A DECADE OF

PIONEERING E-WASTE MANAGEMENT IN GHANA

2009 - 2019

PURE EARTH BLACKSMITH INITIATIVE
Electrical and Electronic Waste Management Fund
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Green Advocacy Ghana
GreenAd

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Local Initiatives and the Strength of Partnerships
Ghana E-Waste Management

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Ibrahim M. Mohammed

Hon. Dr. Ibrahim Murtala Mohammed (June 2025)

Minister for Environment, Science, Technology and Innovation

Foreword

A DECADE OF PIONEERING E-WASTE MANAGEMENT IN GHANA

The use of Electrical and Electronic Equipment (EEE) is inevitable in modern societies, enabling urbanisation, convenience, efficiency, and global connectivity. It drives economic growth and fosters technological advancement across communication, healthcare and safety, education, energy efficiency, and sustainability, among others.

Ghana's EEE consumption rate began an upward trend when it formulated its policy on Information and Communication Technology (ICT) for accelerated development in the emerging information and digital age in 2003. As an example of the practical demonstration of the policy related to educational system improvement, Ghana initiated the One Laptop per Child programme in primary schools, among others. The high demand for all types of EEE led to an influx of gadgets, most of which were second-hand and had a relatively short, useful lifespan.

The current rate of EEE growth in Ghana is driven by urbanisation, rising incomes, the adoption of renewable energy, including solar, and ICT expansion. The rapid growth rate also generates E-waste in proportion and poses dire environmental challenges. This makes the effort at material recycling crucial for both the circular economy and environmental protection.

In the world today, knowledge of E-waste is widespread, as are the challenges it poses. In 2009, however, when there was a paucity of knowledge about E-waste and Ghana faced the infamous tag of a dumping ground and the associated toxic exposures, a civil society organisation championed an initiative to stem the tide. The genesis of E-waste management in Ghana was birthed through the publication of the Proposal for the Control of Importation and Management of E-waste in Ghana in July 2009 by Green Advocacy Ghana (GreenAd) with the guidance of the then Ministry of Environment, Science, Technology and Innovation (MESTI), now MEST.

Ghana has every reason to celebrate this unique achievement – a homegrown initiative that has found solutions to our national problem in the E-waste sector. We have indeed come very far, among the pace setters in Africa. Admittedly, our journey and progress in the industry are partly attributable to the immense support and contributions of our friends and partners. We appreciate and recognise you, and remain indebted to the Pure Earth (formerly Blacksmith Institute of the USA); Secretariat of the Basel Convention (SBC); The Dutch Ministry of Housing, Spatial Planning & Environment (VROM-Inspectorate); Dutch Recyclers Association (NVMP); Oeko Institut-Germany; Swiss Federal Labs for Material Science & Technology (EMPA); RAW Materials Group AB-Sweden; GIZ; and KfW.

The motivation for the proposal came mainly from the leadership provided by MEST, the Environmental Protection Authority (EPA), the Ministry of Communications and the Ministry of Trade and Industry. The initial engagement with these ministries provided the impetus to forge ahead during the early stages of the proposal development.
The acceptance of the proposal publication, through its patronage and sponsorship of various component projects, formed the foundation of E-waste management and the basis for the immense interest shown by both national actors and international partners. Almost a decade on, the once-unknown sector (E-waste) has now become a household name and is widely recognised.

In Ghana, we often fail to recognise our heroes and heroines while they are alive. With this humble initiative, we seek to rectify that anomaly, at least in the E-waste sector. It is deeply unfortunate that this function is taking place in the wake of the passing of one of the leading giants and apostles of the E-waste campaign – the late Hon. Dr Mrs Bernice Heloo, former Deputy Minister of MEST and former Member of Parliament for Hohoe. She stood firmly with the GreenAd field officers and led the charge with unwavering commitment and vision.

The original objective of the proposal focused on controlling waste importation and indiscriminate dumping, as well as on sound, sustainable scavenging and management of E-waste in Ghana. There were, however, additional beneficial outcomes, including reductions in emissions and energy use, climate change mitigation, and some contributions to the Sustainable Development Goals (SDGs), that clearly exceeded the expectations of the initiators.

The publication we are launching, **A Decade of Pioneering E-waste Management in Ghana,** documents the decade-long journey (2009 to 2019) of a humble local initiative that blossomed into a major E-waste development effort. It highlights initial studies, interim pilot interventions and a further three-year medium-term solution. This **E- Waste Decade Report,** features academic research in the sector, and it is intended to serve as an information resource on E-waste, providing a link to related studies and publications for the benefit of the numerous local and foreign researchers. And above all, the publication points the way forward for sustainable E-waste management in Ghana, led by the National E-Waste Fund.

Ibrahim M. Mohammed

Hon. Dr. Ibrahim Murtala Mohammed (June 2025)
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Acknowledgements

The preparation of the "Decade of Pioneering E-Waste Management in Ghana" reflects the collective vision, dedication, and sustained collaboration of numerous institutions and individuals who have contributed to the development of Ghana's e-waste management sector over the period of 2009 to 2019. The journey documented in this report would not have been possible without the support, leadership, and partnership of many actors who believed in the initiative from its earliest stages.

We acknowledge with deep appreciation the leadership, guidance and institutional support provided by the Ministry of Environment, Science, and Technology (MEST) and the Environmental Protection Authority (EPA). Special recognition is also due to Hon. Haruna Iddrisu, then Minister for Communications.

We pay special tribute to the late Dr. Mrs. Bernice Heloo, former Deputy Minister of MEST and Member of Parliament for Hohoe, whose leadership and steadfast commitment helped drive early progress on Ghana's e-waste agenda. We also recognize the leadership of Prof. Kwabena Frimpong-Boateng, then Minister for Environment, together with the valuable contributions of Mrs. Cynthia Bediako, Chief Director at MEST, and Mrs. Lydia Essuah, whose administrative and policy support were instrumental to the process.

We express our sincere appreciation to our international partners whose technical expertise, financial support, and research collaboration have significantly contributed to the progress captured in this report. These include Pure Earth (formerly the Blacksmith Institute), the Secretariat of the Basel Convention, Oeko-Institut e.V., EMPA, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), KfW, the Nordic Fund, the Swedish Geological, and other partner institutions whose support was instrumental in advancing research, piloting key interventions, and strengthening policy development within the sector.

We are particularly grateful to the many experts and professionals from partner institutions who worked closely with the initiative over the years. These include Richard Fuller, Russell Dowling, Bret Ericson, Kira Traore, and Professor Jack Caravanos all of Pure Earth; John Alexis Pwamang; the late Lambert Faabeluon; Letitia Abra-Kom Nyaaba, Larry Kotoe, Lovelace Sarpong, and Kwabena Bretwum all of the EPA; Raphael Fasko, Esther Mueller, Simonne Rufener, and Mathias Schluep of EMPA; Andreas Manhart, Siddharth Prakash, and Johanna Jacobs of Oeko-Institut; and Alexander Batteiger and Markus Spitzbart of GIZ.

We also acknowledge the support of national stakeholders, especially the first constituted e-waste management board responsible for managing the Agbogbloshie Recycling Centre (ARC) who played important roles in advancing the initiative, including Mr. Ras Mubarak (CEO) and Theophilus Anaman of the National Youth Authority, Mr. Emmanuel Asiedu (GRATIS Foundation), Mr. Mohammed Ali of the Greater Accra Scrap Dealers Association along with GreenAd's Executive Director among others, and CEHRT Ghana for the technical and financial support from its earliest stages.

Our sincere appreciation further extends to a number of valued collaborators whose professional expertise and support strengthened the initiative at various stages. These include Dr Carl Stephen Osei and Dr Edith Clarke of the Ghana Health Service, Dr. Kwadwo Ansong Asante of CSIR Water Research Institute (CSIR-WRI), Prof Martin Oteng-Ababio, Professor Julius Fobil of the University of Ghana, Joseph Yeboah of United Nations Industrial Development Organization, Dr Sampson Atiemo of the Ghana Atomic Energy Commission, Dr Vincent Kyere of the Mountain Research Institute, and Vivian Ahiabor of City Waste Ltd.

Finally, we acknowledge the dedication of the editorial team and contributors who made this publication possible: Yaw Amoyaw-Osei, Elizabeth Amoyaw-Osei, Samuel Bennett Akuffo, Benjamin Gyawu, Ewurama Kakraba Ampeh, Amy Naki Okletey, Emefa Dako, Obed Opoku Agyekum, Jeffery Baah-Poku, Christian Badoo, Emilia Osei-Asante, Kojo O. Amoyaw-Osei, Kweku Attafuah-Wadee, Nana Osei Amoyaw-Osei, Seth Ofobri, Gladys Schwinger, Lilian Brew, Evelyn Gyampo, Amoah Antwi, Daniel Onwonah-Owiredu, Edwina Arday, Sylvester S. Batsa, and Dickson Asare.

While it may not be possible to mention every individual and institution that contributed to Ghana's e-waste management, we extend our heartfelt gratitude to all partners, practitioners, researchers, and stakeholders whose dedication and collaboration made this pioneering journey possible.

Table of Contents

List of Tables

List of Figures

List of Acronyms

ARC	Agbogbloshie Recycling Centre
ASGM	Artisanal and Small-Scale Gold Mining
BOD	Biochemical Oxygen Demand
BMZ	German Ministry of Economic Cooperation and Development
COD	Chemical Oxygen Demand
Cond	Condensation
CRTs	Cathode-Ray Tubes
DMA	Dimethylacetamide
EEE	Electrical and Electronic Equipment
EMPA	Swiss Federal Laboratories for Materials Science and Technology
EPA	Environmental Protection Authority
FEV	Forced Expiratory Volume
FVC	Forced Vital Capacity
GAEC	Ghana Atomic Energy Commission
GAHP	Global Alliance on Health and Pollution
GASDA	Greater Accra Scrap Dealers Association
GDP	Gross Domestic Product
GHS	Ghana Health Service
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.
HBCD	Hexabromocyclododecane
HOC	Handing Over Centre
HPLC-ICP-MS	High-Performance Liquid Chromatography Coupled to Inductively Coupled Plasma – Mass Spectrometry
ICGC	International Central Gospel Church
IQR	Interquartile Range
KfW	KfW Bankengruppe (KfW Banking Group – German Government Development Bank)
KLRA	Korle Lagoon Recreational Area
MESTI	Ministry of Environment, Science, Technology, and Innovation
MEST	Ministry of Environment, Science & Technology
MMA	Methyl Methacrylate
MoTI	Ministry of Trade and Industry
MRI	Mountain Research Institute
NGO	Non-Governmental Organization

NVMP	Netherlands Association for the Disposal of Metal and Electrotechnical Products
NYA	National Youth Authority
PAHs	Polycyclic Aromatic Hydrocarbons
PBDD/Fs	Polybrominated Dibenzo-P-Dioxins and Furans
PBDEs	Polybrominated Diphenyl Ethers
PCB	Polychlorinated Biphenyl
PCDD/Fs	Polychlorinated Dioxins, Furans
PCDEs	Polychlorinated Diphenyl Ethers
PEF	Polyethylene Furan
pH	Potential of hydrogen (acidity or basicity)
PXDFs	Brominated/Chlorinated Dibenzofurans
PXDEs	Diphenyl Ethers
SBC	Secretariat of the Basel Convention
SDGs	Sustainable Development Goals
SETAC	Society of Environmental Toxicology and Chemistry
TSS	Total Suspended Solids
TSIP	Toxic Sites Identification Program
Turb	Turbidity
UG	University of Ghana
ULAB	Used Lead-Acid Batteries
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
VROM	Netherlands Ministry of Housing, Spatial Planning and Environmental Management
WEEE/E-waste	Waste Electrical and Electronic Equipment
XRF	X-ray Fluorescence

List of Chemical Symbols

Element	Chemical Symbol
Arsenic	As
Arsenite	AsO^{3-}_{3}
Arsenic (5+)	As (V)
Barium	Ba
Cadmium	Cd
Cobalt	Co
Carbon dioxide	CO_2
Chromium	Cr
Copper	Cu
Iron	Fe

Element	Chemical Symbol
Mercury	Hg
Manganese	Mn
Ammonia	NH_3
Nitrate	NO_3
Lead	Pb
Phosphate	PO_4
Promethium	Pm
Selenium	Se
Zinc	Zn

Statement from the Executive Director

TSIP Team for a Training Session

Green Advocacy Ghana (GreenAd) was established in 2007 with the aim of stepping up environmental advocacy in Ghana, through partnerships in research on health and environment, environmental education, and community sanitation and waste management campaigns. Our research on health and the environment focused on the National Toxic Sites Identification Programme (TSIP) in partnership with Pure Earth (then Blacksmith Institute, USA), which inventoried contaminated sites across the country. The formation of Green Clubs initiated in schools and publication of the GreenAlert newsletter for children and youth, marked our groundbreaking environmental education campaign while the mobilization of communities for coastal clean-up and sanitation awareness activities benefitted communities such as Bankuman, near Tema New Town.

GreenAd maintained focus on the three core areas until 2009 when emphasis shifted to what was then considered a looming threat in the waste sector: the uncontrolled dumping, crude recycling of, and pollution from Waste Electronic and Electronic Equipment (WEEE), popularly referred to as E-waste – particularly in Agbogbloshie.

Bankuman Beach – Pile of Fabric Waste

During the TSIP survey, which launched GreenAd's journey in the E-waste space, the Agbogbloshie E-waste disposal and dismantling area recorded unusually high pollutant concentrations, scoring 9 out of 10 on the Blacksmith Pollution Index. Hazardous chemicals such as Lead (Pb), Cadmium (Cd), Arsenic (As), and Mercury (Hg) originating from E-waste activities were identified in high concentrations at the site.

The pollution situation was so serious that industries and banks along Hansen Road (Abossey Okai Road), opposite the Agbogbloshie Scrapyard and the Onion Market area, sought an intervention from the Ministry of Environment, Science, Technology and

Bankuman Beach Clean-up Exercise

Innovation (MESTI). Some even threatened to relocate from the area since asthmatic workers amongst them always suffered attacks whenever they stepped outside the offices. Once MESTI referred the complaint to the Environmental Protection Agency (EPA), GreenAd was invited and requested to intervene to stop the burning of E-waste and other wastes.

The scale of pollution sparked international curiosity and negative publicity for Agbogbloshie, leading to its inclusion among the Top Ten polluted places in the world. This, however, ultimately birthed an initiative towards E-waste management in Ghana, culminating in a major intervention to eliminate crude recycling and the associated pollution menace. The initiative, captioned **"Proposal for the Control of Importation and Management of E-waste in Ghana",** also included studies to establish empirical evidence of the magnitude and severity of the E-waste threat for the information of decision-makers, and potential partners; and to inform policy review and development.

The proposal preparation was challenging due to paucity of knowledge about the sector. Nonetheless, it was crucial given that neither public nor private sector actors showed interest in E-waste at the time. It was prepared with mixed optimism, due to the international publicity dimension and sheer scope of the problem, as well as a lack of financial backing to look up to. The mixed optimism and uncertainty miraculously turned into a timely and compelling proposal, immediately sought after, and bought into by several partners.

The objective of this publication is to document the decade-long journey of a humble local initiative that led to major developments and a high level of interest in the E-waste sector. It underscores an initiative that began without any prior assurance of governmental action or foreign assistance, which could serve as an example for other Civil Society Organisations could serve as an example for other Civil Society Organizations (CSOs) to emulate. It is also to encourage state actors to be proactive in partnering and supporting similar innovative endeavours by CSOs in tackling national environmental challenges. The publication is also intended to serve as an information resource on E-waste and a link to related studies for the benefit of the teeming number of both local and foreign researchers who regularly make inquiries at GreenAd.

The original objective of the proposal focused on the control of illegal importation and indiscriminate dumping, as well as the sound and sustainable scavenging and management of E-waste in Ghana. There were, however, unspecified outcomes and added benefits, including savings on emissions and energy (city mining), Climate Change mitigation, and Sustainable Development Goals (SDGs) contributions that have been far-reaching and beyond expectations.

Partnership has always been, and continues to be, the hallmark of the E-waste success story. We are most grateful to our partners, whose contribution and support made all the difference – MESTI and EPA, Pure Earth, GIZ, KfW, Oeko-Institut, the Basel Convention Secretariat, the Nordic Fund, Swedish Geological, and EMPA.

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Yaw Amoyaw-Osei

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Executive Summary

The strategy for addressing the E-waste problem focused on developing a national proposal for managing the E-waste sector. It had two key components comprising research and practical intervention. The research component explored the scientific, socio-economic, health, and commercial aspects through both primary data collection and literature review, with resulting publications on E-waste. This facilitated dissemination of empirical data to enable an appreciation of the seriousness of the E-waste menace. It also revealed the related unexplored potentials and opportunities associated with the sector. The practical intervention component aimed to restrain the importation of Waste Electronic and Electric Equipment (WEEE) or used (second-hand) Electronic and Electrical Equipment (EEE) as well as facilitate the introduction of sound recycling measures that eliminate the crude method of metal recovery from the E-waste. Proposal development involved senior-level institutional stakeholders, including the Ministry of Environment, Science and Technology (MEST), Ministry of Trade and Industry (MoTI), Ministry of Communications (MoC), Environmental Protection Authority (EPA), National Youth Authority (NYA), Accra Metropolitan Assembly (AMA) and the Centre for Environment and Health Research and Training (CEHRT). Published in July 2009, the proposal was promptly shared with partners who expressed immediate interest in its respective components, enabling early implementation as funding was secured for an initial range of studies and publications ahead of the practical intervention phase.

Research and Studies

Eight key studies related to E-waste management were conducted over the decade, providing empirical evidence of the severity of the E-waste problem and raising awareness among policymakers. These included the Toxic Sites Identification Programme (TSIP), which recorded pollution levels at Agbogbloshie scoring 9 out of 10 on the Blacksmith Pollution Index and led to its listing among the Top Ten Polluted Places in the world. The Chemical Exposure and Health Status Assessment found significantly elevated levels of heavy metals including Lead, Cobalt, Chromium, Copper, Iron, and Selenium in E-waste workers. The Socio-Economic Assessment revealed that the E-waste sector employed up to approximately **33,600 workers nationally, with an estimated annual value of between $105 million and $268 million,** yet remained uncounted in Ghana's GDP due to its informal nature. The Ghana E-Waste Country Assessment, the National Strategy for E-Waste Management, the World Bank Technical Report on Sustainable Management of E-Waste, an Air Quality Improvement Evaluation Study, and a comprehensive Environmental and Social Audit of the Agbogbloshie dumpsite further built the knowledge base and guided the design of interventions.

Key Practical Interventions

The foremost practical intervention was the establishment of the Agbogbloshie Recycling Centre (ARC) in 2014, as a direct response to the crude and polluting metal recovery practices at the scrapyard. Motorized cable-stripping machines and a granulator were imported and installed to eliminate the burning of cables. The ARC processed approximately 25 tonnes of waste cables during its pilot phase, recovering clean copper and aluminium at premium prices. Operational training for E-waste workers, a business study tour to Sweden for GASDA members and EPA officials, and equipment trials to select preferred recycling methods were carried out in partnership with Pure Earth,

GASDA, GIZ, EMPA, and other partners. Architectural designs for the full redevelopment and transformation of the scrapyard into a modern E-waste village were also prepared. Plans to replicate the ARC in four additional urban centres (Koforidua, Kumasi, Sekondi-Takoradi, and Tamale) were developed, with the GRATIS Foundation commissioned to design locally manufacturable recycling equipment, though full implementation awaited funding.

Building on the ARC pilot, a GIZ-Oeko Pilot Incentive System (2018–2019) introduced a payment mechanism for waste cable collection, purchasing approximately 27.5 tonnes through 1,389 individual transactions and establishing a model for reducing cable burning. This pilot informed the larger MESTI-KfW Incentive Payment System launched in 2020, which extended coverage to cables, batteries, cathode ray tubes, and thermoplastics. From 2020 to 2022, the programme purchased over 457,000 pounds of cables, 69,000 pounds of batteries, and 232,000 pounds of thermoplastics, diverting these materials from burning and harmful recovery methods. GreenAd served as the implementing operator of both the ARC and the Handing Over Centre (HOC) under the KfW project.

A significant legislative achievement of the decade was the enactment of the Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917) and the accompanying Hazardous, Electronic and Other Wastes (Classification) Control and Management Regulations (LI 2250). These instruments, drafted with contributions from GreenAd, EPA, MEST, and international partners including Dell and HP, provided Ghana with a comprehensive regulatory framework for the management and control of E-waste, including provisions for Extended Producer Responsibility (EPR) and payment of EPR fees in form of an Advanced Eco-levy on imported EEE and Tyres, and the establishment of the National E-Waste Management Fund.

Significant Contributions by Researchers and Partner Institutions

The decade's progress was substantially shaped by pioneering contributions from researchers and institutions whose work built the scientific and policy foundation for Ghana's e-waste sector. John Pwamang of the EPA played a central role in coordinating key studies, leading the National E-Waste Strategy, advancing the legislative process for Act 917, and launching the National Integrated E-Waste Management Programme in 2018. International research and consultancy partners, including Oeko-Institut e.V. and the Mountain Research Institute contributed to feasibility assessments, incentive system design, and sector formalisation efforts.

Academic researchers have produced a substantial body of scientific literature documenting the health and environmental dimensions of e-waste in Ghana. Dr. Kwadwo Ansong Asante of the CSIR Water Research Institute has published extensively on heavy metal contamination, dioxin-like compounds, and halogenated pollutants at Agbogbloshie. Professor Martin Oteng-Ababio of the University of Ghana has provided critical socioeconomic and governance analyses, examining the informal sector's role, the impact of formalization policies, and the urban dynamics of e-waste recycling. Professor Julius Fobil contributed public health research documenting occupational exposures and the particulate matter burden on e-waste workers. Together, these researchers produced more than two dozen peer-reviewed journal articles and conference papers that placed

Agbogbloshie in the international scientific literature and informed both national policy and global awareness of e-waste health risks.

The Way Forward: MEST, EPA and The National E-Waste Management Fund

Looking beyond the decade, Ghana's e-waste management must transition from pilot-scale interventions to a nationally coordinated system, anchored on the Integrated National E-Waste Management System developed by the EPA to provide the institutional and regulatory foundation for scaling up e-waste management nationwide. The system is to promote the design and implementation of EPR as the core financing and product accountability mechanism. The National Electronic and Electrical Waste Management Fund established under Act 917 (now under Act 1124) is positioned as the central institutional engine for Ghana's next phase of action, with a mandate to manage and deploy resources at scale. The system by MEST, EPA and E-Waste Fund is built on public-private partnerships, with EPR serving as the primary financial backbone, requiring importers and manufacturers to contribute to the Fund for the products they place on the market. The informal sector, including the scrap dealers, cable strippers, and dismantlers who have been central to Ghana's e-waste story will be formalised through structured registration, health and safety certification, and inclusion in Fund-supported incentive schemes.

The Fund will co-finance the establishment of regional e-waste processing hubs in Kumasi, Takoradi, Tamale, and the Volta Region, building on the original ARC replication plan. A national e-waste take-back and drop-off network, a digital traceability platform for real-time tracking of material flows, and community-centred reverse logistics operated by trained youth agents will address the collection bottleneck that has long constrained the sector. Occupational health protections for e-waste workers, including on-site health screening, provision of protective equipment, and enrolment in the National Health Insurance Scheme, will be integrated as conditions for formalization support. Longer term, the Fund seeks to build a circular economy for electronics in Ghana in which materials are recovered at the highest possible value and Ghanaian entrepreneurs capture an increasing share of returns from e-waste processing.

The decade documented in this report is a testament to what is achievable when committed civil society actors, researchers, informal workers, government agencies, and international partners align around a common purpose. Ghana's first national e-waste proposal, published in 2009 without assurance of government backing or foreign assistance, catalyzed a decade of pioneering work that produced regulatory frameworks, recycling infrastructure, a substantial body of scientific knowledge, and proof of concept for incentive-based collection. The second decade must build on this foundation by developing the institutional capacity, financial sustainability, and national coordination needed to transform e-waste management from a patchwork of interventions into a functioning, inclusive, and enduring national system.

Chapter One

Introduction

1.0 Introduction

1.1 The Agbogbloshie Scrapyard

The Agbogbloshie Scrapyard (Figure 1.1) stretches about 2.5km southwards to the sea within the Accra Metropolis. A significant portion of land adjacent to the Scrapyard is a municipal refuse dump. The Ring Road South Industrial Area and the Korle Lagoon Recreational Area (KLRA) border the site to the north and northeast, respectively. The Agbogbloshie Onion Market, a kraal, a slaughter area, and the International Central Gospel Church (ICGC) are all landmarks within the site environs. The Odaw drains the area from the northern section of Accra into the Korle Lagoon (Figure 1.2).

The Scrapyard and its surrounding dumpsite were considered the second-largest E-waste processing area in West Africa. This was the center for E-waste disposal, crude recycling, and salvaging reusable E-waste components. The area eventually gained notoriety in the international press for the excessive levels of pollution emanating from the site, which affected surrounding areas in the south of Accra.

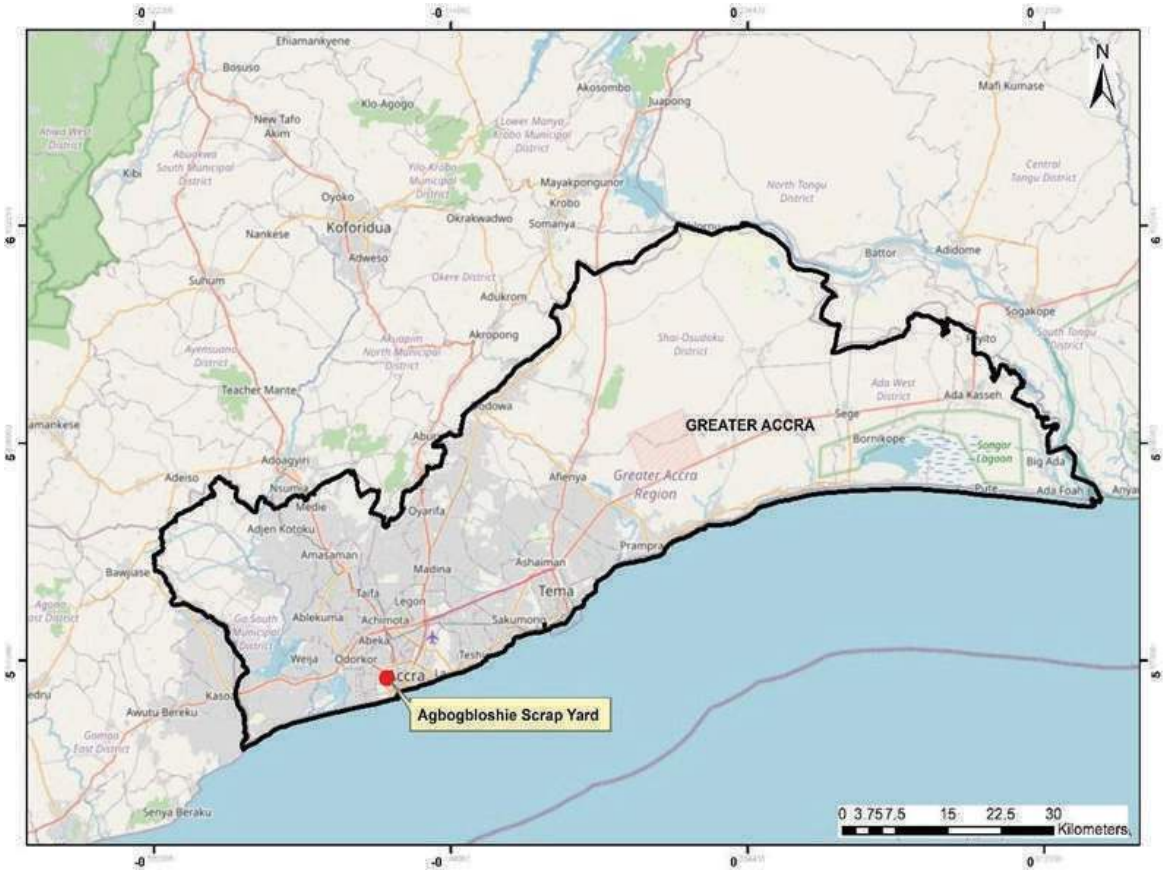


Figure 1. 1 Map of Greater Accra Showing Agbogbloshie

The Scrapyard was originally used for the crude containment of sludge from the Korle Lagoon during the Korle Lagoon Ecological Restoration Project (KLERP) in 1998 but later turned into a final waste disposal site. The Scrapyard was formally established by the Greater Accra Scrap Dealers Association (GASDA) in 2010 when the land on which the flourishing scrap business operated was allocated to them by the National Youth Authority (NYA). About 3,000 people worked in the E-scrap business, salvaging copper

and other metal components from E-waste materials using open burning as a means of recovering the component metals. The burning process reduced the bulk of E-waste dumped, but it generated toxic fumes and hazardous oil wastes that stained the site grounds and polluted the Odaw River.

