase electricity generation capacity from the current 1,986MW to over 4,000MW by 2015.
The policy addresses challenges and issues relating to the following areas:

- Power Sub-sector;
- Renewable Energy Sub-sector;
- Waste-to-Energy;
- Energy Efficiency and Conservation;
- Energy and Environment; and
- Energy and Gender.

Under the area of Energy Efficiency and Conservation section, the policy seeks to:

- Reduce wastage in all aspects of the energy sector;
- Ensure efficient production and transportation as well as end –use efficiency and conservation of energy;
- Develop and implement programmes and measures to help consumers optimize their energy use; and
- Support a sustained and comprehensive public education and awareness creation campaign on the methods and benefits of energy conservation.

The Energy and Environment section of the policy also addresses among others to ensure that energy is produced and utilised in an environmentally sound manner as well as to ensure effective disposal of all hazardous substances and materials associated with the production, transportation, and use of energy.

3.2.7 National Environmental Sanitation Policy, 2010

The Environmental Sanitation Policy (2010) is the outcome of reviews to address limitations of the old policy published in 1999 to reflect the changing context of national and international development priorities. The policy is aimed at developing and maintaining a clean, safe and pleasant physical and natural environment in all human settlements, to promote the socio-cultural, economic and physical well-being of all sections of the population. It recognises the need to develop rapid response systems for adopting emerging international regulations on issues such as global warming, Waste Electrical and Electronic Equipment (WEEE), ICT as well as special hazardous waste. The policy also proposes collaboration among appropriate agencies to enable

tracking of end-of life Waste-Electrical and Electronic Equipment (WEEE) and the export of items such as scrap metal which will provide basis for cross-sectoral recognition of incentive schemes.

3.3 National Laws and Regulations

The relevant national laws and regulations considered include the following:

1. Environmental Protection Agency Act;
2. Environmental Assessment Regulations;
3. Draft Hazardous and Electronic Waste Control and Management Bill;
4. Factories, Offices and Shops Act;
5. Energy Commission Act;
6. Energy Efficiency Regulations;
7. Management of ozone depleting substances and products regulations (LI 1812)
8. Local Government Act.
9. Mercury Law;
10. Ghana Standards Authority Decree;
11. Export and Import Act; and
12. Ghana Revenue Authority Act;

3.3.1 Environmental Protection Agency Act, 1994 (Act 490)

The Act grants the Agency enforcement and standard setting powers, and the power to ensure compliance with such standards and guidelines. The Act mandates the EPA to ensure compliance with the Environmental Assessment (EA) requirements, and among others, to:

- Control the discharge of waste and the generation, treatment, storage, transportation and disposal;
- Control and monitor use and advice on regulation and management of hazardous substances;
- Develop environmental standards such as the Ambient Air Level Guidelines; and
- Develop comprehensive database on environment and environmental protection for the promotion of sound ecological systems, effective planning and sustainable development.

The Agency is vested with the power to determine what constitutes an 'adverse effect on the environment' or an activity posing 'a serious threat to the environment or public health', to require EAs Environmental Management Plans (EMPs), Annual Environmental Reports (AERs), etc. of undertakings, to regulate and serve 'Enforcement Notice' for any offending or non-complying undertaking (including projects with hazardous waste generation).

The Agency is required to conduct monitoring to verify compliance with Environmental Permit conditions, environmental standard and other mitigation commitments. Furthermore, a requirement for EA for an undertaking by EPA precludes any authorising Ministry, Department or Agency from licensing, permitting, approving or consenting such undertaking, unless notified otherwise by the Agency.

3.3.2 Environmental Assessment Regulations, 1999 (LI 1652)

The Environmental Assessment Regulations prohibit commencing an 'undertaking' (including e-waste recycling or processing facilities), without prior registration and environmental permit (EP). Undertakings are grouped into schedules for ease of screening and registration, and for environmental permit. The schedules include undertakings requiring registration and environmental permit (Schedule 1), EIA mandatory

undertakings (Schedule 2), as well as Schedule 5-relevant undertakings. Environmental management system refers to the environmental requirements at the implementation phase for projects, etc. The main requirements during the project implementation phase include Environmental Management Plan (EMP), Annual Environmental Report (AER) and Environmental Certification.

3.3.3 Draft Hazardous and Electronic Waste Control and Management Bill (2011)

In 2010, the government developed a hazardous and electronic waste control and management bill. It is in a draft version and its being re-processed by Ghana's Parliament. The bill consists of two parts:

- Part one addresses hazardous waste and other waste. It sets out provisions regarding the control of trans-boundary movement of hazardous wastes and disposal, management of hazardous waste and other waste and miscellaneous provisions
- Part two addresses electronic waste. It introduces the e-waste levy, e-waste recycling fund and provisions for e-waste recycling plants.

Under the e-waste levy, a manufacturer or importer of electronic equipment is required to register with the Environmental Protection Agency and pay electronic waste levy in respect of electronic equipment that is imported into the country or manufactured in the country. The levy is to cater for the costs of the collection, treatment, recovery and environmentally sound disposal and recycling of electronic waste. The e-waste recycling fund is to provide finance for the management of electronic waste and reduce the adverse impact of electronic waste on human health and the environment. In particular, the fund shall be used for:

- The construction and maintenance of electronic waste recycling or treatment plants;
- Research into methods of electronic waste preservation, prevention and control;
- Research into electronic waste treatment and recycling;
- Publication of reports; and
- Education of the public on the safe disposal of electronic waste as well as the negative effects of electronic waste.

3.3.4 Factories, Offices and Shops Act

The Factories, Offices and Shops Act, 1970 (Act 328) mandates the Factories Inspectorate Department to register factories and ensure that internationally accepted standards of providing safety, health and welfare of persons are adhered to. It defines a factory to include any premises (whether in or not in a building) in which one or more persons are employed in manual labour, among others.

3.3.5 Energy Commission Act 1997

The Energy Commission is a government agency under the Ministry of Energy set up by the Energy Commission Act of 1997 (Act 541) as a statutory body on energy in Ghana and commissioned to regulate, manage, develop and utilize energy resources in Ghana. It is mandated to promulgate rules, standards and procedures and grant licenses for the transmission, wholesale supply, distribution and sale of electricity and natural gas, refining, storage, bulk distribution, marketing and sale of petroleum and also to provide for related matters. Pursuant to the act therefore, wholesale electricity and natural gas suppliers, transmitters and distributors of electricity and natural gas, and marketers of petroleum products offering or intending to offer for sale to customers in Ghana must apply to the Energy Commission for a Provisional Generation License to offer such services.

As part of its mandate, the Energy Commission has formulated a series of energy efficiency regulations known as Minimum Energy Performance Standards and Information Labels. The objective is to improve the level of energy efficiency of appliances imported, marketed and used in Ghana. These regulations are:

- Energy Efficiency Standards and Labelling Regulations, 2005 (LI 1815)
- Energy Efficiency Regulations, 2008 (LI 1932)
- Energy Efficiency Standards and Labelling Regulations, 2009 (LI 1958)
- Energy Efficiency Standards and Labelling (Amendments) Regulations, 2010 (LI 1970)

3.3.6 Energy Efficiency Regulations (2008) LI 1932

The Energy Efficiency Regulations, 2008 (LI 1932) forms part of the Minimum Energy Performance Standards and Information Labels developed by the Energy Commission to improve efficient end use of energy. The regulation prohibits the manufacture, importation and sale of used household refrigerators, freezers and air-conditioning systems as well as Incandescent Filament Lamps.

3.3.7 Management of Ozone Depleting Substances and Products Regulations (LI 1812)

The Regulations prohibit the import and export of a controlled substance or product without prior registration and obtaining a permit. LI 1812 also makes it illegal to manufacture goods containing or designed to use a controlled substance listed under its Schedule I. The regulation provides management processes for Ozone Depleting Substances and Products under the following:

- Schedule III – Permit Application form for the import or export controlled substances and products
- Schedule V – Annual Reporting format
- Schedule VI – Declaration by end-user of controlled substances and products
- Schedule VII – Records to be maintained for controlled substances and products

3.3.8 Local Government Act (1994) Act 462

The Ministry of Local Government and Rural Development (MLGRD) is the supervising ministry for the Metropolitan, Municipal and District Assemblies (MMDAs) in Ghana. One core function of the MMDAs is the collection and disposal of solid waste through the Waste Management Departments (WMDs) and the Environmental Health and Sanitation Departments of MMDAs.

3.3.9 Mercury Law, 1989 (PNDC 217)

The law legalises the possession and use of Mercury provided it is done with government authorisation and purchased from a government authorised dealer. The Minister responsible for Trade may issue a license to a person authorising that person to import into the Republic, possess, buy, sell or deal in Mercury, subject to the conditions specified in the license. A person who imports or possesses Mercury without the requisite license commits an offence and on conviction is liable to a fine not exceeding five hundred penalty units or to a term of imprisonment not exceeding two years or to both the fine and the imprisonment.

3.3.10 Ghana Standards Authority Decree, 1973

The Ghana Standards Board (GSB) established by NRCD 1973 of 1973 is vested with the responsibility for preparing standards for products and processes and for ensuring compliance with Government policies on Standards, Metrology, Standardization, Testing, and Quality Assurance of both locally manufactured and imported products and services throughout the country.

3.3.11 Export and Import Act, 1995 (Act 503)

The Ministry of Trade and Industries is responsible for regulating international trade - import and export of goods. The Export and Import Act governs a liberalized trade regime without import licenses but within certain regulatory boundaries. The Minister of Trade and Industries is empowered to prohibit or restrict the exportation or importation of any goods, by legislative instrument. The main thrust of the import-export trade regime is as follows:

- No license is required to import goods;
- Imports for commercial purposes should be covered by an Import Declaration Form (IDF);
- All commercial goods are subject to local inspection to ensure quality, quantity and price and other specifications;
- All commercial goods are to be covered by Final Classification and Validation Report. The Minister may by Regulations exempt goods from Inspection and Final Classification and Valuation Report; and
- Importer shall comply with other enactments e.g. Permit, license or certificate.

3.3.12 Ghana Revenue Authority Act, 2009, (Act 791)

In December 2009, the three tax revenue agencies, the Customs, Excise and Preventive Service (CEPS), the Internal Revenue Service (IRS), the Value Added Tax Service (VATS) and the Revenue Agencies Governing Board (RAGB) Secretariat were merged in accordance with the Ghana Revenue Authority Act, 2009 (Act 791). The Ghana Revenue Authority (GRA) thus replaces the revenue agencies in the administration of taxes and customs duties in the country.

3.4 Other Key National Institutions

The other relevant national institutions considered are:

1. Ministry of Environment, Science Technology and Innovation;
2. Ministry of Trade and Industry;
3. Ghana Atomic Energy Commission;
4. GRATIS Foundation;
5. Institute for Industrial Research (CSIR-IIR);
6. Ghana Standards Authority;
7. Ghana Ports and Harbours Authority; and
8. National Youth Authority.

3.4.1 Ministry of Environment, Science Technology and Innovation (MESTI)

MESTI has policy formulation functions on environment, science and technology for the accelerated socio-economic development of the nation and to promote the use of appropriate, environmentally friendly, scientific and technological practices and techniques. Specific medium-term objectives include:

- Intensification of the application of safe and sound environmental practices;
- Development and promotion of a science and technology culture at all levels of society;
- Strengthening of compliance of human settlements standards in communities; and
- Promotion, co-ordination and evaluation of research and development activities.

3.4.2 Ministry of Trade and Industry

The Minister is empowered under the Imports and Export (Permitted and Prohibited Goods) Regulations, 1980 to grant licenses prior to the importation of goods specified in the second schedule which includes a number of chemicals and obsolete electrical and electrical equipment.

3.4.3 Ghana Atomic Energy Commission

The Ghana Atomic Energy Commission (GAEC) was established by an Act of Parliament, Act 204 of 1963, as the sole Agency in Ghana responsible for all matters relating to peaceful uses of atomic energy. The Act 204 was amended in 1993 by PNDC Law 308 to enable it create other institutes under the Commission. This amendment resulted in the creation of two institutes - the Radiation Protection Institute and the Biotechnology and Nuclear Agriculture Research Institute (BNARI), in addition to the National Nuclear Research Institute (NNRI) formerly Kwame Nkrumah Nuclear Research Institute (KNNRI). The founding Act 204 has been superseded by Act 588 of 2000 enabling GAEC to undertake commercialization of its research and development results. The Commission makes recommendations to the Government for legislation in the field of nuclear radiation and radioactive waste management.

3.4.4 GRATIS Foundation

The Ghana Regional Appropriate Technology Industrial Service (GRATIS Foundation) promotes industrialisation by developing and distributing appropriate technology to small scale and medium-sized enterprises. The foundation is specialized in designing, manufacturing, and selling of precision agro food processing and sanitation equipment including palm oil processing, fruit juice extractors, palm oil extractors, cassava graters, feed mixers and many other food processing machines.

3.4.5 Institute for Industrial Research (CSIR-IIR)

The CSIR-IIR which is Ghana's foremost industrial research and development organization emerged out of the merger of the former Industrial Research Institute (IRI) and Scientific Instrumentation Centre (SIC) in 1998. The overall aspirations of the Institute has been to assist in poverty reduction through the creation of opportunities for generating and increasing incomes within the SMEs; contribute towards food security, generate foreign exchange earnings and apply cost-effective industrial technologies that are both environmentally friendly and commercially viable.

The current programmes of the CSIR-include the development and promotion of Renewable Energy Technologies, Industrial Processes, New Materials, Improved Sanitation, local Equipment Fabrication and Information/Communication Technology.

3.4.6 Environmental NGOs

Non-governmental organizations (NGOS) have become an important ally in the development process of the Third World. Activities of NGOS serve to mitigate the cost of developing countries institutional weaknesses, which often include administrative shortcomings and an inability to efficiently carry out essential development tasks, such as providing social services or protecting the environment. In recent years, NGOs have grown rapidly both in numbers and in the volume of resources they mobilize. In 1987, international NGOs transferred about $5.5 billion from the industrial to the developing countries - nearly $1 billion more than the International Development Association (UNDP, 1990:136).

3.4.7 Ghana Standards Authority

The Ghana Standards Authority (GSA) was established by the Standards Decree, 1973 (NRCD 173) as Ghana Standards Board, changing it from its previous name, National Standards Board as it was when first established in August, 1967. The GSA is the National Statutory Body responsible for Metrology, Standards, Testing, Inspection and Certification. In 2011, its name was changed from Ghana Standards Board (GSB) to its current name, the Ghana Standards Authority (GSA).

The mandate of the Authority involves the following:

- Establishing and promulgating standards to ensure high quality of goods produced in Ghana, whether for local consumption or for export;
- Providing quality assurance through inspection, testing and metrology;
- Assisting operators in both the manufacturing and service sectors to improve their competitiveness by establishing effective Quality Management Systems along ISO/IEC 9001:2008 and 22000:2005;
- Promoting standardization in industry and commerce; and
- Promoting standards in public and industrial welfare, health and safety.

3.4.8 Ghana Ports and Harbours Authority

The Ghana Standards Authority was set up by the Ghana Ports and Harbours Authority Act, 1986 (PNDCL 160). The Law spells out the functions of the GPHA. Among other things, the Authority shall plan, build, develop, manage, maintain, operate and control ports and in particular shall:

- Provide in a port the facilities that are necessary for the efficient and proper operation of the ports;
- Maintain the port facilities and extend and enlarge the facilities as the Authority considers fit;
- Regulate the use of a port and of the port facilities; and
- Provide facilities for the transport, storage, warehousing, loading, unloading and sorting of goods passing through a port, and operate road haulage services for hire reward.

3.4.9 National Youth Authority

Formally National Youth Council (NYC) is a statutory body established by the Government of Ghana in 1974 by NRCD 241 to co-ordinate and facilitate youth development and empowerment activities in the country. The NYA is under the Ministry for Youth & Sports.

The core activities of the national youth authority are as follows:

- The NYA registers youth groups and associations throughout the country to build reliable data for effective programming. It provides out-of-school youth, especially the deprived, with skills training through the Youth Leadership and Skills training Institutes.
- It organizes programmes to provide the youth with the best information to enable them make informed choices on health and career, while sensitizing them on governance, civic responsibilities and morality
- It provides opportunities for the youth to build their own enterprises and create wealth for themselves and the nation.
- It coordinates the activities of all youth organizations and formulates policies and programs in respect of all youth activities.

3.5 International and Multilateral Environmental Agreements

The four international and multilateral environmental agreements considered include:

1. The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal;
2. The Vienna Convention on Protection of the Ozone Layer;
3. The Stockholm Convention on Persistent Organic Pollutants;
4. ILO Convention on the Safety of Chemicals at the Workplace; and
5. The Minamata Convention on Mercury.

3.5.1 Basel Convention on the Control of Trans-boundary Movements

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal is designed to reduce the movements of waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries (LDCs). It does not, however, address the movement of radioactive waste.

The Convention is also intended to minimize the amount and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the source of generation, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate. The Convention was opened for signature on 22 March 1989, and entered into force on 5 May 1992.

The Convention does not directly address e-waste, however, hazardous waste categorized and listed under Annexes I, II, VIII and IX describes elements primarily associated with e-waste. The convention also provides protocols under Annex IV on disposal techniques as well as resource recovery, reclamation, recycling and re-use for such hazardous wast

3.5.2 Vienna Convention for the Protection of the Ozone Layer

The Vienna Convention was adopted in 1985 and entered into force on 22 Sep 1988. In 2009, the Vienna Convention became the first Convention of any kind to achieve universal ratification. The objectives of the Convention were for Parties to promote cooperation by means of systematic observations, research and information exchange on the effects of human activities on the ozone layer and to adopt legislative or administrative measures against activities likely to have adverse effects on the ozone layer.

The Convention did not require countries to take concrete actions to control ozone depleting substances. Instead, in accordance with the provisions of the Convention, the countries of the world agreed the Montreal Protocol on Substances that Deplete the Ozone Layer under the Convention to advance that goal.

3.5.3 Stockholm Convection on Persistent Organic Pollutants

The Stockholm Convention on Persistent Organic Pollutants (POPs) was adopted and opened for signature at a Conference of Plenipotentiaries held from 22 to 23 May 2001 in Stockholm, Sweden.
Ninety-two (92) States and the European Community signed the Convention at a ceremony in Stockholm on 23 May 2001. The Stockholm Convention entered into force on 17 May 2004, 90 days after the submission of the fiftieth instrument of ratification.

The convention marks the global commitment to protect human health and the environment from POPs. Considered as another milestone in combating the adverse impacts of organic pollutants, the Convention calls

for government commitment to take measures to eliminate or reduce the releases of these chemicals into the environment. Nations are obliged to establish national mechanisms to formulate and implement their own blueprint of actions for a sustainable healthy environment. Ghana signed and adopted the Convention on 23 May 2001 in Stockholm, Sweden, and ratified it on 30May 2003.

Due to the crude recycling process of WEEE, persistent organic pollutants are released into the environment from the burning of Polyvinyl Chloride (PVC) and other plastics used in computers and other related products.

3.5.4 The ILO Convention on the Safety of Chemicals at the Workplace

The ILO Convention on the Safety of Chemicals at the Workplace also known as the Chemicals Convention No. 170 was adopted by the International Labour Organisation (ILO) governing body on the 25th of June 1990 in Geneva. The convention applies to all branches of economic activity in which chemicals are used and admonishes for the safe use of chemicals in the workplace. Use of chemicals at the workplace means any activity which may expose a worker to a chemical including;

- Production of chemicals;
- Handling of chemicals;
- Storage of chemicals;
- Transport of chemicals;
- Disposal and treatment of waste chemicals;
- Release of chemicals resulting from work activities;
- The maintenance, repair and containers for chemicals.

Therefore, WEEE such as electricity transformers, vehicle engines, car batteries, generators, etc. that are crudely dismantled for recycling expose scrap to fluids, oils and acids contained in them. These chemicals are harmful to their health and to the environment.

3.5.5 The Minamata Convention on Mercury

This is an international treaty designed to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. The Convention was a result of three years of meeting and negotiating, after which the Convention was ratified by delegates from 140 countries on January 19, 2013. It is expected that over the next few decades, this international agreement will enhance the reduction of mercury pollution from the targeted activities responsible for the major release of mercury to the immediate environment.

3.6 Identified Gaps and Recommendations

The Ghana ICT for Accelerated Development Policy (ICT4AD) and other related socio-economic programmes of Government seek to accelerate an ICT led development process to transform Ghana into a middle income, information rich, knowledge based and technology driven economy. While the ICT4AD Policy is promoting and accelerating the common application of ICT and other EEE tools, the policy however, makes no provision for the management of the waste generated from the end of life ICT devices and products, such as desktop computers, laptops, mobile phones, and accessories, including batteries; television sets, radios and network hardware. All electrical and electronic devices have an end to their useful life, and

end of life EEE (i.e. WEEE) need to be properly managed (including recycling and sound disposal, especially of the hazardous fractions), in order to safeguard public health and the environment.

The 1992 Constitution of Ghana requires the State to take appropriate measures to protect and safeguard the environment for posterity, to seek co-operation with other states in protecting the wider international environment, to safeguard the health, safety and welfare of all persons in employment, as well as being the duty of every citizen to protect and safeguard the environment. The National Environmental Policy and a few of the national laws also have provisions for safeguarding the environment generally, but could also potentially provide the basis for the control and management of e-waste in the country.

The Environmental Policy (2012) lists e-waste as one of the emerging environmental challenges with prominence in Ghana. The policy describes e-waste as used equipment in the form of computers, copying machines, television sets, mobile phones and electronic equipment, imported into Ghana without regard to their age and degree of usefulness. It acknowledges that the burning of components of e-waste to retrieve useful parts releases emissions and toxins that cause detrimental impacts on human health and the environment. However, the policy does not mention the need for sustainable means of collection and recycling or disposal of hazardous e-waste fractions; neither does it offer guidance to prohibit illegal importation.

The Occupational Safety and Health Policy of Ghana derived from provisions of the International Labour Organization (ILO) Conventions 155 and 161; which seeks 'to prevent accidents and injuries arising out of or linked with or occurring in the course of work, by minimizing as far as reasonably practicable the cause of the hazards in the working environment and, therefore the risk to which employees and the public may be exposed', remains a draft document, a decade and over since it was drafted.