Figure 1. 2 Map showing the Agbogbloshie Site (marked red)

1.2 E-Waste Management Initiative

With the advent of Information and Communication Technology (ICT), the Government of Ghana began to promote an agenda of computer literacy, increasing the deployment of technological devices in institutions. This, coupled with the modernization of other socio-economic sectors and globalization, generally resulted in the expanded acquisition and use of more electronic and electrical equipment (EEE).

Without any formal mechanisms in Ghana to manage end-of-life EEE, the quantum of E-waste generated locally and the phenomenon of global dumping in Ghana posed a significant problem that was certain to reach a tipping point. Moreover, there was a dearth of public-sector interest and policy, and of private-sector initiative, in E-waste management at the time.

E-waste components may often be associated with hazardous substances such as halogenated compounds, heavy metals and other contaminants (Table 1.1). Aware of the dire health consequences of potential releases of such hazardous substances into the environment (if not properly managed), GreenAd was obliged to step into the uncharted E-waste sector to develop a solution proposition titled - A Proposal for the Sound Management of E-waste in Ghana.

Table 1. 1 WEEE Components and Associated Hazardous Substance

Component Substance	Occurrence in E-Waste
1. Halogenated Compounds	
PCB (polychlorinated biphenyls)	Condensers Transformers
TBBA (tetrabromo-bisphenol-A) PBB (polybrominated biphenyls) PBDE (polybrominated diphenyl ethers)	Fire retardants for plastics (thermoplastic components, cable insulation)
Chlorofluorocarbon (CFC)	TBBA is presently the most widely used flame retardant in printed wiring boards and casings.
PVC (polyvinyl chloride)	Cooling unit, Insulation foam
2. Heavy Metals and Other Metals	
Arsenic	Small quantities in the form of Gallium arsenide within light emitting diodes
Barium	Getters in CRT
Beryllium	Power supply boxes which contain silicon controlled rectifiers and x-ray lenses
Cadmium	Rechargeable NiCd-batteries, fluorescent layer (CRT screens), printer inks and toners, photocopying- machines (tonner drums)
Chromium VI	Data tapes, floppy-disks
Lead	CRT screens, batteries, printed wiring boards

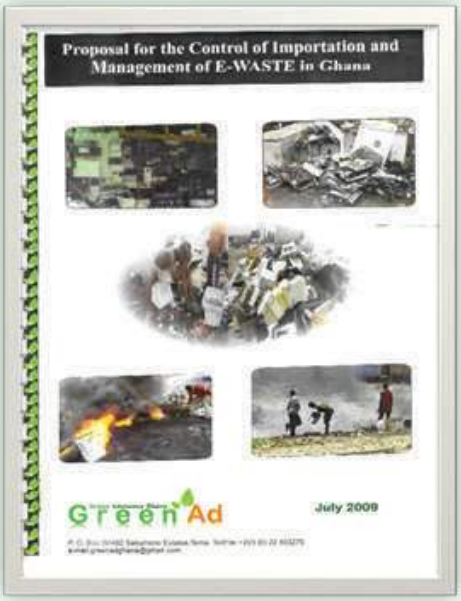
Lithium	Li-batteries
Mercury	Fluorescent lamps that provide backlighting in LCDs in some alkaline batteries and mercury wetted switches
Nickel	Rechargeable NiCd-batteries or NiMH-batteries, electron gun in CRT
Rare Earth elements (Yttrium, Europium)	Fluorescent layer (CRT-screen)
Selenium	Older photocopying machines (tonner drums)
Zinc Sulphide	Interior of CRT screens, mixed with rare earth metals
3. Other Contaminants	
Toner Dust	Toner cartridges for laser printers / copiers
Radioactive substances	Medical equipment, fire detectors, active sensing element in smoke detectors.

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

Thus, the proposal was developed in response to the imminent pollution threat to public health and the environment, the urgent need for solutions, and the necessary upscaling of such solutions. The proposal defined the magnitude of the E-waste problem, identified the key feasible proposal phases, outlined the implementation plans and possible schedules, as well as the management arrangements for its implementation.

Prepared and published in 2009, the E-waste proposal was well received, and its implementation was almost immediate. Different components of the proposal reflecting the interest of various partners were 'adopted' for implementation. The result is the remarkable progress in the development of the E-waste sector in Ghana.

This publication, A Decade of Pioneering E-waste Management in Ghana, documents the journey and contributions made in the development of the sector and the quantum of savings on emissions and pollution to the environment. It covers the role of partnerships that have been key in achieving our shared goals.



Authors:
Yaw Amoyaw-Osei & Dr Edith Clarke

The publication will serve as a historical account and knowledge repository for the benefit of other CSOs and NGOs working in the sector, and other related sectors. It will also be a valuable resource that points to other related publications for governmental and academic institutions, researchers, and students.

1.3 The Cycle of Major Events

The initial assessment of the situation posited the e-waste sector as highly problematic because of the way it would compound the already intractable general waste management conundrum the nation was grappling with. There was therefore an urgent need for a management response, leading to the development of the Proposal for the Sound Management of E-waste in Ghana. The events defined for implementation in the proposal are listed in Box 1.1.

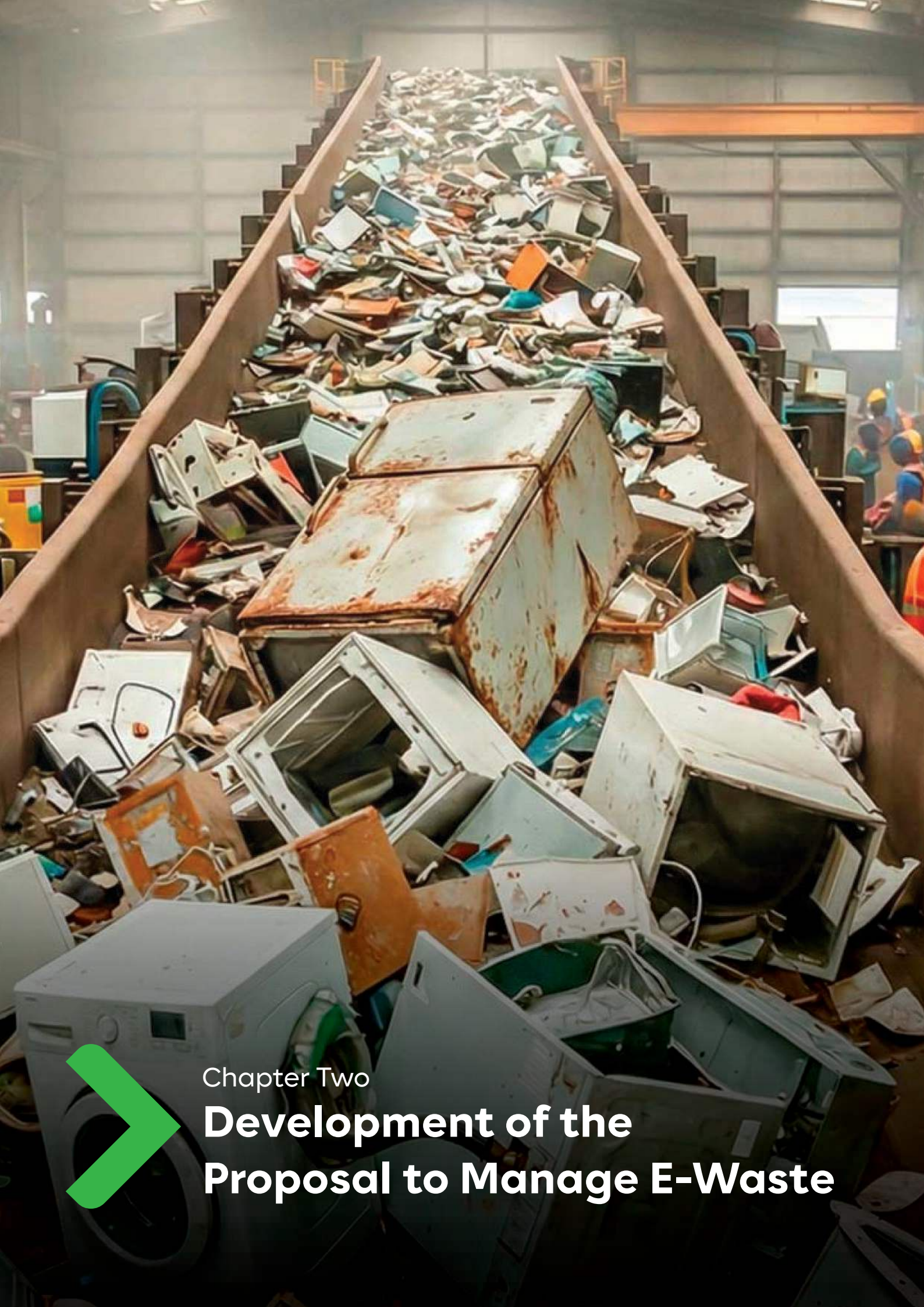
Box 1.1	Decade Cycle of Events
2009	› The antecedent - Toxic Sites Identification Project (TSIP) › Proposal for the Sound Management of E-waste in Ghana Preparation
2010 - 2015	› Research and studies and publications on E-waste
2012	› Foreign (Sweden) study/business tour for E-waste workers and others › Series of training on safety and awareness raising on E-waste handling › Contribution towards the formulation of the E-waste Bill
2013-2014	› E-waste Recycling Centre at Agbogbloshie Establishment › Importation and installation of recycling equipment (cable stripping machines) › Agbogbloshie Scrapyard re-development and transformation designs
2014 -2021	› E-waste Recycling Operations

The practical components of the intervention included establishing a site as an E-waste Recycling Center at Agbogbloshie, importing and installing recycling equipment (cable-stripping machines), and conducting Pilot E-waste Recycling Operations. For the redevelopment of the Agbogbloshie Scrapyard, architectural designs were prepared to transform the site into a modern E-waste Village.

The demonstration of interest of national stakeholders (including MESTI and EPA) and international partners (including GIZ and KfW), through financial and technical support, made the transition from the proposal implementation and pilot recycling phases to sustainable management operations, in conformity with emerging national plans, seamless. There was also a significant contribution to the preparation of the Draft Bill on E-waste management in 2016, leading to the enactment of the Hazardous and Electronic Waste Control and Management ACT 917, 2016 and the Hazardous, Electronic and Other Wastes (Classification) Control and Management Regulations 2016 (LI 2250).

The records of major activities (some overlapping the decade), which have and are significantly pushing the frontiers of the growing E-waste management activities to new heights are listed in Box 1.2.

Box 1.2	Post-Decade Major Events and Activities
2017 - 2018	› GIZ-Oëko Pilot Incentive Payment System
2018	› The E-waste Technical Guidelines
2019	› Establishment of the National E-waste Fund Office
2020 - 2021	› MESTI-KfW Incentive Payment for a Defined Scope of E-waste Types



Chapter Two

Development of the Proposal to Manage E-Waste

2.0 Development of the Proposal to Manage E-Waste

2.1 Institutional Involvement

The proposal development was in four main parts:

- Defining the E-waste problem
- Identifying the two key proposal phases
- Outlining the implementation plan
- Management system for implementing the proposal

The key institutions that participated in the proposal development are listed in Box 2.1 with pictures of the engagement sessions below.

Box 2.1 Key Participating Institutions

- Environmental Protection Agency (EPA)
- Ministry of Environment, Science, Technology, and Innovation (MESTI)
- Ministry of Communications
- Ministry of Trade and Industry
- Ghana Ports and Harbours Authority
- Ghana Atomic Energy Commission

Meeting at the EPA

Meeting at MESTI

Meeting at the Min. of Communications

Meeting at the Min. of Trade & Industry

Meeting at the Ghana Ports & Habour Authorty

Meeting at the Ghana Atomic Energy

2.2 Defining the E-waste Problem

The emerging E-waste problem was defined in the context of E-dumping in Ghana and the imminent prospect of substantial local generation, driven by high national EEE consumption and ICT policy promotion (Box 2.2).

Box 2.2 The E-waste Problem Definition

- High booming informal second-hand EEE import trade.
- High patronage of second-hand EEE by all levels of society.
- Absence of any mechanism to regulate importation (in line with the Basel Convention on Transboundary Movement of Hazardous Wastes).
- A significant portion (estimated at 15-20%) of the imports ended up as junk on arrival.
- Very short useful lifespan of the rehabilitated second-hand EEE.
- Truckloads of 'over-storage' WEEE delivered by some institutions or from WEEE auctions or roaming WEEE scavengers.
- Crude recovery of copper and other metals using fire, emitting toxic fumes.
- Reducing the bulk of dumped E-waste through burning with associated severe pollution.
- Improper recycling of used lead acid batteries, etc., polluting the environment.
- Disease burden on the immediate/nearby population from high level pollution emanating in Agbogbloshie

A pile of E-waste at the Scrapyard

A Burner Setting E-waste on Fire

The E-waste problem definition was also intended to sensitize key institutions and other stakeholders to the E-waste menace, in order to solicit their buy-in and participation in the initiated national campaign.

2.3 Key Phases of the Proposal

The proposal development was in four main parts:

- The control of second-hand EEE importation; and
- Measures for the management of WEEE and safe disposal.

The above phases corresponded with the respective Implementation Plans 1 and 2. (Box 2.3).

Box 2.3 Proposal Phases

Phase 1: Proposal Objectives for Control of Second-hand EEE Importation

- Inventory of imports, WEEE generation, and human exposure.
- Environmental management mainstreaming into the Ghana ICT policy.
- Regulations to prohibit indiscriminate EEE importation.

Phase 2: Proposal Objectives on Measures for WEEE Management

- Capacity building in WEEE management.
- Establishment of WEEE receiving centres.
- Awareness creation on WEEE and knowledge transfer to the receiving centres.
- WEEE management operations at the receiving centres.
- Recycling (and disposal) systems established for segregated WEEE/hazardous fractions.

2.4 Proposal Implementation Plans

The implementation plans proposed are outlined in 1A to 1C and 2A to 2E, consisting of actions and corresponding expected outputs/results, are presented in sub-sections 2.3.1 to 2.3.8 below.

2.4.1 Implementation Plan 1A

Inventory of imports, WEEE generation and human exposure

Survey of imported and locally assembled EEE WEEE generation (by institutions, repair shops, etc.) Assessment of human exposure to heavy metals Survey of the dumpsite & scavengers Socio-economic survey of the E-scrap business	Records of country of EEE imports Rate of generation/records of WEEE in storage Health status of exposed and control population Heavy metal distribution at the dumpsite Socio-economic contribution of the sector to GDP

2.4.2 Implementation Plan 1B

Strategic Environmental Assessment (SEA) of the ICT Policy

Conduct SEA for the national ICT Policy Involve stakeholders in a process of Policy reform.	SEA document of the ICT Policy Revised ICT policy with reforms for handling/ managing end of life EEE.

2.4.3 Implementation Plan 1C

Regulations to prohibit indiscriminate EEE importation

Prepare EEE Import Bill and Guidelines Obtain stakeholder inputs prior to drafting the Bill	Draft Bill and Guidelines on EEE importation EEE Import regulations and management guidelines

2.4.4 Implementation Plan 2A

Capacity building for WEEE management

Establish Training Centre for the E-waste industry Organize international training programme on WEEE recycling/ industry. Organize training workshops for selected E-waste technicians.	E-waste knowledge transfer Centre at Agbogbloshie International training/business tour First set of trainers trained in WEEE management 12 E-waste technicians trained to train others.

2.4.5 Implementation Plan 2B

Establishment of WEEE Receiving Centres in other urban centres

Acquire sheds for receipt and storage of WEEE	Six Receiving Centres established country wide.

2.4.6 Implementation Plan 2C

Awareness creation on WEEE and the Receiving Centres

Adverts on Receiving Centres for sound processing of all WEEE. Adverts inviting all to hand in their WEEE Adverts on recyclable E-components for sale	30 Newspaper adverts. 30 Radio announcements

2.4.7 Implementation Plan 2D

WEEE Management Operations at the Receiving Centres

Receive WEEE (for "fees") at Receiving Centres
Dismantle and segregate WEEE fractions (metals, reusable, hazardous, etc.)
Prepare suitable site to receive the less hazardous fractions

Incentive system for WEEE hand-in operations
Safe handling of segregated less hazardous fractions and sale of useful components
Receipt and storage of less hazardous fractions
Landfill available to dispose of less hazardous fractions

2.4.8 Implementation Plan 2E

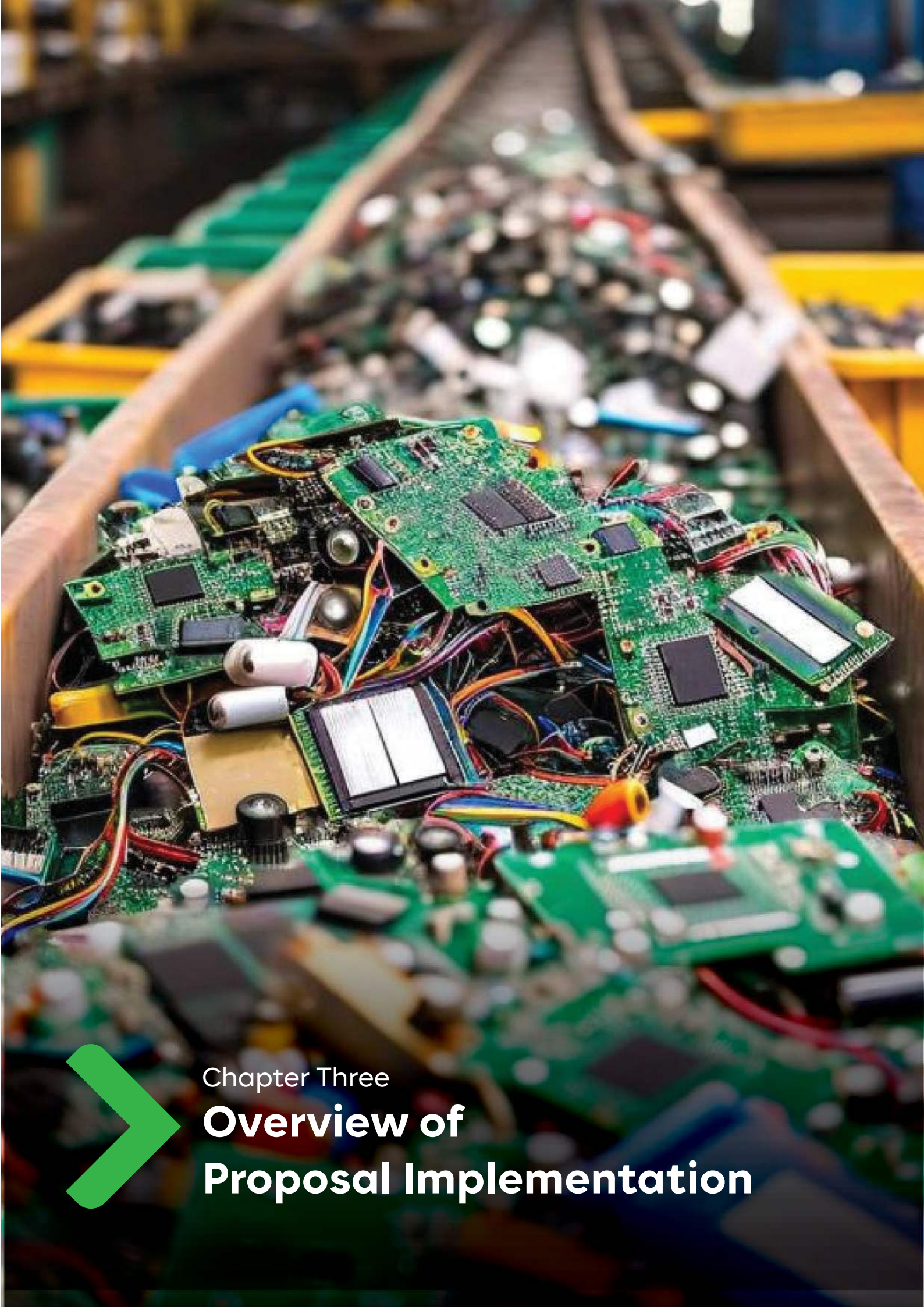
Management System for Hazardous WEEE Fractions

Set up a location to receive hazardous fractions
Explore international partnership for export of hazardous fractions (that cannot be handled locally)

Transfer hazardous fractions to central location for safe storage.
Partnership/protocol for export of hazardous fractions

2.5 Management System for Proposal Implementation

A management board with MESTI and EPA in the supervisory and lead roles respectively was recommended. Other key institutions on the management board included the NYA and the GRATIS Foundation. Specific functions, including direction and leadership on policy and as development of regulatory features for E-waste management was proposed. Time slots for implementation activities, indicative budgets, and the identified institutions that needed to collaborate to achieve expected goals were factored into the management systems.



Chapter Three

Overview of Proposal Implementation

3.0 Overview of Proposal Implementation

The implementation of the proposal covered key studies, foreign tour, recycling equipment trials and capacity building, establishment of the E-waste recycling centre, and other tasks and activities listed in Box 3.1.

Box 3.1 Overview of Broad Tasks and Activities

- Key studies conducted and associated tasks and publications.
- Business/study tour to Sweden for GASDA towards formalization of E-waste activities.
- Training and awareness on safe handling of E-waste and recycling operations.
- Recycling equipment trials to select preferred/suitable type for adoption.
- Establishment of the Agbogbloshie E-waste Recycling Centre.
- Preparatory work on the E-waste Bill formulation.
- Design and Re-development for transformation of the E-waste scrapyard.
- Air quality monitoring of the area to verify improvement.
  Key E-waste related activities.
- Support to other partners in the E-waste sector.

A summary of the key studies, activities and tasks performed, and the respective outputs and publications are presented in Sub-sections 3.1 to 3.6.

3.1 Key Studies/Tasks and Publications (2009-2016)

Action/Task Performed	Publication/Output
Shared the published 'Proposal for the Control of Importation and Management of E-waste in Ghana' with partners	Premiere sponsorship secured for the health survey component (2009-2010) • Pure Earth • Ghana Health Service
General survey of existing businesses (mainly informal) and economic dynamics of SMEs in the (W)EEE sector	Socio-economic Assessment and Feasibility Study of Sustainable E-Waste Management in Ghana by *Prakash et. al (2010)*
Exposure effects analysis of E-waste workers - test for 12 heavy metals presence in urine and blood specimen, and full body examination	Assessment of Health Status and Effects of Exposure to Chemicals at Agbogbloshie E-Waste Recycling and Dumpsite (published in 2011).

› Field data collection on repairs/ refurbishment, local assembly, and in-country material flow, as well as EEE import data classification and analysis for 2006 to 2010	› Ghana E-waste Country Assessment SBC E-waste Africa project by *Amoyaw-Osei et.al (2011)*
› Extended producer responsibility, hand-in / take back system for Ghana and second hand EEE import control	› Ghana E-Waste Project - National Strategy (published in 2011)
› EEE import data classification, compilation, and analysis (2011 to 2015) and survey of repairs/refurbishment and local assembly/ production to derive recommendations to support sustainable management	› Technical Report on the Sustainable Management of E-Waste in Ghana – prepared for the World Bank (published in 2015)
› Formulation of a framework Bill initiated to regulate importation of EEE and the management of WEEE in Ghana	› Draft Bill prepared (2012) and enacted into the – • Hazardous and Electronic Waste Control and Management Act (2016) • Hazardous and Electronic Waste Control (Classification) Regulations (2016)

3.2 Business/Study Tour to Sweden for Operators and EPA

Action/Task Performed	Publication/Output
› Swedish study tour of E-waste recycling and metal industries and institutions - • Boliden • DATEC Recycle • Kuusakoski • SIMs Recycling, • Ericsson • Sony Ericsson • Swedish EPA	› The first-hand experience enhanced awareness of GASDA members to the business opportunities of the E-waste sector. Tour enabled GASDA members to embrace the intended change (formalization of the sector) and built confidence in their partnership with GreenAd. Visit to the Swedish EPA afforded the Ghana EPA officials a learning opportunity on E-waste sector crimes - related to clandestine importation and port inspection mechanisms.

3.3 Recycling Equipment Trials, Training and Awareness Raising

Action Taken	Output/Outcome
Cable recovery equipment trials by GASDA members (E-waste workers) to select suitable equipment type	Motorized cable stripping/recovery equipment preferred (to manual machine) and selected.
Training on sound recycling and safe working practices conducted by both local and international partners	Training offered to GASDA members to safeguard their health and protect the surrounding environment and people.
Awareness raising on the recycling activities to eliminate burning and the associated pollution affecting their health and the environment.	Adequate publicity carried out to ensure Effective patronage of the ARC and avoidance of burning/pollution.

3.4 Establishment of the Agbogbloshie E-waste Recycling Centre

Action Taken	Output/Outcome
Allocation of the recycling site at the Scrapyard by NYA and design of the site to position shipping containers to house the recycling machines.	Site for the shipping containers prepared for their installation.
Procurement and installation of the shipping containers (four 40-footer) and other facilities at the Agbogbloshie Recycling Centre	Set up of facilities to house the recycling machines at the Agbogbloshie Recycling Centre completed
Arranged importation, delivery, and installation of the motorized cable stripping and granulator machines from USA	Four imported stripping machines and granulator arrived at the Tema Port, and installation completed.
Equipment tested and operators selected from GASDA members for training.	Test trials of the machines successfully carried out and operators trained
Launching of the stripping machines and the E-waste Recycling Centre and the pilot recycling operation at Agbogbloshie	The Agbogbloshie Recycling Centre opened, management committee formed, and E-waste pilot recycling operation begun.

3.5 Preparatory work on the E-waste Bill formulation

Action Taken	Publication/Output
› Stakeholder engagement and initial wording of Bill › Stakeholder validation workshops	› Draft Bill

3.6 Designs for Re-development and Transformation of the E-waste Scrapyard

Action Taken	Publication/Output
› Architectural design contract awarded for converting the site to modern E-waste working sheds and facilities in collaboration with GASDA	› Site architectural designs for E-waste working sheds and facilities for transformation of the Scrapyard prepared and delivered.
› Presentation of the architectural designs to the NYA for adoption and implementation discussion	› The architectural designs for the Scrapyard transformation and modernization agenda shared with NYA.

3.7 Air Quality Monitoring in Agbogbloshie Area

The air quality monitoring task in Sub-section 3.7 was performed though not specified in the proposal.

Action Taken	Output/Outcome
› Ambient air quality baseline monitoring in the Agbogbloshie area pre-pilot recycling period › Continuous monitoring to evaluate possible air quality improvement following the pilot recycling operations (2014)	› Pure Earth Country Report (2014) Ghana

The implementation of Sub-sections 3.8 and 3.9 tasks and related actions were facilitated by GreenAd. Some of the tasks (in 3.9), however, fell outside the decade period (2009-2018) of the proposal implementation.

3.8 Key E-Waste Related ESIA Study

Action Taken	Output/Outcome
› Environmental and Social Audit (heavy metal concentration/distribution, liquid waste discharges, toxic fumes/ emissions) of the Agbogbloshie dumpsite and scrapyard.	› Environmental and Social Audit Report prepared for decommissioning of the dumpsite and aftercare management (2018)

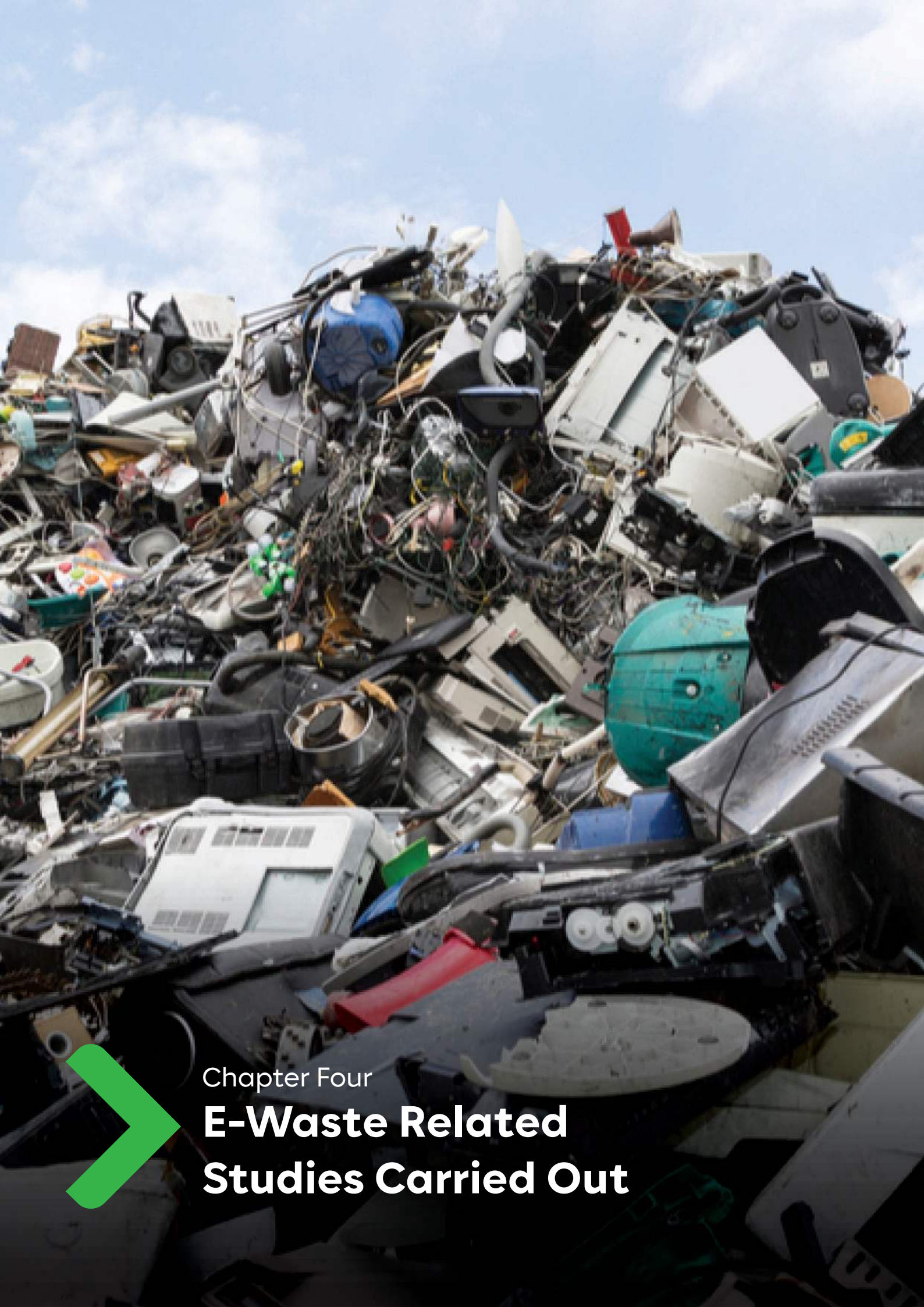
3.9 Support to other Partners in the E-Waste Sector (2017 - 2021)

Action Taken	Output/Outcome
› GIZ Pilot Incentive System for waste cable purchases based on an agreed pricing mechanism, computer-based software application for online purchase transactions, and relying on ARC facility for waste reception	› Implementation of the incentive scheme for the purchases of waste cables, with GreenAd as the operator of the pilot incentive system established
› MESTI-KfW Incentive Payment System – Recycling and disposal of waste electrical and electronic equipment in an environmentally sound way	› Setup of the Handing Over Centre (HOC) under the LI 2250 and the Technical Guidelines for E-waste management for implementation of the incentive scheme for purchases of waste cables, batteries, thermoplastics, and CRTs.

The activities listed in Box 3.2 could not be carried out (though listed in the proposal) due to resource constraints and other limitations.

Box 3.2 Listed Activities in the Proposal that could not be Implemented

- SEA of the ICT policy
- Establishment of E-waste receiving centres
- Establishment of E-waste operational centres
- Advertisement of the prepared National E-waste Proposal for partners and sponsorship publicity.



Chapter Four

E-Waste Related Studies Carried Out

4.0 E-Waste Related Studies Carried Out

A total of eight studies on E-waste management were conducted. Five of the studies directly evolved from the proposal, two were incidental but relevant, and one served as a precursor and justification for the planned E-waste interventions (Box 4.1). The studies provided empirical evidence of the severity of the E-waste problem and helped raise awareness among relevant policy-and decision-makers.

Box 4.1 Key Studies

- Toxic Sites Identification Programme (TSIP)
- Socio-Economic Assessment and Feasibility Study on Sustainable E-waste Management
- Ghana E-waste Country Assessment
- Assessment of Health Status and Effects of Exposure to Chemicals at Agbogbloshie E-Waste Recycling and Dumpsite
- Ghana E-waste Project – National Strategy
- World Bank Technical Report on the Sustainable Management of E-waste in Ghana
- Environmental and Social Audit of Old Fadama (Agbogbloshie) Dumpsite Decommissioning ESIA
- Air quality monitoring of the Agbogbloshie Scrapyard.

4.1 Toxic Sites Identification Programme – Agbogbloshie in Focus

The Toxic Sites Identification Programme (TSIP) was developed to provide inventoried data on contaminated sites across low- and middle-income countries. This was to make such data available to the respective countries to facilitate further pollution studies, control, and management. Countries with highly polluted sites were also assisted to clean up. The TSIP data featured on the database of the Global Alliance on Health and Pollution.
(https://gahp.net/contaminated-sites-database/).

Exploratory TSIP work commenced in Ghana at Agbogbloshie by Pure Earth (at the time, Blacksmith Institute) in May 2009. This sparked a special interest in Agbogbloshie due to the high levels of pollution recorded. In 2012, formal TSIP work resumed with the training of 12 Site Investigators in the Blacksmith Institute's Site Identification Protocol and the use of handheld XRF machines for heavy metal analysis in soils (see Figures 4.1 and 4.2). TSIP sites in Ghana included: e-waste processing sites, waste dumpsites (with ULAB), chemical formulation sites, Artisanal Gold Mining (ASGM) legacy sites, and tannery operation sites.

Figure 4. 1A Group of TSIP Site Investigators and Trainers

Standing L to R:
Y Amoyaw-Osei
John Adu
Jack Carravanos
B O Antwi
Sefakor Roland
Obed O Agyekum
Bret Ericsson
Sampson Atiemo
Mark Jona
Joseph Yeboah

Sitting L to R:
Bennett Akuffo, Meredith Block, Evelyn Asante, Christiana Badoo, Harry Okyere

Figure 4. 2 Use of Handheld XRF in TSIP Work

In 2009, and between 2012 and 2017, about 230 sites were successfully assessed, reviewed, and incorporated into the global database. GreenAd served as the Secretariat for the Blacksmith Institute in Ghana, with the Executive Director as the Country Coordinator. The key pollutants encountered included Pb, Cd, As, Cr(t), Hg, and PCB. The pollution level at Agbogbloshie scored 9 out of 10 on the Blacksmith Pollution Index (Figure 4.3) – the highest of all the sites surveyed in the country. The sampling sites surveyed are shown in Figure 4.4.

The excessive pollutant levels recorded gave rise to negative international publicity, leading to Agbogbloshie's listing among the Top Ten Polluted places in the world in a 2013 publication by Green Cross and Pure Earth (https://www.greencross.ch/wp-content/uploads/uploads/media/media_2013_11_05_top_ten_wwpp_en.pdf). The publication prompted three major interventions (Box 4.2).

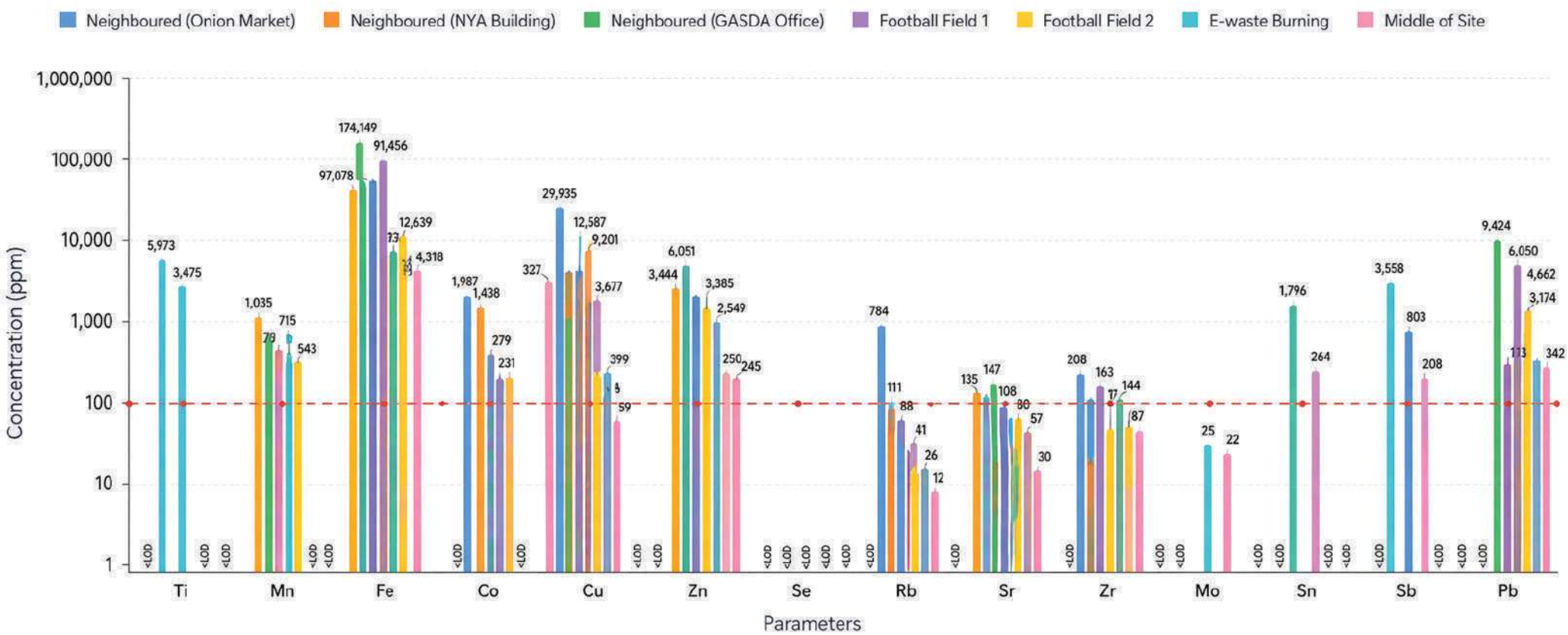


Figure 4. 3 Pollution Levels Recorded at Agbogbloshie XRF Readings (ppm) – May 2009

Figure 4. 4 Image of Agbogbloshie Showing Sampling Sites

Box 4.2 Major Interventions Resulting from the Negative Publicity

- Health and exposure survey of heavy metals and chemical poisoning of workers at the Agbogbloshie Scrapyard
- Introduction of cable stripping equipment to recover Copper and other metals from the E-waste stream (aimed at eliminating burning as a recovery method - the main source of pollution)
- Environmental and Social Audit conducted towards the Agbogbloshie dumpsite decommissioning ESIA.

4.2 Chemical Exposure and Health Status Assessment

The E-waste workers informally dismantled WEEE fractions, using fire to recover metals for sale. This exposed them to various hazardous chemical substances. Fire was also used to reduce the bulk of the dumped WEEE at the site, making room for more materials and operations.

The burning and unsafe handling of WEEE fractions exposed workers to harmful heavy metals like lead, mercury, copper, and arsenic, as well as hazardous liquids including Lead Acid Battery waste and toxic fumes. The Health Assessment at the E-waste recycling and dumpsite examined their knowledge, perceptions, and practices regarding health risks from toxic fumes and potential chemical poisoning and considered the overall health status of the workers and their chemical body burden.

Burning of Cables to Extract Copper

Dark Smoke from Burning at the Site

Figure 4. 5 The Burning of E-Waste at the Agbogbloshie Site

The 87 E-waste workers and 87 control population involved in the study came from the Scrapyard/dumpsite area and the Makola Market (free of E-waste activities), respectively. The E-waste worker-cohort primarily comprised young men from the Northern Regions (many without formal education). The group also consisted of manual workers, primarily from the same location.

The study included a full-body physical examination and laboratory analysis of urine and blood samples for 12 heavy metals in the subjects (Figure 4.6). This assessment was conducted in collaboration with Pure Earth and the Ghana Health Service.

Blood Sample Being Taken

Conducting Body Examination

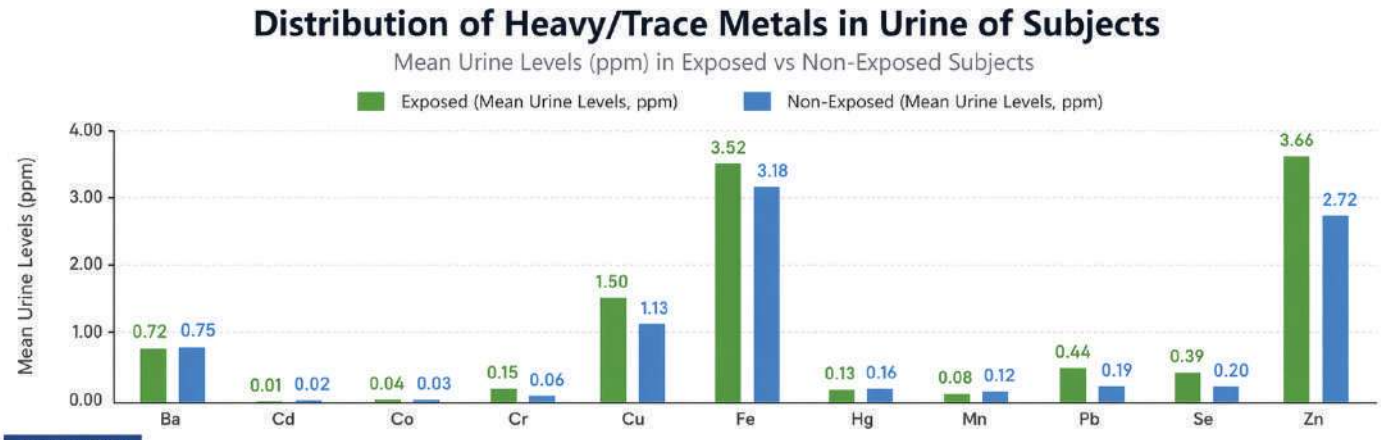
Records Compilation

Figure 4. 6 Sample Collection, analysis and data synthesis

Serum and urine samples showed significantly elevated levels of Co, Cr, Cu, Fe, Se, and Pb in the exposed subjects compared with the non-exposed subjects. However, the results also showed that several heavy metals were elevated among not only E-waste workers, but the control subjects as well for Cr, Hg, Ba, and Mn in serum, and Cr, Cu, and Hg in urine (Figure 4.7).

Furthermore, Mn levels were higher in non-exposed subjects than in exposed subjects, both in serum and urine. The findings were quite unexpected and required further detailed examination to explain the observed results. Chest examinations revealed no obvious abnormalities, except for a few with signs of wheezing, suggestive of mild bronchitis, asthma, or other obstructive airway encountered.

The evidence masked the observed and inhaled fumes that constantly engulfed the area. Some people (especially in the Onion Market) were diagnosed as heavy smokers from chest x-ray results, though many of them never smoked. Moreover, there were complaints to MESTI and EPA by businesses and banks across the road from the scrapyard, who threatened to relocate from the area due to pollution. Some reports indicated that asthmatic patients arrived at work and dashed straight to their offices from their vehicles to avoid asthma attacks from exposure to the incessant toxic fumes.

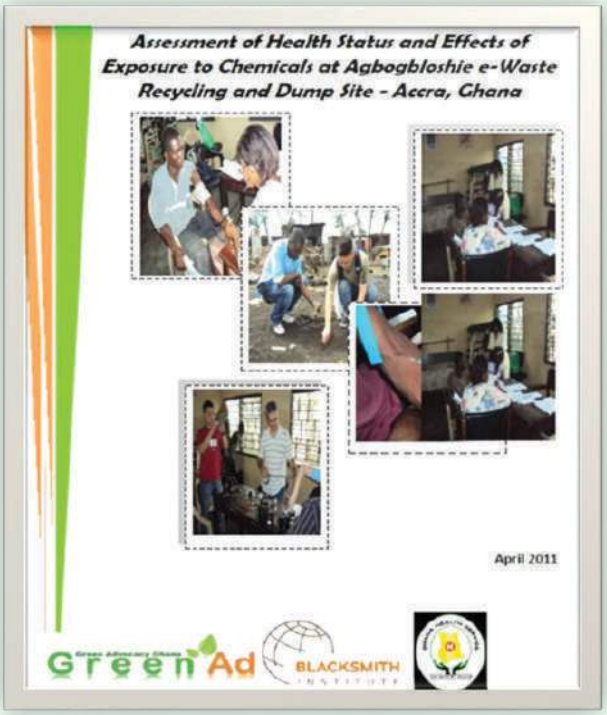


Summary Table

Metal	Reference Standard (ppm)	Sample Sizes		Mean Urine Levels (ppm)		Proportion with elevated level (%)	
		Exposed	Non-Exposed	Exposed	Non-Exposed	Exposed	Non-Exposed
Ba	<0.6	86	86	0.72	0.75	24.4	20.8
Cd	<0.001	33	33	0.01	0.02	100.0	75.0
Co	<0.01	47	47	0.04	0.03	97.9	100.0
Cr	<0.01	64	64	0.15	0.06	100.0	100.0
Cu	<0.06	86	86	1.50	1.13	100.0	100.0
Fe	N/A	86	86	3.52	3.18	N/A	N/A
Hg	<0.004	24	24	0.13	0.16	100.0	100.0
Mn	N/A	86	86	0.08	0.12	N/A	N/A
Pb	<22.8	32	32	0.44	0.19	0.0	0.0
Se	N/A	36	36	0.39	0.20	N/A	N/A
Zn	<1.4	85	85	3.66	2.72	91.8	79.2

Note: N/A = Not Applicable

Figure 4. 7 Distribution of Heavy/Trace Metals in Urine of Subjects



Authors
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Dr Carl Stephen Osei
Yaw Amoyaw-Osei

To help improve the health conditions, and to address self-medication practices among E-waste workers, it was considered necessary to promote ease of access to healthcare, coupled with an educational drive on safe dismantling operations. It was decided therefore to site a health post at the scrapyard in a panelled shipping container (Figure 4.8) under GHS. The plan was, however, shelved when GIZ secured funding to establish a Health Post under a Technical and Economic Cooperation Agreement between the Government of Ghana (Ministries of Finance and Environment) and the Federal Republic of Germany (the Ministry of Economic Cooperation and Development (BMZ).

Figure 4. 8 Container Intended for use as Health Post

4.3 Socio-Economic Assessment of the E-Waste Sector

The Socio-economic Assessment and Feasibility Study of Sustainable E-Waste Management report was published in 2010. The study was in partnership with Oeko-Institut e.V., VROM- Inspectorate, and NVMP. This aimed at establishing a clear understanding of the socio-economic dynamics of E-waste activities and management, particularly the informal refurbishing and recycling sector in Ghana. The study was conducted through primary field data collection, focusing on the listed areas in Box 4.3.

Box 4.3 Focus of the Socio-Economic and Feasibility Study

- Improving recycling technology options and the multiple socio-economic aspects of the sector
- Crafting feasible ways to integrate the informal sector into possible business models
- Identifying new market niches to generate significant employment and income opportunities for the urban poor.

The socio-economic assessment relied on the UNEP/SETAC "Guidelines for Social Life Cycle Assessment of Products" (known as S-LCA Guidelines), and the Oeko-Institut's Sustainability Toolkit "PROSA" (Product Sustainability Assessment). The guidelines and toolkit provided a comprehensive list of socio-economic indicators and followed the stakeholder approach allocating the indicators allocated to pre-defined stakeholder categories. Three key stakeholder categories – workers, local communities, and society – were defined to assess the socio-economic impacts of refurbishing and the E-waste recycling sector.

The feasibility analysis was carried out for three product groups – desktop computers, Cathode Ray Tube (CRT) devices (old TVs and computer monitors containing CRTs), and refrigerators and freezers. The analysis assessed the applicability of alternative recycling technologies, the economic, environmental, and social improvement potential of each technology as well as the various steps in the recycling process, with their attendant benefits, including CO2 savings.

The study revealed that the E-waste sector employed up to about 33,600 refurbishers, collectors, and recyclers nationwide, with about 21,000 working in Accra alone. The estimated E-waste processed annually was between 10,000 and 13,000 metric tons. The corresponding annual revenues (Figures 4.9 and 4.10) showed the estimated annual value of from $105 to $268 million. Despite its significant role in the economy, the sector's informal nature meant its contribution was never included in the national Gross Domestic Product (GDP). If the sector's contribution were included, it would account for count for approximately 0.29% to 0.55% of the GDP in 2010.

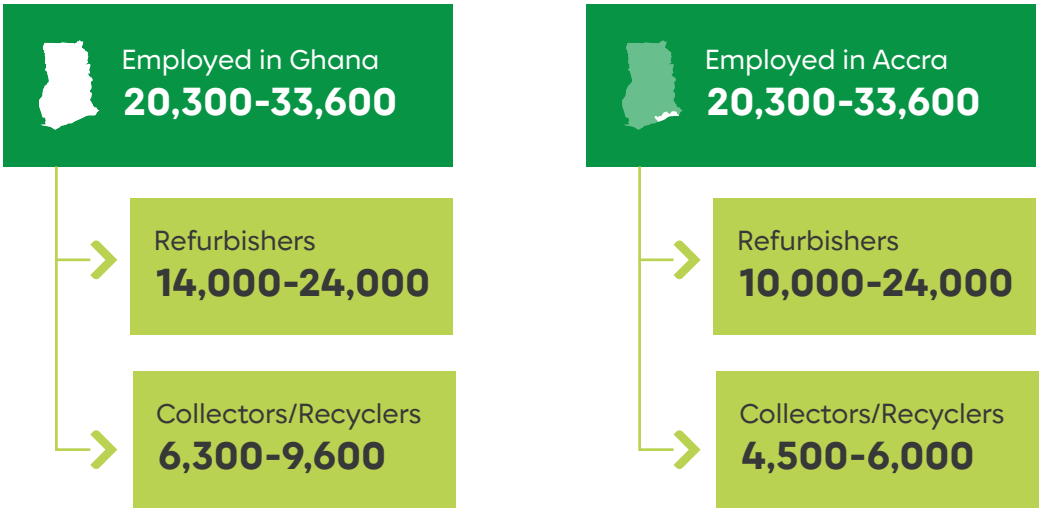


Figure 4. 9 Estimated Population of E-Waste Workers (Accra and Ghana)

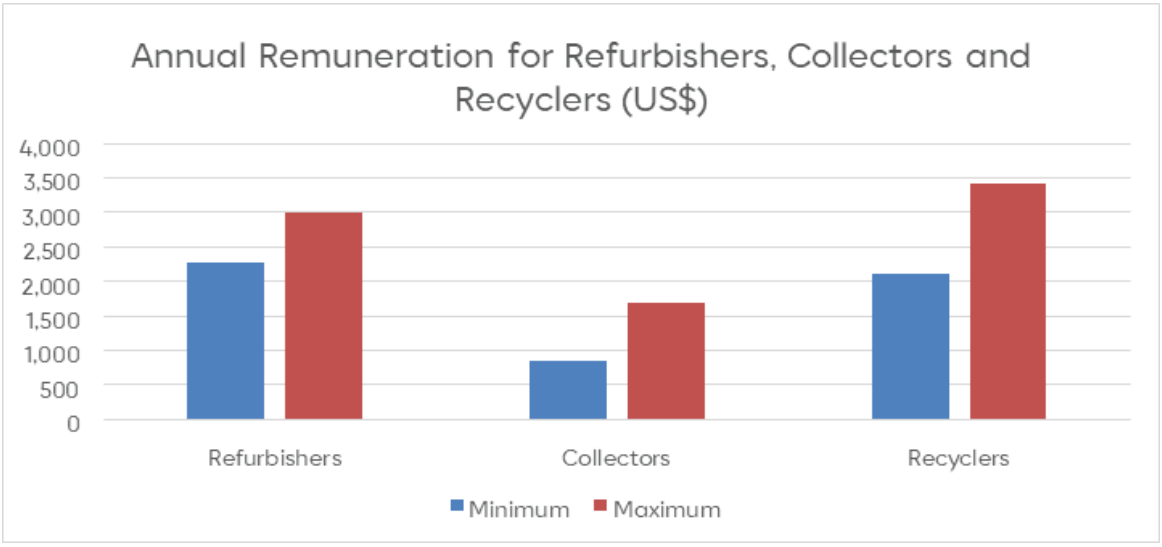


Figure 4. 10 Annual Remuneration for Refurbishers, Collectors, and Recyclers

Though providing a source of income, especially for internal migrants from northern Ghana, most informal WEEE operators lived in squalid conditions. The monthly incomes of collectors were estimated between $70 and $140; for refurbishers between $190 and $250; and for recyclers, between $175 and $285. Despite the low incomes, the workers had access to regular and rapid cash flow, which meant a lot to them.


Öko-Institut e.V.
GreenAd
NVMP
Socio-economic assessment and feasibility study on sustainable e-waste management in Ghana
commissioned by:
the Inspectorate of the Ministry of Housing, Spatial Planning and the Environment of the Netherlands (VROM-Inspectorate) and the Dutch Association for the Disposal of Metal and Electrical Products (NVMP)

A key recommendation was to incorporate the informal sector into future E-waste strategies – deploying manual labor for pre-processing – and developing appropriate regulatory frameworks and financing mechanisms. Furthermore, efforts were required to focus on high-value recyclable products, address the management of hazardous fractions, and regulate the import of EEE.

4.4 The Ghana E-Waste Country Assessment

The Ghana E-waste Country Assessment was a part of the Secretariat of the Basel Convention (SBC) E-Waste Africa Project undertaken in partnership with the Oeko-Institut e.V., the Ministry of Housing, Spatial Planning, and the Environment of the Netherlands (VROM- Inspectorate), and the Dutch E-Waste Compliance Scheme (NVMP). The study sought to understand the movement of EEE/WEEE from their origins to their end of life.