The policy statement of the OSH Policy (draft 2004) is: 'to prevent accidents and injuries arising out of or linked with or occurring in the course of work, by minimizing as far as reasonably practicable the cause of the hazards in the working environment and, therefore the risk to which employees and the public may be exposed'. The policy is derived from provisions of the International Labour Organization (ILO) Conventions 155 and 161. The policy document has specific sections on objectives, scope, strategies, activities promotion and awareness creation which ensure that workers are protected.

The OSH Policy needs to be updated to become more current and relevant, as the substantive policy for OSH in Ghana. This would have adequate provisions to probably replace the old fashion Factories, Offices and Shops Act, and consequently enable the Factories Inspectorate Department to perform its role of registration of factories (including WEEE operations and operational sites), and supervision along internationally accepted standards of safety, health and welfare protection.

CHAPTER FOUR

EEE COUNTRY CONTEXT

- **EEE Inventory**
- **WEEE Generation and Storage**
- **Contribution to the National Economy**

4.0 EEE COUNTRY CONTEXT

This chapter provides an understanding of the annual imports of EEE into the country over the past 5 years; estimates of WEEE generation; as well as the contribution of the sector to the national economy (income levels and employment).

4.1 EEE Inventory (Types and Volumes)

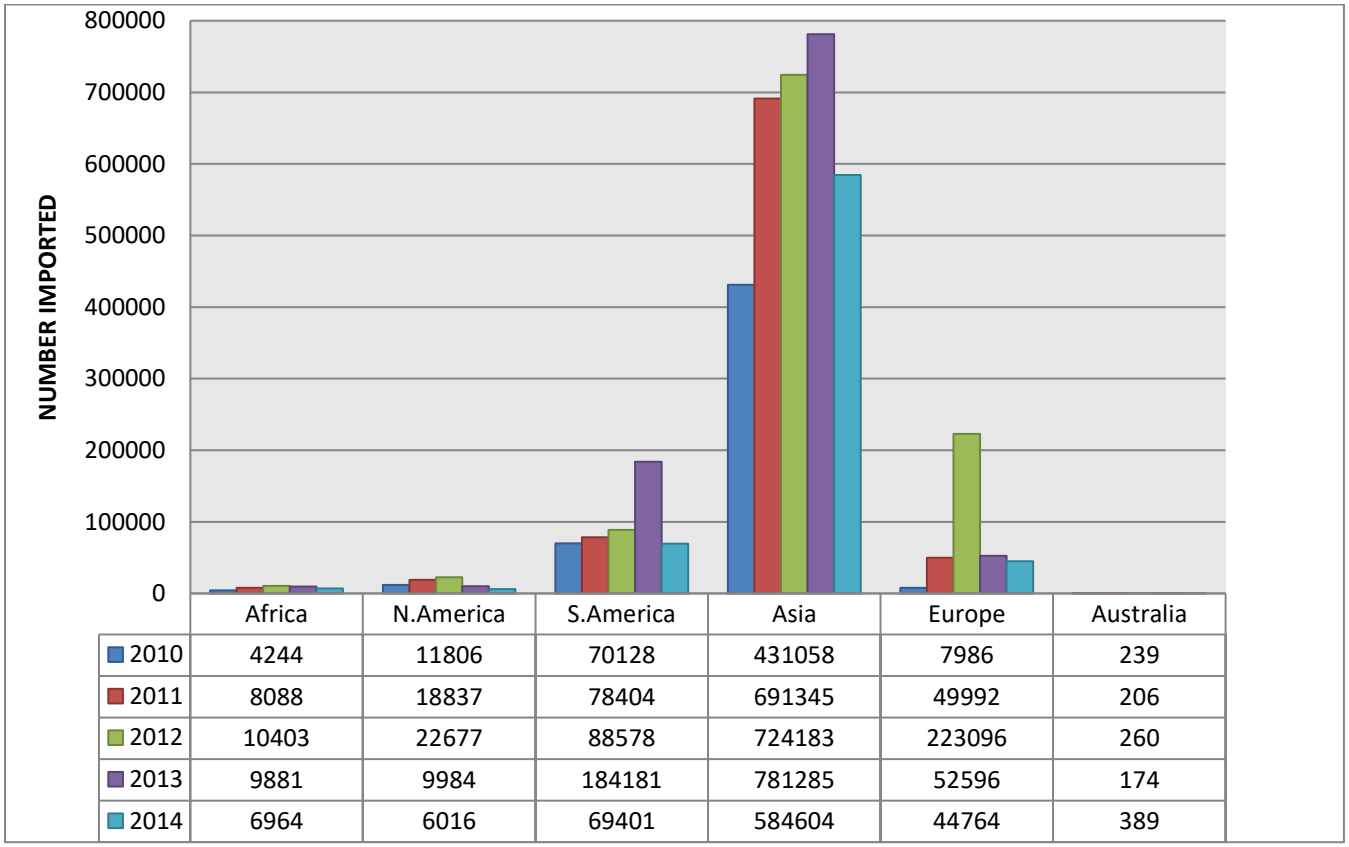
The Ghana e-waste inventory study classified all EEE into Large Household Appliances; Small Household Appliances; Consumer Electronics; ICT Equipment only; and EEE Components and Parts (an emerging group). The study also distinguished all categories of EEE into new and used imports.

4.1.1 Large Household Appliances Imports

The study defined large household appliances to include equipment such as grillers, dish washers, air conditioners, electric heaters, laundry dryers, washing machines, stoves and refrigerators. EEE import data from the various continents for the past 5 years (2010 - 2014) were evaluated and trends established. These were further categorised into "new" and "used" appliances.

(a) New Appliances

The trend observed for new large household appliances is presented in in Figure 4.1.



	Africa	N.America	S.America	Asia	Europe	Australia
2010	4244	11806	70128	431058	7986	239
2011	8088	18837	78404	691345	49992	206
2012	10403	22677	88578	724183	223096	260
2013	9881	9984	184181	781285	52596	174
2014	6964	6016	69401	584604	44764	389

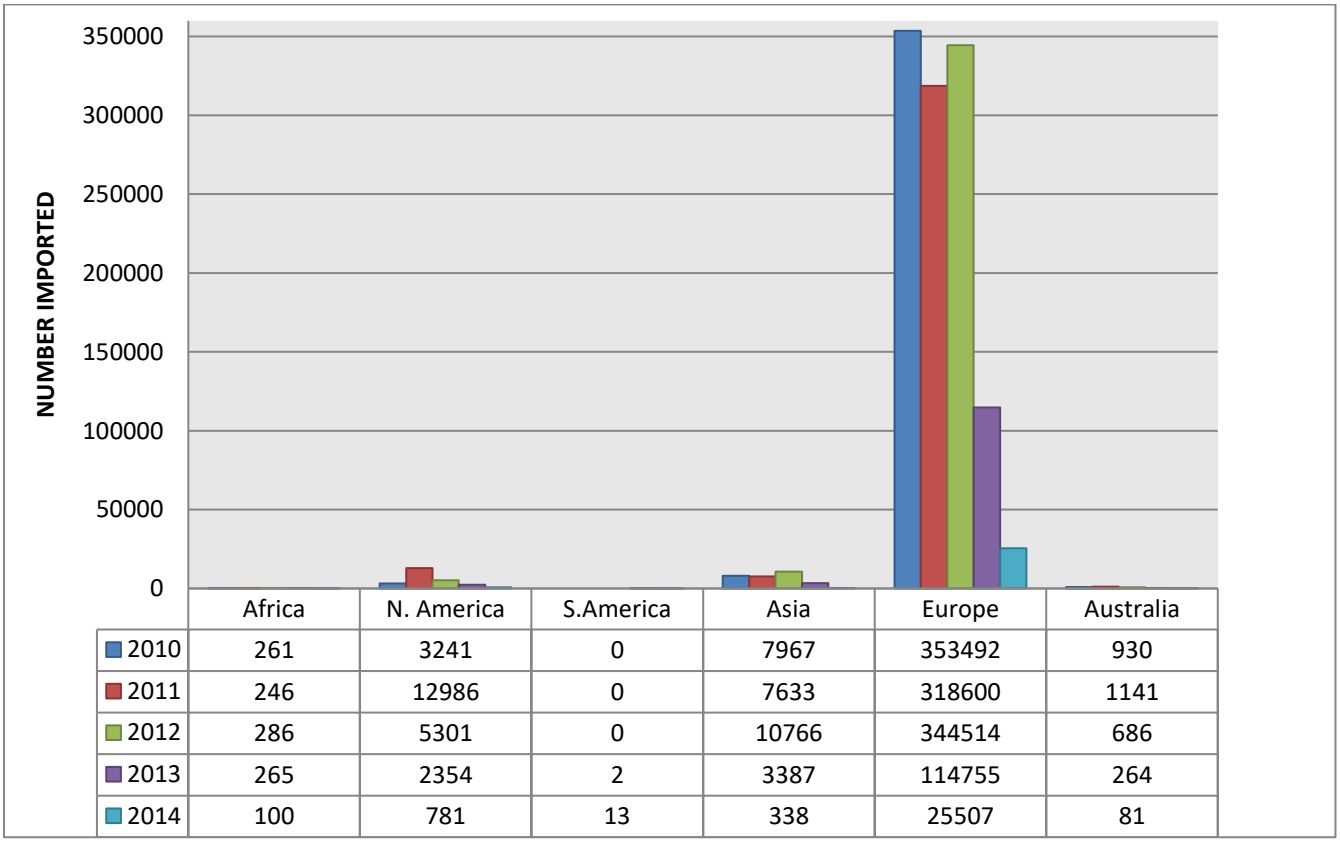
Figure 4. 1 Large Household Appliances Import for 2010 – 2014 (New Appliances)

The major findings are the following:

- Africa, North America and Australia recorded very low numbers of large household appliances in all 5 years as compared to the other regions, with average annual values of 7916, 13864 and 253.6 respectively;
- However, for Africa, North America, Europe and Australia there was a trend of annual increase which peaked in 2012 after which an annual decline begun;
- Imports from Asia recorded the most number of new large household appliances in all years, with an average annual value of about 642495;
- For South America (mean increment of 12% until it rose sharply to 107% in 2013) and Asia (mean increment of 24%) imports, there was an annual increase which peaked in 2013 after which it dropped significantly the subsequent year (62% and 15% for South American and Asian imports); and
- Import of new large household appliances from Europe was significantly high, recording an annual average of about 75686.

(b) Used Appliances

The trend observed for 'used' large household appliances is presented in Figure 4.2.



	Africa	N. America	S.America	Asia	Europe	Australia
2010	261	3241	0	7967	353492	930
2011	246	12986	0	7633	318600	1141
2012	286	5301	0	10766	344514	686
2013	265	2354	2	3387	114755	264
2014	100	781	13	338	25507	81

Figure 4. 2 Large Household Appliances Imports for 2010 – 2014 (Used Appliances)

The following trends regarding 'used' large household appliances imports were observed over the last 5 years:

- Imports of used large household appliances from Africa, North America, South America, Asia and Australia were very low in all years as compared to Europe (recording an annual average volume of 231373.6; about thrice the volume of new equipment from same continent over same period);
- Europe recorded the highest number of used large appliances in all years (231,373.6);
- South America had the least number of used large appliances in all years (annual average of 3);
- Africa recorded a peak volume of 286 in 2012, after which there was a decline;
- North America had a peak of used large appliances in 2011 after which it declined;
- South American imports recorded no used large appliances until 2013 after which there was over 600% increase in 2014;
- Asia recorded its highest number of imports of used large appliances in 2012 after which there was a series of sharp declines;
- Europe had its highest number of imports of used large appliances in 2010 after which there was gradual decline over the years; and
- Australia recorded an increase from 2010 to 2011 (23%) after which there was a series of sharp declines (40% in 2012, 62% in 2013, and 70% in 2014) in imports of used large appliances from the region.

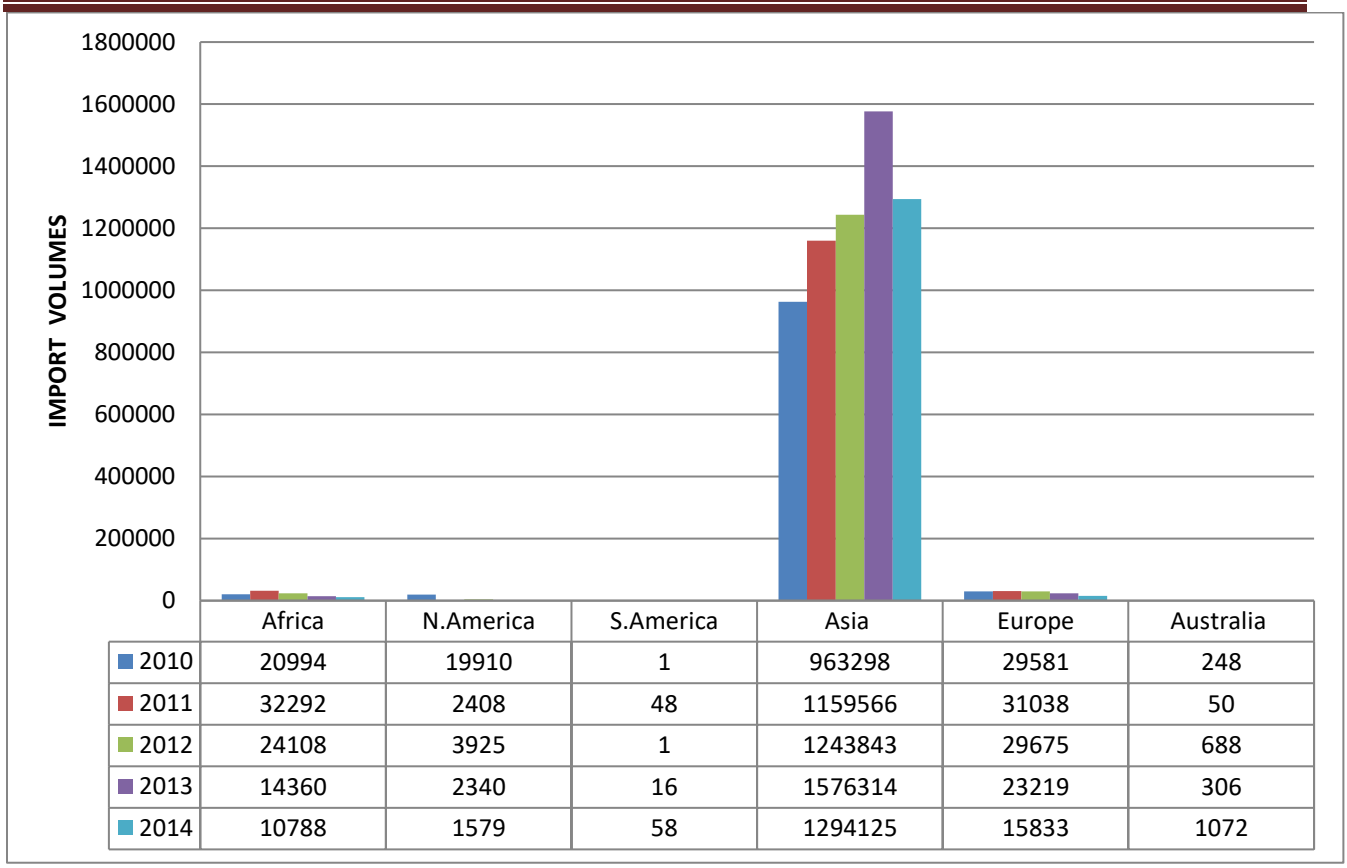
4.1.2 Small Household Appliances Imports

The study defined small household appliances to include equipment such as toasters, toothbrushes, fans, vacuumers, mixers, blenders, lawnmowers, kettles, microwaves, irons, popcorn makers, hair dryers and coffee machines. EEE import data from the various continents for the past 5 years (2010 - 2014) were evaluated and trends established. These were further categorised into "new" and "used" appliances.

(a) New Appliances

The trend observed for new small household appliances is presented in Figure 4.3. The following deductions could be made:

- A total of 6,501,684 "new" small appliances were imported into the country over the period 2010 – 2014, with a significant 95.93% of the total volumes coming from Asia and an average of about 1247429.2 per annum;
- The total imports from Europe, Africa, N. America, Australia and S. America were 129,346; 102,542; 30,162; 2,364; and 124 respectively; and
- The average annual imports from Europe, Africa, N. America, Australia and S. America were 25869.2, 20508.4, 6032.4, 472.8 and 24.8 respectively.

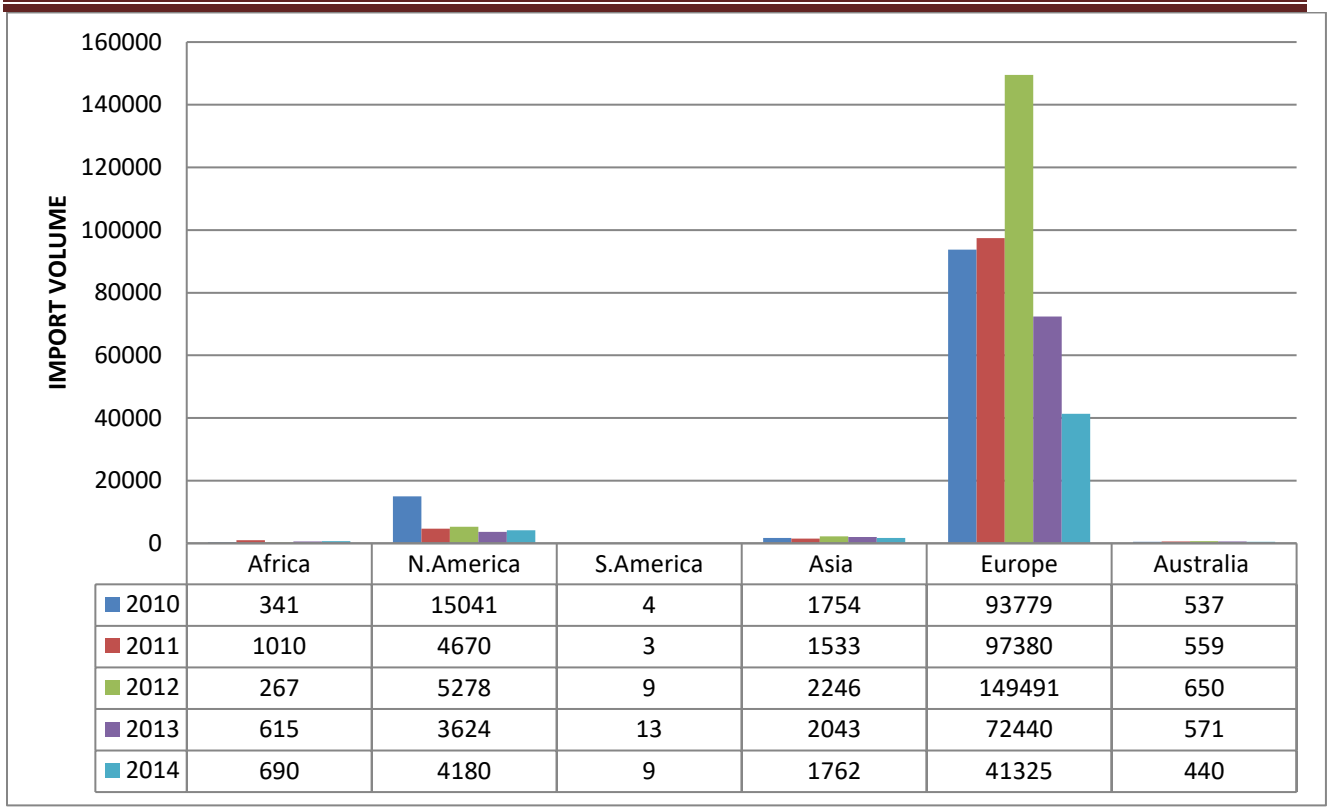


	Africa	N.America	S.America	Asia	Europe	Australia
2010	20994	19910	1	963298	29581	248
2011	32292	2408	48	1159566	31038	50
2012	24108	3925	1	1243843	29675	688
2013	14360	2340	16	1576314	23219	306
2014	10788	1579	58	1294125	15833	1072

Figure 4. 3 Small Household Appliances Imports for 2010 – 2014 (New Appliances)

(b) Used Appliances

The trend observed for 'used' small household appliances is presented in Figure 4.4 below:



	Africa	N.America	S.America	Asia	Europe	Australia
2010	341	15041	4	1754	93779	537
2011	1010	4670	3	1533	97380	559
2012	267	5278	9	2246	149491	650
2013	615	3624	13	2043	72440	571
2014	690	4180	9	1762	41325	440

Figure 4. 4 Small Household Appliances Imports for 2010 – 2014 (Used Appliances)

Analysis of the import figures for used small appliances reveals the following:

- A total of 502,264 "used" small household appliances were imported into the country over the period 2010 – 2014, with a significant 90.5% of the total volumes coming from Europe with an average of about 90,883 per annum;
- The total imports from N. America, Asia, Africa, Australia and S. America were 32793, 9338, 2923, 2757 and 38 respectively; and
- The average annual imports from N. America, Asia, Africa, Australia and S. America were 6558.6, 1867.6, 584.6, 551.4 and 7.6 respectively.

4.1.3 Consumer Electronics Imports

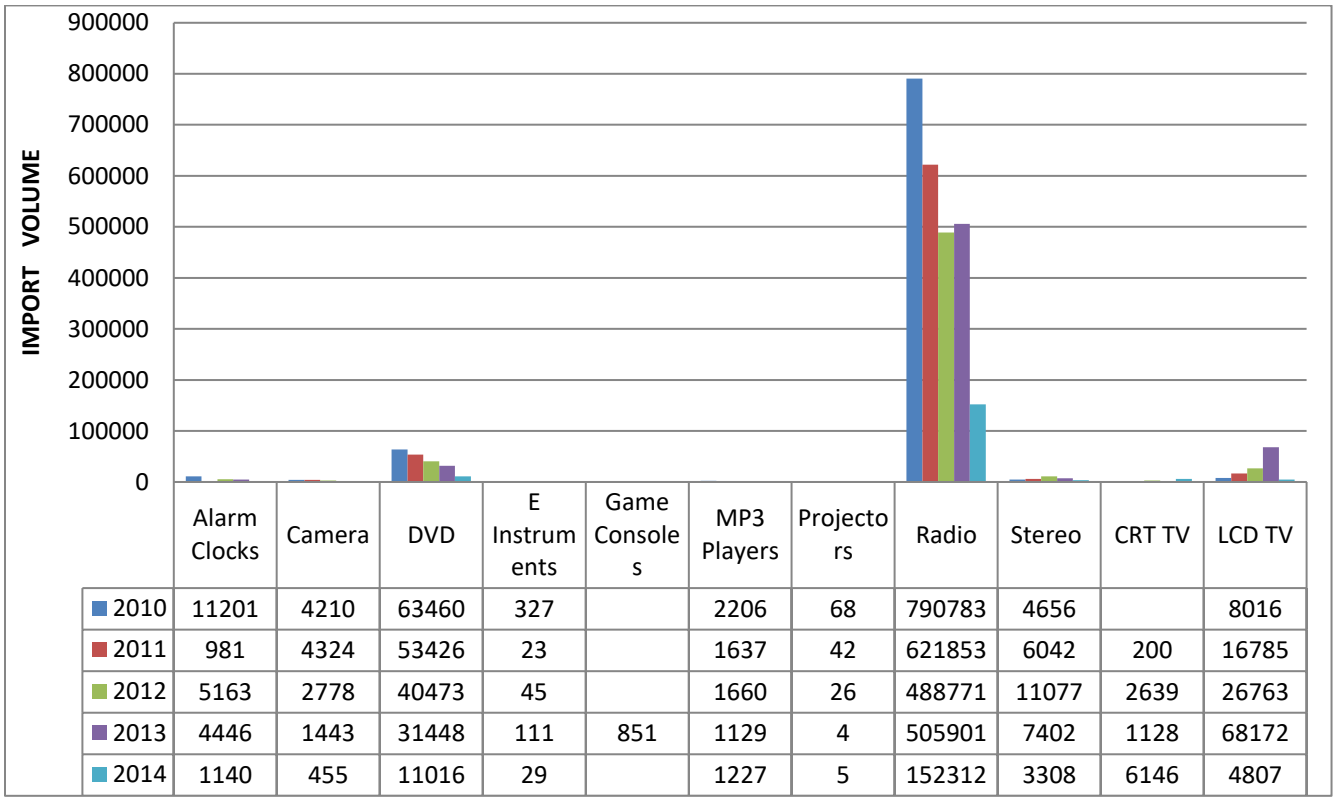
The major consumer electronic products imported into the country included alarm clocks, cameras, DVD, e-instruments, MP3 players, projectors, stereo players, game consoles, CRT TV, LCD TV and radio sets.

(a) New Products

Import trends for new consumer electronics are presented in Figure 4.5. The following patterns were observed:

- Out of the 11 main consumer electronics imported, radio sets alone occupied a significant 86% of all imports over the 5-year study period. The average volumes per year amounted about 511,924 units;
- The next two consumer electronic types imported over the period were DVD players and LCD TVs; both recording a combined percentage of about 11% (amounting to about 324366 units);

- The remaining 8 major consumer electronics imported into the country occupied about 3% (about 89163 units); and
- In terms of annual imports of new consumer electronics, total volumes fell steadily from 884,927 in 2010 to 579,395 in 2012, and rose to about 622,035 in 2013 and fell drastically by about 71% to 180,445 in 2014.



	Alarm Clocks	Camera	DVD	E Instruments	Game Consoles	MP3 Players	Projectors	Radio	Stereo	CRT TV	LCD TV
2010	11201	4210	63460	327		2206	68	790783	4656		8016
2011	981	4324	53426	23		1637	42	621853	6042	200	16785
2012	5163	2778	40473	45		1660	26	488771	11077	2639	26763
2013	4446	1443	31448	111	851	1129	4	505901	7402	1128	68172
2014	1140	455	11016	29		1227	5	152312	3308	6146	4807

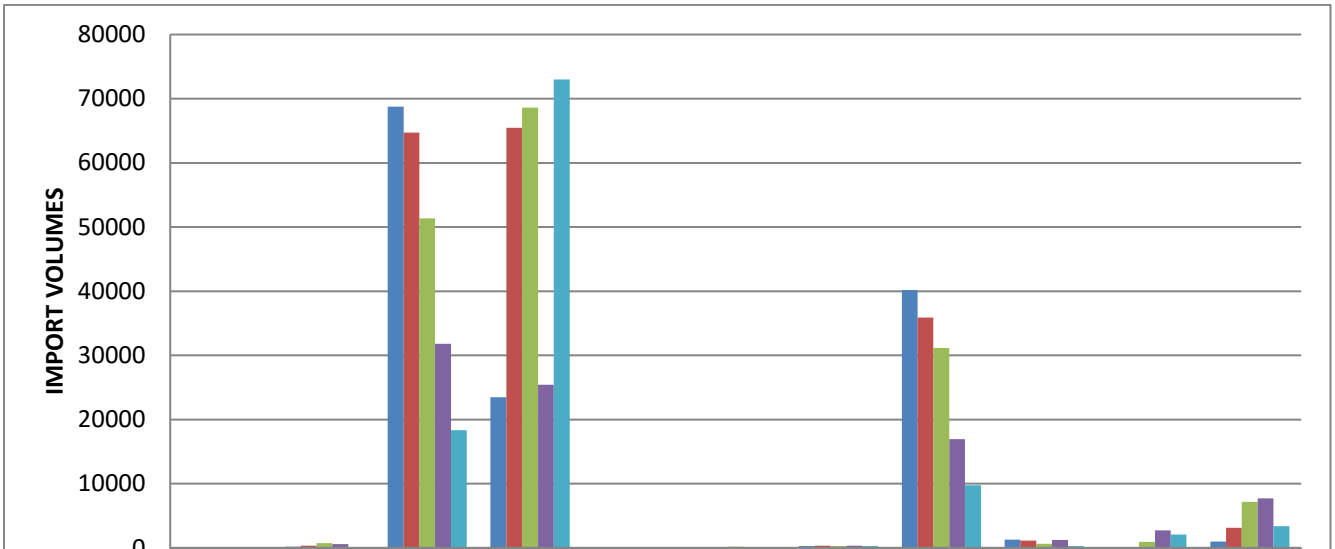
Figure 4. 5 Consumer Electronics Imports for 2010 – 2014 (New Products)

(b) Used Products

Import trends for used consumer electronics are presented in Figure 4.6. The key patterns observed were that:

- Import of used consumer electronics was significantly high for DVD players (with total volumes of about 234,935 units over the study period) and e-instruments such as organs and guitars (about 256,026) and moderately high for radio sets (volumes of 133,990) and LCD TVs (about 22,393);
- Total volume imports of used consumer electronics over the period was highest in 2011, followed by 2012, 2010, 2014 and 2013 in that order recording volumes of 171106, 161131, 135190, 107218 and 86808 respectively;
- It is imperative to note that while used radio sets and stereo systems perform slightly different functions, the total import volumes for radio sets were about 29 times the volumes for stereo sets; and
- The desire to own used LCD TVs has increased significantly over the past 5 years recording volumes of about 22,393 units over the period. However, this figure is about 18% of total imports of 'new' LCD TVs over the same period; and

- The total volume of used consumer electronics (661,453) during the study period was about 22% of the volumes for new consumer electronic products (2,972,115).



	Alarm Clocks	Camera	DVD	E Instruments	Game Consoles	MP3 Players	Projectors	Radio	Stereo	CRT TV	LCD TV
2010	34	194	68740	23470		4	267	40188	1293		1000
2011	1	321	64698	65486	11	8	317	35919	1146	64	3135
2012	2	744	51360	68621	1	201	302	31150	648	931	7171
2013	2	569	31793	25439		10	336	16969	1240	2741	7709
2014	1	59	18344	73010	11	4	272	9764	292	2083	3378

Figure 4. 6 Consumer Electronics Imports for 2010 – 2014 (Used Products)

4.1.4 ICT Equipment Only

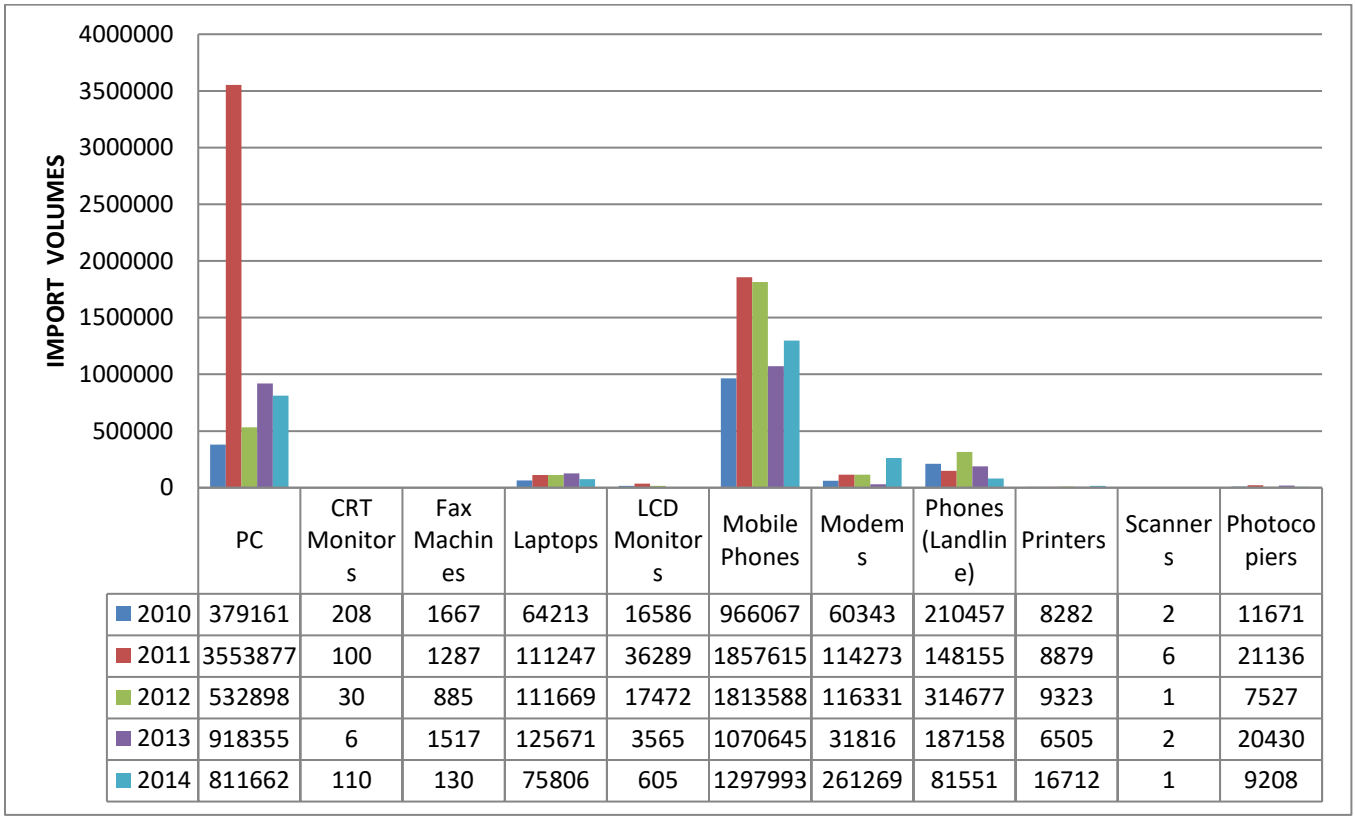
The major ICT equipment imported into the country during the study period included the following: CRT monitors, fax machines, laptops, LCD monitors, mobile phones, modems, phones (landline), printers, scanners and photocopiers.

(a) New ICT Equipment

Trend analysis of the import figures for new ICT equipment reveals the following patterns (as indicated in Figure 4.7):

- Mobile phone penetration into the Ghanaian market during the past decade has seen a phenomenal growth. Over the study period a total import volume of about 7,005,908 was recorded, amounting to an annual average import volume of about 1,401,181.6 phones. Mobile phone imports however, were slightly higher than total volumes of PC imports (6,195,953) over the same period. Annual average of PC imports amounted to about 1,239,190.6 per annum;
- Both mobile phones and PCs had a significant combined percentage share of about 85.6% of all ICT equipment imports over same period;

- Landline phones, modems and laptops occupied a significant share of the total imports (2,014,636) of new ICT equipment over the last 5 years, with a combined percentage share of about 13.1%, while the remaining 1.3% was made up of all the other ICT equipment; and
- The annual average of new ICT equipment imports over the period amounted to about 3,083,327.8.



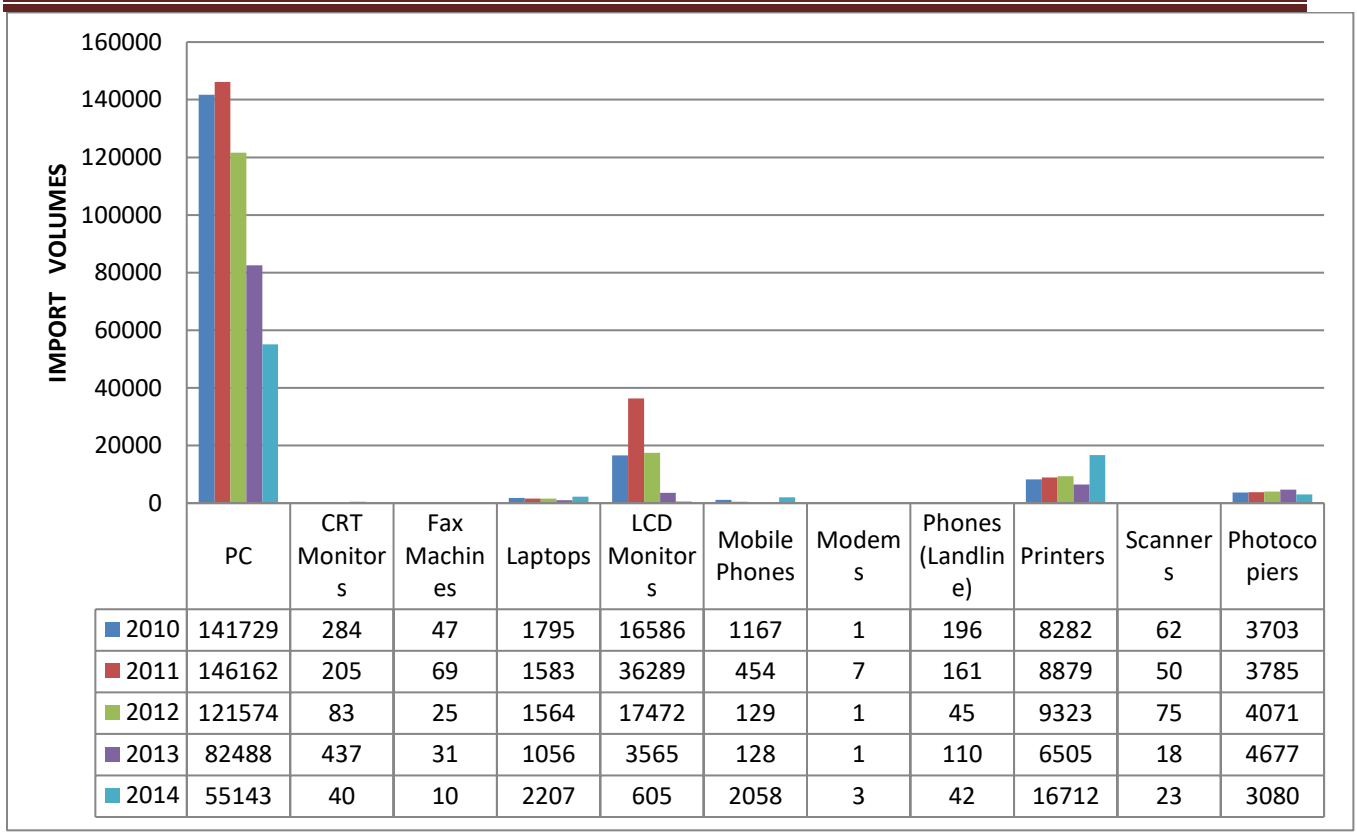
	PC	CRT Monitors	Fax Machines	Laptops	LCD Monitors	Mobile Phones	Modems	Phones (Landline)	Printers	Scanners	Photocopiers
2010	379161	208	1667	64213	16586	966067	60343	210457	8282	2	11671
2011	3553877	100	1287	111247	36289	1857615	114273	148155	8879	6	21136
2012	532898	30	885	111669	17472	1813588	116331	314677	9323	1	7527
2013	918355	6	1517	125671	3565	1070645	31816	187158	6505	2	20430
2014	811662	110	130	75806	605	1297993	261269	81551	16712	1	9208

Figure 4. 7 ICT Equipment Imports for 2010 – 2014 (New Equipment)

(b) Used ICT Equipment

The trend observed for 'used' ICT equipment is presented in Figure 4.8 below. Analysis of figures for used ICT equipment is discussed below:

- The total imports of used ICT equipment (704,797) for the study period was about 4.6% of total imports of new ones (15,416,639) over the same period;
- Import volumes of used PCs were significantly high throughout the period, recording a total figure of about 547,096 units and an annual average of 109,419.2 units. Used PCs occupied a significant portion of 77.6% of all imports of used ICT equipment. However, PC imports gradually decreased over the period from 141729 units in 2010 to 55143 units in 2014;
- The next three significant imports were of used LCD monitors, printers and photocopiers, recording total volumes of 143,534 units. This translated into a percentage share of about 20.4%; and
- A remarkable observation was that there were more imports of new mobile phones than used phones. Import volume of new mobile phones was about 1780 times the import volume of used mobile phones.



	PC	CRT Monitors	Fax Machines	Laptops	LCD Monitors	Mobile Phones	Modems	Phones (Landline)	Printers	Scanners	Photocopiers
2010	141729	284	47	1795	16586	1167	1	196	8282	62	3703
2011	146162	205	69	1583	36289	454	7	161	8879	50	3785
2012	121574	83	25	1564	17472	129	1	45	9323	75	4071
2013	82488	437	31	1056	3565	128	1	110	6505	18	4677
2014	55143	40	10	2207	605	2058	3	42	16712	23	3080

Figure 4. 8 ICT Equipment Imports for 2010 – 2014 (Used Equipment)

4.1.5 EEE Components and Parts

EEE imports over the past years have seen a significant showing of EEE components and parts to service faulty or malfunctioning EEE. The main EEE parts imported included computer screens, power banks, CD-ROMs, DVD ROMs, mobile phone screens, laptop batteries, TV screens, money counting machines, external hard drives, pen drives and mobile phone batteries.

(a) New Components and Parts

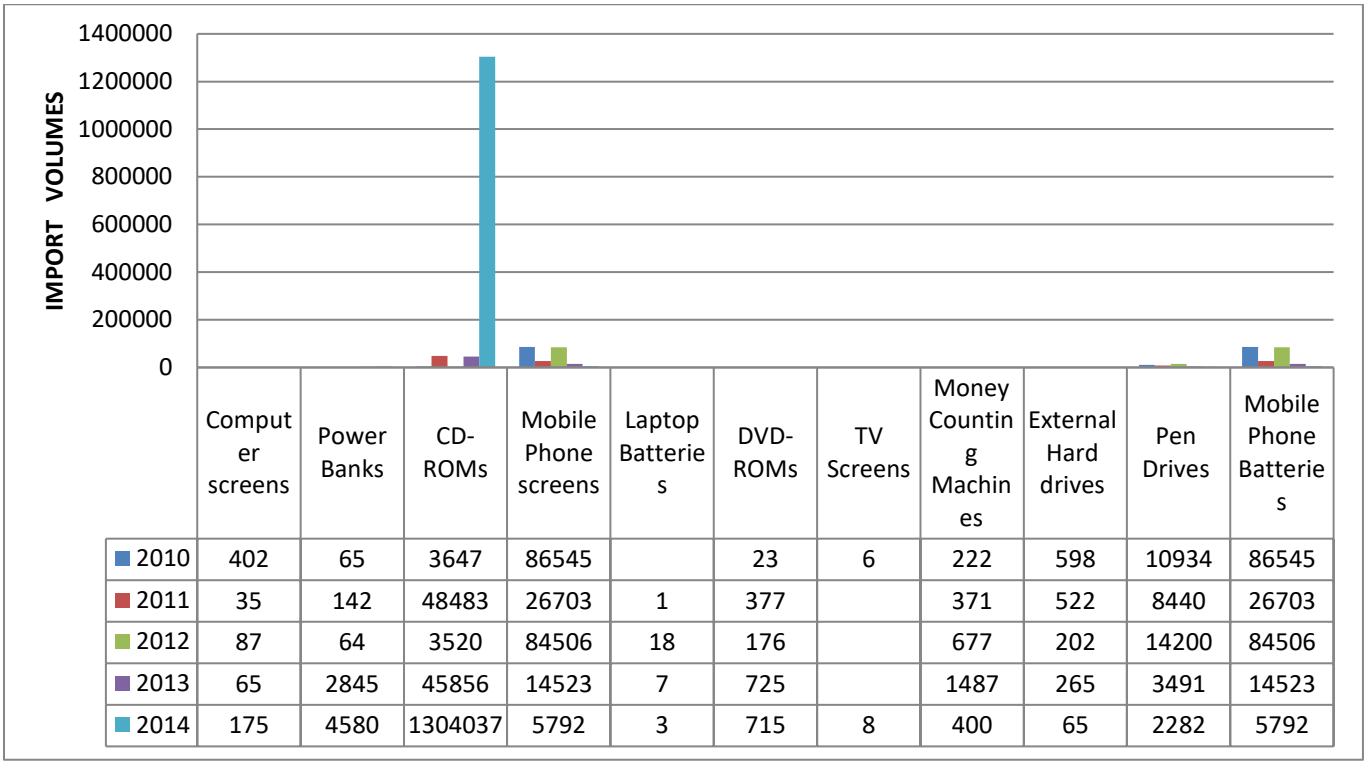
Analysis of figures for new EEE components and parts (figure 4.9) is presented below:

- Significant imports were made for new CD-ROMs, mobile phone screens and batteries, recording total volumes of 1,405,543 units; and 218,069 units each for both mobile phone screens and batteries.
- Average annual imports for new CD-ROMs, mobile phone screens and batteries were 281,108.6; 43,613.8 and 43,613.8 respectively.