The two main components were: transboundary movements of EEE (imports, especially from EU countries), and a country assessment of new, used, and end-of-life EEE, its flow, and E-waste management practices in the formal and informal sectors. The transboundary movement component examined the importation of used and end-of-life EEE into Ghana by land, sea, and air, as well as records of re-exportation in the sub-region. The purpose was to help improve trade in EEE, control dumping, and ensure environmentally sound management policies in-country (Box 4.4).

Box 4.4 Purpose of the E-Waste Country Assessment

- Improve level of information available on flows of WEEE and EEE being imported into Ghana
- Describe the legal and regulatory frameworks in place
- Improve decision-making and increase communication between exporting
- and importing countries
- Develop environmentally sound management policies for nationally generated E-waste.

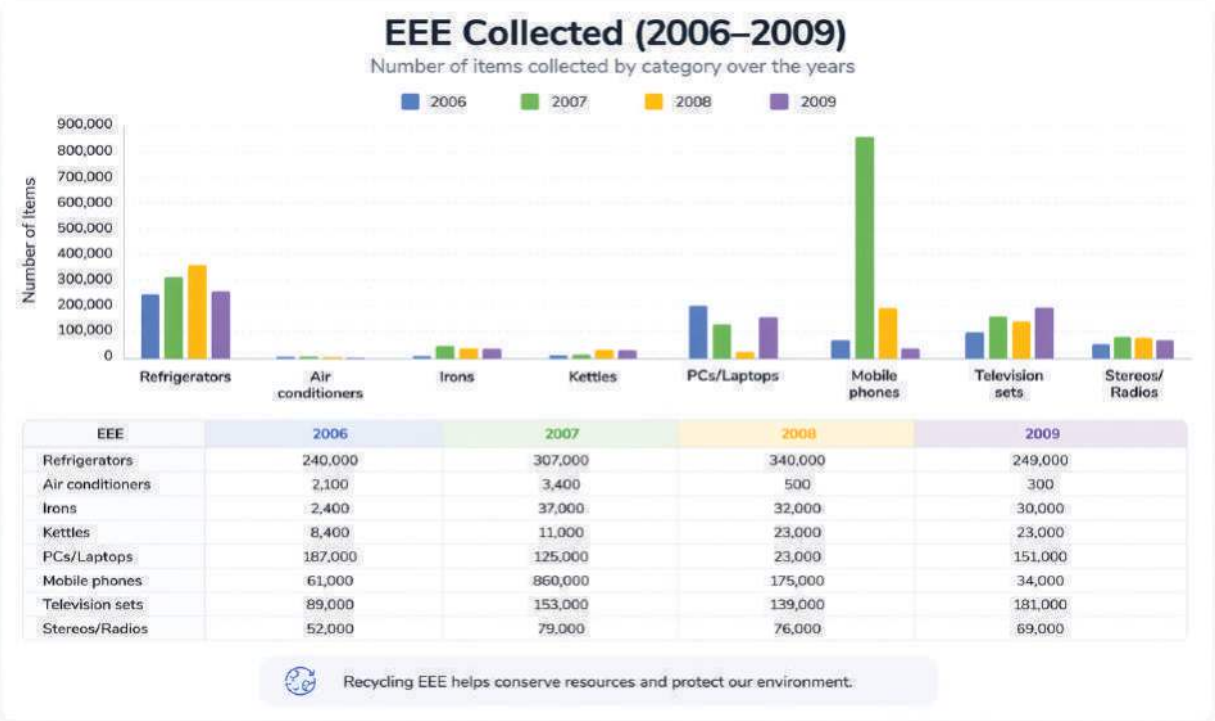
The Accra-Tema area was the focus of the study which covered the period of November 2009 to January 2011. The key stakeholders and sources of data included GASDA, Ghana Ports and Harbours Authority (GPHA), importers, assemblers, consumers, collectors, repairers, and other downstream processors and recyclers of EEE (with Accra-Tema area as focus of the study). Import data were assembled by the then Customs, Excise, and Preventive Service (CEPS) (now Customs Division of GRA), and UN Comtrade for the EEE in focus (Box 4.5).

Box 4.5 Country Assessment Focus of EEE

- Large household appliances: refrigerators and air conditioners
- Small household appliances: iron and kettles, etc.
- Information and communication technologies (ICT)
- Personal computers and mobile phones
- Consumer electronics
- Televisions, radio/HiFi.

Data from CEPS on the import of EEE (all products) indicated a total of 3,763,100 units for the period 2006 - 2009. However, the study results showed a higher figure than that provided by CEPS. Cross-checking declarations with a database containing information on the shipping manifests was rarely done (as indicated to the research team), no doubt the data obtained (Figure 4.11) was considered less accurate, especially for air conditioners and mobile phones

Figure 4. 11 CEPS Import Data on New and Used EEE (Units, 2006-2009)



EEE	2006	2007	2008	2009
Refrigerators	240,000	307,000	340,000	249,000
Air conditioners	2,100	3,400	500	300
Irons	2,400	37,000	32,000	30,000
Kettles	8,400	11,000	23,000	23,000
PCs/Laptops	187,000	125,000	23,000	151,000
Mobile phones	61,000	860,000	175,000	34,000
Television sets	89,000	153,000	139,000	181,000
Stereos/Radios	52,000	79,000	76,000	69,000

The data retrieved from the UN Comtrade Database for four tracer products – refrigerators, air conditioners, PCs/laptops, and television sets – was used to extrapolate the total import of all EEE into Ghana in terms of tonnage (Table 4.4).

Table 4. 1 CEPS Import Data on New and Used EEE (Units, 2006-2009)

	2003	2004	2005*	2006	2007	2008
All EEE imported	63,000	93,000	N/A	100,000	137,000	169,000

*Source: UN Comtrade, *2005: no data available*

It was estimated that new EEE accounted for 30% of all EEE imported, considering the household survey and the CEPS data. The Government's ICT policy was also noted to have led to an increase in the consumption rate of imported EEE, especially desktops, laptops, and mobile phones with corresponding high future WEEE flows.

The EEE were mainly imported from European and North American countries, though increasingly from Asia, primarily China and UAE (Dubai). The assessment analysed the stakeholders involved in the importation, as well as the players in the distribution, consumption of EEE and the handling of WEEE. Figure 4.9 presents an overview depicting how stakeholders and the mass flows they generated interlinked.

The EEE were mainly imported from European and North American countries, though increasingly from Asia, primarily China and the UAE (Dubai). The assessment analyzed the various stakeholders involved in the importation, as well as the players in the distribution and consumption of EEE and the handling of WEEE. Figure 4.12 presents an overview of how stakeholders and the mass flows they generated interlinked.

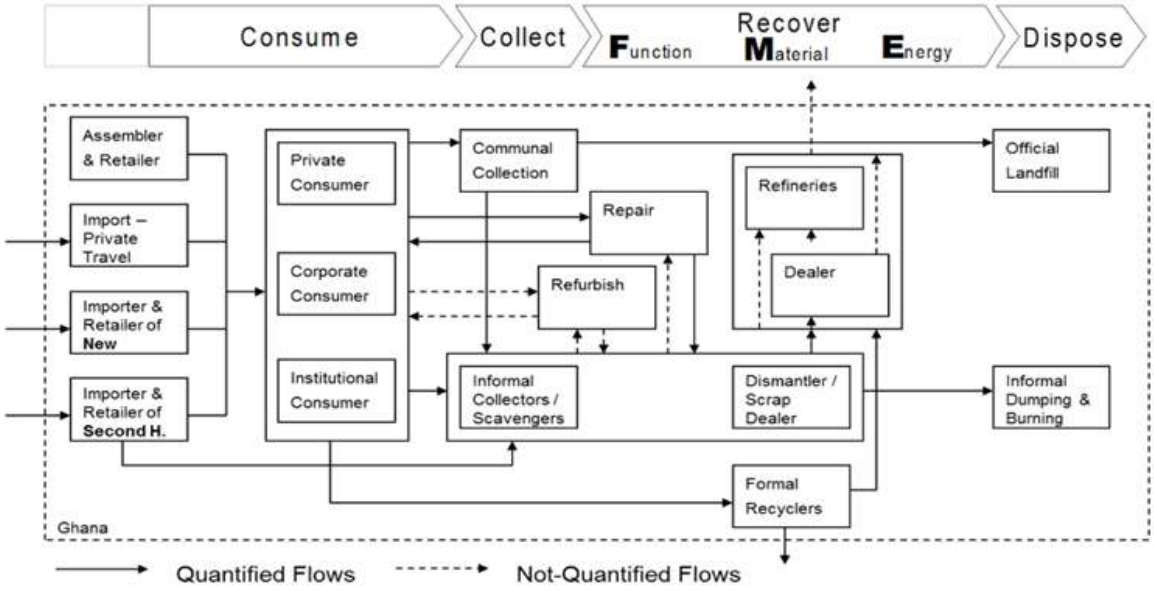
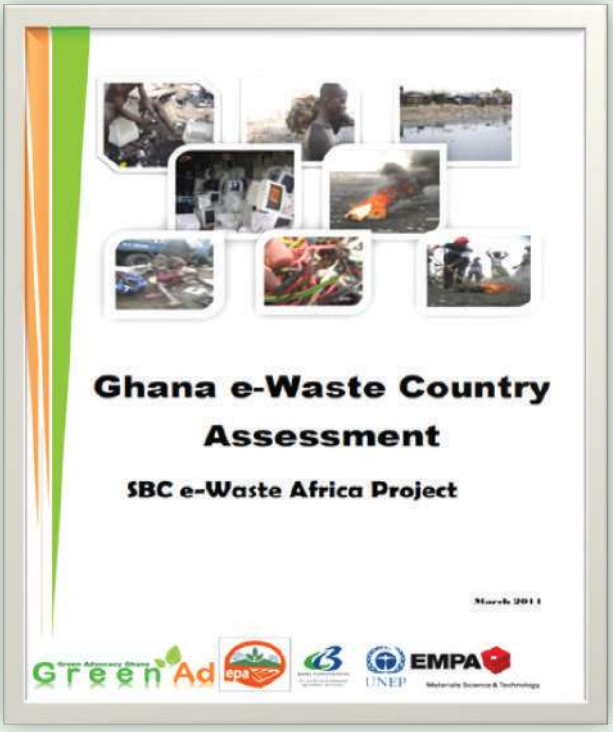


Figure 4. 12 Mass Flow System of EEE in Ghana



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Imports were mainly done by two groups: formal business importers and small-scale or informal importers. However, an estimated 10% (1,300 tons) of EEE imports were by individuals, such as foreign travellers. The devices included mostly small-sized EEE such as mobile phones, digital cameras, laptops, etc. easily carried on one's body and luggage, thereby evading customs clearance and import data.

The formal importers made purchases directly from manufacturers of brand-new items and from various sources for second-hand EEE e.g., the USA army, federal institutions, and

private companies as well as locations in Europe, while some were obtained from auction sales. Estimates of formal imports are given in Box 4.6.

Box 4.6 Records of Estimates from Formal Importers

- About 70% of the imports arrived in a good working condition
- About 20% could be serviced (repaired/refurbished) to get them functioning
- About 10% did not function.

On the other hand, the quality of imported EEE traded at the port (informal) was usually of lower quality than those bought by formal importers. The quality of estimated EEE from informal small-scale importers is given in Box 4.7.

Box 4.7 Records of Estimates from Informal Small-Scale Importers

- About 60% of the imports arrived in a working condition
- About 20% could be serviced (repaired/refurbished) to get them functioning
- About 20% did not function and went to waste.

The repairable 20% (in both cases) were often old and near end-of-life, with lifespans of less than two years. Based on the lifespan estimates, the amount of EEE that reached its end-of-life every year amounted to a total flow of 109,000 tons or about 5kg per capita of WEEE generated in 2009 in Ghana. However, not all WEEE reached the collection and recycling system, as a significant portion was stored. For end-of-life management, most consumers relied on informal collectors (about 92.4%), while about 4.9% ended up in the domestic waste stream, and the remainder either kept in storage or 'donated'.

Generally, informal collectors and recyclers dismantle, separate fractions, and recover valuable materials such as copper, iron, aluminum, and printed wiring boards from WEEE, then sell them to downstream processors and industries for use in production or to private businesses for export. Except for lead that is informally smelted into new lead bars (but with highly toxic emissions), no downstream processes are available to recover hazardous fractions and, therefore, are improperly disposed of using means like burning.

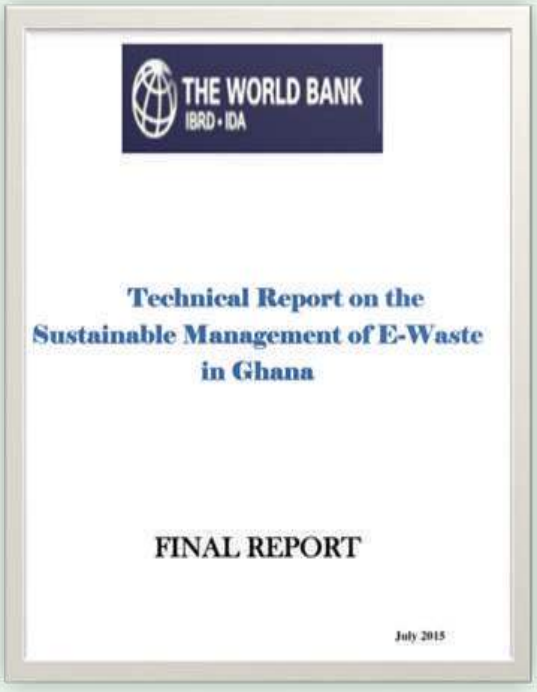
The burning of monitor screens and other 'non-profitable' fractions such as plastic casings of all kinds, keyboards, capacitors, dry batteries, etc., releases toxic substances, including dioxins. This puts the environment and the health of workers and the public, including pregnant women and children, at high risk. Apart from toxin inhalation, heavy metals and hazardous dust were also found to contaminate food items in the nearby market, raising additional health concerns. Harmful substances were also released into soils leading to long-term contamination of the burning sites.

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

The Technical Report on Sustainable Management of E-Waste in Ghana, published in July 2015, was the result of a study commissioned by the World Bank and carried out in partnership with the Ghana EPA. The main review areas are listed in Box 4.8, and the five classified groups of EEE included: large households; small households; IT and telecommunication; consumer electronics; and others (EEE parts).

Box 4.8 Areas Reviewed by the Study

- The quantum and trends of EEE importation
- The policy and regulatory environment guiding the importation of new and old (used) EEE
- The local assembly/production industry
- The state of informal repair/refurbishment sector
- The sources and pattern of WEEE generation
- The handling and disposal of WEEE.

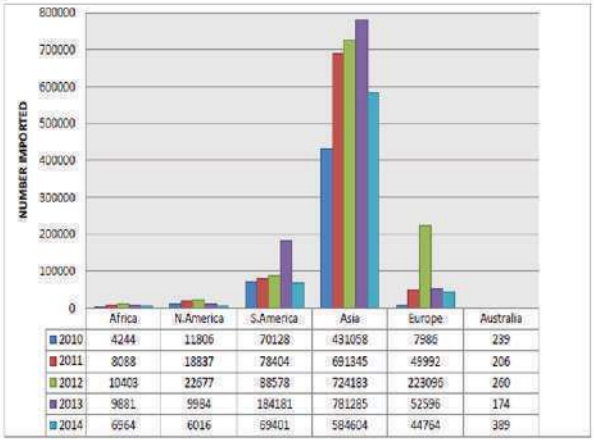


Authors
Yaw Amoyaw-Osei

Data on the types and quantities of EEE imports for a five-year period (2009 to 2014) was sourced from the Customs Division of GRA to create an inventory of inflows. The analyzed data of imports (categorized into new and used/second-hand) is presented in (Figure 4.10a-h). Other data sets on dealership, employee numbers, income levels, quantities of imports, refurbishment, and recycling, etc. were gathered from the main actors, including importers, refurbishers, and recyclers.

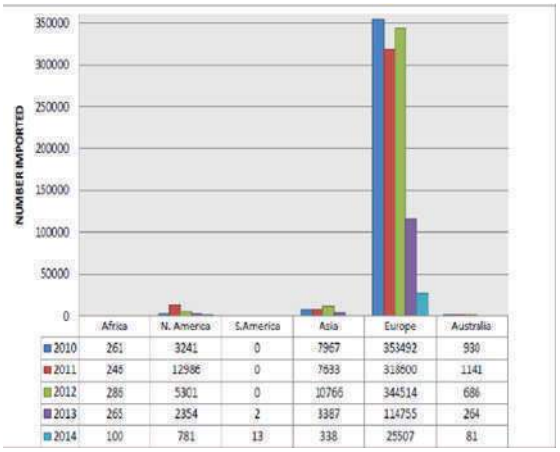
The Agbogbloshie Scrapyard was adopted as the reference hotspot and for the estimation of obsolete equipment recycled. Additionally, the exposure risks to the health of persons involved, as well as the contribution of the sector to the national economy were reviewed.

A review of institutional limitations in regulating and monitoring good practices for health and the environment, stemming from prior studies, led to the development of an action plan for E- waste management in Ghana. The plan addressed the implications of informal E-waste handling and recycling, focusing on risk management.



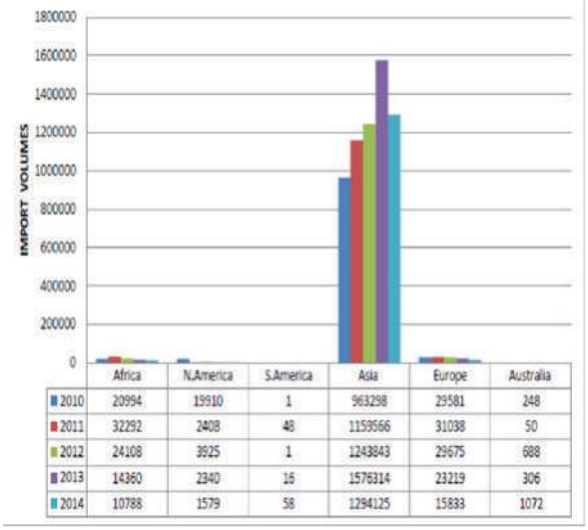
	Africa	N.America	S.America	Asia	Europe	Australia
2010	4244	11806	70128	431058	7986	239
2011	8088	18837	78404	691345	49992	206
2012	10403	22677	88578	724183	223095	260
2013	9881	9984	184181	781285	52596	174
2014	6964	6016	69401	584604	44764	389

4.10(a) Large Household Equipment (New)



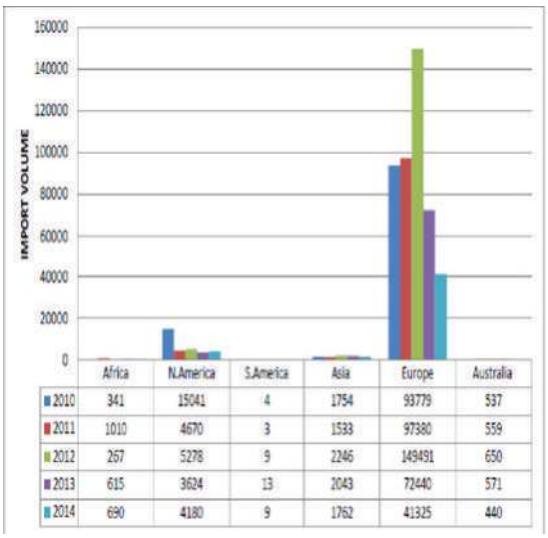
	Africa	N. America	S.America	Asia	Europe	Australia
2010	261	3241	0	7967	353492	930
2011	245	12986	0	7633	318600	1141
2012	286	5301	0	10766	344514	686
2013	265	2354	2	3387	114755	264
2014	100	781	13	338	25507	81

4. 10(b) Large Household Equipment (Used)



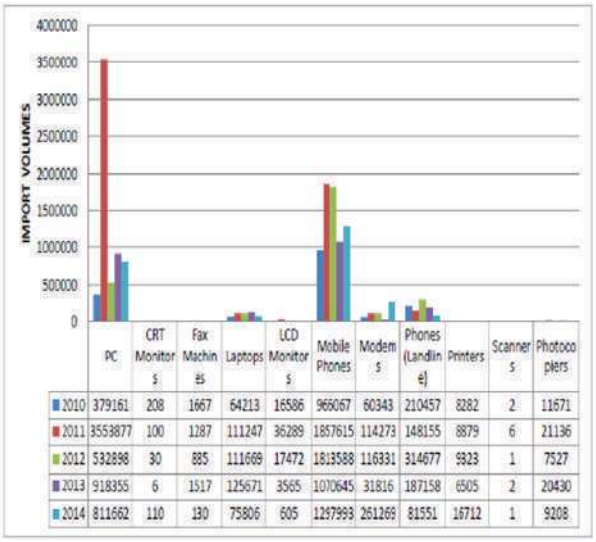
	Africa	N.America	S.America	Asia	Europe	Australia
2010	20994	19910	1	963298	29581	248
2011	32292	2408	48	1159566	31038	50
2012	24108	3925	1	1243843	29675	688
2013	14360	2340	16	1576314	23219	306
2014	10788	1579	58	1294125	15833	1072

4.10(c) Small Household Equipment (New)



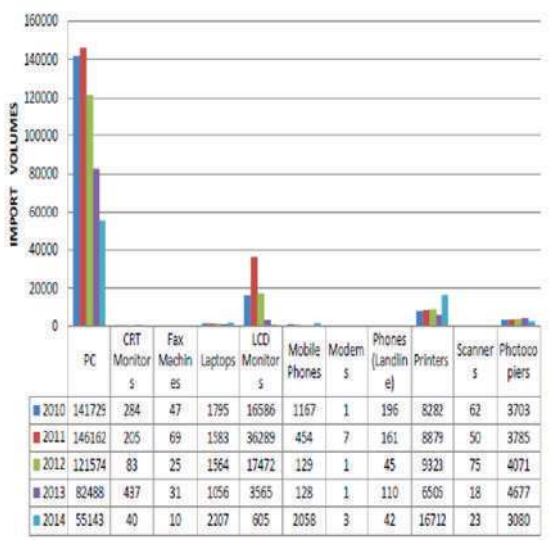
	Africa	N.America	S.America	Asia	Europe	Australia
2010	341	15041	4	1754	93779	537
2011	1010	4670	3	1533	97380	559
2012	267	5278	9	2246	149491	650
2013	615	3624	13	2043	72440	571
2014	690	4180	9	1762	41325	440

4.10(d) Small Household Equipment (Used)



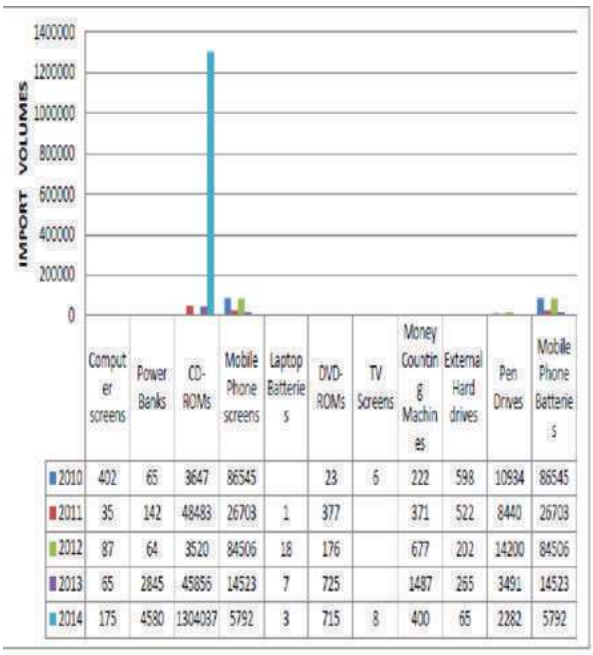
	PC	CRT Monitors	Fax Machines	Laptops	LCD Monitors	Mobile Phones	Modems	Phones (Landline)	Printers	Scanners	Photocopiers
2010	379161	208	1667	64213	16586	966067	60343	210457	8282	2	11671
2011	3553877	100	1287	111247	36289	1857615	114273	148155	8879	6	21136
2012	532898	30	885	111669	17472	1813588	116331	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

4.10(e) ICT Equipment Imports (New)



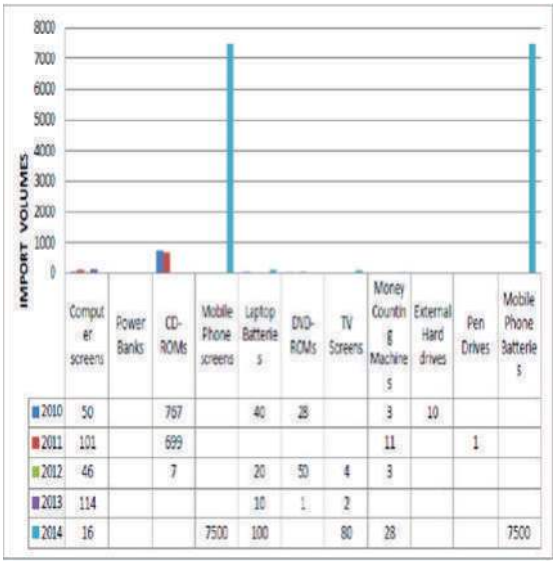
	PC	CRT Monitors	Fax Machines	Laptops	LCD Monitors	Mobile Phones	Modems	Phones (Landline)	Printers	Scanners	Photocopiers
2010	141729	284	47	1795	16586	1167	1	196	8282	62	3703
2011	146162	205	69	1383	36289	454	7	161	8879	50	3785
2012	121574	83	25	1564	17472	129	1	45	9323	75	4071
2013	82488	437	31	1056	3565	128	1	110	6505	18	4677
2014	55143	40	10	2207	605	2058	3	42	16712	23	3080

4.10(f) ICT Equipment Imports (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	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	1304087	5792	3	715	8	400	65	2282	5792

4.10(g) Consumer Electronics/Components (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	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

4.10(h) Consumer Electronics/Components (Used)

Figure 4. 13 EEE Import Data (New and Used) for 2009-2014

A key finding was that despite ratifying several relevant multilateral environmental agreements and conventions (Box 4.9), Ghana had no specific legislation for the control of and trade in end-of-life and near-end-of-life EEE. A set of recommendations constituting highlights of the Action Plan for E-waste management in Ghana was provided (Box 4.10).

Box 4.9 Some Relevant Multilateral Environmental Agreements and Conventions

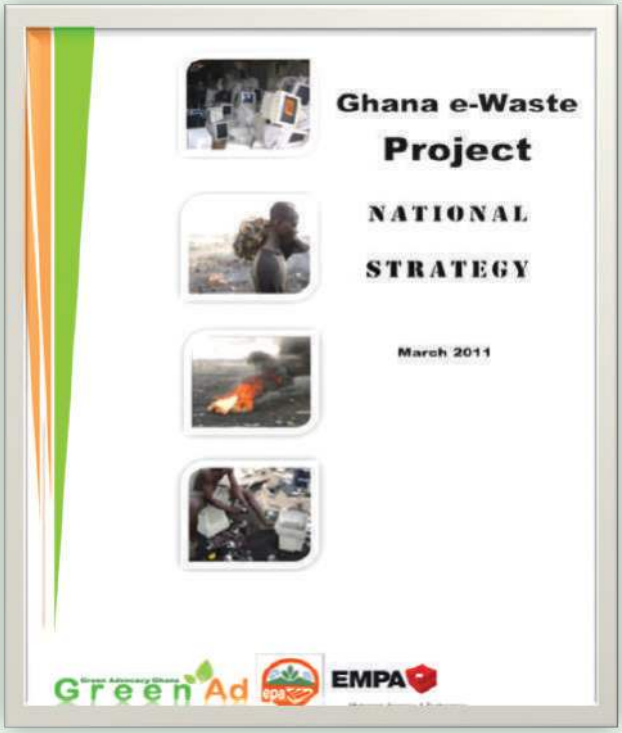
- The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal
- The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure of certain Hazardous Chemicals and Pesticides in International Trade
- The Vienna Convention on Ozone Depleting Substances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

Box 4.10 Highlights of Proposed Action Plan and Recommendation

- Recommended policy and guidelines to manage the import of e-waste, and work standards for recycling, refurbishing and disposal
- Environment management systems, including investments for infrastructure and technology needed for clean recycling of various fractions, disposal of end products, and occupational and health safety standards
- Clean-up plan of the contaminated sites to minimize exposure risks to operators and persons working and shopping in the nearby food market
- Systematic monitoring of occupational health and exposure of workers
- Proposed systems to formalize collection and transportation of E-waste
- Capacity building and awareness creation
- Public Private Partnership (PPP) initiatives and involvement of producers of EEE goods to improve production and buy-back systems
- Systems for monitoring and enforcement.

4.6 Ghana E-Waste Project - National Strategy

The National Strategy for E-waste Management had several objectives and principles to provide policy and management direction and facilitate the overall sound and sustainable management of the sector. The strategy was the outcome of studies conducted under Components 1, 2, and 3 of the SBC E-waste Africa Project and the Ghana-Netherlands Cooperation. It was developed with the support of and partnership with the United Nations Environment Programme (UNEP), Swiss Federal Institute of Material Testing and Research (EMPA), and John Pwamang of the Ghana EPA.



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The EEE importation, retail, and recycling industry served as a source of income for many Ghanaians and foreign migrants. However, the sector grappled with pollution, limited recycling facilities, and an absence of industry standards. Moreover, there were no national regulations for importing or recycling hazardous WEEE fractions. This underscored the need to formalize practices and implement proper procedures.

The strategy covered three basic elements: policy and legislation (Box 4.11), business and finance (Box 4.12), and technology and skills (Box 4.13).

Box 4.11 Elements of the Strategy - Policy and Legislation

- Develop improved legislation to control illegal importation of used EEE.
- Institute mandatory registration and licensing of scrap dealers and refurbishers to facilitate training and control of their operations.
- Publish directives requiring the public to hand in end-of-lie EEE to licensed dealers only.
- Create awareness at all levels of governance and the public on –
    - The dangers of the current handling processes,
    - The new hand-in/take back system, and
    - The recycling centres.
- Develop an enforcement mechanism centred around EPA's Compliance and Enforcement Network (CEN), such as designating the Technical
- Committee on Waste Shipment Prevention (TCWSP) as a sub-committee for the control and management of WEEE in Ghana.

Box 4.12 Elements of the Strategy - Business and Finance

- Adopt a business model (acceptable to GASDA) for ease of ownership.
- Abolish informal scrap yards operating in major cities (especially those using fire/ burning).
- Provide support for re-designation and change of status to formal recycling
- Hold consultations with major manufacturers and local dealers in EEE on implementation of Extended Producer Responsibility in Ghana.
- Develop and introduce EEE levies, mandatory licensing, and EEE management fund.
- Apply the EEE management fund for the control and sound management of WEEE.

Box 4.13 Elements of the Strategy - Technology and skills

- Build a demonstration plant/information centre to promote improved E-waste dismantling and refurbishment.
- Establish a formal and efficient WEEE recycling industry, nation-wide.
- Strengthen the capacity of the E-Scrap Dealers' Association and the training of the members in safe and efficient handling and good business practices.
- Establish regional associations to ensure national integration in the WEEE recycling industry.
- Promote the fabrication and sale of items from E-scrap (e.g., metal plates from refrigerators and deep freezers, etc).
- Develop a facility for the temporary storage of hazardous fractions of E-waste and make arrangements for final disposal in an environmentally sound manner.
- Establish collection centres (to be managed by qualified stakeholders/ operators).

The National E-waste Strategy informed the formulation and establishment of certain key interventions in the sector (Box 4.14).

Box 4.14 Key Interventions Originated from the National Strategy

- Pilot Incentive System by GIZ (Section 5.5)
- Incentive System for Selected E-Waste Types by MESTI and KfW (Chapter 6)
- Establishment of the national E-waste Fund (Chapter 8)

4.7 Air Quality Improvement Evaluation Study

Following the introduction and implementation of the pilot recycling activities at ARC (Section 5.1), an air quality monitoring programme was instituted to evaluate the success or otherwise in terms of air quality improvement in the area. This was in line with the primary objective of the recycling intervention, which was to eliminate the crude recovery methods for metals and the associated pollution in the area. The three key variables used as the basis for the evaluation are provided in Box 4.15, while Box 4.16 lists the six monitoring stations.

Box 4.15 Monitoring/Evaluation Variables

- Air pollution
- Volume and weight of waste cables processed
- Financials

Box 4.16 Monitoring/Sampling Stations

- Onion Market
- ARC Pilot site
- Burning areas
- ICGC Church
- Agbogbloshie-Korle Bridge
- Bank Area (across the road, opposite the Scrapyard)

The ARC facility processed over 12,770 pounds of E-waste materials (cables), with 7,917 pounds of recovered clean metals (Table 4.2). The remaining 4,853 pounds of waste PVC plastic coating (38% of the total weight) would otherwise be burned with the release of toxic fumes.

Table 4. 2 Quantities of E-waste Fractions after Processing (lbs.)

Total Collected	Plastic Coating	Metals
12,770	4,853	7,917

The increased incentive funds disbursed meant less available material recovery through combustion over the two-year period, resulting in a corresponding reduction in emission volumes (Box 4.17).

Box 4.17 Volumes of Emissions Averted

- 6,800 pounds of CO2 emission.
- 2,700 pounds of toxic pulmonary irritant hydrochloric acid.
- 14.6 pounds of Lead.

Though the burning of waste cables (the primary source of pollution) significantly reduced, the burning of vehicle tyres, household and municipal wastes at the dumpsite continued. Also, the previous cable burning sites were converted into additional refuse burning areas; thus, the monitoring results showed no improvement. The results for the important human health indicator parameter – PM2.5 for instance – were exceedingly high for all the sampling locations (Figure 4.14).

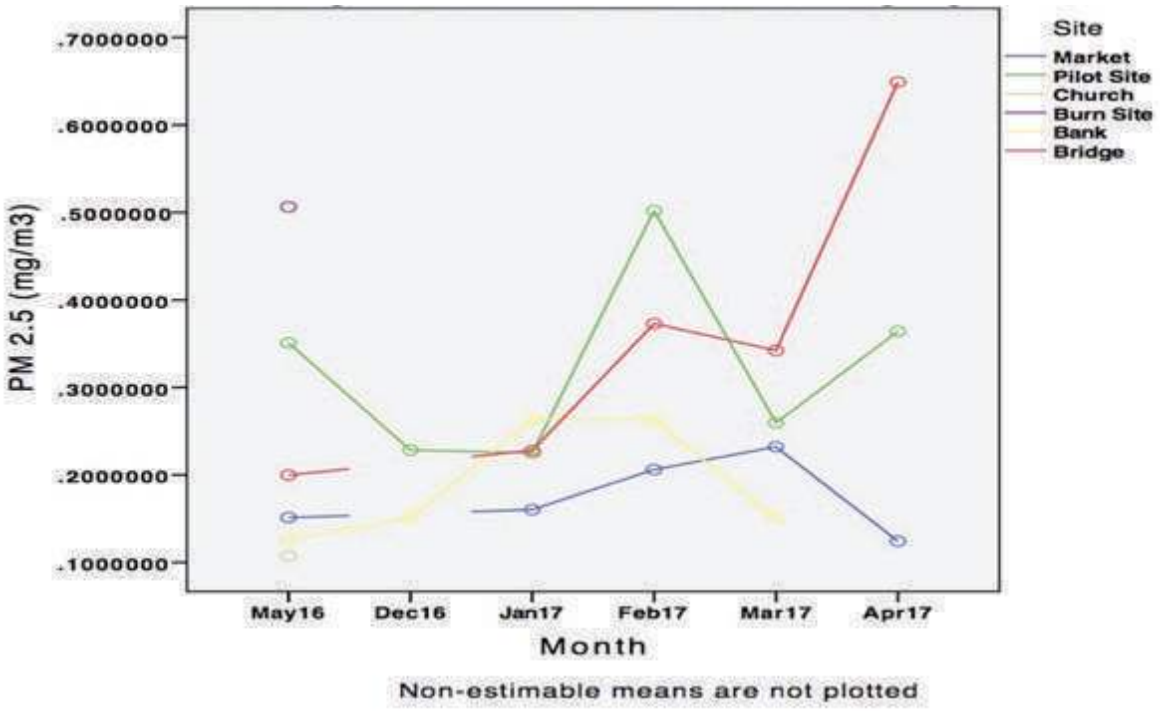
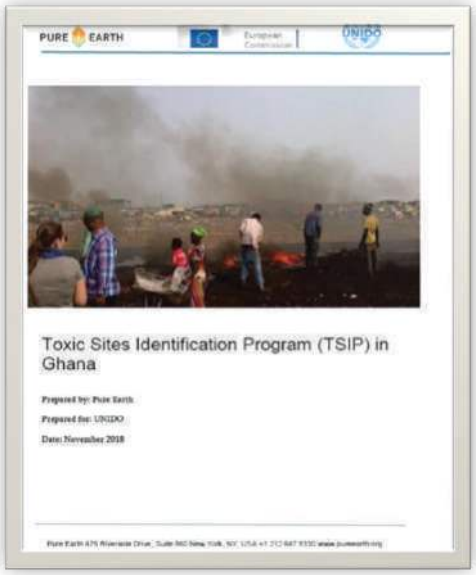


Figure 4. 14 Average PM2.5 Concentrations in Agbogbloshie

Despite the generally dismal results, it was estimated that the project constituted substantial CO2 by diverting WEEE from burning and reducing toxic emissions – representing significant 'emissions averted', in relation to climate change, pollution, and health risk mitigation.

4.8 Environmental and Social Audit of the Dumpsite

The Agbogbloshie (Old Fadama) dumpsite decommissioning Environmental and Social Impact Assessment (ESIA) was conducted as a component of the Greater Accra Resilient and Integrated Development (GARID) Project, under the Ministry of Sanitation and Water Resources (MSWR) and funded by the World Bank. This was an opportunity for the systematic closure, capping, and aftercare management of the notorious E-waste dumpsite. The main purpose of decommissioning the dumpsite is listed in Box 4.18.



Box 4.18 Decommissioning Intervention was to Eliminate:

- The continuous generation and flow of polluted leachate into the Odaw and surrounding areas
- Waste deposition/disposal (of all kinds), which contributed to the highly insanitary condition and seasonal flood events in the areas
- The hazardous and life-threatening exposure to people living and/or working on or near the dumpsite
- Burning of solid and electronic waste on the dump, releasing toxic fumes into the wider environment
- The source of pollution of Agbogbloshie and surrounding areas and a blight to the landscape of the south of Accra.

As part of the decommissioning ESIA, a comprehensive Environmental and Social Audit of the dumpsite and its vicinity was conducted by GreenAd (Box 4.19) to gain a deeper insight into the pollution levels.

Box 4.19 Areas of the Environmental and Social Audit

- Heavy metal concentration and distribution within the dump
- Leachate flow and quality
- Air quality situation of the area
- Population living and/or working on the dump
- Pickers of plastics and pieces of metals (after dismantling and burning)
- Hawkers of food and drinking water
- Head-potters
- Burners of E-waste components
- Women and children
- Animals foraging on the contaminated dump.

4.8.1 Heavy Metal Concentrations

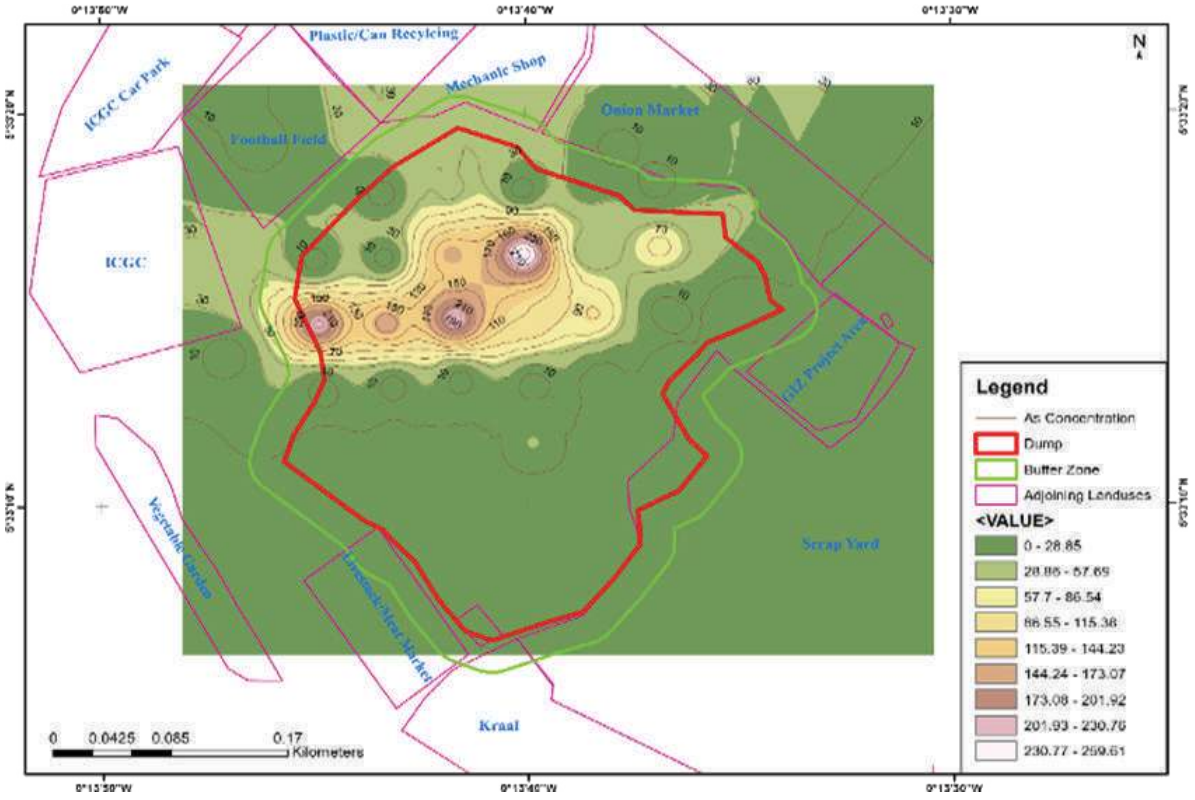
Analysis of heavy metal concentrations showed the level of contamination and its distribution in the area. The results confirmed that the dominant heavy metals are the primary constituents in any typical E-waste space (Box 4.20).

Box 4.20 Heavy Metals of Significance

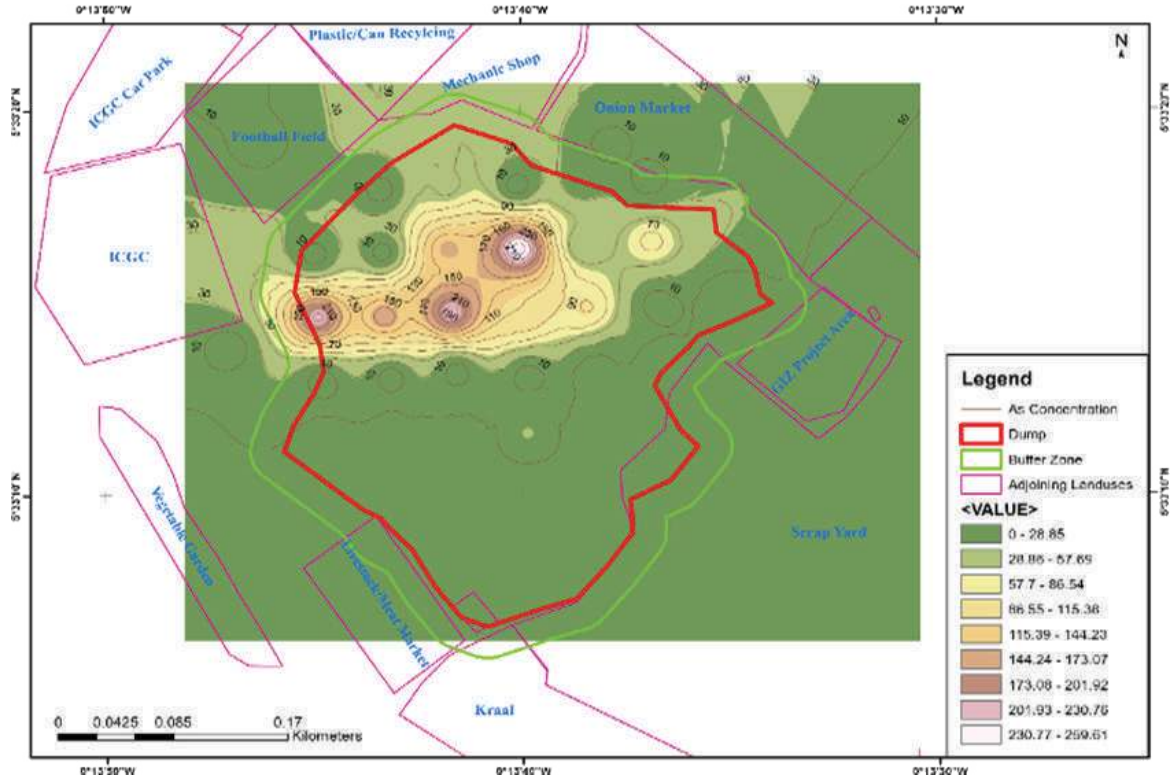
- Arsenic
- Mercury
- Lead
- Chromium

Figure 4.12 depicts the distribution of the heavy metals with high concentrations encountered – a) Arsenic, b) Mercury, c) Lead, and d) Chromium.

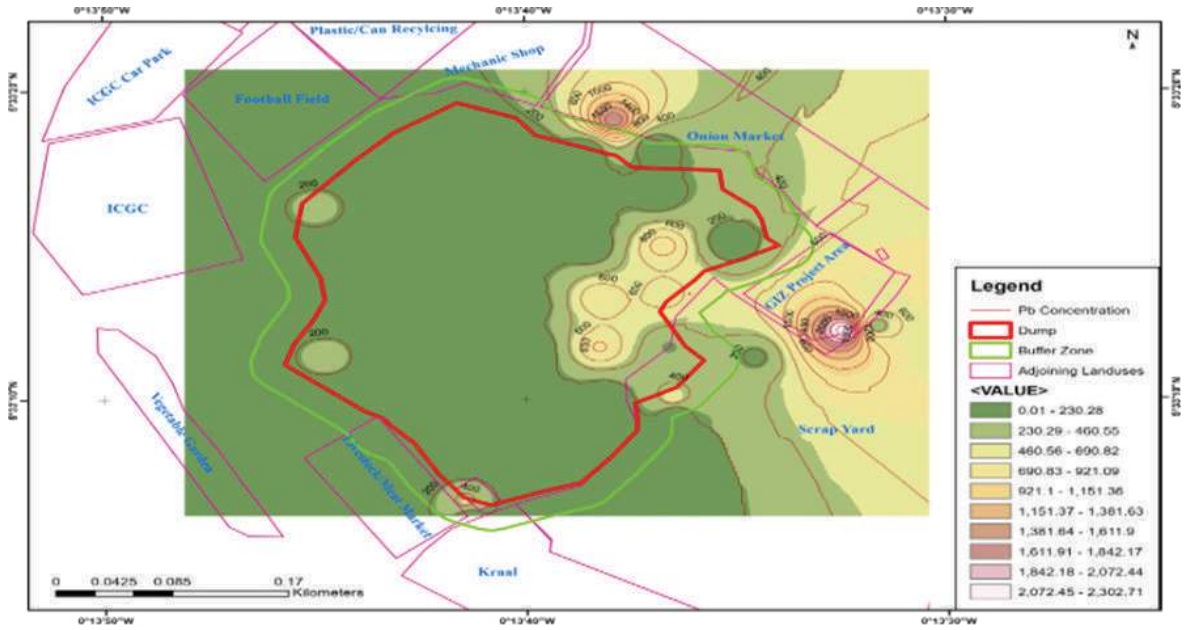
Arsenic Concentration/Distribution Map



Mercury Concentration/Distribution Map



Lead Concentration/Distribution Map



Chromium Concentration/Distribution Map

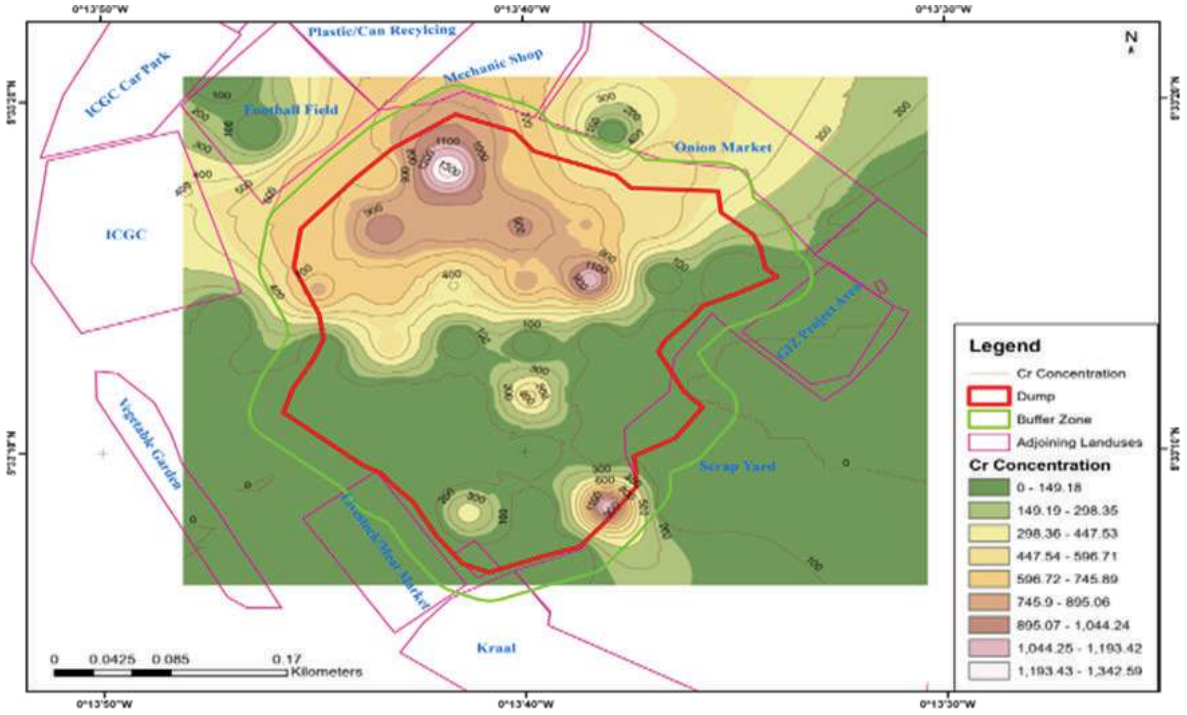


Figure 4. 15 Maps Showing Distribution of Heavy Metals

4.8.2 Leachate Generation and Flow

Polluted, leachate-laden runoff from the dump (Figure 4.16 and 4.17) was used to irrigate nearby vegetable farms, and it also contaminated the football field used by schoolchildren and others as a playing field (Figure 4.18).