(b) Used Components and Parts

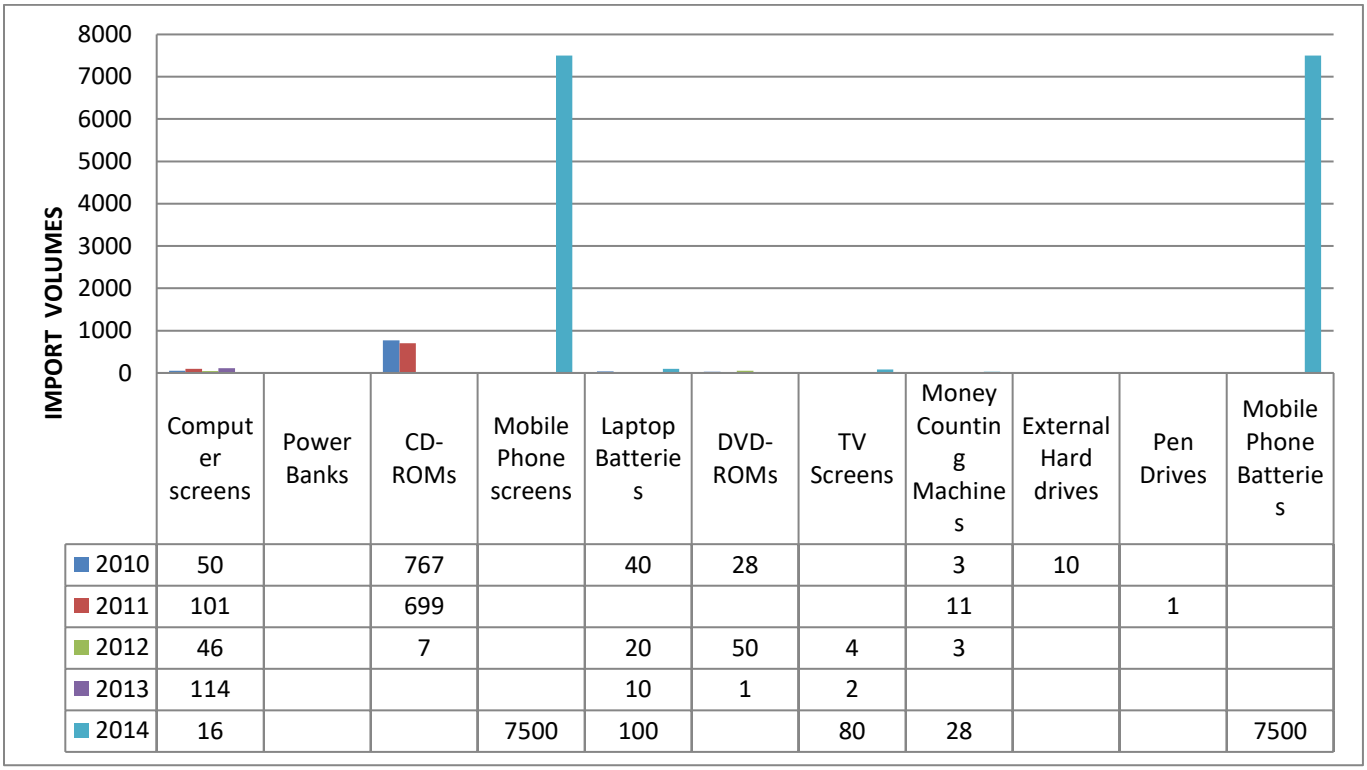
Analysis of figures for used EEE components and parts (Figure 4.10) is presented below:

- Total imports of all used EEE components and parts amounted to about 17,191 units being 0.91% of total imports of all new EEE components and parts; and
- Main used components and parts imported were mobile phone screens and batteries, with combined import volumes of 15,000; while CD ROMs marshaled a total amount of 1473.



	Computer screens	Power Banks	CD-ROMs	Mobile Phone screens	Laptop Batteries	DVD-ROMs	TV Screens	Money Counting Machines	External Hard drives	Pen Drives	Mobile Phone Batteries
2010	402	65	3647	86545		23	6	222	598	10934	86545
2011	35	142	48483	26703	1	377		371	522	8440	26703
2012	87	64	3520	84506	18	176		677	202	14200	84506
2013	65	2845	45856	14523	7	725		1487	265	3491	14523
2014	175	4580	1304037	5792	3	715	8	400	65	2282	5792

Figure 4. 9 EEE Components and Parts Imports for 2010 – 2014 (New Parts)



	Computer screens	Power Banks	CD-ROMs	Mobile Phone screens	Laptop Batteries	DVD-ROMs	TV Screens	Money Counting Machines	External Hard drives	Pen Drives	Mobile Phone Batteries
2010	50		767		40	28		3	10		
2011	101		699					11		1	
2012	46		7		20	50	4	3			
2013	114				10	1	2				
2014	16			7500	100		80	28			7500

Figure 4. 10 EEE Components and Parts Imports for 2010 – 2014 (Used Parts)

4.2 WEEE Generation and Storage

The E-Waste National Strategy Report of 2011 identified that high level of demand has led to an influx of EEE into the country, most of which are second-hand, because most people are unable to acquire brand new ones. Considerable proportions of these imports are old, near or at end-of-life which are sooner or later consigned as WEEE for disposal. The report concludes that this trend has led to ever increasing large stocks of EEE and WEEE in Ghana.

Furthermore, results of studies conducted under Components 1, 2 and 3 of the Secretariat of the Basel Convention (SBC) E-waste Africa Project and the Ghana–Netherlands Cooperation estimated the existing stored base of WEEE to be about 30% of the installed base of EEE. The installed base was computed from the tonnage equivalent of the total import volumes of tracer products as presented in Table 4.1 basing the conversion from volumes into weight on an e-waste guide on average weight of major electrical and electronic equipment (Appendix 5). The amounts of stored (W)EEE generated within the study period is as given in Table 4.2. This implies that an annual average of 9398.47 tons of stored WEEE was recorded.

The same table also provides indications as to how much WEEE is estimated to have gone directly into the recycling industry. A total of about 109,648.773 tons of WEEE is estimated to have benefited recyclers.

Table 4. 1 Import Volumes of Major Tracer Products in Tonnage (2010 - 2014)

ICT Equipment					
Imports in Tons	**PC**	**Laptops**	**LCD monitors**	**CRT monitors**	**Mobile**
Used	5,416.25	28.718	350.23	14.79	0.39
New	61,339.935	1,710.12	350.29	6.40	700.59
Total	66,756.185	**1,738.838**	**700.52**	**21.19**	**700.98**
					69,917.713
Consumer Electronics					
Imports in Tons	**CRT TV**	**LCD TV**	**Radio**	**Stereo**	
Used	82.04	105.25	5,119.24	324.85	
New	142.59	585.35	267.98	46.19	
Total	224.63	**690.60**	**5,387.22**	**371.04**	**6,673.49**
Large Household Appliances					
Imports in Tons	**Refrigerator**		**Air Conditioners**		
Used	41,306.48		13,196.05		
New	24,883.53		134.82		
Total	**66,190.01**		**13,330.87**		**79,520.88**
Small Household Appliances					
Imports in Tons	**Iron**		**Kettle**		
Used	105.79		21.11		
New	310.25		91.87		
Total	**416.04**		**112.98**		**529.02**

Table 4. 2 Estimated Quantities of WEEE Generation (tons) (2010 - 2014)

Total (Used/New)	ICT Equipment	Consumer Electronics	Large Household Appliances	Small Household Appliances	Total tonnage
Installed EEE	69,917.713	6,673.49	79,520.88	529.02	156,641.103
WEEE Stored	20,975.310	2,002.05	23,856.26	158.71	46,992.330
WEEE to Recycling	48,942.403	4,671.44	55,664.62	370.31	109,648.773

4.3 Contribution to the National Economy

The refurbishing and repair sector has been found to be partially formalised, with expert opinion suggesting that about 20% of all refurbishing / repair businesses might be registered with the formal bodies (Pwamang 2010). Collection, disassembly, material recovery and final disposal take place almost only in the informal sector. Till date, there is no statistical information, either from government or non-governmental sources, on the number of people employed in the refurbishing and e-waste recycling sector in Ghana. The Labour Market Information System (LMIS) of the Ministry of Employment and Social Welfare, and the Ministry of Trade and Industry of Ghana do not provide any employment information based on business activity (Socioeconomic Assessment & Feasibility Study of E-Waste Management in Ghana, August 2010).

4.3.1 Employment Creation

(a) Importers/Distributors

Employment offered by the import/distribution sector per company was most significant. For instance between only two companies Hi-sense and Zepto Ghana Ltd., each company employs an average of about 40 workers (Appendix 2A). With an estimated average household size of about 4 persons (GLSS 5), each import / distribution company is estimated to provide support to about 160 persons, excluding potential extended family dependents. The support of this sector to the economy is therefore significant.

(b) Refurbishers

A survey of a total number of 69 people involved in the EEE refurbishing industry was conducted in areas such as Kwame Nkrumah Circle, Abeka Lapaz, Darkuman and Spintex Road, known to be prominent areas for such activities. The following employment characteristics were observed (Appendix 2B):

- Out of the total number of respondents interviewed, 20% of them were EEE repairers only; 25% sold repaired items; 1.5% were into installation of EEE only; 30% repaired and sold new and repaired items; and 23% of them were into repair and sale of repaired items.
- The 69 respondents in turn employed a total workforce of 161; an average employee size of about 2. This is consistent with findings of an earlier e-waste country assessment conducted by GreenAd Ghana in 2011.
- Due to the very low income levels earned, 13% of respondents had other sources of livelihood, whilst 87% solely depended on EEE sales and repairs. These involved farming activities, video production, car sales, car fitting, concrete mixing operations and clothe sales.
- While 61% of respondents had between 1-3 dependents; 25% had between 4-7 dependents; 3% had between 8-10 dependents; whiles 1% had more than ten (10) dependents.

(c) Recyclers

Sixty-seven (67) recyclers were involved in the study (Appendix 2C); 31% of whom have primary school education; 29% have secondary education; 3% have tertiary education; while 37% have no educational background. The recycling processes involve dismantling electronic and electrical devices with crude equipment such as chisel, hammers, pliers and screw drivers without any Personal Protective Equipment (PPE). Items retrieved include hard drive disk, mother board and metals such as iron, aluminum copper and brass. Such retrieved components are mostly bought by Nigerian scrap dealers.

Twenty-three (23) of the recyclers representing 33% of the respondents dump the unrecyclable components on the Agbogbloshie site very close to the Odaw River, while 44 respondents (representing 67%) burn such components at the same location. Out of the total number of respondents interviewed, 51 of them operate individually whilst 16 of them operate in groups of between two to ten. Out of the total of the respondents, 14 of them representing 21% had no dependents; 42 of the respondents representing 63% had between 1 - 3 dependents; 9 of the respondents representing 13% had between 4 - 7 dependents; 2 of the respondents representing 3% had between 8 - 10 dependents; while none of the respondents had dependents above 10.

(d) Regional and Country Context

Country estimates of employment created in the e-waste recycling and refurbishing sector were done based on the same approach employed in the Socioeconomic Assessment & Feasibility Study of e-Waste Management in Ghana conducted by Öko-Institut e.V. and Green Advocacy Ghana in August 2010.

The most important cluster for e-waste recycling in Ghana is Agbogbloshie. According to information from the President of the Agbogbloshie Scrap Dealers Association, the association has a membership of about 4,000. Expert opinion suggests that about half of the members, i.e. about 2,000 people, focus primarily on e-waste, while the other half on automobile dismantling and material recovery from automobiles. The primary socio-economic data collection (Appendix 2C) revealed that on an average 3–4 workers are employed by one recycler.

Considering that Agbogbloshie controls the major part of the (informal) recycling industry in Accra, and taking the number of people from Agbogbloshie Scrap Dealers Association as the calculation basis, it can be assumed that about 6,000 to 8,000 people are involved in informal e-waste collection and recycling operations in the region of Accra. Furthermore, on the basis of data from the World Bank, the 2013 total fertility rate (TFR) for Ghana is 3.9 births per woman. It could therefore be assumed that about 23,400 to 31,200 people in Accra thrive partially or fully on e-waste collection and recycling operations.

In the refurbishing/repair sector, expert opinions suggest that 80% of the businesses are not registered with any local or national body (Pwamang 2010). As a result, it was difficult to scientifically estimate the true number of refurbishing/repair businesses in Ghana. Based on a registered membership of 600 (according to GESTA - Repairers Association), it can be estimated that at least 3,000 refurbishing/ repair businesses can be found scattered in the region of Accra and Tema, if not more. The socio-economic data (Appendix 2B) revealed that each refurbishing/repair business employs between 2 – 3 employees, suggesting a total employment for about 6,000 to 9,000 people in Accra and Tema. Again, using the 2013 TFR of 3.9, it is estimated that at least 23,400 to 35,100 people thrive partially or fully on refurbishing/repair of EEE in the region of Accra.

Thus, refurbishing and e-waste recycling sectors employ about 12,000 to 17,000 people in Accra and Tema. In terms of household dependency, it is assumed that the refurbishing and e-waste recycling sectors sustain about 46,800 to 66,200 people in the Greater Accra Region.

Expert opinion suggests the refurbishing and e-waste recycling sector in Accra/Tema might account for about 40% – 60% of the total size of Ghanaian refurbishing and e-waste recycling activities. This implies that about 20,000 to 42,500 people are employed in the refurbishing and e-waste recycling sector in Ghana, constituting about 0.2% to 0.4% of the total labour force in Ghana (PHC, 2010). Using the TFR of 3.9, it is estimated that about 182,520 to 258,180 people in Ghana are partially or fully dependent on refurbishing and e-waste recycling operations. This represents about 0.72% to 1.02% of the total Ghanaian population (25.37 million).

Table 4.3 summarizes calculations of employment created in refurbishing and e-waste recycling business in Ghana and compares to results obtained from the 2010 socioeconomic assessment study:

Table 4. 3 Employment Generation in Ghana's Refurbishing and Recycling Sector

	Refurbishers		**Collectors /Recyclers**		**Total**	
	2010	2015	2010	2015	2010	2015
Employed in Accra/Tema	10,000–15,000	6,000-9,000	4,500-6,000	6,000-8,000	14,500-21,000	12,000-17,000
Employed in Ghana	14,000-24,000	10,000-22,500	6,300-9,600	10,000-20,000	20,300-33,600	20,000-42,500
Dependents in Accra/Tema	60,000-90,000	23,400-35,100	27,000-36,000	23,400-31,200	87,000-126,000	46,800-66,200
Dependents in Ghana	84,000-144,000	91,260-136,890	37,800-57,600	91,260-121,680	121,800-201,600	182,520-258,180

An attempt was also made to estimate the number of people employed in the Import and distribution sector based on the annual import volumes and the percentage of Ghanaians employed in the Information and Communication sector as captured by the 2010 Population and Housing Census (National Analytical Report). Due to the lack of reliable data on people involved in the EEE import and use sector, the PHC value of 0.4% for the ICT sector was taken as the basis for any extrapolation. Per the PHC, the total number of employed persons above 15yrs in Ghana is ***10,243,476;*** 0.4% of which amounts to ***40,973.904*** for the ICT sector. With ICT imports accounting for about52.92% of all imports (Table 4.4) within the study period, a simple ratio and proportion argument was applied to generate a corresponding employment size for all imports; and the figure arrived at was 77,426 persons. The essence of this extrapolation is premised on the fact that Ghana's ICT is reported to be on a phenomenal rise. According to the National Communications Authority (NCA), monthly mobile internet usage in Ghana increased by 9.73% in April, 2015, bringing the total number of mobile internet subscribers in Ghana to 14,254,407. Meanwhile, mobile phone penetration stands at 27 million, which is bigger than the national population. However, the total number of active mobile phone lines in Ghana as at November, 2012 stood at 25,344,745.

Table 4. 4 Estimated Employment Sizes in the EEE Import Sector

EEE Type	Total Imports	% Import	Estimated Employment
ICT Equipment, Components and Parts	18,034,983	52.92%	40,973.904
Consumer Electronics	3,633,568	10.66%	8,253.625
Small Household Appliances	7,003,948	20.55%	15,911.068
Large Household Appliances	5,407,666	15.87%	12,287.526
Grand Total	**34,080,165**	**100.00%**	**77,426.123**

4.3.2 Income Generation Levels

(a) Importers/Distributors

The import/distribution sector is the most formalised and lucrative compared to the refurbishing and recycling sectors of the EEE industry. Managerial staff of 2 of the country's biggest distribution companies earned an average monthly income within a GH¢3,000 – GH¢5,000 range; while mid-level staff received between GH¢ 1,000 and 2,000. Meanwhile junior staff receive an average salary of less than GH¢1,000.

(b) Refurbishers

The monthly income ranges for refurbishers and their employees was estimated. 20.2% of the respondents / employers earned average monthly income levels above GH¢ 3,000; 30.4% earned average incomes between GH¢ 2,000 and GH¢3,000; while the remaining 49.3% of respondents earned less than GH¢ 2000.

Employees of respondents earned incomes not more than GH¢1000. However, only seven (7) managed to earn incomes between GH¢500 – GH¢1000 while a significant 95.7% of the employee population earned meagre levels of less than GH¢500 a month.

(c) Recyclers

Sixty-four (64) of the respondents interviewed depended solely on e-waste recycling as means of livelihood, while three (3) of the respondents had additional sources of livelihood. Two (2) of such respondents are commercial motorbike riders whilst the other is a car washing bay attendant.

Average monthly incomes of the respondents were determined. Only 14.9% of the recyclers could take home an average income higher than GH¢1000, while a majority proportion of about 64.2% earned incomes within the GH¢500 - GH¢1000 bracket. The remaining 20.9% of respondents earned incomes lower than GH¢500 at the end of the month.

(d) Regional and Country Context

Although there is no verifiable quantitative information on the role e-waste recycling materials play in the development of other sectors, it is still possible to estimate the contribution of total refurbishing and e-waste recycling sector to the national economy on the basis of average salaries (see Table 4.5 on Remuneration) and the number of workers (see Table 4.3 on employment creation). Table 4.5 below shows how the value creation by refurbishing and e-waste recycling sector in Ghana was calculated. Similar calculations were used in the Socioeconomic Assessment & Feasibility Study of e-Waste Management in Ghana conducted by Öko-Institut e.V. and Green Advocacy Ghana in August 2010. The table also compares the 2010 figures to current 2015 figures to establish e-waste contribution patterns over the past few years.

Table 4. 5 E-Waste Contribution to the National Economy

	Refurbishers		Collectors /Recyclers		Total	
	2010	**2015**	**2010**	**2015**	**2010**	**2015**
Remuneration per month (USD)	190 – 250	272 - 544	70 – 140 175 - 285	136 - 272	435 – 675	408 - 816
Remuneration per year (USD)	2,280 – 3,000	3,264 -6,528	840 – 1,680 2,100 - 3,420	1,632 – 3,264	5,220 – 8,100	4,896 – 9,792
Number of people employed	14,000 – 24,000	10,000-22,500	6,300 – 9,600	10,000-20,000	20,300 – 33,600	20,000 - 42,500
Contribution to national economy per year (USD)	Remuneration per year (in USD) multiplied by the number of people employed in refurbishing and e-waste recycling sector in Ghana				105,966,000 – 268,128,000	97,920,000 - 416,160,000

Table 4.3 shows clearly that while there was a reduction (by about 6.7%) in the size of employment offered by the refurbishing sector, the numbers employed by the collection and recycling sector increased significantly by about 65%. This was met with a corresponding increase in the level of contribution to the national economy.

CHAPTER FIVE

CONTAMINATION PROFILE OF AGBOGBLOSHIE

- **General Background**
- **Base Map of the Scrap Yard**
- **Impacts of Contaminants**

5.0 CONTAMINATION PROFILE OF AGBOGBLOSHIE

5.1 General Background

The designated land uses of the surrounding areas of the Agbogbloshie Scrapyard are the Ring Road South Industrial Area to the north and north-east, and the Korle Lagoon Recreational Area, stretching southwards about 2.5km to the sea. The two main land use areas are separated by the Abossey Okai Road, but have the Odaw Stream running across them. The Odaw channel drains the area from the northern section of Accra discharging into the Korle Lagoon, just beyond the point where it dissects the Korle Lagoon Recreational Area into two main sections - the Agbogbloshie part and the Old Fadama/Gallaway portion.

The popular Agbogbloshie Yam Market is situated within a portion of the Ring Road South Industrial Area, close to the Odaw, along the Abossey Okai Road. The Korle Lagoon Recreational Area covers the land occupied by Old Fadama (Sodom and Gomorrah) and Gallaway on the eastern side of the Odaw and the Korle Lagoon, and the land on the western side, stretching to the Korle Bu Road, which includes the Agbogbloshie Scrapyard.

The Scrapyard is bordered to the north by the Onion Market and the Abosey Okai Road, to the west by a mixed activity area (including a Kraal and slaughter area) and the ICGC buildings, and east by the Odaw Stream, with Old Fadama on the other side of the Odaw. A significant portion of land adjacent the Scrapyard (to the south and south-west) is noted for refuse dumping and burning; though a major portion of the Scrapyard was itself reclaimed with waste material. Figure 5.1 is a map of the southern part of Accra showing the various land uses whereas a close-up aerial view of the Agbogbloshie Scrap Yard and adjoining land uses is shown in Figure 5.2.

Aerial photographs depicting trends of development over a period of 13 years (2000 – 2013) of the site (boundaries marked out in red) and its neighbouring land use activities show the sort of changes the area has undergone (Figures 5.3 to 5.6).