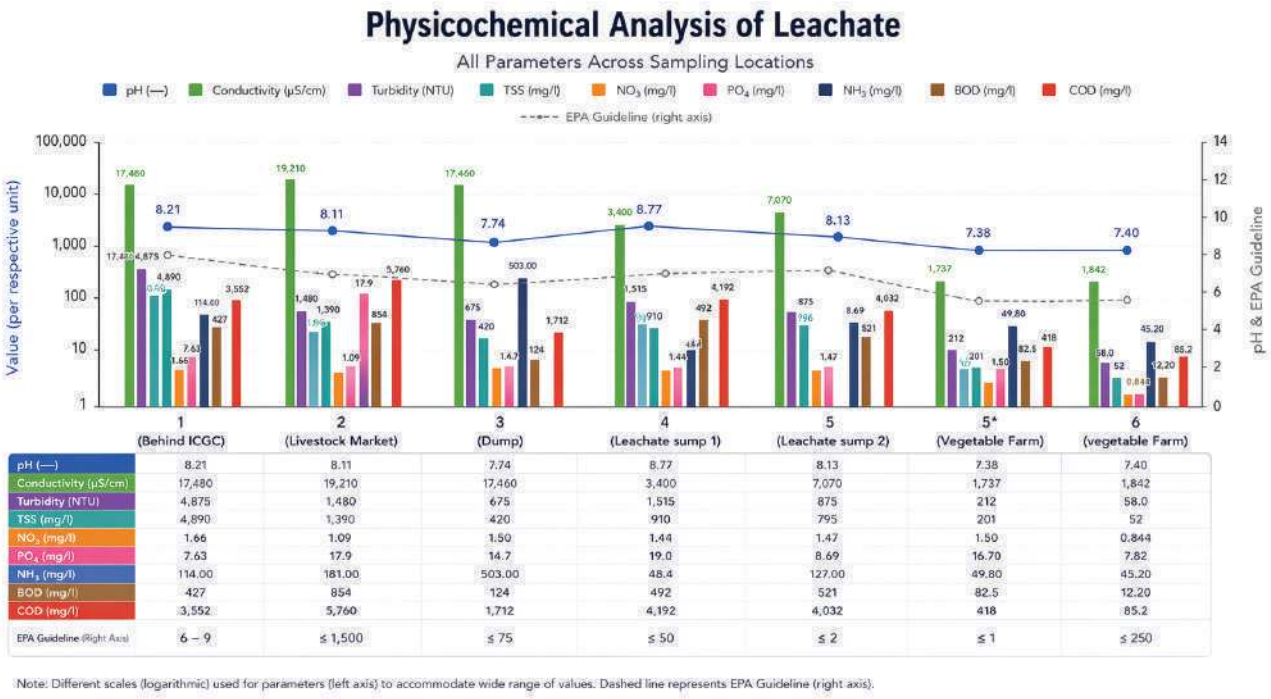


Figure 4. 16 Physicochemical Analysis of Leachate

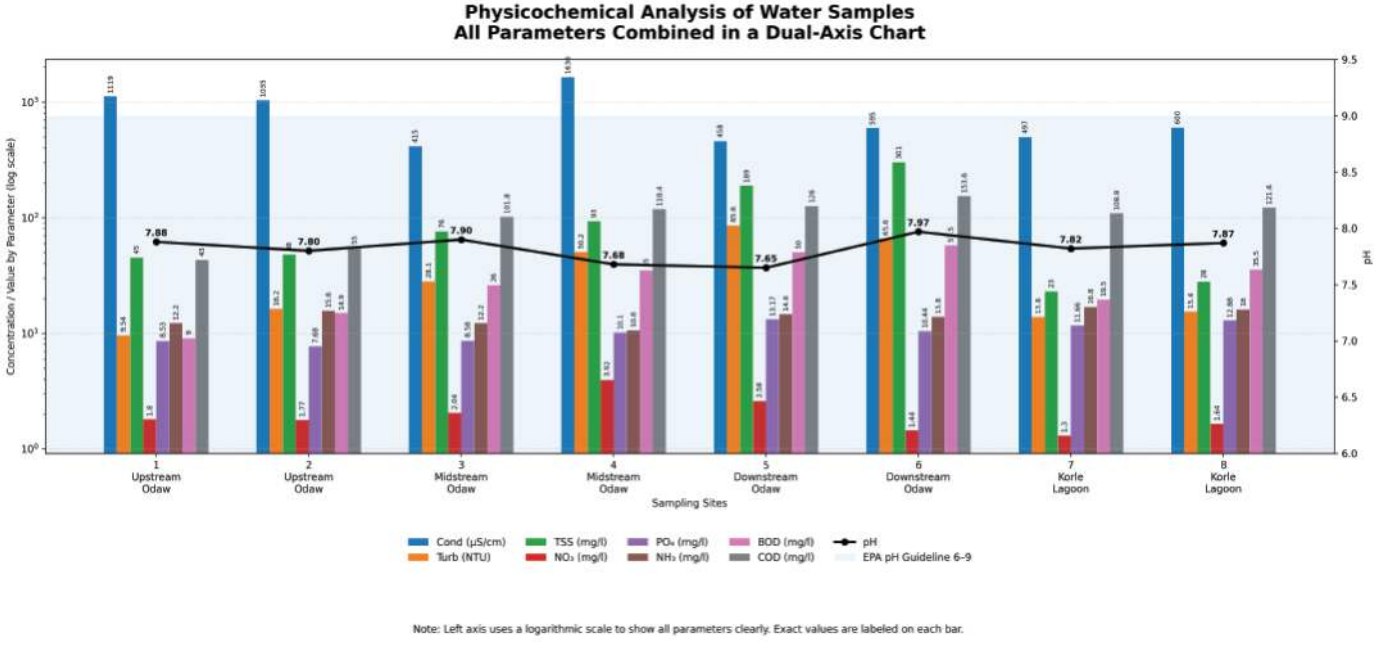


Figure 4. 17 Contents of Heavy Metals in Leachate

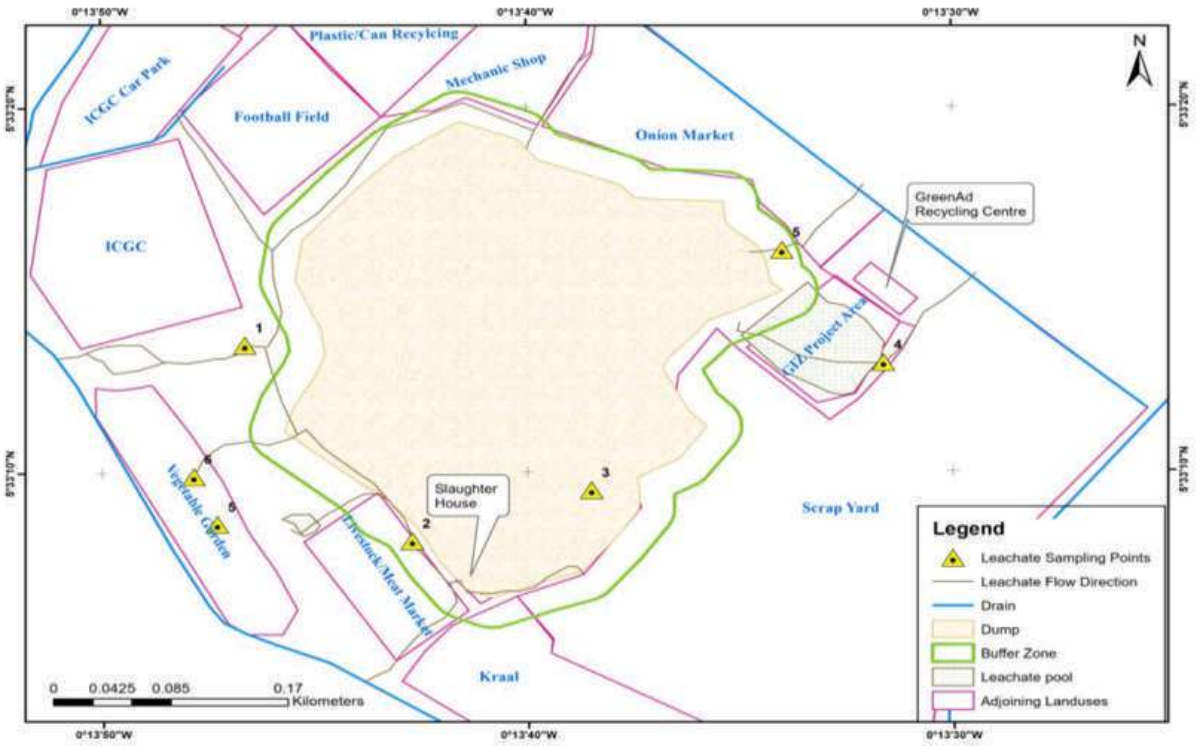


Figure 4. 18 Leachate Sampling Points

4.8.3 Polluted Ambient Air

The ambient air was found to be contaminated with heavy metals (Lead (Pb) and Mercury Hg), especially in the Onion Market area (Figure 4.19).

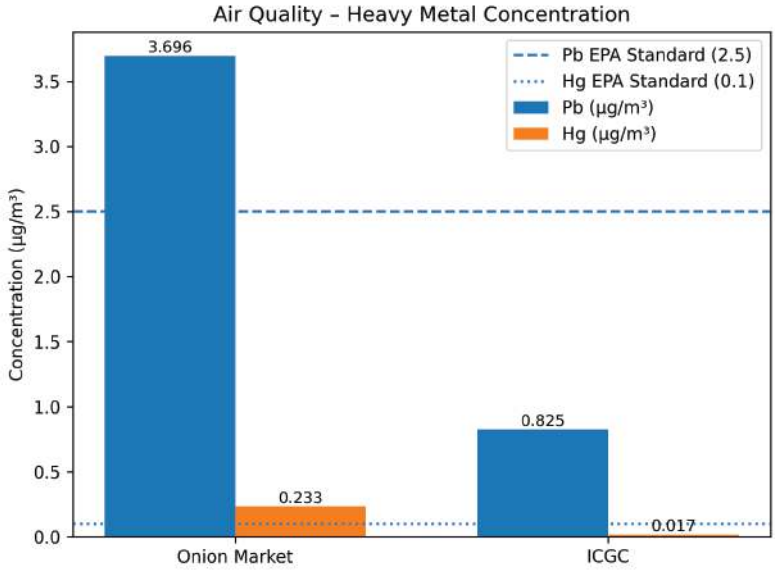


Figure 4. 19 Air Quality – Heavy Metal Results

4.8.4 Occurrences on and around the Dumpsite

The dump and its surroundings were host to a wide range of activities (Box 4.21), and exposed workers and the public attracted to the area to air pollution and heavy metal poisoning.

Box 4.21 Range of Activities on the Dump and Surroundings

- People lived in shacks on the dump
- Other people lived and worked in structures on the dump
- Toilets facilities existed on the dump
- Some women lived with their children and the children cooked on it (Figure 4.14a)
- Women seen sorting through onion chaff to pick good ones (Figure 4.14b)
- Burners of E-waste engaged in burning
- Young boys picked pieces of metals – residues from E-waste burning
- Hawkers (water and food) followed burners as they worked (Figure 4.14c)
- Pupils playing on the park close to the dump (Figure 4.14d)
- Worshippers to ICGC commuted to church and for other functions near the dump
- Workers of ICGC and other organisations reporting daily to work in the area
- Traders and market women carried out business at the Onion Market and other areas nearby
- The public patronised the Onion Market and the Agbogbloshie Market.

A. Children cooking on the dump - an area with high Cr, Hg and As concentrations (Figure 4.20 a, b & d)

B. Women sorting through onion chaff on top of the dump – in area recording high Cr, Hg and As levels

C. Women (one carrying a child) hawking in an E-waste burning area that had high Cr, Hg and As concentrations

D. Pupils playing on the park close to the dump that recorded high Pb levels, also exposed to smoke from the burning. Cattle foraging in the background on the dump (Figure 4. 20c)

4.8.5 Environmental and Health Risks

The Box 4.22 lists the main health risks and hazards associated with the dump. Other indirect risks, for instance foraging livestock, and vegetables cultivated with leachate-contaminated water, invariably affected humans through the food chain.

Box 4.22 Exposure Risks and other Hazards

- Incessant offensive odour and stench from decomposing organic waste and faeces
- Proliferation of flies and fly invasion, e.g. interfering with social events at ICGC
- Smoke and toxic fumes from E-waste and municipal waste burning
- High concentration of airborne heavy metals like Lead and Mercury emissions
- Leachate-laden runoff used for vegetable watering and other purposes
- People living/working on the dump, exposed to heavy metal poisoning
- Women (hawkers) and children exposed to pollutant residues and pricks and cuts by contaminated sharp objects
- Foraging livestock (including cattle) on contaminated dump potentially bio-accumulating heavy metals and transferring through meat other products to humans
- Patronage/consumption of contaminated vegetables with leachate, microbial and chemicals
- Filthy plastic litter blown around and into people's dwellings and workplaces by wind.

Chapter Five

Key Interventions

5.0 Key Interventions

5.1 Outline of the Practical Interventions

The original proposal envisaged a national program for the sound management and control of e-waste dumping in Ghana. The outcome of the pollution survey under TSIP catalyzed the development of the proposal. The high levels of pollution recorded which led to the listing of Agbogbloshie among the Top Ten polluted places in the world (2013), also became the impetus for the practical interventions (Box 5.1) aimed at changing the Agbogbloshie narrative, and the incessant international negative press.

Box 5.1 Planned Key Interventions and Activities

- Development of an E-waste recycling and knowledge transfer centre at Agbogbloshie -
  - Metal recovery equipment trials for cable waste and selection of preferred type
  - Importation of motorized cable stripping machines and granulator
  - Allocation of the recycling site at Agbogbloshie by NYA
  - Setup of facilities and establishment of the Agbogbloshie Recycling Centre
  - Launch of the E-waste pilot recycling operations
- Formalization and adoption of eco-friendly E-scrap business model
  - Study tour of E-waste recycling/metal industries and institutions in Sweden
  - Towards energy-efficient recycling of E-scrap - the Agbogbloshie 'city mining'
- Transformation of the scrapyard into a modern, well-designed E-waste centre
  - Agbogbloshie Scrapyard transformation collaborative designs
  - Engagement with the National Youth Authority to facilitate implementation
- Replication of the Agbogbloshie Recycling Centre in other urban centres
  - Plan to establish similar recycling facilities in 4 urban centres
  - Commissioning of recycling equipment design by GRATIS Foundation
  - Funding for the manufacture of the recycling equipment.

5.2 Agbogbloshie E-waste Recycling Centre Establishment

In 2014, the Agbogbloshie Recycling Centre (ARC) was established in direct response to international exposure of Agbogbloshie as a highly polluted area. The cable recycling equipment was to help mitigate the crude burning recovery method and its associated pollution. The expected results were to generate a large inflow of E-scrap for recycling rather than burning (Box 5.2), in partnership with Pure Earth, the National Youth Authority (NYA), and the Greater Accra Scrap Dealers Association (GASDA).

Box 5.2 Expected Results of operations at the ARC

- Clean, unoxidized materials recovered to attract premium sale prices for scrap workers
- General emission reduction of toxic substances in the area
- Improved health and safety outcomes for the informal E-waste workers.

5.2.1 Selection of Preferred Recovery Equipment and Training Sessions

Led by both local and foreign partners (including Pure Earth and GreenAd), cable recovery Equipment trials (Table 5.1) were conducted for GASDA members to select the most suitable and acceptable equipment (Figure 5.1). Motorised stripping machines were eventually selected as the preferred means of recovery.

Table 5. 1 List of Tools Used in the Trials

• Blue quick grip	• SA tool stripper	• Automatic stripper
• Block plane	• Husky bolt handles	• Pliers
• Cranker	• IPL Ripper & Stripper	• Wire cutter
• Rollers	• Butcher blades	• Pack of blades
• Green strippers	• Blade grips	• Round roller

Figure 5. 1 Demonstration of Use of Simple Tools to Strip Cables

Several other training sessions were held, including a three-day workshop on responsible recycling practices and showcased the functionality of the stripper machines and the granulator (Figure 5.2), in collaboration with Pure Earth and Hunter College, USA, and DATEC Technologies, Scotland.

Figure 5. 2Demonstration/Testing of the Granulator

5.2.2 Allocation of the Recycling Site at Agbogbloshie

The selected area for the recycling operation was formally transferred to GreenAd after a search by the site designating team from the NYA, GASDA, and the Project Contractor. The affected scrap workers and vehicle owners occupying the area were therefore relocated.

5.2.3 Setting up of facilities for the Recycling Centre

The ARC consisted of three 40-foot shipping containers arranged in a U-shape, with a wide gate enclosing the central section (Figure 5.3). A preliminary business model and project implementation plan were developed for the industry starting from Agbogbloshie, alongside efforts to promote cooperative group formation and a series of stakeholder sensitization sessions to ensure efficient recycling center operations.

5.2.4 Importation of Motorized Cable Stripping Machines and Granulator

Pure Earth sponsored the purchase and importation of four motorized cable-stripping machines (Figure 5.4) and a granulator (Figure 5.5) to handle large and small cables, respectively. The machines were installed and tested with assistance from the GRATIS Foundation.

Figure 5. 3 Layout of the ARC Site

Figure 5. 4 A Stripping Machine at the ARC

Figure 5. 5The ARC's Granulator

5.2.5 Launch of ARC Operations

The Agbogbloshie E-waste Recycling Project was initiated in November 2013 and formally launched in October 2014 by the then Deputy Minister for Environment (MEST), Hon. Dr Mrs. Bernice Heloo, assisted by Kira Traore, Dr Mrs. Edith Clarke and Hon. Ras Mubarak (Figures 5.6 and 5.7).

The Deputy Minister was happy that eventually Ghana has received support from the Black Smith Institute to address a major concern of the Ministry about the pollution at Agbogbloshie and the severe health hazards posed to E-waste workers and the community at large. She was full of praise and hope that the project would be

successfully implemented and in future scaled up to other urban centres in Ghana.

The event was chaired by Dr. Edith Clarke, Head of the Occupational Health Unit at GHS, who characterized E-waste activities as a double-edged sword. On the one hand, it served as a source of livelihood for thousands of workers and their dependents, while on the other, it posed significant environmental and human health risks. She recalled the Prakash et. al, 2010 study that revealed high levels of heavy metals in blood and urine samples taken from subjects at Agbogbloshie and noted that such heavy metals could cause lung, liver, and kidney diseases leading to death.

Figure 5. 6 Colourful Set Up for the Launch of ARC

Figure 5. 7 Hon. Mrs. Heloo being assisted to Officially Open the Facility

The Executive Director of GreenAd and Country Coordinator for Pure Earth, Amoyaw Osei, re-echoed the significant role E-scrap workers played in recycling WEEE locally, in his welcomed address. He hoped that the new facility would truly eliminate burning and associated pollution, protecting the health of the more than 3,000 E-scrap workers, the public, and the landscape. Other dignitaries who graced the occasion included: Mr. John Pwamang (Executive Director, EPA); Mr Emmanuel Asiedu (CEO, GRATIS Foundation); Hon. Ras Mubarak (CEO, NYA); Mr Mohammed Alihu (Secretary, GASDA); and Mrs Kira Traore (Program Director for Africa, Pure Earth).

Mr John Pwamang expressed profound gratitude on behalf EPA to the Pure Earth and GreenAd for making the dream possible, and admonished GASDA and its members to stop burning cables and make good use of the wire-stripping equipment.

Mr. Emmanuel Asiedu was delighted with GRATIS's collaboration with the other partners and assured that the organization would be happy to fabricate and maintain components/equipment to make E-waste recycling environmentally friendly.

Hon. Ras Mubarak underscored the importance of society finding solutions to the myriad problems facing youth and was therefore pleased when GreenAd approached the Authority to partner on the project.

Mr. Mohammed Alihu indicated that GASDA supplied about 30,000 metric tons of ferrous and other metals to industries but was concerned about the associated pollution, which had become synonymous with metal recycling at the site. He therefore expressed GASDA's gratitude to Pure Earth and GreenAd.

Kira Traore was in Ghana to participate in the launch and thanked everyone who supported the project. She expressed hope that the facility would soon become self-sustaining and profitable, and that neighboring countries would come to see the transformation at Agbogbloshie and learn from it.

Figure 5.8 shows the composition of the Board appointed to manage the ARC operations and future expansion to other urban centres. Hon. Mubarak administered the oath of office.

From L to R:
Abdul Rahman (GASDA)
John Pwamang (EPA)
Mohammed Ali (GASDA)
Mohammed Hassan Mohammed (GASDA)
Emmanuel Asiedu (GRATIS Foundation)
Theophilus Anaman-Mensah (NYA)
Yaw Amoyaw-Osei (GreenAd)

Figure 5. 8 The ARC Board

The launch featured a performance titled 'Wahala dey Agbogbloshie' by the Environmental Club of the Queensland International School, and an exhibition (Box 5.2) depicting the daily hazardous events at the Scrapyard and the preparatory activities and demonstration for the new project respectively.

Box 5.2 Launch Exhibition

- Pictures depicting the Agbogbloshie E-waste story
- Training sessions and international visits by the recyclers;
- Handheld tools used in wire stripping during the experimentation phase
- A demonstration of the copper wire strippers in action.

Various media houses, including GTV, Metro TV, ETV, JOY TV, UTV, ATV, BTA, The Daily Graphic, Citi FM, and Peace FM, were represented to cover the story. They took turns interacting with the lead partners, other stakeholders, and invited guests.

5.2.6 Output of the ARC Operations

The introduction of the wire stripping machines ensured the recovery of clean Copper and Aluminium and earned the workers premium price for the otherwise oxidized metals from burning.

The main obstacle to the cable stripping process was the generation of legacy waste (plastic insulation materials) (Table 5.2). Approximately 1.2 tonnes of this material was sold, with the Ghana EPA's support in identifying permitted plastic waste recycling companies. However, due to its un-recyclability, 10.6 tonnes of plastic cable waste was left unsold and is still being stored by GreenAd (Figure 5.9).

Table 5. 2 Materials Recovered at the Pilot Phase

Cable Materials Delivered	Types	Material Weight (tons)
Materials (metals) recovered from cables	Copper	6.8
	Aluminium	6.7
Plastic coating/insulation waste material sold	PE	0.6
	HDPE	0.6
Undesirable plastic insulation (legacy waste)	PVC	10.6
Total weight of cables processed/stripped		25.2

Figure 5. 9 Legacy waste from the stripping of cables

5.3 Formalization and Adoption of Eco-friendly E-Scrap Business Model

The formalization and adoption of an eco-friendly E-Scrap business model at Agbogbloshie was pushed forward through an energy-efficient recycling methodology for e-scrap, which was nicknamed the 'Accra City Mining' business. It was an ambitious proposition sponsored under the NORDIC fund that involved a business trip to Sweden for GreenAd and our key stakeholders – the GASDA and EPA.

The trip was intended to prepare the GASDA members to appreciate the potential business opportunities at Agbogbloshie by visiting some existing formal recycling companies. Their involvement was also intended to enable the representatives to share the knowledge they acquired in Sweden with other members to raise awareness. The hope was that this approach would encourage GASDA to embrace and implement the formalization initiative proposed for Agbogbloshie, further strengthening the trust and rapport between GASDA and GreenAd.

For the EPA, the Sweden trip would also enhance its capacity to manage E-waste, as the sector remained largely uncharted at the time. It was designed to allow this regulatory body to learn from Sweden's E-waste sphere to better understand the policies, laws, and technologies needed to manage electronic waste.

5.3.1 Energy efficient recycling of e-scrap - NORDIC Fund

This collaborative project, involving GreenAd, Raw Materials Group AB, and the NORDIC Facility (funder), aimed to enhance e-waste recycling while improving scrap workers' living and health conditions and local environmental conditions. The project's primary components focused on capacity building and training, empowering scrap dealers and other stakeholders to adopt more efficient and eco-friendly recycling methods.

In August 2011, a team of four from the Ghana EPA, two Greater Accra Scrap Dealers, and three GreenAd staff visited prominent environmental institutions and recycling companies in Sweden. Sites and institutions visited included Boliden, Ericsson, Kuusakoski, SIMs Recycling, DATEC Recycling, Elklitson, and the Swedish EPA. Images from this visit can be seen below in Figure 5.10:

A. Ericsson's Vice President for Sustainability and Corporate Responsibility giving a presentation on Sustainability and the Networked Society

B. Demonstration of metals retrieved from E-waste recycling (gold, silver, copper)

C. Meeting at Swedish EPA

D. Raw materials Group AB Meeting

E. Left to right: Mohammed Alihu (GASDA); Lovelace Sarpong (EPA); Lambert Faabeluon (EPA); Bennett Samuel Akuffo (GreenAd)

F. SIMs Recycling Demonstration of how CRTs are handled/treated

G. Meeting at Kuusakoski

H. Kuusakoski - Demonstration of how the collected E-waste is sorted

I. E-waste stockpile at Kuusakoski

J. Team Visit to DATEC Sweden

K. Visiting Team featured in a Local Swedish Newspaper

Figure 5. 10 Pictures from the Sweden Visit

Overall, this expedition provided GreenAd and the EPA with a deeper understanding of policies, laws, and potential strategies and interventions for effective WEEE management. It also heightened GASDA's awareness of business opportunities in the e-waste sector, enabling them to adapt to industry changes and bolstering confidence in their partnership with GreenAd.

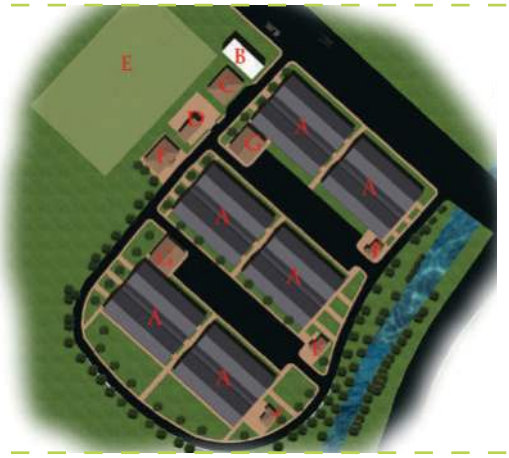
5.4 Transformation Plan for the Agbogbloshie Scrapyard

The Agbogbloshie scrapyard neighborhood and areas across the Odaw/Korle to Galaway presented an ugly blight of the southern Accra landscape, which the transformation agenda sought to cure in a progressive manner.

As component of the Ghana E-waste project, the Transformation Scheme was developed by GreenAd, the EPA, and other key collaborators to convert the Agbogbloshie E-scrapyard and surrounding area into a formal recycling GreenAd The village was designed to accommodate approximately 3,000 E-scrap operators and included facilities such as a training and information centre, a prayer area, sanitary facilities, a canteen, and a health post (Figure 5.11). The village also included the installation of a granulator/shredder to facilitate the separation of copper from cables, among others.

The Transformation Agenda was a comprehensive plan to transform the scrapyard and surrounding landscape (including the slum at Gallaway) into a modern E-scrap hub and work environment, free of the existing informality and slum. The scrapyard transformation was envisioned and planned under the NORDIC facility to:

- Establish a new face of E-waste working environment with appropriate working facilities;
- Support and facilitate compliance with standards by all operators;
- Provide a heating system/facility to facilitate dismantling of components such as
- Provide receptacles for waste oil, acid residue from Lead Acid Batteries, etc.;
- Provide receptacles for the disposal of other hazardous fractions; and
- Eliminate children's involvement and related activities at the new operational site.



KEY

A - SHEDS
B - ADMINISTRATION
C - HEALTH POST
D - FIRE TENDOR
E - SOCCER FIELD
F - CHANGING ROOM
G - CANTEEN

Figure 5. 11 Proposed Design for the Agbogbloshie Scrapyard Transformation

The primary goal of this initiative was to transform the Agbogbloshie site into a model that could serve as an example for other regions of Africa to emulate. Under this, the project, as shown in Box 5.3, sought to:

Box 5.3 Aims of the Transformation Project

- Create a national industrial enclave for E-Waste management at Agbogbloshie.
- Transform the area into a modern e-scrap business, information, and technology transfer centre in Ghana.
- Develop frameworks towards the control and regulation of used EEE imports.
- Develop frameworks for the sound management of the waste generated.

The project was conceived as a pilot development initiative at Agbogbloshie and intended to serve as a learning model for other sites in Ghana and beyond. The center was designed to occupy a 15-acre parcel of land from the National Youth Authority (NYA), which was predominantly utilized by scrap dealers at the time.

5.5 Replication of the Agbogbloshie Recycling Centre in Other Urban Centres

The knowledge and experience gained from the pilot E-waste recycling operations at Agbogbloshie were intended to be leveraged to disseminate recycling expertise to other urban centres with high E-waste generation rates. In line with this objective, a three-step strategy was formulated (see Box 5.2), with the GRATIS Foundation playing a central role.

Box 5.4 The Three-Step Strategy

- Plan towards establishing similar recycling facilities in 4 urban centres
- Commissioning of recycling equipment design by GRATIS Foundation
- Funding for the manufacture of the recycling equipment.

5.5.1 Plan towards Establishing 4 Urban Recycling Centres

The plan included establishing similar recycling facilities in four urban centres – Koforidua, Kumasi, Sekondi-Takoradi and Tamale. These areas were recognized as significant generators of E-waste in Ghana that were also exposed to environmentally harmful recovery methods. Consequently, they were identified as the initial areas to benefit from this initiative.

5.5.2 Commissioning of Recycling Equipment Design by GRATIS Foundation

The stripping and granulated recovery equipment used during the stripping pilot were imported from the USA. Faced with resource constraints for additional equipment imports to set up recycling facilities in the identified urban centers, the decision was made to explore the possibility of local equipment manufacturing. As a result, the GRATIS Foundation was enlisted to design a replica of the stripping equipment, which they successfully completed.

5.5.3 Funding for the manufacture of the recycling equipment

The manufacturing contract was put on hold after the design phase, pending potential funding partners to move forward with production. Unfortunately, the Agbogbloshie Scrapyard Transformation and ARC Replication projects were halted due to a lack of funding and an eventual shift in the project scope and design toward developments like the GIZ Pilot (below).

5.6 GIZ-Oëko Pilot Incentive System

The GIZ-Oëko Pilot Incentive System, a part of intervention levels 2 and 3 within the Ghana E-waste Programme, aimed to create and test an E-waste take-back system, starting with waste cables. It was introduced as a more sustainable follow-up to the Agbogbloshie Pilot Project Phase I, which had left quantities of unrecyclable materials due to the stripping of cables. The Pilot Incentive System was designed to establish a more environmentally friendly approach to eliminate burning activities at Agbogbloshie and enhance the holistic management of E-waste.

For this pilot, the concept was to create a payment system for cables that would incentivize E- waste scrap collectors to sell their whole cables rather than engage in uncontrolled burning. The incentives were paid to individuals upon delivering cables, and the payment was set slightly higher than the local material value of the cables. This accounted for the service provided by the scrap dealers in addition to the material value. This project was initiated by GIZ in collaboration with Oeko-Institut, Mountain Research Institute (MRI), and GreenAd (as the implementer). The Greater Accra Scrap Dealers Association (GASDA) also played a role in establishing a pricing mechanism for the various cable grades. The objectives of this pilot were to:

Box 5.5 Objectives of the Pilot

- Develop and test implementation, pricing, transaction & documentation modalities
- Test and document market reactions to such incentive-based collection
- Collect and document lessons learned from this exercise to facilitate comparable e-waste management models in Ghana and beyond.

GreenAd employed the Akvoflow software-based program for purchasing and documentation. Collaborating with GASDA, Oeko, and City Waste Recycling, GreenAd established a pricing mechanism for various cable grades and assessed market responses to the incentive-based collection and purchases. After successful testing and trial implementation, the pilot incentive system became operational. Each transaction was meticulously photo-documented, and all relevant data (cable weight, grade, compensation paid, payment method, recipient's name) were recorded digitally using the Akvoflow Software.

This pilot primarily targeted electronic cables because of their significant relevance to pollution prevention (specifically, avoiding cable burning). Additionally, electronic cables are less complex in terms of material composition, allowing the team to learn lessons that could then be applied to the handling of more complex e-waste types, such as whole devices.

Furthermore, the cable granulator installed at City Waste Recycling (a project partner) had process waste copper and aluminum cables with a maximum core thickness of 2.5 mm. Consequently, the Pilot Incentive System focused on thin and medium cables with a core diameter less than 2.5 mm using a grading system to account for differences in metal contents.

A total of 27.5 tons (24,947.58kg) of waste cables comprising 1,389 individual transactions (including attached plugs and components) were purchased over a 10-month implementation period.

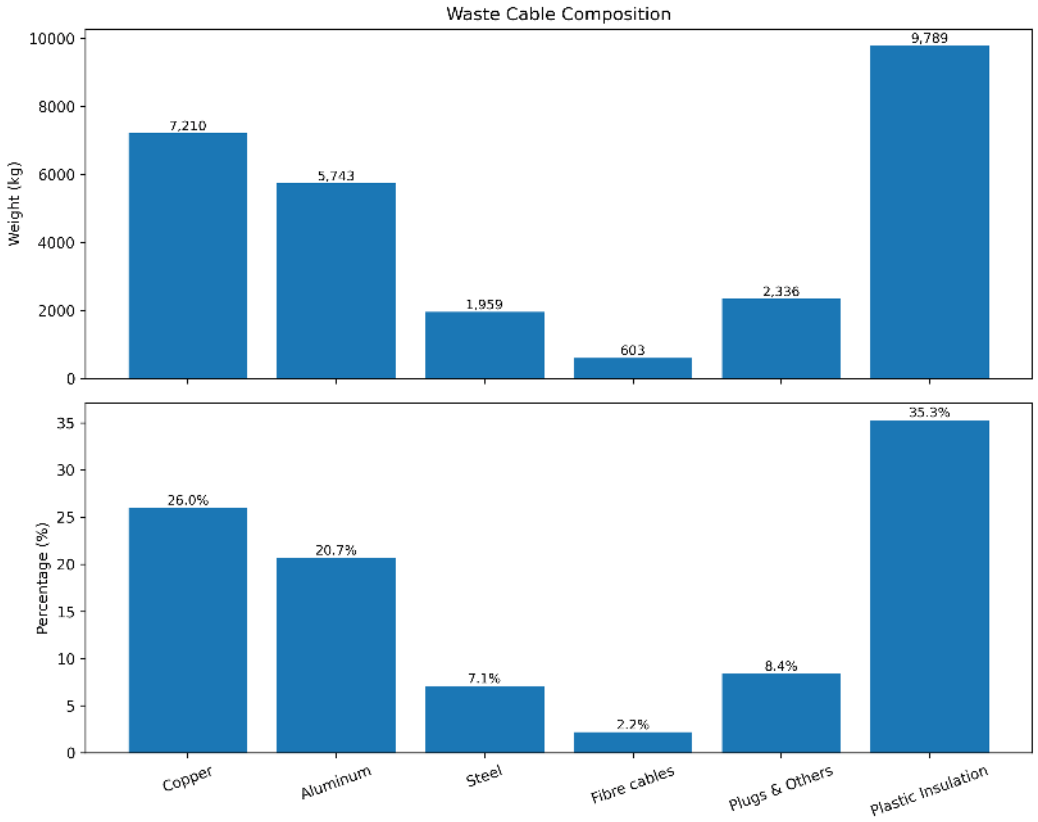


Figure 5. 12 Quantity (weight and percentage) of the Waste Cables

In this context, people in Agbogbloshie and neighbouring areas benefited from reduced pollution as the scrap workers were more inclined to supply their cables to the centre. Although some level of cable burning continued during the whole course of implementation, a significant reduction was evident, especially in the second half of the trial (Figure 5.12).

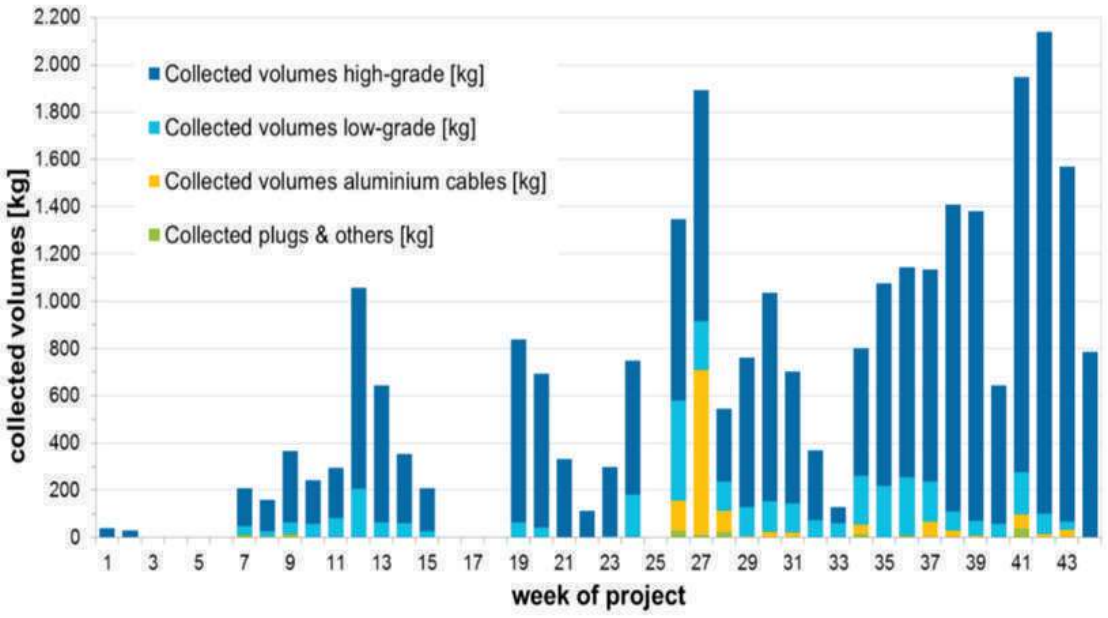


Figure 5. 13 A chart showing the volumes of cable types received over the project weeks

Despite this progress, one group, the Kilimanjaro Burners, continued to burn cables but lost market, as many scrap dealers started to channel cables to the handover centre instead. It was reported that some individuals of this group also deserted burning and became suppliers to the center. The reasons this group continued to burn cables despite a more economically attractive option were believed to be related to the following factors:

Box 5.6 Hindrances to the Project Progress

- The leaders of the Kilimanjaro Burners cultivate a strong sense of independence and were reluctant to enter into working agreements with a project that has a strong affiliation with GASDA. While representatives of the Kilimanjaro Burners regularly visited the handover centre to seek cooperation under special conditions (e.g., being provided with upfront payments to collect waste cables), these were not accepted by the project as they would have jeopardised transparency and accountability.

- Over the last years of intensive media coverage on the Old Fadama scrapyard, pictures of cable burning activities became iconic and many journalists visiting the area sought to get such pictures for their coverage and agreed to pay cash to orchestrate such photos. As visits of journalists to the scrap market are quite frequent, charges for pictures and films developed into a second income stream for many burners.
- A company selling personal protective equipment in Ghana repeatedly visited the Kilimanjaro Burners and built close ties with them. While the burners received various advantages that may have ranged from small payments to medical treatment. The company used pictures and stories of cable burning and its dangers to promote their sales of personal protective equipment. Thus, like the payments from journalists, there were benefits to the continuation of e-waste burning activities.

Nonetheless, the GIZ pilot incentive model became a credible alternative to waste recovery by burning, with the added advantage of not discriminating against small-scale cable collectors, and it contributed to a significant reduction of emissions. It also provided a template for future e-waste management systems in Ghana and informed the formulation of the MESTI-KfW Incentive E-waste Management Project (Chapter 6).

Chapter Six

Beyond the Decade

6.0 Beyond the Decade

6.1 MESTI/KFW Incentive Payment System for Selected E-waste Types

Following the GIZ Incentive Payment System Pilot, the Ministry of Environment, Science, Technology (MEST), in collaboration with the German Development Bank (KfW), established an expanded Incentive Payment System project at Agbogbloshie, which covers four e-waste types (box 6.1).

Box 6.1 E-waste Types Covered

- Batteries
- Cables
- Cathode Ray Tubes
- Thermoplastics

Figure 6. 1 Launch of additional waste streams by Minister (MEST)

The facility (established at the ARC site) has been operated by GreenAd (implementing partner) from 2020 to date. The objectives of this project as shown in Box 6.2 are to:

Box 6.2 Objectives of the Project

- Reduce the damage that the unsound recycling of e-waste has on environmental and human health
- Maintain the livelihoods of scrap workers from the sale of valuable E-waste fractions.

The e-waste types brought to the HOC by scrap dealers are purchased at agreed pre-determined market prices by weight. The purchased e-waste is temporarily stored at the facility (Figures 6.1 and 6.2) and is ultimately transported to the MESTI/KfW warehouse to be auctioned to registered formal recycling companies.

Figure 6. 2 E-waste Cables in Drums at the Facility

Figure 6. 3 Purchased E-waste in Facility Containers

All incoming volumes and incentive payments are documented using data management software which is synchronised to an online platform, giving real-time information to HOC operators and partners. This ensures credibility and trust between operators and scrap dealers and allows for easy tracking of e-waste inflows. The mode of payment is also instant, via MTN Mobile Money, guarantee that the incentive system is attractive to these sellers.

The incentive payment system was formulated based on the hypothesis that if informal recyclers have more economically attractive options to sell their collected e-waste, complemented by training and awareness efforts, they would sooner or later use this option in place of their sub-standard, polluting recycling processes. Thus, this project would incentivise them to move away from environmentally damaging methods of metal recovery.

From 2020 to 2022, about 457,898.20 pounds of cables, 69,072 pounds of batteries, 232,890.70 pounds of thermoplastics, and 67 CRTs were purchased (Table 6.1). This represents the amount of e-waste in these categories that would have been burnt for metal recovery and would have had adverse effects on the environment and human health.

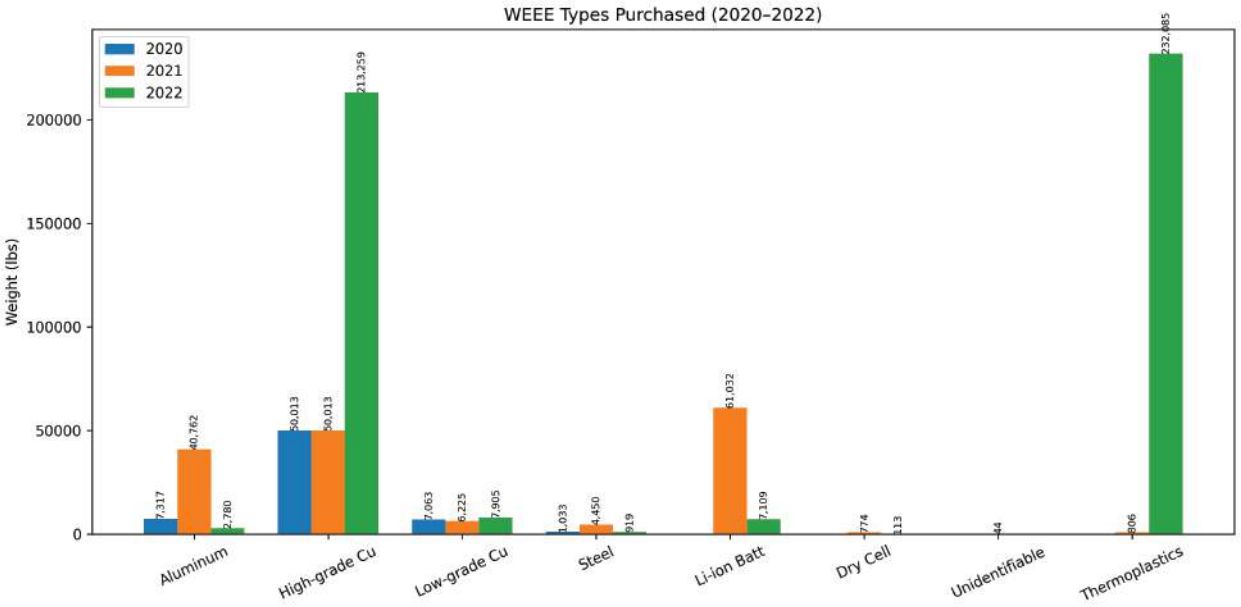
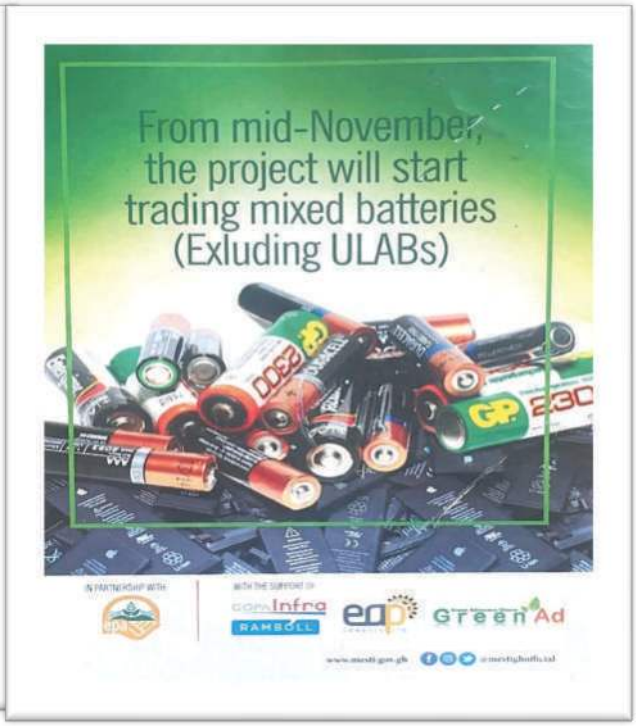


Figure 6. 4 Weights of WEEE Types Purchased in 2020,2021 and 2022

Table 6.1b Quantity of CRTs Purchased in 2020, 2021 and 2022

Type of WEEE	2020	2021	2022
CRTs**	-	-	67

* WEEE types not purchased in 2020
** WEEE types not purchased in 2020 and 2021



Chapter Seven

Significant Contributions by Researchers And Other Institutions

7.0 Significant Contributions by Researchers And Other Institutions

Notable professional contributions to advancing e-waste knowledge and management in Ghana were made during the period, supporting key areas such as advocacy, management, and academic research. This section recognises these professionals, their pioneering efforts, and guidance in academic research, which have helped build a scientific knowledge base for the e- waste ecosystem in Ghana. The relevant links to their work and publications are also provided for easy reference. The areas include:

- Management support for advancement of the sector; and
- Other Institutions
- Research and scientific publications.

7.1 Management Support for Advancement of the Sector

7.1.1 John Pwamang (Executive Director, EPA)

1. Coordination role in the E-waste Africa Project

Lead coordinating role in the implementation of the E-waste Africa Project (Secretariate of the Basel Convention). This involved developing Terms of Reference to hire consultants to conduct various studies. The outcome of these pioneering exercises included: the Socio- economic Assessment and Feasibility Study on Sustainable E-Waste Management in Ghana (2010); and Ghana E-Waste Country Assessment (March 2011).

2. Chairman of the Waste Shipment Prevention Committee

The Chairman of an inter-agency technical body under the Basel Convention called the Waste Shipment Prevention Committee, formed to address the transboundary shipment of hazardous substances. The frontline agencies included the EPA, the Ghana Ports and Harbours Authority, the Customs Division of the Ghana Revenue Authority, and GreenAd.

3. Ghana E-waste Project - National Strategy

The National Strategy, developed in partnership with the EPA and EMPA, was aimed at addressing uncontrolled dumping and hazardous practices by proposing a regulatory framework for e-waste importation, promoting responsible recycling practices, and creating a sustainable e-waste management industry. This is the brainchild of John Pwamang and Yaw Amoyaw-Osei and can be regarded largely as the precursor to national E-waste legislations and policy (2011).

4. Preparation of the Hazardous and Electronic Waste Legislations

Played a coordination role in preparing the Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917) and the Hazardous, Electronic and Other Wastes Classification Regulations, 2016 (LI 2250). This involved facilitating drafting of texts of the Bill with the Attorney General's Department; and presenting the draft Bill to the Parliamentary Select Committee on Environment, Science and Technology (2012 - 2016).

5. Energy Efficient Recycling of Electric and Electronic Scrap (the Nordic Fund)

Played a pivotal role in defining the scope of work for the grant, and the modalities for the study tour of the Agbogbloshie E-scrap workers to understudy Swedish metal recycling industries. The project involved addressing the environmental and social issues associated with e-scrap recycling in Ghana and focused on the resource potential of e-scrap through environmentally friendly recycling methods to reduce pollution, conserve resources, and improve the livelihoods of e-scrap workers.

6. Agbogbloshie E-waste Pilot Recycling Project

The Agbogbloshie E-waste Recycling Project Phase 1 was launched in October 2014 with the goal of eliminating cable burning and associated pollution in that part of Accra. The committee setup and inaugurated by the Deputy Minister of MESTI to manage and expand the deployment of similar recycling facilities in other urban centres was led by Mr Pwamang.

7. UNITAR/UNDP/EPA-Ghana Project on the Elimination of PCBs

Coordinating role in implementing the UNITAR/UNDP/EPA-Ghana Project on Capacity Building for the Elimination of PCBs in Ghana. The policy and legislation of this project contributed to the drafting of the Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917).

8. Eco-levy collection/scheme - new and used EEE importation

Facilitated the operationalization of the Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917) to collect the Eco-levy on new and used electrical and electronic equipment imported to Ghana. Also, coordinated the drafting of agreements with External Service Providers under Act 917.

9. Launch of National Integrated E-waste Management Programme

Coordinated the preparation and launch of the National Integrated E-waste Management Programme in August 2018, by the President Nana Addo Danquah Akuffo-Addo

Figure 7. 1 Launch of the National Integrated E-waste Management Programme

7.1.2 Larry Kotoe (Deputy Director, EPA)

In consolidating the gains of the past decade, the contributions of Mr. Larry Kotoe were instrumental in translating enacted laws and policy commitments from paper into practice, leading the design and implementation of a coordinated national e-waste management system that continues to shape the sector today.

Design and Collection of Advance Eco-levy

Ghana designed and implemented an EPR fee collection mechanism to ensure the efficient and transparent mobilisation of EPR fees on regulated electrical and electronic products at the point of importation. The system was anchored on the classification and deployment of 365 Harmonised System (HS) Codes covering electrical and electronic equipment subject to EPR obligations. The initiative strengthened regulatory oversight, reduced revenue leakage, enhanced transparency, and positioned EPR fee collection as a sustainable financing backbone for Ghana's national e-waste management system under the Extended Producer Responsibility framework.

Audit of the E-Waste Value Chain

As part of strengthening regulatory oversight in the evolving e-waste sector, compliance audits of e-waste facilities including collection centres, dismantling centres, treatment, recycling, and disposal facilities covering technical capacity, operational performance, and occupational health and safety has become imperative. Through this process, compliance audits serve as a critical instrument for ensuring environmentally sound management, guiding facility improvements, and supporting the transition from pilot interventions to a regulated e-waste management system.

Re-design of the National Integrated E-Waste Management Scheme/System

Ghana's National Integrated E-Waste Management Scheme provides a coherent, system-wide framework for the environmentally sound management of electrical and electronic waste, anchored in Act 917 (now Act 1124), LI 2250, and the EPA's Technical Guidelines. The Scheme integrates legal, institutional, financial, and operational elements across the entire e-waste value chain from collection and transport through dismantling, treatment, recycling, and final disposal under a clearly defined tiered system.

Technical Guidelines on Environmentally Sound E-Waste Management (2022)

In 2022, Ghana's e-waste regulatory framework was consolidated into a comprehensive and enforceable operational instrument (the technical guidelines) that gave practical effect to Act 917, LI 2250, and related legislation. The guideline was anchored on a clearly defined five-tier work-flows comprising collectors, collection or buy-back centres, transporters, treatment and recycling facilities, and final disposal facilities for hazardous fractions.

National E-Waste Management Policy

The National Electrical and Electronic Waste (E-Waste) Management Policy provides Ghana with a comprehensive strategic framework to guide the sustainable management of electrical and electronic waste across the entire product lifecycle. Its purpose is to address the environmental, public health, social, and economic risks associated with improper e-waste management by strengthening coordination among stakeholders, operationalising EPR, improving collection and recycling infrastructure, integrating the informal sector, and enhancing financing, data systems, and enforcement.

National E-Waste Inventory

In 2022, Ghana's e-waste regulatory framework was consolidated into a comprehensive and enforceable operational instrument (the technical guidelines) that gave practical effect to Act 917, LI 2250, and related legislation. The guideline was anchored on a clearly defined five-tier work-flows comprising collectors, collection or buy-back centres, transporters, treatment and recycling facilities, and final disposal facilities for hazardous fractions.

Establishment of Collection and Dismantling Facilities in Ghana

The establishment of e-waste collection and dismantling centres under the World Bank Funded Africa Environmental Health and Pollution Management Program (AEHPMP), is highly valuable to Ghana's e-waste management sector, as it provides the physical backbone for transitioning e-waste handling from unsafe informal practices to an organised, regulated, and circular system.

7.2 Other Institutions

7.2.1 Oeko-Institut e.V.

The Oeko-Institut is one of Europe's leading independent research and consultancy organisations working for a sustainable future. In Ghana and elsewhere, the Oeko-Institut works across disciplines with partners from industry, academia and civil society, participating in joint projects and networks, including in the e-waste sector (see below).

Projects

1. Improving lead-acid battery recycling in Sub-Sahara Africa

Lead-acid batteries are used in cars, off-grid solar energy applications or backup power systems. Under the right conditions, used lead-acid batteries (ULABs) can be effectively recycled, and the high market price of lead can make this a profitable business. However, in many world regions, recycling operations are often far from international best practices. Lead-consuming industries are increasingly aware of potential health and safety risks in their supply chains and have introduced policies to mitigate them. While this often leads to the suspension of business relationships with suppliers in low- and middle-income countries, the root causes of the problem remain widely unresolved. Similarly, many battery-using industries in low- and middle-income countries (e.g., solar industry, mobile network providers) develop policies on sound business conduct and aim at finding responsible solutions for end-of-life batteries. While these efforts are going in the right direction, they are widely uncoordinated and do not unfold their full market demand for responsible recycling solutions.

A combination of push-factors (national regulation and enforcement) and pull-factors (demand for responsible recycling solutions) is needed for systemic improvements. At the moment, Oeko-Institut has completed a project to scope an initiative that will soon be implemented in Ghana and other selected African countries. It will combine these push- and pull-factors and will aim to secure buy-in and support from government, civil society and industry stakeholders.

To keep up with subsequent developments, find Oeko-Institut through the website: https://www.oeko.de/en/

7.2.2 Mountain Research Institute

Mountain Research Institute (MRI) is a Ghanaian research and consulting firm that specializes in sustainable environmental and circular economy solutions within the domain of sustainable resource cycles to promote sound economic development.

Projects

1. National E-waste Inventory (NEI)

MRI is currently undertaking the compilation of the National E-waste Inventory for Ghana, which is a World Bank-EPA project. The overall objective of this assignment is to undertake a nationwide situation analysis of e-waste to understand the physical flow of e-waste by provenance and type, and to assess the economic and social weight of the sector.

2. Formalising Scrap Associations

Mountain Research Institute recently supported scrap dealers in the Eastern Region of Ghana, to formalize their alliance as the Eastern Regional Scrap Dealers Association (ERSDA). As part of this, they supported the association to organise an election for an interim executive whose mandate was to put in place a draft constitution and kickstart the process of formalizing the association.

To keep up with subsequent developments, find MRI through the website: https://www.mountainresearchinstitute.com/

7.3 Research and Scientific Publications

7.3.1 Research and publications by Dr. Kwadwo Ansong Asante

Dr. Kwadwo Ansong Asante is a Principal Research Scientist at the CSIR Water Research Institute (CSIR-WRI) in Ghana and the Head of the Environmental Chemistry and Sanitation Engineering Division of the Institute. He has co-authored numerous articles and books on emerging contaminants and heavy metals from the open burning of e-waste in Ghana, etc. including the ones listed below.