The aerial photograph (of 2000) shows very few structures/development (mostly on the northern section of the site), with notable vegetation cover at the southern and south-eastern sections (Figure 5.3). The 2004 to 2013 scenes, however, show a progressive increase in development activities on the site as well as the neighbouring areas such as Old Fadama, with distinctively no vegetation (Figures 5.4 to 5.6). This is an indication of the intensity of developments in the area within the last decade.

The Agbogbloshie Scrapyard has grown to become a major dumping ground for WEEE with an estimated population of 3,000 dealing in all kinds of e-scrap business. The waste dumping activities in the area combined with the informal recycling at Agbogbloshie results in tons of wastes and e-waste ending up at the site daily. While other wastes are burned straight away, the e-waste is broken into fractions to salvage copper and other metal components for both the local and foreign markets. The salvaging process often involved burning of cables and other components to recover the useful materials until a recent introduction of cable stripping equipment on site. Less valuable materials and plastics such as casings of computer main frames and TV sets, and other hazardous fractions, etc. (Table 5.1) when accumulated may be burned to reduce volume and make space available. Hazardous wastes oils from various sources such as Lead acid batteries are also released indiscriminately on the ground.

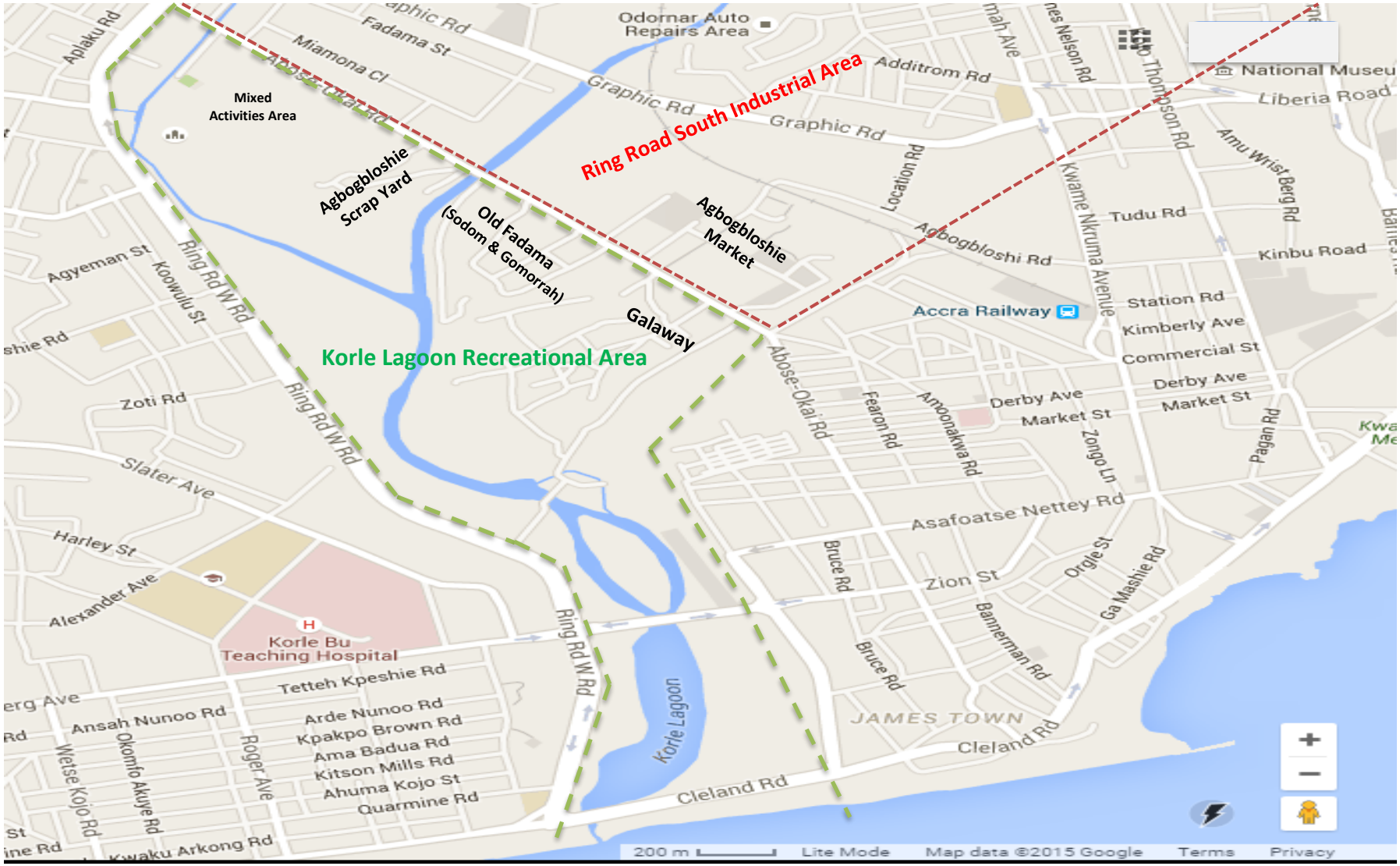


Figure 5. 1 Map of the Southern Part of Accra

Figure 5. 2 *Agbogbloshie Scrap yard Showing Adjoining Landuse*

Table 5. 1 WEEE Components and Associated Hazardous Substances

	Substance	Occurrence in E-Waste
Halogenated Compounds		
1	PCB (polychlorinated biphenyls)	Condensers Transformers
2	TBBA (tetrabromo-bisphenol-A) PBB (polybrominated biphenyls) PBDE (polybrominated diphenyl ethers)	Fire retardants for plastics (thermoplastic components, cable insulation)
3	Chlorofluorocarbon (CFC)	TBBA is presently the most widely used flame retardant in printed wiring boards and casings.
4	PVC (polyvinyl chloride)	Cooling unit, Insulation foam
Heavy Metals and Other Metals		
5	Arsenic	Small quantities in the form of gallium arsenide within light emitting diodes
6	Barium	Getters in CRT
7	Beryllium	Power supply boxes which contain silicon controlled rectifiers and x-ray lenses
8	Cadmium	Rechargeable NiCd-batteries, fluorescent layer (CRT screens), printer inks and toners, photocopying-machines (printer drums)
9	Chromium VI	Data tapes, floppy-disks
10	Lead	CRT screens, batteries, printed wiring boards
11	Lithium	Li-batteries
12	Mercury	Fluorescent lamps that provide backlighting in LCDs, in some alkaline batteries and mercury wetted switches
13	Nickel	Rechargeable NiCd-batteries or NiMH-batteries, electron gun in CRT
14	Rare Earth elements (Yttrium, Europium)	Fluorescent layer (CRT-screen)
15	Selenium	Older photocopying-machines (photo drums)
16	Zinc Sulphide	Interior of CRT screens, mixed with rare earth metals
Other Contaminants		
17	Toner Dust	Toner cartridges for laser printers / copiers
18	Radio-active substances	Medical equipment, fire detectors, active sensing element in smoke detectors

Source: http://ewasteguide.info/hazardous-substances

Figure 5. 3 Aerial Photograph of Agbogbloshie and surrounding landuse in 2000

Figure 5. 4 Aerial Photograph of Agbogbloshie and surrounding landuse in 2004

Figure 5. 5 Aerial Photograph of Agbogbloshie and surrounding landuse in 2008

Figure 5. 6 Aerial Photograph of Agbogbloshie and surrounding landuse in 2013

5.2 Base Map of the Agbogbloshie Scrapyard

The methodology used in generating the base map for the Agbogbloshie site is provided in Section 2.5 (under Chapter 2) of this report. The map provided in Figure 5.7 gives an indication of the location of Agbogbloshie, which is on the south-western part of Greater Accra, and provides locations of all 31 sampling points used for this study. The points or areas where the samples were taken included: football playing field, immediate surroundings of Agbogbloshie Mosque and tire burning sites. Others included the immediate area around old transformers, re-cycling site, built up areas, footpath, roads and other accessible areas within the scrapyard.

5.3 Assessment of Contaminants

Main Contaminants

Burning is a common method used to reduce waste volumes, which is practiced at waste dumps and scrapyards, such as Agbogbloshie. The burning process in particular releases contaminants into the atmosphere, soils and water bodies with dire health consequences. An analysis of the soils at selected points on the Agbogbloshie site using soil surface samples (based on 31 spots) and samples from 3.6 inches beneath the soil surface (based on 22 sampled spots) identified 13 key contaminants. The soil analyses, which were done with a XRF Analyzer (and subsequently confirmed at CSIR laboratory) identified Zinc (Zn), Lead (Pb), Rubidium (Rb), Strontium (Sr), Zirconium (Zr), Iron (Fe), Copper (Cu), Titanium (Ti), Manganese (Mn), Arsenic (As), Antimony (Sb), Tin (Sn) and Cobalt (Co) as the main contaminants. Table 5.1 indicates that for soil surface analysis Zn, Pb, Rb, Sr, Zr and Fe were the major contaminants at the site found at between 90% – 100% of the sampled spots. This was followed by Cu, Ti and Mn which were found at between 70% - 85% of the sampled spots. As, Sb, Co and Sn were the least occurring ones found at 13% - 29% of the sampled locations.

Analysis based on samples at 3.6 inches beneath soil surface indicated Fe, Zn, Pb, Sr and Zr as the major occuring contaminants, found at between 90% - 100% of the locations; followed by Rb, Ti, Cu and Mn found at between 50% - 86% of sampled spots. The least occuring ones were As, Sb, Sn and Co found at between 4.5% - 27.3% of sampled spots.

A study conducted in 2011 to assess and describe the health status and extent of exposure of handlers of e-waste to elements associated with electronic waste at the Agbogbloshie site identified Fe, Zn, Cu, Pb and Co (out of 11 other elements) in significant concentrations based on blood and urine analysis from 87 participants (Clarke et al, 2011). The key elements identified from the soil analyses are therefore consistent with the identified elements of that study.

A comparison of concentration levels of some of the toxic heavy metals identified at the site, such as Zn, Pb, Cu and As with set limits from three geographic locations and that of the World Health Organisation (WHO) guidelines indicated that their mean concentration levels were higher for the site (Table 5.1). Mean concentrations for Zn, Cu and As was more than twice higher for the site as compared to limits for Germany, Canada and Taiwan. Mean concentration levels for Pb was slightly higher than limits at Canada and Taiwan; and more than 7 times higher than WHO set guidelines for dry soils but lower than those for Germany.

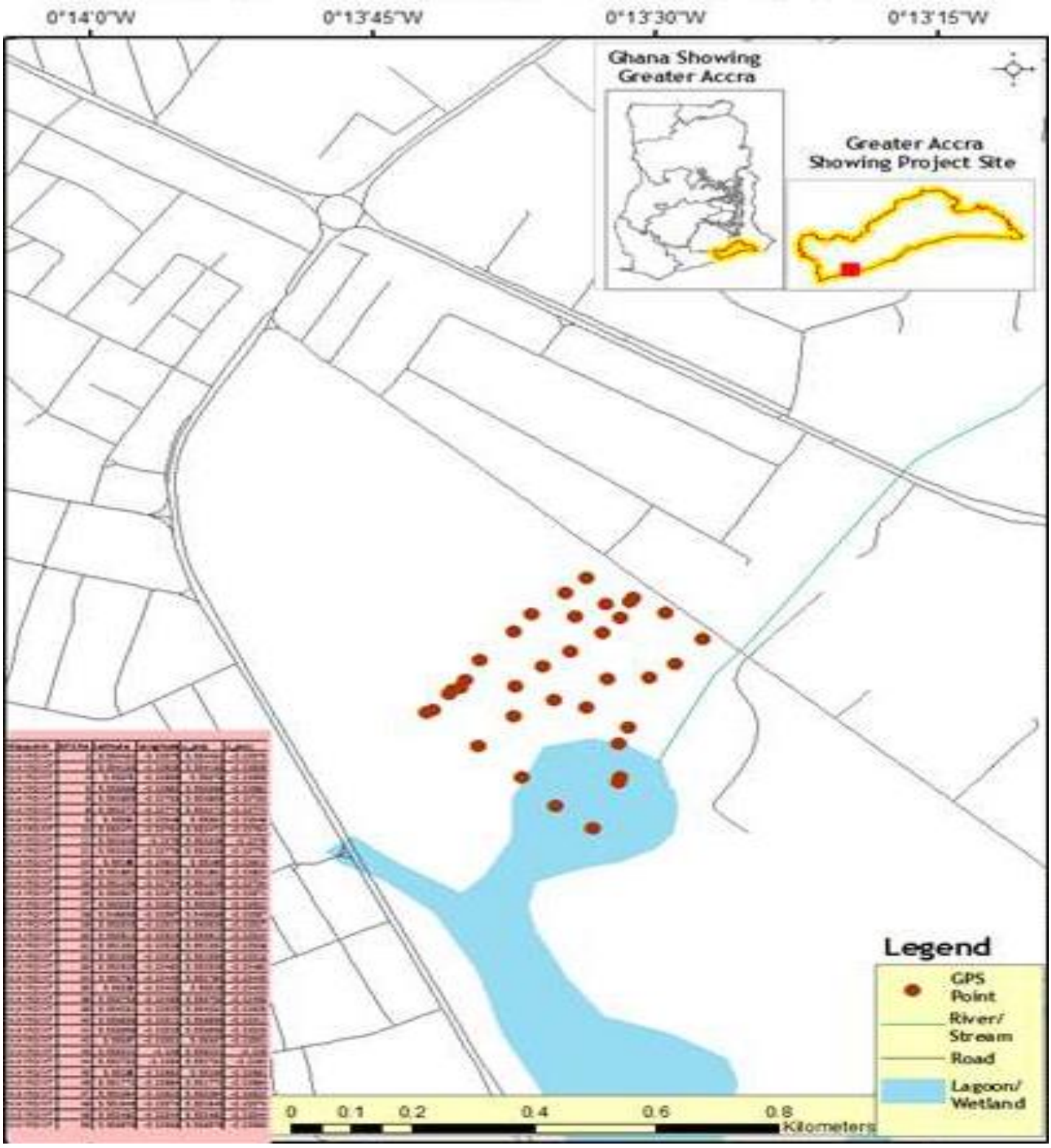


Figure 5. 7 Base Map Showing Sampling Points of Agbogbloshie Scrapyard

Table 5. 2 Summary of Contaminant Occurence from Sampled Spots

Soil Surface			3.6 inches Beneath Surface		
Elements	Occurrence – out of 31 Sample Spots (%)	Concentration (ppm)	Elements	Occurrence – out of 22 Sample Spots (%)	Concentration (ppm)
Zn	100.0	157 - 15122	Fe	100.0	14406 - 41304
Pb	100.0	18 - 4000	Zn	95.5	66 - 95256
Rb	100.0	12 - 300	Pb	95.5	21 - 31
Sr	100.0	60 - 906	Sr	95.5	39 - 287
Zr	96.8	134 - 448	Zr	90.9	189 - 294
Fe	93.5	7336 - 86393	Rb	86.4	14406 - 41304
Cu	83.9	42 - 11490	Ti	81.8	2136 - 25186
Ti	77.4	2504 - 12087	Cu	72.7	542 - 932
Mn	74.1	159 - 762	Mn	50.0	261 - 274
As	29.0	39 - 419	As	27.3	32 - 6996
Sb	25.8	290 - 59629	Sb	22.7	350 - 1622
Co	19.4	337 - 1267	Sn	18.2	278 - 1278
Sn	12.9	300 - 343	Co	4.5	2535

Table 5. 3 Comparison of Major Occuring Heavy Metals with Existing Standards

Element	Mean Concentration Levels at Agbogbloshie (ppm)	Germany (ppm)	Canada (ppm)	Taiwan (ppm)	WHO Guidelines (ppm)
Zn	1734	600	600	600	
Pb	529	1000	200	500	70
Cu	1213	200	150	200	
As	204	50	20	60	

5.3.1 Potential Impacts on Soil

E-waste recycling at Agbogbloshie involves burning of cables (dismantled from electrical or electronic gadgets) with styrofoam as fuel to isolate copper or aluminium components for sale. The burning activities at the site (Figure 5.7) releases heavy metals such as Zn, Pb, Fe, Cu, etc into the atmosphere; some of which eventually settle on the immediate soil with some seeping to the sub-strata during periods rainfall. The fact that the burning also takes place on unfortified grounds at the site also makes it easy for these contaminants to be directly released into the soil. The presence of these contaminants is confirmed by XRF and laboratory analyses of soil samples from the Agbogbloshie site collected at surface and depth of 3.6 inches as summarized in Table 5.1 and detailed in Appendices 3A and 3B.

Figure 5. 8 Burning of E-waste at section of the Agbogbloshie Scrapyard

Heavy metals such as Co, Cu, Fe, Mn and Zn are required in minute quantities by soil organisms. Excessive amounts of these elements as shown in Tables 5.1 and 5.2 can become harmful to organisms. Other heavy metals such as Pb and As do not have any beneficial effect on organisms and are thus regarded as the main threats to both plants and animals (Chibuike & Obiora, 2014). The harmful effect of these heavy metals on soil organisms affects the breakdown of organic matter and thus slows generation of soil nutrients and subsequent growth of plants.

5.3.2 Potential Impacts on Surface Water

The recycling activities at Ghanaian scrap yards (especially Agbogbloshie) include mainly dismantling, uncontrolled dumping as well as pyrolytical processes. Recycling activities at numerous small workshops within the scrap yard often take place directly on un-fortified ground. Harmful substances released during dismantling therefore lead directly to discharges to soil. Within the burning areas, scrap yard workers use numerous temporary fires to burn plastics, mainly from copper cables and wires as well as monitor and TV casings. The burning operations create an accumulation of ash and partially burned materials. Insulating foam from dismantled refrigerators, primarily polyurethane, or old car tyres are the main fuels used for the fires, contributing in itself to acute chemical hazards and long-term contamination at the burning sites

During periods of heavy rainfall storm water runoff picks up surface dusts and soils waste motor oil and WEEE debris along with any chemical contaminant they may contain. These are carried into lower-lying lakes, lagoons, streams and rivers which ultimately flow into the ocean. A change in the water chemistry due to surface water contamination can negatively affect all levels of an ecosystem. It can impact the health of lower food chain organisms and, consequently, the availability of the food supply up through the food chain. It can also impact the health of wetlands and impair their ability to support healthy ecosystems, control flooding, and filter pollutants from storm water runoff. Contaminated surface water can also negatively affect the health of animals and humans when they drink, bathe in, eat crops that take up pollutants from contaminated water used for irrigation or, for aquatic organisms, when they ingest contaminated sediments. Aquatic organisms, like fish, have the ability to accumulate and concentrate

contaminants in their bodies. When other animals or humans ingest these organisms, they receive a much higher dose of contamination than they would have if they had been directly exposed to the original source of the contamination which could lead to cancer, reproductive abnormalities and in some cases death.

5.3.3 Potential Impacts on Ground Water

The potential release of contaminants from e-waste to soil at the Agbogbloshie site is amply evidenced by the presence of such elements as iron, zinc, lead, strontium and zirconium (at a depth of 3.6 inches from soil surface) in 90 – 100% of sampled spots at concentrations as indicated in Table 5.1. Some of these metals are highly or moderately soluble in water and therefore easily leached (Adedeji Oludare et al, 2014). When the soils at these deeper soil levels are porous it aid percolation and therefore these dissolved chemical contaminants seeps deeper to contaminate ground water. Groundwater contaminants can enter the body directly through water supplies or by eating foods prepared with contaminated groundwater or grown in fields using contaminated sources of water for irrigation. It may also affect humans and animals when they are in direct contact with contaminated waters.

Health effects from groundwater pollution depend on the specific pollutants in the water. Pollution from groundwater often causes diarrhea and stomach irritation, which can lead to more severe health effects. The effect of Pb in humans, as an example, vary with the quantity present but include damage to the kidney, liver, nervous system, reproductive system, impaired growth and interference with blood system (Adedeji Oludare et al, 2014).

CHAPTER SIX

INTRODUCTION

- **Action Plan for E-Waste Management**
- **Environmental Management System for E-Waste Recycling at Agbogbloshie**
- **The Project and Components**
- **Purpose of the ESIA**
- **Methodology for the ESIA Process**
- **Project Registration and ToR for ESIA**
- **Report Organisation**

6.0 ACTION PLAN FOR E-WASTE MANAGEMENT

6.1 Policy Recommendations for E-Waste Management in Ghana

Ghana currently has no specific legislation (such as the Directive 2012/19/EU of the European Commission on waste electrical and electronic equipment (WEEE Directive)) for the control of and trade in end-of-life and near end-of-life EEE imported (as used EEE) into the country. There is also no specific guidance on the management of WEEE, including those generated locally. This is in spite of the fact that the country has ratified a number of chemical and waste related Multilateral Environmental Agreements (MEAs) and conventions, and adopted a number of codes and international declarations including the following:

- The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal;
- The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure of certain Hazardous Chemicals and Pesticides in International Trade;
- The Vienna Convention on Ozone Depleting Substances and the Montreal protocol on Phase of Ozone Depleting Substances
- The Stockholm Convention on Persistent Organic Pollutants; and
- ILO Convention on the Safety of Chemicals at the Workplace.

A review of existing legislation as well as other relevant studies in the e-waste sector, such as the Ghana E-waste Country Assessment and the Ghana E-waste National Strategy indicates areas where the enforcement or promulgation of new legislation would be crucial in the management of e-waste and setting of industry standards.

6.2 Enforcement and Amendment of Existing Legislation

There are currently existing legislations, which though not specifically targeted at WEEE, provides guidance on the management of activities related to the e-waste sector in Ghana. Enforcement and/ or amendment of these requirements would provide a framework for the management of hazardous substances related to activities such as burning and indiscriminate disposal of e-waste components and hazardous fractions at "recycling" sites, such as Agbogbloshie. These include:

- Environmental Protection Agency Act, 1994 (Act 490);
- Environmental Assessment Regulations, 1999 (LI 1652);
- Energy Efficiency Regulations, 2008 (LI 1932);
- National Environmental Policy (2012);
- The Ghana ICT for Accelerated Development Policy (ICT4AD);
- Occupational Safety and Health Policy of Ghana (Draft 2004);
- Mercury Law, 1989 (PNDC 217); and
- Local Government Act (1994) Act 462.

6.2.1 Environmental Protection Agency Act, 1994 (Act 490)

The Act established the Environmental Protection Agency, with the mandate to regulate, coordinate and manage the environment. Though the Act does not specifically mention WEEE, it provides enough guidelines for the management of toxic or hazardous substances. Section 2 of the Act requires the EPA to, among others:

- Provide standards and guidelines relating to the pollution and the discharge of toxic wastes and control of toxic substances;
- Coordinate activities and control the generation, treatment, storage, transportation and disposal of industrial wastes; and
- Control the volumes, types, constituents and effects of waste discharges, emissions, deposits or other sources of pollutants and/or substances which are hazardous or potentially dangerous to the quality of life, human health and the environment.

Section 10 of the Act establishes the Hazardous Chemicals Committee which is required to monitor the use of hazardous chemicals by collecting information on the importation, exportation, manufacture, distribution, sale, use and disposal of such chemicals, etc.

6.2.2 Environmental Assessment Regulations, 1999 (LI 1652)

The Environmental Assessment Regulations prohibit commencing an 'undertaking' (including e-waste recycling or processing facilities), without prior registration and an environmental permit (EP). Undertakings are grouped into schedules for ease of screening and registration, and for environmental permit. The EPA should, by way of enforcement, institute mandatory registration and licensing of WEEE recycling companies - including the informal operators (scrap dealers and refurbishers), to facilitate training and control of their operations.

6.2.3 Energy Efficiency Regulations, 2008 (LI 1932)

The Regulations, among others, prohibit the importation as well as the sale and distribution of used refrigerators, freezers and air-conditioners. Enforcement would control the volumes of EEE that come into Ghana, many of which end up at sites like the Agbogbloshie Scrapyard.

6.2.4 National Environmental Policy (2012)

The policy could be amended to include the need for sustainable means of collection or recycling or disposal of e-waste fractions; as well as guidance to prohibit illegal importation. Amendments to this policy must lead to the establishment of specific regulations to control the importation and likely emissions of hazardous substances from uncontrolled combustion activities, including burning of WEEE in the country.

6.2.5 The Ghana ICT for Accelerated Development Policy (ICT4AD)

The policy should be amended to make provision for the management of the waste generated from the use of ICT devices, products and services industry. Primary focus could be on ICT devices such as desktop computers, laptops, mobile phones, and accessories, including batteries; television sets, radios and network hardware. The policy should also make room for the management (including recycling and sound disposal) of waste ICT products, equipment and accessories.

6.2.6 Occupational Safety and Health Policy of Ghana (Draft 2004)

This policy needs to be updated to become more current and relevant, and made a substantive policy for OSH in Ghana. Amendments to this policy should, among other things, focus on setting specific workplace health and safety standards including standards for WEEE recycling facilities.

6.2.7 Mercury Law, 1989 (PNDC 217)

The Law provides for the importation, possession, trading (buying, selling or dealing) and use of Mercury, but is silent on importation, trading, possession/handling, recycling, release and disposal of Mercury-containing electrical or electronic appliances/gadgets. There is a need for an amendment to the law to include specific WEEE requirements.

6.2.8 Local Government Act (1994) Act 462

This Act should make specific provisions for the segregation of waste (solid), including WEEE to enhance recycling of these wastes by certified recycling companies or facilities and hence reduce or avoid hazardous components of electrical or electronic appliances/gadgets getting into wrong hands.

6.3 Requirement for New Legislation

In order to properly regulate the activities of the sector as well as set internationally acceptable standards for the operations of recycling facilities there would be the need for new legislation for the following areas:

- Adoption of EU WEEE guidelines;
- Domestication of chemicals and waste related conventions; and
- Extended producer/ importer responsibility.

6.3.1 Adoption of EU WEEE Guidelines

Technical Committee for Waste Shipment Prevention (TCWSP), which comprises representatives from GPHA, EPA, Standards Authority, Customs, etc., has adopted the EU WEEE guidelines. There is, however, the need to subject these guidelines to stakeholder review and then gazetting by the Honourable Minister for implementation, pending formal Regulations on WEEE.

6.3.2 Domestication of Chemicals and Waste Related Conventions

There is the need to develop legislation to domesticate relevant provisions of the chemicals and waste related Conventions (Basel, Rotterdam and Stockholm). This will put in place a suitable legal framework to ensure the control of transboundary movements of WEEE and also ensure their environmentally sound disposal in Ghana.

6.3.3 Extended Producer/ Importer Responsibility

One of the key gaps in existing legislation is the lack of legal guidance that enhances collection of WEEE, especially from domestic users. One avenue to deal with this would be to make it obligatory for private producers and importers to establish buy-back schemes in Ghana. The details of such arrangements could be worked out through consultations with the major manufacturers of electrical and electronic equipment (e.g. Compu-Ghana, Ericsson, Nokia, Dell Computers, etc.).

6.4 Environmental Management System for WEEE Recycling at Agbogbloshie

The rapid accumulation of e-waste in Ghana merits the development and implementation of a comprehensive Environmental Management System (EMS) if the e-waste sector is to be made environmentally and socially sustainable. This EMS considers environmental and social policies to guide WEEE recycling operations, the environmental, and social and health and safety risks posed by various crude recycling methods; and measures to mitigate them. The roles and responsibilities for

implementation of policies and mitigation measures as well as capacity needs and building measures have been considered.

6.4.1 Environmental Policy

Sustainable management of e-waste recycling should be committed to protecting human health and the environment and exploring clean environmental technologies and practices. The policy should give consideration to partnership with other recycling set-ups towards ensuring a more comprehensive recycling process. WEEE recycling operations must be guided by the following:

- Collection and transportation of WEEE to the recycling site must be conducted in a manner that do not pose safety risks to either the collector or the general public;
- Personal protection must be provided in the form of requisite PPE for every person involved in the recycling process;
- Recycling of WEEE should not be limited to only the 'useful parts' such as the metal components; it should be extend to cover the entire equipment; i.e. plastic, foam, wood etc.;
- Environmentally-friendly processes should be employed in the recycling process; burning on-site should be avoided;
- Collaborations should be established with other recycling set-ups to take up 'left-over' material after metal components have been removed;
- WEEE recycling entities should be formally registered with the requisite institutions and observe all permitting and licensing requirements;
- There must be medical screening for all employees of the WEEE recycling set-up at least once every 6 months;
- There must be capacity building for every worker aimed at updating their skills to conform to international best practice and keep them abreast with the environmental implications of their operations.
- This policy will be reviewed and updated annually to reflect outcomes of internal and external auditing processes.

6.4.2 Relevant Legal and Other Requirements

Existing direct policy requirements and guidance on EEE and WEEE management are mostly scanty or embedded in more general policies guiding various sectors. There have been quests to develop policies that address EEE issues more vividly or strengthen existing ones to reflect the issues more clearly. The relevant legal, regulatory and policy framework guiding the sector and suggestions to make them more prominent have been addressed comprehensively in Chapter Three of this report; the following are highlights of the key ones:

- Ghana ICT for Accelerated Development (ICTAD) Policy;
- National Policy on Public Private Partnership;
- National Environmental Policy;
- Occupational Safety and Health Policy of Ghana (Draft 2004);
- National Energy Policy;
- Environmental Sanitation Policy;
- Environmental Protection Agency Act;
- Environmental Assessment Regulations;
- Draft National Hazardous Waste Bill;

- Factories, Offices and Shops Act;
- Energy Commission Act;
- Energy Efficiency Regulations
- Local Government Act.
- Mercury Law;
- Ghana Standards Authority Decree;
- Export and Import Act; and
- Ghana Revenue Authority Act.

6.4.3 Environmental Aspects and Impacts

Recycling of WEEE is laudable and consistent with international environmental best practice such as the 3Rs principle. The practice is also lucrative as valuable metals such as lead, aluminium and cadmium obtained from WEEE are sold for profit. The crude and informal methods used in WEEE recycling at sites such as Agbogbloshie however expose humans and environment alike to quite a number of health, safety and environmental contamination risks. The most prominent of these risks are:

- Occupational health and safety risks;
- Public health and safety risks; and
- Impacts on soil, air and water.

(a) Occupational Health and Safety Risks

The crude working methods of recycling and the haphazard nature of organization of the working area at Agbogbloshie makes it injury-prone. Persons working on the site rarely use any PPE and as such are exposed to the vagaries of their work. There have been reported incidences of pieces of metal, thrown forcefully from equipment being dismantled, lodging into the skin or eyes of workers. The soft-material slip-ons worn by most of the workers as footwear increases the potential for their feet being pierced and injured by pieces of scrap metal scattered around.

Perhaps an even more serious risk is exposure to the smoke generated from widespread burning at the site. Elevated urine levels of Co, Cr, Cu, Fe and Pb and serum levels of Co, Fe, Hg, Pb, Se and Zn were found in persons working at the Agbogbloshie recycling site in a 2011 Health Assessment Study conducted by GreenAd, Pure Earth (formerly BlackSmith Institute) and Ghana Health Service. Toxic levels of metals in the body could cause metallosis with symptoms such as high blood pressure, visual impairment, cognitive impairment, nerve problems and thyroid (Appendix 6).

(b) Public Health and Safety Risks

A major portion of WEEE is transported to the Agbogbloshie site by truck pushers who comb around the city scavenging for discarded equipment and metal scrap. These operatives ply same routes as normal traffic, usually making use of portions of outer lanes of main roads. The dangers of their activities are obvious as they interfere with traffic flow and often come into conflict with vehicles; endangering their own lives as well as the lives of other road users. In August 2011, the Accra Metropolitan Assembly (AMA) placed a ban on the operations of all truck pushers citing the traffic nuisance and safety risks of their operations as the main reason (www.ama.gov.gh).

(c) Impacts on Soil, Air and Water

The effects of uncontrolled dumping and burning activities on soil, air and water milieu at Agbogbloshie have been addressed in detail in Chapter Five of this report. The issues are with regards to accumulation of mostly heavy metals such as lead, zirconium, Copper, Titanium etc. (as a result of indiscriminate burning) in the surrounding environment. The deposited elements are washed into nearby water bodies via surface run-off and subsequently lead to contamination. In the case of Agbogbloshie, run-off from the heavily contaminated scrap yard area washes into the adjacent Odaw River which ultimately flows into the ocean.

Burning activities at the site contributes to increased levels of heavy metals in the surrounding air and beyond as made evident in the 2011 Health Assessment Study. Levels of heavy metals were found to be elevated in the urine and serum of participants in the study who lived over 1km from the scrap site. This was deemed by the report as being suggestive of their exposure arising out of the activities of e-waste recycling at the scrap yard.

(d) Waste Generation

An e-waste country assessment conducted by Green Advocacy Ghana in 2011 established that over 30,000 tons of solid waste such as plastics, CRT-glass, printed circuit boards, batteries and accumulators, condensers as well as other hazardous components were informally dumped in Agbogbloshie or similar dump sites in 2009 alone. Plastics accounted for over 50% of the non-recoverable fractions. They are piled up on the dump site and occasionally burnt to reduce the volume. Burning usually took place at night to disguise the black clouds of smoke emerging from these enormous fires. This ultimately resulted in emissions to air and subsequently also to soil and water through particle deposition. CRT-glass amounted to over 30% of the disposed fractions. After removing the plastic casing and the metal-containing fractions from a CRT-monitor or TV, the tube was taken to the dumpsite, where it was crushed to remove the last metal part. Batteries, accumulators, condensers and other hazardous components such as mercury switches or parts containing chlorofluorocarbons (CFCs) and hydro chlorofluorocarbons (HCFCs) accounted for less than 5% each. The disposal path of these hazardous fractions was mainly dumping which would lead to emissions/discharges of cadmium, mercury, lithium, PCBs, CFCs and HCFCs to soil, air and water.

6.4.4 Mitigation and Enhancement Measures

(a) Formalization of WEEE Collection

A formalized WEEE collection arrangement must be put in place in connection with other efforts to regularize and formalize other aspects such as clean recycling and safe and sustainable disposal of hazardous waste from portions of WEEE, etc. There will be demand for the raw material (WEEE) once a there is a functional streamlined recycling set up. To meet the demand, avenues must be created for organized collection of the material. Collection depots can be set up at strategically selected points around the city and well publicized to get the populace to buy into it. Segregation of WEEE from Municipal Solid Waste should be implemented; people can then deposit their e-waste at designated depots for a token; or transport arrangements can be made to pick them up from homes, offices etc. The following measures could also be considered:

- Registration and licensing of WEEE collectors so they can be taken on to run collection depots;
- Establishment of an association for collectors which will set standards for their operations;
- Organizing training programmes for all operatives in e-waste on how to conduct their operations in a safe and environmentally friendly manner;
- Stock taking at depots to track volumes of WEEE; and
- Enforcement of ban on operations of informal collection (truck pushers) of WEEE.

(b) Clean E-Waste Recycling Technology

Quite a number of technologies have been developed by some of the world's leading electronics companies for recycling e-waste in a manner that poses little risk to the environment. Electronics companies such as Mitsubishi, Panasonic, Hitachi, Sumitomo, Toshiba, Sharp and JFE Holdings have developed various systems for dismantling electronic items, separation of waste streams and recovery of valuable metals (WIPO, 2013). For instance, Toshiba has developed a system for crushing and sorting end-of-life EEE; the equipment to be recycled is put into a large plant for crushing and sorting; the crushed parts are then separated by manual visualization. In order to collect different recycled materials like iron, aluminum, stainless steel and plastics, a combination of mechanical (magnetic, excess current, high magnetism) and manual sorting is used (http://www.toshiba.co.jp). Figure 6.1 is a flow diagram of the process.

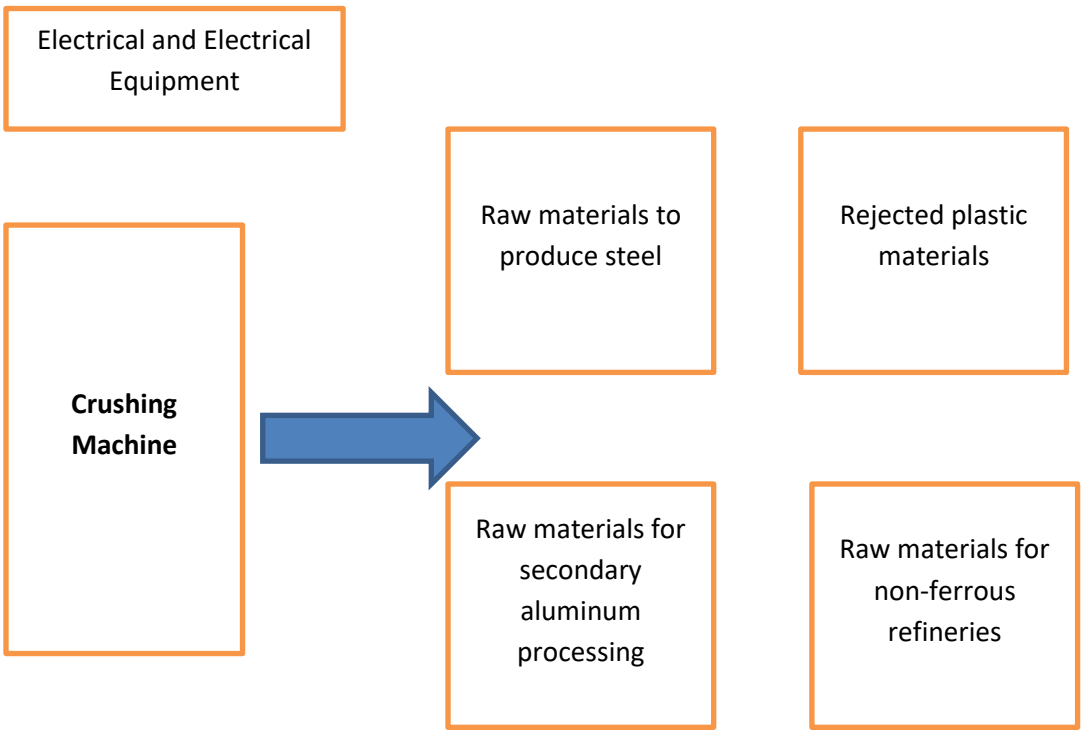


Figure 6. 1 Recycling Steps for End-of-Life EEE

Technologies from a few of the electronics companies are summarized as follows:

Mitsubishi (Proprietary method for separating plastics)
Plastics are separated manually after dismantling the equipment followed by separation of metals from the plastic at the shredding phase. This residual plastic is then fed for separation by specific gravity. In separation by specific gravity, the substances in plastic mixture are separated according to the weight of different substances.

Panasonic (High-Precision Resin Sorting System)
The system uses near-infrared rays to instantly identify specific plastic materials contained in the residues carried on a conveyor, and the plastic materials that are identified are shot down for recovery with compressed air. This system enables the sorting and recovery of plastic materials by type at purity of over 99%, and also enables the removal of plastic materials that contain bromine. The mass production equipment is compact in size, does not require the use of water, and has the potential to process 1,000 tons annually (http://panasonic.net/eco/factory/recycle/other.html).

Hitachi (Separation and Collection of Rare Earth Magnets from End-of-Life Products)
Hitachi has developed machinery that separates and collects rare earth magnets from hard disks and compressors. For HDD's a drum type unit spins to shake and prang the HDD's continuously, which loosens screws and disassembles the HDD's into their structural components. HDD's components like casing, disk, rare earth magnet components, etc. are separated. Since the rare earth magnets emerge from the machine separately the workers can then easily pick out desired components by screening them visually (http://www.hitachi.com/New/cnews/101206.html).

(c) Clean-Up Plan for Agbogbloshie Scrap Yard

A number of remediation strategies are available for consideration; four of them are summarized as follows:

- Removal and replacement of contaminated soils by either:
  - Removal and treatment to decontaminate the soils to safe heavy metals levels and returning the treated soils to the original site; or
  - Removal of contaminated soils and replacement with uncontaminated soil.
- Applying treatments to the site aimed at transformation of contaminants. The treatment could be thermal, biological, or chemical applied on or offsite.
- Immobilization of contaminants
  - Involving capping of the contaminated site, chemical and "in-situ" stabilization, solidification, and containment technologies.
- Extraction, separation and recovery of contaminants
  - Involving soil treatment by, soil washing, thermal extraction, and phytoremediation extraction using "in-situ" phytoextraction using specially selected plants to "pull" the lead out of the soil. Where appropriate ground water treatment using gravimetric separation, ion exchange, and bio-chemical or phytoremediation6 extraction.

Immobilization of contaminants is a relatively cheap method compared to the others and it involves capping the overlying area of the contaminated site to control cross contamination by infiltrating surface water. In-situ capping refers to the placement of a permanent subaqueous covering or cap of clean material (e.g. concrete) over contaminated sediment. This process does not disrupt the environment or generate hazardous wastes; instead it prevents the off-site migration of soils contaminated with heavy metals.

Clean-up of the contaminated recycling site should be a collaborated responsibility of the Accra Metropolitan Assembly, being the main city authority and the National Youth Authority which has a stake in the ownership of land at Agbogbloshie. There would have to be collaboration with other institutions such as MESTI and EPA. Upon completion of the clean-up, clean technology for recycling WEEE (discussed in preceding paragraphs) should be set-up to secure employment for the hitherto informal recycling operatives.

Potential Bottlenecks to Remediation

There are a number of hindrances to the remediation of the site:

- Lack of political will; for instance to conduct mass evacuation of squatters on portions of the Agbogbloshie land to allow for works to be conducted;
- Land ownership issues;
- Conflicting plans of state institutions for the site; and
- Financial constraints.

A remediation plan would have to cover the entire Korle Lagoon Recreational Area, which includes the contaminated Agbogbloshie scrap yard, and this will involve extensive evacuation of the large population of squatters who have created make-shift communities such as Sodom and Gomorrah and Gallaway. Over

the years, successive governments have shied away from conducting such evacuations for fear of becoming unpopular with the people.

Ownership of the scrap yard and immediate adjoining lands is not certain as two government bodies, NYA and AMA, are laying claim to it. This could be a source of hindrance as it may be difficult to reconcile varying plans that the two bodies may have for the site. A remediation programme will be capital intensive; the cost factor making it unattractive to government.

(d) PPP Initiaives and Buy-Back Systems

Second-hand EEE volumes in Ghana imported mostly from Europe and North America is very high (as shown in the EEE inventory in Chapter 4) mostly due to their lower prices and also the unregulated import regime for second hand EEE. The sheer volumes have led to an informal industry that recycles or reprocesses e-waste to recover valuable metals such as lead and Mercury for sale. This however is done in a manner that contaminates the environment and endangers the lives of operatives and the public in general.

The traditional role of government is to provide primary infrastructure that would enable environmentally and socially sustainable activities. However, due to limited resources, most governments have resorted to the concept of Public Private Partnerships in the provision of infrastructure and other services to promote development, employment, etc.

PPP is an arrangement between the government, a statutory entity or government owned entity on one side; and a private sector entity on the other, for the provision of public assets and/or related services for public benefit. This is usually through investments being made by and/or management undertaken by the private sector entity for a specified period of time. There is a substantial risk sharing with the private sector; and the private sector receives performance linked payments that conform (or are benchmarked) to specified, pre-determined, and measurable performance standards.

One major policy intervention to manage the large volumes of WEEE generated is the implementation of buy-back systems; which provides an avenue for users of EEE to replace old and functioning equipment for new ones at a discounted fee. The system also makes provision for owners of WEEE to surrender them for proper end-of-life treatment. The scheme will involve government partnering with financial institutions, producers and importers of electronic and white goods.

A system could be run that awards major importers of EEE credits when they bring in environmentally-friendly equipment. Importers could then be required to accumulate specified credit targets that will qualify them to receive incentives such as tax rebates on their imports. Satisfactorily compliant importers could be awarded with a certificate of recognition of their efforts at protecting the environment. This would be publicized to promote the image of the compliant companies.
Government will have to facilitate the scheme by executing the following:

- Nationwide sensitization of the scheme through the use of mass media for the general public to embrace the concept;
- Provision of tax rebates on imported EEE and its accessories to make it affordable;
- Provision of rebate system for consumers of EEE;

- Encourage financial institutions to provide credit facilities for consumers of EEE such as consumer finance schemes and;
- Imposing high tariffs on second-hand EEE to discourage its patronage.

6.5 Action Plan Implementation

6.5.1 Proposed Management Structure

Implementation of the Action Plan for the management of EEE and e-waste requires the involvement of a number of institutions from both government and private sectors. Implementation can be divided into two main components, being;

1. Development of new policies or modification of existing ones to make them more relevant in directly addressing EEE and e-waste management; and
2. Remediation and reclamation of e-waste contaminated sites; including introduction of cleaner recycling technology, formalization of WEEE collection and provision of training for e-waste operatives on the use of new technology.

The first component of implementation would be under the oversight of MESTI; and is to involve a Law Reform Committee (LRC) on EEE with members drawn from the Energy Commission (EC), EPA, AMA, Factories Inspectorate Department (FID) and relevant NGOs. The second component would be overseen by the Accra Metropolitan Assembly (AMA) given that the Agbogbloshie scrap yard is within its jurisdiction so far as land zoning in concerned. Their mandate will include clean-up and reclamation of the site. The AMA would have to collaborate with the National Youth Authority (NYA) on the issue of job security for the existing recycling operators at the site and EPA on the management of hazardous waste from hazardous fractions that result from the recycling. The roles of institutions and organizations to be involved in the implementation of the action plan are as follows:

(a) Ministry of Environment, Science, Technology and Innovation (MESTI)

The Ministry is mandated to promote the application of science and technology to drive socio-economic transformation in the country. To this effect, it seeks to ensure that the application of science, technology and innovation brings about enhanced productivity in all sectors of the economy while ensuring sustainable environment and human development. The sustainable management of EEE and e-waste is as such directly under the purview of MESTI. The Ministry will spearhead policy and law reform on EEE and e-waste in relation to the following:

- Facilitation of the formation of the LRC on EEE;
- Identification of any other policy gap in addition to those already identified in this study;
- Consultation with relevant government bodies 'hosting' the policies or laws to which amendments have been proposed to agree on or streamline the proposed amendments;
- Submission of proposed new bills on EEE for parliamentary debate and ascent into law; and
- Facilitation of 'gazetting' of amendments to EEE-related laws and policies

(b) Energy Commission

As the regulator of energy resources in Ghana, the EC's contribution on the LRC will be with respect to:

- Policy recommendations to regulate the energy efficiency of EEE entering the country; and
- Suggestions on up-scaling and improvement of buy-back systems

(c) Environmental Protection Agency

The role of the EPA on the committee will entail:

- Establishing an Environmental Framework, e.g. SEA for e-waste recycling operations;
- Alternative, environmentally-friendly technologies for recycling EEE;
- Health and safety standards to be observed at recycling sites;
- Monitoring of environmental performance of recycling operations;
- Clean-up and reclamation methods for contaminated recycling sites; and
- Managing hazardous waste fractions from recycled WEEE.

(d) Accra Metropolitan Assembly

The AMA will undertake the following roles in the plan implementation:

- Develop a reclamation plan for the entire Odaw drain and Korle Lagoon Area;
- Source for funding for the clean-up and reclamation of Agbogbloshie scrapyard;
- Source for funding for the establishment of a clean technology recycling center at the reclaimed scrap yard;
- Provide for and promote segregation of WEEE at source (homes, offices, public places etc.);
- Set up WEEE collection depots and put in place plans to incentivize the populace to donate their WEEE; and
- Enact and enforce prohibition of the operations of informal WEEE collection and recycling.

(e) National Youth Authority

The NYA will undertake the following roles in the plan implementation:

- Collaborate with AMA to develop a reclamation plan for Agbogbloshie and the Odaw drain and Korle Lagoon Area;
- Supervise the temporary relocation of operatives at Agbogbloshie scrap yard to one half of the site to allow for clean-up on the other half; and vice-versa

(f) Factories Inspectorate Department

The FID will provide safety standards for setting up recycling facilities. They will be one of the licensing bodies to give approval for recycling facilities to be operated at Agbogbloshie.

(g) Association of Recyclers

The Greater Accra Scrap Dealers Association (GASDA) will be the representatives of Agbogbloshie recyclers and will communicate their opinions to be considered in any decision regarding their operations. The association will be the main vehicle for negotiating with the operatives at the site in order to foster understanding and prevent any potential clashes.

6.5.2 Monitoring and Enforcement

Although implementation of the Action Plan would involve quite a number of stakeholders, the roles of 4 institutions in monitoring and enforcement will be necessary:

(a) Energy Commission

- Imposition of remediation measures such as the buy-back system on the major EEE importers/ manufacturers in the country;
- Conduction of quarterly inspection of the premises of participant importers/manufacturers to ascertain compliance and progress in view of the directive

(b) Environmental Protection Agency

- Conduct compliance monitoring at e-waste recycling site targeted at adherence of operatives to the management of 'non-useful' components generated from the recycling activities;
- Lead the education of operatives on environmental and safety best practices regarding recycling operations

(c) Accra Metropolitan Assembly

- Enforce ban on the operations of informal WEEE collectors/truck pushers;
- Provide a safe and secured environment for site clean-up works;
- Facilitate the orderly temporary settlement of recyclers to allow for clean-up and reclamation works;
- Issue necessary permit for the establishment of any WEEE recycling set-up; and
- Facilitate training of GASDA to perform basic safety monitoring e.g. check use of PPE.

(d) National Youth Authority

- Monitor progress of WEEE recyclers who have been migrated unto the new clean-method; and
- Set up a job security support program to assist recyclers to get established once they are moved unto the 'new system'

6.6 Awareness Creation and Capacity Building

There will be need to create awareness for all stakeholders whose operations will be affected by the new policy change, for instance, importation of EEE, buy-back system etc. Awareness would also have to be created to educate the general public on new measures to better manage EEE and e-waste; e.g. segregation at source. Education will also have to be directed at scrap dealers/ recyclers at Agbogbloshie on the permitting regime for their operations.

Capacity building will be key to the successful implementation of the Action Plan. After the initial conferral with operatives at the recycling site on the in-coming system is done, the next step will be to get them to familiarize with the new technology; its operational module, safety handling, output efficiency etc. A capacity-building programme must be drawn targeted at periodically updating the knowledge base of e-waste recycling operatives on issues related to new technologies, health and safety standards etc. Table 6.1 shows the awareness creation and capacity needs areas, the target recipients and the means of achieving awareness creation and capacity building objectives.

Table 6. 1 Awareness Creation and Capacity Needs Areas

Awareness Creation/ Capacity Building Concern	**Target Group**	**Method**
Disclosure on changes made in policy and its implications on the operations of dealers in EEE	• Importers of EEE • Distributors of EEE	Target group consultations
Public education and awareness on the e-waste menace and measures to manage it	• General public	Radio, television and print advertisement
Education on the clean-up plan for Agbogbloshie	• Operatives at the recycling site	Target group discussion

Education on the need to move away from the crude method of recycling e-waste	• Operatives at the recycling site	Target group discussion
Education of the new technology and its operation	• Operatives at the recycling site	Training workshop
Education on the need for use of PPE, and observance of safety measures regarding e-waste recycling operations	• Operatives at the recycling site	Training workshop
Training of members of the recyclers association to conduct basic daily safety monitoring at the site	• GASDA	Training workshop
Refresher programmes on new technologies for e-waste recycling, modifications to existing technology, new standards for health and safety, etc.	• Operatives at the recycling site	Training workshop

6.7 Implementation Timelines and Budget

The budget indicates key activity areas captured in the Action Plan and their anticipated periods for implementation based on requisite actions. It covers estimated costs for implementing the plan over a period of two (3) years i.e. from June 2015 to June 2018. The estimated cost of implementation is nine million, four hundred and forty Ghana Cedis (GHS 9,440,000). Table 6.2 shows the Action Plan

Table 6. 2 Budget for Implementation of Action Plan

	Activity Areas	Timelines	Responsible Body	Estimated Cost (GHS)
1	Policy Intervention for Good E-Waste Management • Formulation of new policies amendments to existing ones • Stakeholder consultations	June 2018	MESTI/ EPA/ Law Reform Commission	300,000
	Implementation of EMS • Providing clean technologies (including importation, transportation and installation) • Training of staff at recycling facility • Implementation of mitigation and monitoring measures • External audits of EMS	December 2015 January 2016 March 2016 June 2016	EPA/ Relevant NGOs	5,000,000
	Site Clean-up • Implementation of remediation plan • Consultation with land users • Temporary relocation of structures to other sections on the site • Conrete earthworks for capping	December 2016	NYA/ AMA	1,500,000
	Other Interventions • Develop PPP Initiatives	December 2016	MESTI/ EPA	700,000

	Activity Areas	Timelines	Responsible Body	Estimated Cost (GHS)
	○ Consultations and stakeholder workshops • Design buy-back systems ○ Stakeholder consultations ○ Public awareness creation • Establishment and implementation of improved e-waste collection system in collaboration with District Assemblies			
	Capacity Building and Awareness Creation • Capacity needs assessment • Conducting capacity building exercises for auditors and supervisors • Advertise on media platforms	June 2016	EPA/ Relevant NGOs	700,000
	Monitoring and Enforcement • Roles to be discharged by identified relevant institutions/bodies (Quarterly)	December 2016	EPA/AMA	240,000
	Upgrading of existing facility for environmentally sound disposal of hazardous wastes arising from remediation activities and hazardous fractions of e-waste			1,000,000
	Total			**9,440,000**

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APPENDICES

The following pages contain information that support analyses made in this report and validate conclusions arrived at.

Appendix 1A	Field Survey Questionnaire for Importers
Appendix 1B	Field Survey Questionnaire for Refurbishers
Appendix 1C	Field Survey Questionnaire for Recyclers
Appendix 1D	Outline for EEE Import Data Capture from Custom Sources
Appendix 2A	Results of Survey of EEE Importers
Appendix 2B	Results of Survey of EEE Refurbishers
Appendix 2C	Results on Survey of EEE Recyclers
Appendix 3A	Coordinates of Sampling Sites
Appendix 3B	Results from In-Situ Analysis
Appendix 3C	Results from Water Research Institute Lab
Appendix 4	EEE Data From Customs Division
Appendix 5	Average Weight of Major Electrical and Electronic Equipment
Appendix 6	Data on Heavy Metals and other Chemical Species linked to E-Waste

APPENDIX 1A

Field Survey Questionnaire for Importers

1. What electrical and electronics equipment (EEE) do you deal in? Please tick.

LARGE HOUSEHOLD APPLIANCES		
☐ Fridge	☐ Electric heater	☐ Griller
☐ Air conditioner	☐ Electric/Gas stove	Others
☐ Dishwasher	☐ Washing machine	
SMALL HOUSEHOLD APPLIANCES		
☐ Iron	☐ Hand dryer	☐ Toaster
☐ Kettle	☐ Fan	☐ Popcorn maker
☐ Blender	☐ Microwave	Others
☐ Coffee Maker	☐ Vacuum cleaner	
IT and TELECOMMUNICATION EQUIPMENT		
☐ Fax machine	☐ Phone (landline)	☐ LCD monitor
☐ Modem	☐ Printer	☐ CRT monitor
☐ Mobile phone	☐ Scanner	Others (Please Specify)
☐ Router	☐ Photocopier	
CONSUMER EQUIPMENT		
☐ Laptop/notebook/Tab	☐ Projector	
☐ TV (LCD/LED)	☐ Digital camera	
☐ TV (CRT)	☐ Calculator	
☐ DVD	☐ VCR	
☐ Sound system	☐ Others	

2. How many employees do you have?……

3. Please tick a range of employee salaries that apply to this organization.

Managerial	Above GH¢5,000 ☐	Between GH¢3,000 – GH¢5,000 ☐	Less than 3,000 ☐
Mid-level Staff	Above GH¢4,000 ☐	Between GH¢2,000 – GH¢4,000 ☐	Less than 2,000 ☐
Junior Staff	Above GH¢2,000 ☐	Between GH¢1,000 – GH¢2,000 ☐	Less than 1,000 ☐

APPENDIX 1B

Field Survey Questionnaire for Refurbishers

Date of Interview……

I. DEMOGRAPHY OF INTERVIEWEE

Name……. Age……

Sex…… Location of Business…….

Highest Education Level attained

Primary ☐ JHS/Secondary ☐ Tertiary ☐ None ☐

II. ISSUES

1. What EEE do you deal in? .....

2. What services do you provide?

Repair ☐ Sale of new equipment ☐ Sale of repaired equipment ☐

3. (If the manager/in-charge) how many employees do you have? ……

4(a).What is your average monthly income? Please tick a range as appropriate.

(b). Please tick ranges for your employees (if applicable)

	Above GHS3,000 ☐	Between GHS2,000 – GHS3,000 ☐	Less than 2,000 ☐
No.			
	Above GHS2,000 ☐	Between GHS1,000 – GHS2,000 ☐	Less than 1,000 ☐
No.			
	Above GHS1,000 ☐	Between GHS500 – GHS1,000 ☐	Less than 5,000 ☐
No.			

5. Is this the only means by which you earn your daily living? Yes ☐ No ☐

6. How many of your employees are engaged in other sources of income?.....

7. What are the other activities you (or your employees) engage in to earn additional income?

…….....

8. How many dependents do you have? None ☐ 1-3 ☐ 4-7 ☐ 8-10 ☐ Above 10 ☐

APPENDIX 1C

Field Survey Questionnaire for Recyclers

Date of Interview……

I. DEMOGRAPHY OF INTERVIEWEE

Name……. Age……

Sex…… Location of Business…….

Highest Education Level attained

Primary ☐ JHS/Secondary ☐ Tertiary ☐ None ☐

II. ISSUES

A. What are the types of electrical and electronic devices you collect? Please tick as applicable.

Refrigerators	Air Conditioners	Others (Please list)
Computers	Monitors	(i)
TVs	Mobile phones	(ii)
Radio/HiFi	Iron	(iii)
Kettle	Microwave	(iv)

B. How many devices do you collect on the average per day or per week?
(Help them arrive at an average)

Refrigerators…….per day/ week	Air Conditioners…….. per day/ week
Computers…… per day/ week	Monitors…….. per day/ week
TVs…….. per day/ week	Mobile phones……. per day/ week
Radio/HiFi…… per day/ week	Iron……. per day/ week
Kettle……. per day/ week	Microwave…….. per day/ week
Others (Give details)……	

C. Rate of recycling – how much is recycled in a day or in a week

Refrigerators…….per day/ week	Air Conditioners…….. per day/ week
Computers…… per day/ week	Monitors…….. per day/ week
TVs…….. per day/ week	Mobile phones……. per day/ week
Radio/HiFi…… per day/ week	Iron……. per day/ week
Kettle……. per day/ week	Microwave…….. per day/ week

Others (Give details)……

D. What does the recycling process entail? (What do you remove and what do you throw away?).

Please give details

Refrigerators…… ……	Radio/HiFi…… ……
Air Conditioners……..……..	Iron……. ……
Computers…… ……..	Kettle……. ……
Monitors…….. ……..	Microwave…….. ……
TVs…….. …….	Others (Give details)……
Mobile phones……. ……	

E. What happens to the parts that are retrieved from equipment?

……

F. What happens to the parts that are left of recycled equipment?

Burnt on site ☐ Dumped as refuse ☐

Other …….

G. What is your average monthly income? Please tick a range as appropriate.

Above GHS1,000 ☐ Between GHS500 – GHS1,000 ☐ Less than 500 ☐

H. Is this the only means by which you earn your daily living? Yes ☐ No ☐

I. What are the other activities you (or your employees) engage in to earn additional income?

…….....

J. How many dependents do you have? None ☐ 1-3 ☐ 4-7 ☐ 8-10 ☐ Above 10 ☐

APPENDIX 1D

EEE Import Data Capture Tool

YEAR…….		EEE Type……	
Country of Import		**Quantity**	
		New	**Used**
1			
2			
3			
4			
5			
6			
7			
8			

APPENDIX 2A

Results for Field Survey of Importers

Company	EEE Types	Import Volumes	Product Sales	Number of Employees	Salary Ranges
Zepto	*Consumer Equipment* • Laptop/notebook/tablet • TV (LCD, LED)	101 – 300 101 – 300	101 – 300 101 – 300	**11**	Managerial – less than GH¢3,000 Mid-level staff – less than GH¢2,000 Junior Staff – less than GH¢1,000
Hi-sense Ghana Ltd.	*Large H. Appliances* • Fridge • Air conditioner • Washing machine *Small H. Appliances* • Iron • Kettle • Blender • Microwave • Toaster *ICT Equipment Only* • Mobile Phone Consumer Equipment • TV (LCD, LED)	301 - 1000 101 – 300 51 – 100 >1000 >1000 301 - 1000 301 – 1000 301 – 1000 >1000 >1000	301 – 1000 101 – 300 51 – 100 101 – 300 101 – 300 310 – 1000 101 – 300 101 – 300 301 - 1000	**68**	Managerial – GH¢3,000 – 5,000 Mid-level staff – less than GH¢2,000 Junior Staff – less than GH¢1,000
				79	

APPENDIX 2B

Results for Field Survey of Refurbishers

Dates for Survey: 27th -29th March 2015
Survey Method: Questionnaire
Total Number of Respondents: sixty-nine (69)

Table 1: Communities and number of respondents

Community	Number of Respondents
Kwame Nkrumah Circle	29
Abeka Lapaz	12
Nyamekye	6
Darkuman	4
Odorkor	4
East Legon	4
Spintex Road	10

Table 2: Types of EEE Sold/Serviced in Respective Communities

Community	EEE Sold/Serviced
Kwame Nkrumah Circle	Mobile Phones, Tablets, Desktop and Laptop Computers, Game Consoles, Printers
Abeka Lapaz	DVD Players/Home Theaters, Television Set, Blenders, Refrigerators, Desktop/Laptop Computers, Printers, Speakers/Amplifiers, Car tapes, Kettles, Microwave Ovens, Electric Iron, Electric Generators
Nyamekye	DVD Players/Home Theaters, Television Set, Blenders, Refrigerators, Desktop/Laptop Computers, Printers, Speakers/Amplifiers, Car tapes, Kettles, Microwave Ovens, Electric Iron,
Darkuman	Speakers/Amplifiers, Microwave Ovens, Kettles, Television Set
Odorkor	Speakers/Amplifiers, Microwave Ovens, Kettles, Television Set
East Legon	Mobile Phones, Tablets, Desktop/Laptop Computers
Spintex Road	Mobile Phones, Tablets, Desktop/Laptop Computers

Table 3: Number of EEE Dealers

EEE Serviced or Sold	Number of Dealers
Mobile Phones	34
Tablets	20
DVD Players/Home Theaters	10
Television Set	23
Blenders	2
Game Consoles	1
Refrigerators	10
Desktop/Laptop Computers	17
Printers	6

Speakers/Amplifiers	3
Car tapes	1
Kettles	1
Microwave Ovens	4
Electric Iron	4
Gas/Electric Cookers	3
Electric Generators	1

Table 4: Educational Levels of Respondents

Primary	JHS/Secondary	Tertiary	None
1	48	17	3

Table 5: Types Services Provided

Services Provided	Number of Respondents
Repairs Only	14
Sale of new equipment Only	0
Sale of repaired items Only	17
Installations only	1
Repairs , Sales of new items and repaired items	21
Repairs and Sale of new Items	0
Repairs and Sales of Repaired Items	16

Table 6: Number of employees of respondents

Number of Respondents	Number of Employees
2	7
3	5
8	0
9	4
12	1
14	3
21	2

Table 7: Monthly Income range of respondents

Income Range	Number of Respondents
Above GHS 3000	14
Between GH2000-GHS3000	21
Less than GHS2000	34

Table 8: Monthly Income ranges of respondents employees

Income range	Number of Respondents
Above GHS1000	0
Between GHS500-GHS1000	7
Less than GHS500	154

Table 9: Respondents with other means of livelihoods

Yes	No
9	60

Table 10: Respondent's means of other livelihoods

Other sources of livelihood	Number of Respondents
Video Production	1
Car Sales	1
Farming	1
Mechanics	1
Clothe Sales	2
Concrete machine operation	1
Sale of vehicle spare parts	1
Advertising	1

Table 11: Number of Dependents

Number of dependents	Number of Respondents
None	7
1-3	42
4-7	17
8-10	2
Above 10	1

APPENDIX 2C

Results for Field Survey of Recyclers

Dates for Survey: 11th -13th June 2015
Survey Method: Questionnaire/Interview
Total Number of Respondents: sixty-seven (67)

Table 1: Educational Level

Primary	JHS/Secondary	Tertiary	None
21	19	2	25

Table 2: Types of EEE Recycled

• Refrigerators	• Refrigerators	• Refrigerators
• Computers	• Computers	• Computers
• TVs	• TVs	• TVs
• Radio/HiFi	• Radio/HiFi	• Car Engines
• Kettle	• Kettle	• Car Batteries

Table 3: Average Quantities of Electronic and Electronics Devices Collected Per Week

EEE	Quantities
Refrigerators	19
Computers	25
TVs	17
Radio/HiFi	15
Kettle	10
Air Conditioners	14
Monitors	49
Mobile Phones	25
Iron	12
Car Engines	6
Car Batteries	8

Table 4: Average Quantities of Electronic and Electronics Devices Collected Per Week

EEE	Quantities Recycled Per Week
Refrigerators	15
Computers	19
TVs	14
Radio/HiFi	12
Kettle	12
Air Conditioners	23
Monitors	27
Mobile Phones	13
Iron	13
Car Engines	14
Car Batteries	8

A. Recycling processes

The recycling processes involve dismantling the electronic and electrical devices with crude equipment such as chisel, hammers, pliers and screw drivers without any Personal Protective Equipment (PPE). Items retrieved include hard drive disk, mother board and metals such as iron, aluminum copper and brass.

B. Uses of the Retrieved Components

The retrieved metals and other devices from the electrical and electronic equipment are mostly dealers from Nigeria.

C. Disposal of Unretrieved Components

Twenty-three (23) of the refurbishers representing 33% of the respondents dump the unrecycled components on site very close to the Odaw River, while 44 of the recyclers representing 67% of the respondents burn the unrecycled components at the same location.

Table 5: Income ranges of respondents

Income range	Number of respondents
Above GHS1000	10
Between GHS500-GHS1000	43
Less than GHS500	14

Table 6: Number of dependents

Number of dependents	Number of respondents
None	14
1-3	42
4-7	9
8-10	2
Above 10	0

D. Groupings of recyclers

Out of the total number of respondents interviewed, 51 of them operate individually whilst 16 of them operate in groups between two to ten groups.

APPENDIX 3A

Co-ordinates of Sample Sites

No	Codes	GPS Coordinates	
		Latitude	Longitude
1	002	5.554431	-0.225752
2	003	5.554133	-0.226061
3	004	5.553730	-0.226556
4	005	5.553398	-0.226821
5	006	5.552855	-0.227331
6	008	5.552271	-0.227736
7	009	5.553910	-0.225476
8	010	5.552471	-0.225752
9	011	5.552329	-0.226061
10	021	5.552203	-0.226556
11	022	5.551850	-0.226821
12	024	5.551891	-0.227331
13	025	5.551209	-0.227736
14	026	5.550607	-0.225476
15	027	5.550052	-0.227535
16	028	5.549636	-0.227603
17	029	5.550525	-0.227789
18	030	5.550612	-0.228116
19	031	5.551261	-0.228019
20	032	5.551556	-0.227341
21	033	5.552526	-0.226708
22	034	5.552782	-0.226213
23	035	5.553260	-0.225666
24	038	5.553753	-0.225270
25	039	5.554031	-0.225244
26	040	5.553959	-0.225281
27	041	5.553659	-0.225132
28	042	5.553370	-0.224819
29	043	5.553021	-0.224447
30	044	5.552732	-0.224034
31	045	5.552360	-0.224592
32	046	5.551772	-0.225052
33	047	5.552094	-0.225110
34	048	5.551946	-0.225248
35	049	5.552482	-0.225507

APPENDIX 3B

In-Situ Analysis Results

No.	Codes	Heavy Metal Concentration (ppm)															
		Zn		Rb		Pb		Sr		Fe		Mn		Cu		Ti	
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1	002	200	-	12	-	56	-	60	-	8832	-	-	-	-	-	-	-
2	003	353	-	20	-	137	-	73	-	15587	-	1579	-	93	-	-	-
3	004	1295	-	32	-	469	-	641	-	7306	-	597	-	644	-	25047	-
4	005	313	-	53	-	-	-	215	-	11536	-	199	-	169	-	-	-
5	006	430	-	73	-	171	-	176	-	18192	-	240	-	188	-	4440	-
6	008	384	-	35	-	90	-	197	-	15499	-	244	-	114	-	1924	-
7	009		-	-	-	-	-		-	-	-	-	-	-	-	-	-
8	010	170	66	22	21	39	22	83	39	2225	14406	610	-	6517	542	-	2397
9	011	-	-		-	-	-		-		-	-	-	-	-	-	-
10	021	242	377	14	21	182	413	156	183	17161	36958	186	-	42	86	1463	2136
11	022	123	7063	42	51	93	2734	99	70	19486	6014	-	-	54	6995	2509	3146
12	024	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
13	025	411	894	17		103	104	87	76	7341	6628	-	-	56	-	-	-
14	026	202	146	29	32	179	84	137	90	9259	16634	-	231	138	-	1454	2905
15	027	1196	732	42	-	1458	29	113	134	15086	3529	219	181	1294	535	2941	-
16	028	1156	687	31	34	301	100	109	84	21050	>10%	-	-	419	-	4048	3882
17	029	14409	-	46	-	868	-	52	-	16742	-	268	-	2797	-	3524	-
18	030	-	11085	32	-	415	-	5803	-	-	14538	-	-	-	923	-	2495
19	031	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
20	032	15122	95256	80	-	63	43367	55	2466	19480	41304	326	-	74	772	2132	6983
21	033	4794	2345	143	131	1665	131	216	152	>10%	>10%	927	1396	2583	3506	6476	7030
22	034	2126	2099	35	95	4000	9325	906	2368	>10%	27996	762	365	1326	3820	8624	1734
23	035	644	847	19	50	1354	725	853	502	38142	18002	504	300	783	746	3790	4246
24	038	326	-	30	19	124	-	69	19	21961	8425	201	-	101	-	2551	2729
25	039	324	833	15	29	68	609	145	200	34988	25497	284	299	203	725	-	-
26	040	1844	-	18	-	240	-	143	-	32627	-	405	-	237	-	3758	-
27	041	858	108	-	30	872	-	130	58	60120	14177	625	265	624	-	2833	2055
28	042	768	985	18	19	265	497	204	124	38574	>10%	294	-	11490	1290	2135	3453
29	043	171	279	18	17	1118	197	37	44	20048	25186	-	-	411	192	-	-
30	044	1711	1386	84	42	1382	561	289	159	71448	37486	364	-	1364	1416	5459	5153
31	045	410	235	30	16	242	82	55	101	59629	27832	388	-	305	152	5763	-

No.	Codes	Heavy Metal Concentration (ppm)																	
		As		Co		Zr		Sn		Sb		Ba		Ni		Mo		Cr	
		1	2	1	2														
1	002	-	-	-	-	134	-	-	-	-	-	-	-	-	-	-	-	-	-
2	003	-	-	-	-	202	-	-	-	-	-	-	-	-	-	-	-	-	-
3	004	99	-	-	-	302	-	162	-	124	-	-	-	-	-	-	-	-	-
4	005	-	-	242	-	255	-	-	-	-	-	-	-	-	-	-	-	-	-
5	006	-	-	-	-	220	-	-	-	-	-	-	-	-	-	-	-	-	-
6	008	-	-	-	-	323	-	-	-	-	-	-	-	-	-	-	-	-	-
7	009	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-
8	010	-	-	-	-	301	278	-	-	-	-	-	-	-	-	-	-	-	-
9	011	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-
10	021	-	-	-	932	346	189	-	-	-	-	-	-	-	-	-	-	-	-
11	022	-	-	-	416	283	-	-	577	-	666	-	-	-	-	-	-	-	-
12	024	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-
13	025	-	-	-	-	175	227	-	-	-	-	-	-	-	-	-	-	-	-
14	026	-	-	-	-	167	306	-	-	-	-	-	-	-	-	-	-	-	-
15	027	-	-	-	-	443	131	300	-	162	-	-	-	-	-	-	-	-	-
16	028	-	-	2440	-	294	360	-	-	-	-	-	-	-	-	-	-	-	-
17	029	-	-	337	-	246	-	171	-	-	-	-	-	-	-	-	-	-	-
18	030	129	-	-	-	2672	-	-	-	366	-	-	-	-	-	-	-	-	-
19	031	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-
20	032	-	-	343	2535	274	-	-	-	-	350	-	-	-	-	-	-	-	-
21	033	143	100	-	-	1417	97	343	226	290	456	-	2087	-	211	-	1092	-	-
22	034	412	-	1267	-	356	417	-	1279	303	1622	-		-		-	-	-	-
23	035	98	-	-	-	448	377	-	278	230	188	-	2604	-		-	-	-	-
24	038	-	-	-	-	423	415	-	-	-	-	-	-	-		-	-	-	-
25	039	-	130	-	-	277	355	-	-	-	-	-	-	-		-	-	-	-
26	040	-	-	-	-	261	-	-	-	-	-	-	-	-		-	-	-	-
27	041	-	-	-	-	210	366	-	-	-	-	-	-	-		-	-	-	-
28	042	-	-	-	-	191	205	-	-	-	-	--	-	-		-	-	-	-
29	043	-	-	-	-	151	350	-	-	-	-	-	-	-		-	-	-	-
30	044	-	-	-	-	311	197	-	-	285	296	-	-	-		-	-	-	-
31	045	-	-	-	-	374	327	-	-	-	-	-	-	-		-	-	357	-

APPENDIX 3C

Analysis Results from Water Research Institute Lab

Analysis Results

Water Research Institute, Environmental Chemistry Division
CSIR Premises, Airport Res. Area
P. O. Box M. 32
Accra, Ghana
Phone: (+233-21) 775351/52 Fax: (+233-21) 777170 E-mail: info@csir-water.com

Order ID: **Company Name: CEHRT.**

Contact First Name: **Contact Last Name:**
Community: **Site Name:**
Analysis start date: 20/05/15 **Analysis stop date: 27/05/15**

SAMPLE ID	Iron(mg/kg)	Manganese (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)
A-Point-21	23,269	254	427	177	2,581
B-Point-22	63,959	632	362	227	505
C-Point-23	63,691	430	4,109	347	966
D-Point-24	14,461	77	347	1,310	204

Approved by:

Dr. Osmund D. Ansa-Asare (Head, ECD)

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APPENDIX 4

EEE Data from Customs Division of GRA

ICT Equipment Only

Used	PC	CRT Monitors	Fax Machines	Laptops	LCD Monitors	Mobile Phones	Modems	Phones (Landline)	Printers	Scanners	Photocopiers
2010	141729	284	47	1795	16586	1167	1	196	8282	62	3703
2011	146162	205	69	1583	36289	454	7	161	8879	50	3785
2012	121574	83	25	1564	17472	129	1	45	9323	75	4071
2013	82488	437	31	1056	3565	128	1	110	6505	18	4677
2014	55143	40	10	2207	605	2058	3	42	16712	23	3080
Sub-Total	**547096**	**1049**	**182**	**8205**	**74517**	**3936**	**13**	**554**	**49701**	**228**	**19316**
Total											**15416639**
New	**PC**	**CRT Monitors**	**Fax Machines**	**Laptops**	**LCD Monitors**	**Mobile Phones**	**Modems**	**Phones (Landline)**	**Printers**	**Scanners**	**Photocopiers**
2010	379161	208	1667	64213	16586	966067	60343	210457	8282	2	11671
2011	3553877	100	1287	111247	36289	1857615	114273	148155	8879	6	21136
2012	532898	30	885	111669	17472	1813588	116331	314677	9323	1	7527
2013	918355	6	1517	125671	3565	1070645	31816	187158	6505	2	20430
2014	811662	110	130	75806	605	1297993	261269	81551	16712	1	9208
Sub-Total	**6195953**	**454**	**5486**	**488606**	**74517**	**7005908**	**584032**	**941998**	**49701**	**12**	**69972**
Total											**704797**

Consumer Electronics

New	Alarm Clocks	Camera	DVD	E Instruments	Game Consoles	MP3 Players	Projectors	Radio	Stereo	CRT TV	LCD TV
2010	11201	4210	63460	327		2206	68	790783	4656		8016
2011	981	4324	53426	23		1637	42	621853	6042	200	16785
2012	5163	2778	40473	45		1660	26	488771	11077	2639	26763
2013	4446	1443	31448	111	851	1129	4	505901	7402	1128	68172
2014	1140	455	11016	29		1227	5	152312	3308	6146	4807
Sub-Total	**22931**	**13210**	**199823**	**535**	**851**	**7859**	**145**	**2559620**	**32485**	**10113**	**124543**
Total											**2972115**

Used	Alarm Clocks	Camera	DVD	E Instruments	Game Consoles	MP3 Players	Projectors	Radio	Stereo	CRT TV	LCD TV
2010	34	194	68740	23470		4	267	40188	1293		1000
2011	1	321	64698	65486	11	8	317	35919	1146	64	3135
2012	2	744	51360	68621	1	201	302	31150	648	931	7171
2013	2	569	31793	25439		10	336	16969	1240	2741	7709
2014	1	59	18344	73010	11	4	272	9764	292	2083	3378
Sub-Total	**40**	**1887**	**234935**	**256026**	**23**	**227**	**1494**	**133990**	**4619**	**5819**	**22393**
Total											**661453**

EEE Components and Parts

New	Computer screens	Power Banks	CD-ROMs	Mobile Phone screens	Laptop Batteries	DVD-ROMs	TV Screens	Money Counting Machines	External Hard drives	Pen Drives	Mobile Phone Batteries
2010	402	65	3647	86545		23	6	222	598	10934	86545
2011	35	142	48483	26703	1	377		371	522	8440	26703
2012	87	64	3520	84506	18	176		677	202	14200	84506
2013	65	2845	45856	14523	7	725		1487	265	3491	14523
2014	175	4580	1304037	5792	3	715	8	400	65	2282	5792
Sub-Total	**764**	**7696**	**1405543**	**218069**	**29**	**2016**	**14**	**3157**	**1652**	**39347**	**218069**
Total											**1896356**

Used	Computer screens	Power Banks	CD-ROMs	Mobile Phone screens	Laptop Batteries	DVD-ROMs	TV Screens	Money Counting Machines	External Hard drives	Pen Drives	Mobile Phone Batteries
2010	50		767		40	28		3	10		
2011	101		699					11		1	
2012	46		7		20	50	4	3			
2013	114				10	1	2				
2014	16			7500	100		80	28			7500
Sub-Total	**327**	**0**	**1473**	**7500**	**170**	**79**	**86**	**45**	**10**	**1**	**7500**
Total											**17191**

Small Household Appliances

Used	Africa	N. America	S. America	Asia	Europe	Australia
2010	341	15041	4	1754	93779	537
2011	1010	4670	3	1533	97380	559
2012	267	5278	9	2246	149491	650
2013	615	3624	13	2043	72440	571
2014	690	4180	9	1762	41325	440
Sub-Total	**2923**	**32793**	**38**	**9338**	**454415**	**2757**
Total						**502264**

New	Africa	N. America	S. America	Asia	Europe	Australia
2010	20994	19910	1	963298	29581	248
2011	32292	2408	48	1159566	31038	50
2012	24108	3925	1	1243843	29675	688
2013	14360	2340	16	1576314	23219	306
2014	10788	1579	58	1294125	15833	1072
Sub-Total	**102542**	**30162**	**124**	**6237146**	**129346**	**2364**
Total						**6501684**

Large Household Appliances

Used	Africa	N. America	S. America	Asia	Europe	Australia
2010	261	3241	0	7967	353492	930
2011	246	12986	0	7633	318600	1141
2012	286	5301	0	10766	344514	686
2013	265	2354	2	3387	114755	264
2014	100	781	13	338	25507	81
Sub-Total	**1158**	**24663**	**15**	**30091**	**1156868**	**3102**
Total						**1215897**

New	Africa	N. America	S. America	Asia	Europe	Australia
2010	4244	11806	70128	431058	7986	239
2011	8088	18837	78404	691345	49992	206
2012	10403	22677	88578	724183	223096	260
2013	9881	9984	184181	781285	52596	174
2014	6964	6016	69401	584604	44764	389
Sub-Total	**39580**	**69320**	**490692**	**3212475**	**378434**	**1268**
Total						**4191769**

APPENDIX 5

Average Weight of Major Electrical and Electronic Equipment

Item	Average Weight (kg)	Source
Desktop Computer	9.9	Eugster et al. 2007
Laptop Computer	3.5	SWICO Recycling Guarantee 2006 / ecoinvent v2.0
CRT Screen	14.1	Laffely, J. 2007 / Zumbuehl, D. 2006
LCD Screen	4.7	SWICO Recycling Guarantee 2006 / ecoinvent v2.0
Mouse	0.05	Estimate / ecoinvent v2.0
Keyboard	1	Estimate / ecoinvent v2.0
Printer	6.5	Laffely, J. 2007
Television (CRT)	31.6	Zumbuehl, D. 2006
Mobile Phone	0.1	Estimate
Mobile Phone charger	0.1	Estimate
Video Recorder/DVD Player	5	Huisman et al. 2008
Hi-Fi system	10	Huisman et al. 2008
Radio	2	Huisman et al. 2008
Telephone	1	Huisman et al. 2008
Washing Machine	65	Huisman et al. 2008
Tumble Dryer	49	Künzler Bossert & Partner GmbH. 2001
Dish Washer	50	Huisman et al. 2008
Refrigerator	35	Huisman et al. 2008
Fridge/Freezer	35	Huisman et al. 2008
Freezer	65	Künzler Bossert & Partner GmbH. 2001
Microwave	15	Huisman et al. 2008
Electric cooker	46	Künzler Bossert & Partner GmbH. 2001
Vacuum Cleaner	8	Künzler Bossert & Partner GmbH. 2001
Iron	1	Huisman et al. 2008
Kettle	1	Huisman et al. 2008
Toaster	1	Huisman et al. 2008
Mixer	1	Huisman et al. 2008
Hair Dryer	1	Huisman et al. 2008
Electric Heater	5	Huisman et al. 2008
Electric Drill	2	Huisman et al. 2008
Power Saw	2	Huisman et al. 2008
Lawn Mower	15	Huisman et al. 2008

APPENDIX 6

Data on Heavy Metals and other Chemical Species linked to E-Waste

Arsenic - A poisonous metallic element which is present in dust and soluble substances. Chronic exposure to arsenic can lead to various diseases of the skin and decrease nerve conduction velocity. Chronic exposure to arsenic can also cause lung cancer and can often be fatal.
Barium - A metallic element that is used in sparkplugs, fluorescent lamps and "getters" in vacuum tubes. Being highly unstable in the pure form, it forms poisonous oxides when in contact with air. Short-term exposure to barium could lead to brain swelling, muscle weakness, damage to the heart, liver and spleen. Animal studies reveal increased blood pressure and changes in the heart from ingesting barium over a long period of time. The long-term effects of chronic barium exposure to human beings are still not known due to lack of data on the effects.
Beryllium – It has recently been classified as a human carcinogen because exposure to it can cause lung cancer. 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. Exposure to beryllium also causes a form of skin disease that is characterized by poor wound healing and wart-like bumps. Studies have shown that people can still develop beryllium diseases even many years following the last exposure.
Brominated flame retardants (BFRs) - 3 main types used in electronic and electrical appliances are Polybrominated biphenyl (PBB), Polybrominated diphenyl ether (PBDE) and Tetrabromobisphenol - A (TBBPA). Flame retardants make materials, especially plastics and textiles, more flame resistant. They have been found in indoor dust and air through migration and evaporation from plastics. Combustion of halogenated case material and printed wiring boards at lower temperatures releases toxic emissions including dioxins which can lead to severe hormonal disorders. Major electronics manufacturers have begun to phase out brominated flame retardants because of their toxicity.
Cadmium – Components may have serious impacts on the kidneys. Cadmium is adsorbed through respiration but is also taken up with food. Due to the long half-life in the body, cadmium can easily be accumulated in amounts that cause symptoms of poisoning. Cadmium shows a danger of cumulative effects in the environment due to its acute and chronic toxicity. Acute exposure to cadmium fumes causes flu-like symptoms of weakness, fever, headache, chills, sweating and muscular pain. The primary health risks of long term exposure are lung cancer and kidney damage. Cadmium also is believed to cause pulmonary emphysema and bone disease (osteomalacia and osteoporosis).
Chlorofluorocarbons - Compounds composed of carbon, fluorine, chlorine, and sometimes hydrogen. Used mainly in cooling units and insulation foam, they have been phased out because when released into the atmosphere, they accumulate in the stratosphere and have a deleterious effect on the ozone layer. This results in increased incidence of skin cancer in humans and in genetic damage in many organisms
Chromium and its oxides are widely used because of their high conductivity and anti-corrosive properties. While some forms of chromium are nontoxic, Chromium (VI) is easily absorbed in the human body and can produce various toxic effects within cells. Most chromium (VI) compounds are irritating to eyes, skin and mucous membranes. Chronic exposure to chromium (VI) compounds can cause permanent eye injury, unless properly treated. Chromium VI may also cause DNA damage.
Dioxins and furans are a family of chemicals comprising 75 different types of dioxin compounds and 135 related compounds known as furans. Dioxins• is taken to mean the family of compounds comprising polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Dioxins have never been intentionally manufactured, but form as unwanted by-products in the manufacture of substances like some pesticides as well as during combustion. Dioxins are known to be highly toxic to animals and humans because they bio-accumulate in the body and can lead to malformations of the foetus, decreased reproduction and growth rates and cause impairment of the immune system among other things. The best-known and most toxic dioxin is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).
Lead - The fifth most widely used metal after iron, aluminum, copper and zinc. It is commonly used in the electrical and electronics industry in solder, lead-acid batteries, electronic components, cable sheathing, in the glass of CRTs, etc. Short-term exposure to high levels of lead can cause vomiting, diarrhea, convulsions, coma or even death. Other symptoms are appetite loss, abdominal pain, constipation, fatigue, sleeplessness, irritability and headache. Continued excessive exposure, as in an industrial setting, can affect the kidneys. It is particularly dangerous for young children because it can damage nervous connections and cause blood and brain disorders, and IQ problems.
Mercury - One of the most toxic yet widely used metals in the production of electrical and electronic applications. It is a toxic heavy metal that bioaccumulates causing brain and liver damage if ingested or inhaled. In electronics and electrical appliances, mercury is highly concentrated in batteries, some switches and thermostats, and fluorescent lamps.
Polychlorinated biphenyls (PCBs) – A class of organic compounds use in a variety of applications, including dielectric fluids for capacitors and transformers, heat transfer fluids and as additives in adhesives and plastics. PCBs have been shown to cause cancer in animals. PCBs have also been shown to cause a number of serious non-cancer health effects in animals, including effects on the immune system, reproductive system, nervous system, endocrine system and other health effects. PCBs are persistent contaminants in the environment. Due to the high lipid solubility and slow metabolism rate of these chemicals, PCBs accumulate in the fat-rich tissues of almost all organisms (bioaccumulation). The use of PCBs is prohibited in OECD countries, however, due to its wide use in the past, it still can be found in waste electrical and electronic equipment as well as in some other wastes.

Polyvinyl chloride (PVC) – The most widely-used plastic, used in everyday electronics and appliances, household items, pipes, upholstery etc. PVC is hazardous because contains up to 56 percent chlorine which when burned produces large quantities of hydrogen chloride gas, which combines with water to form hydrochloric acid and is dangerous because when inhaled, leads to respiratory problems.
Selenium – Exposure to high concentrations of selenium compounds cause selenosis. The major signs of selenosis are hair loss, nail brittleness, and neurological abnormalities (such as numbness and other odd sensations in the extremities). Source: Information collated from http://www.atsdr.cdc.gov/toxfaq.html