Title 1: Severe dioxin-like compound (DLC) contamination in e-waste recycling areas (EWRAs): An under-recognized threat to local health. **Publication:** Environment International (2020), 139, 105731 **Highlight**: Review of the environmental levels and body burdens of DLCs at EWRAs and compared with the levels reported to be associated with observable adverse effects to assess the health risks of DLC exposure at EWRS. The estimated total daily intakes of DLCs for people in EWRAs far exceeded the WHO recommended total daily intake limit. ***Authors:*** *Qingyuan Dai, Xijin Xu, Brenda Eskenazi,* ***Kwadwo Ansong Asante****, Aimin Chen, Julius N. Fobil, Ake Bergman, Lesley Brennan, Peter D. Sly, Innocent Chidi Nnorom, Antonio Pascale, Qihua Wang, Eddy Y. Zeng, Zhijun Zeng, Philip J. Landrigan, Marie-Noel Bruné Drisse and Xia Huo* ***(2020)****.*		**Title 2: E-waste recycling in Africa: risks and opportunities**. **Publication:** Current Opinion in Green and Sustainable Chemistry (2019), 18, 109-117 pp **Highlight:** E-waste is generated in enormous amounts worldwide and has become a global environmental issue due to inappropriate handling, especially in developing countries. Owing to inadequate infrastructure for management and non-enforcement of laws, multitudes of hazardous substances are released due to the crude way of recycling posing risks for humans and the environment, despite opportunities such as recovery of precious metal, employment, etc. ***Authors: Asante,K.A****., Amoyaw-Osei, Y. and Agusa, T. (2019).*
Title 3: Prevention-intervention strategies to reduce exposure to e-waste Publication: Review of Environmental Health (2018), 33(2), 219-228 pp **Highlight:** As one of the largest waste streams, it continues to grow in response to global demand for consumer electronics. The informal e-waste dismantling activities expose workers to hazardous substances such as cadmium, lead, and brominated flame retardants. Future intervention strategies that recognize the difficult economic realities of informal e-waste recycling are reviewed.		**Title 4: Complex mixtures of brominated/ chlorinated diphenyl ethers and dibenzofurans in soils from the Agbogbloshie e-waste site: Occurrence, formation and exposure implications** **Publication:** Environmental Science and Technology (2019), 53, 3010-3017 pp **Highlight:** The paper investigated the distribution and toxic equivalents (TEQs) of brominated and chlorinated dibenzo-p-dioxins/dibenzofurans (PBDD/Fs and PCDD/Fs) in soils at Agbogbloshie. The composition of

Authors: *Heacock, M., Trottier, B., Adhikary, S.,* ***Asante, K. A****., Basu, N., Brune, M-N., Caravanos, J., Carpenter, D., Cazabon, D., Chakraborty, P., Chen, A., Barriga, F.D., Ericson, B., Fobil, J., Haryanto, B., Huo, X., Joshi, T.K., Landrigan, P., Lopez, A., Magalini, F., Navasumrit, P., Pascale, A., Sambandam, S., Aslia Kamil, U.S., Sly, L., Sly, P., Suk, A., Suraweera, I., Tamin, R., Vicario, E., Suk, W.* ***(2018).***		brominated/chlorinated dibenzo-furans (PXDFs) and diphenyl ethers (PBDEs, PCDEs, and PXDEs) was examined to elucidate possible formation pathways of dioxins from e-waste recycling. The high TEQs of PBDFs (120–5200 pg/g dry weight) indicate the need to consider brominated dioxins besides chlorinated dioxins in future studies on health implications for e-waste workers, etc. ***Authors:*** *Tue, N. M., Matsushita, T., Goto, A., Itai, T.,* ***Asante, K. A****., Obiri, S., Mohammed, S., Tanabe, S. and Kunisue, T.* ***(2019).***
Title 5: Occurrence, profiles, and toxic equivalents of chlorinated and brominated polycyclic aromatic hydrocarbons in e-waste open burning soils. **Publication:** Environmental Pollution (2017), 225, 252-260 pp **Highlight:** The study assessed the occurrence, profiles, and toxicity of chlorinated polycyclic aromatic hydrocarbons (Cl-PAHs) and brominated polycyclic aromatic hydrocarbons (Br- PAHs) in e-waste open burning soils (EOBS). Concentrations of 15 PAHs, 26 Cl-PAHs and 14 Br-PAHs were analysed in EOBS samples and found that e-waste open burning is an important emission source of Cl-PAHs and Br-PAHs as well as PAHs. ***Authors:*** *Nishimura, C., Horii, Y., Tanaka, S.,* ***Asante, K. A****., Ballesteros Jr., F., Viet, P. H., Itai, T., Takigami, H., Tanabe, S. and Fujimori, T.* ***(2017).***		**Title 6: Association between human exposure to heavy metals/metalloid and occurrences of respiratory diseases, lipid peroxidation and DNA damage in Kumasi, Ghana** **Publication:** Environmental Pollution (2018), 235, 163-170 pp **Highlight:** Highlight: Heavy metals and metalloids contamination in soils, water, food and livers of wild rats have been studied in Kumasi, Ghana and despite the estimated risks to residents, there is no epidemiological study to ascertain these projections. In addition, WHO and International Agency for Research on Cancer have reported an increase in respiratory diseases and cancers, in Ghana. The study therefore explored and found significant association between urinary metals and MDA and 8-HdG indicating possibility of lipid peroxidation and/or DNA damage in Kumasi residents. ***Authors:*** *Bortey-Sam, N., Ikenaka, Y., Akoto, O., Nakayama, S. M. M.,* **Asante, K. A****., Baidoo, E., Obirikorang, C., Mizukawa, H. and Ishizuka, M. (2018).*
Title 8: E-waste interventions in Ghana **Publication:** Reviews on Environmental Health (2016), 31 (1), 145-148 pp **Highlight:** In recent times Ghana and Nigeria have become a major destination for e-waste. In Ghana, the e-waste recyclers use mechanical shredding and open burning to remove plastic insulation from copper cables. Currently, equipment to strip both large and small cables are available via the Blacksmith Institute (USA) and it is expected that e-waste workers will embrace the use of these machines, and prevent the burning practices, and hopefully replicate this in other e-waste centres in the country. ***Authors:*** ***Asante, K. A****., Pwamang, J. A., Amoyaw-Osei, Y. and Ampofo, J. A.* *(2016).*		**Title 7: Soil contamination by halogenated polycyclic aromatic hydrocarbons from open burning of e-waste in Agbogbloshie (Accra, Ghana)** **Publication:** Journal of Material Cycles and Waste Management (2017), 19, 1324-1332 pp **Highlight:** The study investigated the occurrence of Cl-PAHs and Br-PAHs in surface soil samples from the Agbogbloshie e-waste recycling site (Accra, Ghana) using quantitative gas chromatography–mass spectrometry (GC–MS) and comprehensive two-dimensional GC–time-of-flight mass spectrometry (GC 9 GC–ToFMS) profiling. ***Authors:*** *Tue, N. M., Goto, A., Takahashi, S., Itai, T.,* ***Asante, K. A****., Nomiyama, K., Tanabe, S. and Kunisue, T.* ***(2017).***

Title 9: Release of chlorinated, brominated and mixed halogenated dioxin-related compounds to soils from open burning of e-waste in Agbogbloshie (Accra, Ghana)

Publication: Journal of Hazardous Materials (2016), 302, 151-157 pp

Highlight: The study examined the concentrations of dioxin-related compounds (DRCs) including chlorinated, brominated, mixed halogenated dibenzo-p-dioxins/dibenzofurans (PCDD/Fs, PBDD/Fs, PXDD/Fs) and dioxin-like polychlorinated biphenyls (DL-PCBs) in surface soil samples from the Agbogbloshie e-waste recycling site. The finding is that people living in Agbogbloshie are exposed to potential high levels of not only chlorinated but also brominated DRCs, requiring assessment of human health implications in future studies.

Authors: *Tue, N. M., Goto, A., Takahashi, S. Itai, T., **Asante, K. A**., Kunisue, T. and Tanabe, S. (2016)*

Title 10: Interplay of metals and bromine with dioxin-related compounds concentrated in e-waste open burning soil from Agbogbloshie in Accra, Ghana

Publication: Environmental Pollution (2016), 209, 155-163 pp

Highlight: Open burning of e-waste releases various metals and organohalogen compounds. The study investigated the interplay of metals (Cu, Pb, Zn, Fe, Co, and Sr) and bromine (Br) in the formation of dioxin-related compounds (DRCs), including polychlorinated dibenzo-p-dioxins/ furans (PCDD/Fs) and dioxin-like polychlorinated biphenyls (DL-PCBs), as well as non-regulated DRCs such as polybrominated dibenzo-p-dioxins/furans (PBDD/Fs) and their monobrominated PCDD/Fs in soils sampled from open burning e-waste sites at Agbogbloshie in Accra, Ghana.

Authors: *Fujimori, T., Itai, T., Tue, N. M., Goto, A., **Asante, K. A**., Otsuka, M., Takahashi, S. and Tanabe, S. (2016).*

Title 11: E-waste and harm to vulnerable populations: A growing global problem
Publication: Environmental Health Perspectives (2016), 124 (5), 550-555 pp

Highlight: E-waste production was estimated globally to be 41.8 million tonnes in 2014. Informal recycling is a source of much-needed income in many low- to middle-income countries, though the rudimentary handling leads to release of substantial harmful chemical, exposing vulnerable populations, including women and children. The paper provided an overview of the scale of health risks, especially to pregnant women and children.

Authors: *Heacock, M., Kelly, C. B., Asante, K. A., Birnbaum, L. S., Bergman, A. L., Brune, M-N., Buka, I., Carpenter, D. O., Chen, A., Huo, X., Kamel, M., Landrigan, P. J., Magalini, F., Diaz-Barriga, F., Neira, M., Omar, M., Pascale, A., Ruchirawat, M., Sly, L., Sly, P. D., van den Berg, M. and Suk, W. A. (2016)*

Title 12: Environmental Pollution: An under-recognized threat to children's health, especially in low- and middle-income countries (LMICs)

Publication: Publication: Environmental Health Perspectives (2016), 124, (3), A41-A45 pp.

Highlight: Exposures to environmental pollutants during windows of developmental vulnerability in early life can cause disease and death in infancy and childhood as well as chronic, non-communicable diseases that may manifest at any point across the life span. According to WHO, pollution is responsible for 8.9 million deaths in the world each year; of these, 94% (8.4 million) are in LMICs. Need to define and track the health effects of pollution, quantify the economic costs to environmental pollution as a risk factor for disease.

Authors: *Suk, W. A., Ahanchian, H., **Asante, K. A.**, Carpenter, D. O., Diaz- Barriga, F., Ha, E-H., Huo, X., King, M., Ruchirawat, M., da Silva, E. R., Sly, L., Sly, P. D., Stein, R. T., van den Berg, M., Zar, H. and Landrigan, P. J. (2016).*

Title 13: Variation and distribution of metals and metalloids in soil/ash mixtures from Agbogbloshie e-waste recycling site in Accra, Ghana.

Publication: Science of the Total Environment (2014), 470-471, 707-716 pp

Highlight: Illegal import and improper recycling of e-waste are an environmental issue in developing countries. Levels of metal(loid)s in the mixtures of residual ash, formed by the burning of e-waste, and the cover soil, obtained using a portable X-ray fluorescence spectrometer (P-XRF) coupled with determination of the 1M HCl-extractable fraction by an inductively coupled plasma mass spectrometer have been studied. This showed that along with common metals, rare metal(loid)s are also enriched in the e-waste burning site.

Authors: *Itai, T., Otsuka, M., **Asante, K. A.**, Muto, M., Opoku-Ankomah, Y., Ansa-Asare, O. D. and Tanabe, S. (2014)*

Title 14: Multi-trace element levels and arsenic speciation in urine of e-waste recycling workers from Agbogbloshie, Accra in Ghana

Publication: Science of the Total Environment (2012), 424, 63-73 pp.

Highlight: To understand human contamination by multi-trace elements (TEs) in e-waste recycling site at Agbogbloshie, Accra in Ghana, this study analysed TEs and arsenic (As) speciation in urine of e-waste recycling workers. Concentrations of Fe, Sb, and Pb in urine of e-waste recycling workers were significantly higher than those of reference sites after consideration of interaction by age, indicating that the recycling workers are exposed to these TEs through the recycling activity.

Authors: *Contributing Authors: **Asante, K. A**., Agusa, T., Biney, C. A., Agyekum, W. A., Bello, M., Otsuka, M., Itai, T., Takahashi, S. and Tanabe, S. (2012).*

7.3.2 Research and Journal Publications – Professor Martin Oteng Ababio

Prof. Martin Oteng-Ababio is a distinguished academic and leading expert in environmental governance, urban sustainability, and the waste economy and management, with a particular focus on e-waste in Ghana. He is a Professor of Urban Geography in the Department of Geography and Resource Development at the University of Ghana. With extensive fieldwork and publications on informal waste economies, climate resilience, and environmental policy, he has played a crucial role in shaping Ghana's approach to e-waste management. He has collaborated with government agencies, international organizations, and research institutions, including the EPA, GIZ, the European Union, and the World Bank, to develop frameworks for safer, more efficient e-waste recycling systems. He has also served in advisory roles for national and regional environmental strategies, ensuring that grassroots waste collectors and informal sector workers are integrated into sustainable solutions. His work connects academic research with practical policy implementation.

Title 1: The local contours of scavenging for e-waste and higher-valued constituent parts in Accra, Ghana.

Publication: Habitat International, 43, pp.163–171. DOI: 10.1016/j.habitatint.2014.03.003

Highlight: Focused on informal sector scavenging of e-waste in Accra, and scavengers' extraction of higher-value components from these discarded devices for resale or reuse, the research addressed the socio-economic dynamics and showcased the livelihoods of individuals despite the hazardous working conditions. Existing policies often overlook the input of scavengers, sidelining them in waste management, and therefore require inclusive regulation to formalise and promote safety in e-waste recycling

Authors: ***Oteng-Ababio, M.****, Amankwaa, E.F. and Chama, M.A. (2014).*

Title 2: E-Waste Circuitry and Value Creation in Accra. Advances in African economic, social and political development.

Publication: Value Chains in Sub-Saharan Africa; Challenges of Integration into the Global Economy, © 2019 pp.115–131. Springer. DOI: 10.1007/978-3-030-06206-4_8

Highlight: The study explored e-waste processing by analysing formal and informal sector operations, and examining initiatives aimed at regulating and managing the sector. A critique of the policies is made for sidelining the informal workers despite their crucial role, and therefore inclusive and context-appropriate policies required for safer, healthier, and more environmentally sustainable working environment.

Authors: ***Oteng-Ababio, M.****, and Grant Richard. (2019).*

Title 3: Solid waste management in African cities: Sorting the facts from the fads in Accra, Ghana.

Publication: Habitat International, Volume 39, pp.96–104. DOI: 10.1016/j.habitatint.2012.10.010.

Highlight: The study highlights the persistent challenges of MSWM in African cities, with a focus on Accra. It demonstrates how investments in technologies may fail if not based on accurate waste composition data, emphasising on the role of informal waste pickers, and the need for their integration into formal waste management systems.

Authors: ***Oteng-Ababio, M.****, Melara Arguello, and Offira Gabbay. (2013)*

Title 4: Formalising E-waste in Ghana: An emerging landscape of fragmentation and enduring barriers.

Publication: Development Southern Africa, 38:1, 73-86, DOI: 10.1080/0376835X.2020.1823822

Highlight: This study reviews Ghana's efforts since 2016 to formalise its e-waste sector, guided by international expertise and partial funding from the Global North. Using serial interviews, the research assesses the changing e-waste landscape, highlighting key challenges such as limited funding, low awareness among policymakers, and inadequate training for informal workers. The sector now operates in a 'grey space" with

		informal practices. Fragmentation of the main e-waste hub is also happening, with informal operations spreading to peripheral areas. ***Authors**: **Oteng-Ababio, M.** and Richard Grant (2021)*
Title 5: Building Policy Coherence for Sound E-Waste Management in a Developing Country. **Publication:** The Journal of Environment & Development. Vol 29, Issue 3, pp. 306 – 328. DOI: 10.1177/1070496519898218 **Highlight:** This examined the importance of Ghana's e-waste policy within the socioeconomic setting. It challenged the promotion of strict trade bans or a single recycling approach and the assumption that extended producer responsibility alone can guarantee effective e-waste management, ignoring the complex, multidimensional character of Ghana's e-waste sector. ***Authors: Oteng-Ababio, M.**, Van der Velden, M, & Taylor, M. B. (2020)*		**Title 6:** E-waste recycling slum in the heart of Accra, Ghana: the dirty secrets. **Publication**: *Handbook of Electronic Waste Management, International Best Practices and Case Studies*; 355-376. DOI: 10.1016/B978-0-12-817030-4.00019-X **Highlight:** The study examined the ongoing conflicts over urban space in Agbogbloshie, a densely populated area in Accra that includes informal settlements, markets, industrial sites, and waste facilities. Drawing on Henri Lefebvre's concepts of the "right to the city" and "lived space," the study criticised the shift from inclusive urban development to a more exclusionary, entrepreneurial approach to urbanisation. ***Authors**: **Oteng-Ababio, M.** and Grant, Richard (2020).*
Title 7: Sustainable Product Lifecycles: A Systemic Approach to the Regulation of E-Waste. **Publication:** Product lifetimes and the environment: 3rd PLATE Conference, September 18–20, 2019, Berlin, Germany, Universitätsverlag der TU Berlin. https://www.smart.uio.no/publications/regulating_e-waste_plate2019.pdf. **Highlight:** This study investigated ongoing regulatory failures in e-waste management, recommending a polycentric regulatory approach that shifts emphasis from government control to understanding how multiple actors—laws, social norms, market forces, and infrastructure—interact to influence behaviour. The finding was that unless the root causes linking hazardous waste practices to the marginalisation of informal workers are addressed, legislation alone will not effectively achieve significant environmental and social change outcomes. ***Authors: Oteng-Ababio, M.**, Van der Velden, and M Taylor, M. B. (2019)*		**Title 8:** Trace metal levels of the Odaw River sediments at the Agbogbloshie e-waste recycling site. **Publication:** *Journal of Science and Technology*, Vol. 34, No. (1), pages 1-8. Nov 19, 2014. DOI:10.4314/just.v34i1.1 **Highlight:** An investigation of the impact of informal e-waste recycling in Accra's Agbogbloshie area on the Odaw River. The site suffered from open burning and dumping of e-waste as a common practice. Analysis of sediment samples collected from sites near and distant from these activities showed elevated levels of metals like copper, cadmium, and lead, indicating pollution related to e-waste. Although contamination levels were below harmful thresholds, the study highlighted the increasing environmental risks and advocates for stricter regulation to safeguard water quality and public health. ***Authors: Oteng-Ababio, M.**, Chama, M. A., and Amankwaa, E. F (2014)*

Authors: Oteng-Ababio, M., *Van der Velden, and M Taylor, M. B. (2019)*	harmful thresholds, the study highlighted the increasing environmental risks and advocates for stricter regulation to safeguard water quality and public health. ***Authors: Oteng-Ababio, M.**, Chama, M. A., and Amankwaa, E. F (2014)*
Title 9: Making Space: Unravelling the Urban Poor's Engagement with E-aste in Accra, Ghana. ***Authors**: **Oteng-Ababio, M.** (2013).* **Publication:** *Ghana Journal of Sociology* Vol. 5, No. (1), pages 40-61. (ISSN 0855-6261). **Summary:** This study investigated how marginalised urban youth sustain their livelihoods through e-waste recycling at Agbogbloshie, based on 80 structured questionnaires and 20 key interviews. It highlights a paradox: while e-waste provides income and demonstrates local innovation, it also presents serious health and environmental hazards. The need to address these conflicting realities by integrating informal sector experience with formal technology.	**Title 10:** Qualitative analysis of the presence of PBDE in ashes, soils and vegetables from Agbogbloshie e-waste recycling site. ***Authors: Oteng-Ababio, M.**, Chama, M.A. and Amankwaa, E.F. (2014)* **Publication:** *Journal of Environmental Research and Management*, Vol. 5, No. (4), pages 71- 80. ISSN 2141-7466 © E3 Journals 2014 **Summary:** This study examined the presence of PBDEs in ashes, soil, and vegetables at the Agbogbloshie e-waste recycling areas. Because vegetables are vulnerable to contamination by persistent organic pollutants, the study employed gas chromatography–mass spectrometry to provide concrete evidence of pollution. The analysis found five different PBDE compounds in all samples, raising significant concerns about the safety of food grown in the area and the wider implications for human health.
Title 11: The Legal and the Reasonable: Exploring the Dynamics of E-waste Disposal Strategies in Ghanaian Households. ***Authors**: **Oteng-Ababio, M.** (2010)* **Publication:** David Publishing Company, pp. 38-52/ Journal of US-China Public Administration: 9(1): 38-52 **Summary:** This study examined household-level e-waste disposal practices in Accra against the backdrop of increasing consumer demand for electronic devices and the lack of formal disposal policies or regulations. The findings revealed that most households tend to store used electronics because of their perceived residual value, while selling to e-waste peddlers is the least common yet rapidly growing disposal option.	**Title 12:** Mapping the Invisible and Real African Economy: Urban E-Waste Circuitry. ***Authors: Oteng-Ababio, M.** and Grant, R. (2013)* **Publication:** *Urban Geography*, Vol. 33, No. (1), pages 1-21. Published online: 16 May 2013 **Summary:** This study investigated the economic significance of e-waste in Ghana, focusing on Agbogbloshie. The findings demonstrated Agbogbloshie as a crucial node in global e-waste networks and functions as an essential part of Accra's broader urban economy, blurring the boundaries between formal and informal sectors systems.
Title 13: Perceptions of Health and Environmental Impacts of E-waste Management in Ghana. ***Authors: Oteng-Ababio, M.** and Agyei-Mensah, S. (2012)* **Publication**: *International Journal of Environmental Health Research* Vol. 22, No. (6), pages 500-517. DOI: 10.1080/09603123.2012.667795 **Summary**: This study investigated how workers and nearby residents perceive health and environmental risks at e-waste sites in Ghana. Findings reveal a gap between expert assessments and local perceptions, with many workers underestimating risks due to economic pressures or lack of awareness.	**Title 14:** E-waste: An emerging challenge to solid waste management in Ghana ***Authors**: **Oteng-Ababio, M.** (2010)* **Publication**: International Development Planning Review. Vol 32, No (2). pp 191-206. Liverpool University Press, 1st February 2010. DOI:10.3828/idpr.2010.02. **Summary:** The study examined Ghana's lack of infrastructure and legal frameworks for managing e-waste amid rising use of electronics like computers and TVs. It analysed current e-waste practices, revealing serious environmental and health risks, and challenged the claim that exporting used electronics to developing countries helped bridge the digital divide, rather than exacerbating waste problems.

7.3.3 Research and Journal Publications – Professor Julius Fobil

Julius Fobil is a Professor of Environmental Health with over a hundred peer-reviewed publications in that field. He is the Provost of the University of Ghana's College of Health Sciences and previously served as Dean of its School of Public Health. One of his research interests is environmental exposure assessment, including the informal sector economy, such as the e-waste sector in Ghana. Some relevant publications are listed below.

Title 1: Prevention-intervention strategies to reduce exposure to e-waste **Publication**: Review of Environmental Health (2018), 33(2), 219-228 pp **Highlight:** As one of the largest waste streams, e-waste, continues to grow in response to global demand for consumer electronics. The informal e-waste dismantling activities expose workers to hazardous substances such as cadmium, lead, and brominated flame retardants. Future intervention strategies that recognize the difficult economic realities of informal e-waste recycling are reviewed. ***Authors:*** *Heacock, M., Trottier, B., Adhikary, S., Asante, K. A., Basu, N., Brune, M-N., Caravanos, J., Carpenter, D., Cazabon, D., Chakraborty, P., Chen, A., Barriga, F.D., Ericson, B.,* ***Fobil, J.****, Haryanto, B., Huo, X., Joshi, T.K., Landrigan, P., Lopez, A., Magalini, F., Navasumrit, P., Pascale, A., Sambandam, S., Aslia Kamil, U.S., Sly, L., Sly, P., Suk, A., Suraweera, I., Tamin, R., Vicario, E., Suk, W.* ***(2018)****.*	**Title 2: Air quality impacts at an e-waste site in Ghana using flexible, moderate-cost and quality-assured measurements** **Publication** GeoHealth (2020), DOI: 10.1029/2020GH000247 **Highlight:** The study describes spatial and temporal information on concentrations of particulate matter (PM) used to assess community and occupational exposures. PM levels were evaluated at the Agbogbloshie e-waste and scrap yard, and at upwind and downwind locations, obtaining both optical and gravimetric measurements, local meteorological data and satellite aerosol optical depth ***Authors:*** *Afua Asabea Amoabeng Nti, John Arko-Mensah, Paul K. Botwe, Duah Dwomoh, Lawrencia Kwarteng, Sylvia Akpene Takyi, Augustine Appah Acquah, Prudence Tettey, Niladri Basu, Stuart Batterman, Thomas G. Robins, and* ***Julius N. Fobil (2020)****.*
Title 3: Pilot study on the internal exposure to heavy metals of informal-level electronic waste workers in Agbogbloshie, Accra, Ghana. **Publication:** Environmental Science and Pollution Research, 24(3), pp.3097–3107. doi: https://doi.org/10.1007/s11356-016-8002-5. ***Authors:*** *Wittsiepe, J., Feldt, T., Till, H., Burchard, G., Wilhelm, M. and* ***Julius N. Fobil (2016***	**Title 4: Working conditions and environmental exposures among electronic waste workers in Ghana.** **Publication:** International Journal of Occupational and Environmental Health (2013). ***Authors:*** *Matthew Akormedi, Emmanuel Asampong,* ***Julius N. Fobil (2013)****.*
Title 5: High levels of PAH-metabolites in urine of e-waste recycling workers from Agbogbloshie, Ghana **Publication**: Science of the Total Environment (2014) ***Authors:*** Torsten Feldt, Julius N. Fobil, Jürgen Wittsiepe, Michael Wilhelm, Holger Till, Alexander Zoufaly, Gerd Burchard, Thomas Göen (2014)	**Title 6: Arsenic burden in e-waste recycling workers: A cross-sectional study at the Agbogbloshie e-waste recycling site, Ghana** **Publication**: Chemosphere (2020), 261, 127712 ***Authors:*** Jennie Yang, Jens Bertram, Thomas Schettgen, Peter Heitland, Damian Fischer, Fatima Seidu, Michael Felten, Thomas Kraus, Julius N. Fobil, Andrea Kaifie (2020)

Title 7: Spatiality in Health: The Distribution of Health Conditions Associated with Electronic Waste Processing Activities at Agbogbloshie, Accra **Publication**: Annals of Global Health (2020) ***Authors:*** Abenaa Adusei, John Arko-Mensah, Mawuli Dzodzomenyo, Judith Stephens, Afua Amoabeng, Saskia Waldschmidt, Katja Löhndorf, Kwame Agbeko, Sylvia Takyi, Lawrencia Kwarteng, Augustine Acquah, Paul Botwe, Prudence Tettey, Andrea Kaifie, Michael Felten, Thomas Kraus, Thomas Küpper, and Julius Fobil (2020)		**Title 8: Effect of Particulate Matter Exposure on Respiratory Health of e-Waste Workers at Agbogbloshie, Accra, Ghana.** **Publication: International Journal of Environmental Research and Public Health (2020).** ***Authors:*** *Afua Asabea Amoabeng Nti, John Arko-Mensah, Paul K. Botwe, Duah Dwomoh, Lawrencia Kwarteng, Sylvia Akpene Takyi, Augustine Appah Acquah, Prudence Tettey, Niladri Basu, Stuart Batterman, Thomas G. Robins, and* ***Julius N. Fobil (2020)****.*

Chapter Eight

THE WAY FORWARD: MEST, EPA and National E-Waste Management Fund

THE WAY FORWARD: MEST, EPA and National E-Waste Management Fund

8.1 Preamble: Standing on the Shoulders of a Decade

A decade ago, Ghana faced the e-waste challenge largely alone, armed with little more than the courage of a few committed civil society advocates, the goodwill of a handful of international partners, and the urgent reality of Agbogbloshie burning on the city's horizon. What followed was a remarkable decade of pioneering work: the publication of Ghana's first national e-waste management proposal in 2009 by Green Advocacy Ghana; groundbreaking health and environmental research; the enactment of the Hazardous and Electronic Waste Control and Management Act (Act 917, 2016); and the catalytic incentive-based collection systems supported by GIZ and KfW.

These achievements belong to all of us, including the researchers, the informal workers, the scrap dealers of GASDA, the regulatory agencies, the development partners, and the communities who lived with and breathed the consequences of unmanaged e-waste. As the key institutions, we inherit this legacy with humility and resolve. The first decade laid the foundation. The next chapter must build the house.

This document outlines MEST, EPA and the Fund's practical vision for how Ghana will accelerate, deepen, and sustain progress in e-waste management in the years ahead. It draws directly on the lessons of the past decade and positions these institutions as the engine of Ghana's next phase of environmental action.

8.2 The Mandate Ahead: From Pilot to National System

The first decade of Ghana's e-waste journey was necessarily experimental. Resources were scarce, knowledge was limited, and the sector was largely invisible to the public. Interventions were therefore targeted, piloted, and incremental, a recycling centre here, an incentive scheme there. These pilots were invaluable precisely because they generated the evidence base, we now hold. We know what works. We know what the informal sector is capable of when properly supported. We know the scale of the health threat. And we know that piecemeal approaches, however well-intentioned, are insufficient for a country generating increasingly significant volumes of e-waste annually.

The core institutions, now enters the scene at precisely the right moment, when advocacy work is complete, the legal framework is in place, and what Ghana needs is institutional capacity, financial sustainability, and coordinated execution at scale. The mandate of these institutions are to among others mobilize, manage, and deploy resources that transform e-waste management from a patchwork of interventions into a functioning national system.

8.3 Public-Private Synergy: The Engine of Scale

No government, however well-resourced, can manage the e-waste challenge alone. Equally, the private sector cannot operate responsibly in the absence of the regulatory architecture that government provides. The Fund's fundamental operating philosophy is one of structured, accountable partnership, where public institutions provide the policy environment and enforcement backbone, and the private sector provides the innovation, logistics, and market mechanisms that drive efficiency and scale.

8.3.1 Extended Producer Responsibility (EPR) as a Financial Backbone

The EPA, the Fund and MEST to implement a robust EPR framework. Importers and manufacturers of electrical and electronic equipment will contribute to the Fund through the payment of advanced eco-levy. This is not punitive; it is an acknowledgement that those who profit from electronics must share responsibility for their end-of-life consequences. The EPR levy system will be graduated, transparent, and backed by enforceable regulation, ensuring predictable revenue inflows that can fund collection, sorting, and recycling infrastructure nationwide.

8.3.2 Integrating and Empowering the Informal Sector

One of the most important lessons of the past decade is that Ghana's informal e-waste sector, the scrap dealers, dismantlers, and cable strippers of Agbogbloshie and beyond, is not the enemy of responsible recycling. It is its most important partner. The core institutions will prioritize the integration of informal workers through structured registration, promoting co-operatives, health and safety education , and inclusion in incentive-based purchase schemes modelled on the successful GIZ and MEST-KfW pilots. Registered informal operators will gain access to Fund-supported equipment, health services, and market linkages. In return, they will be held to verifiable standards for safe handling and the non-burning of e-waste materials. This arrangement will transform a largely unregulated sector into a regulated, valued, and fairly compensated workforce.

8.3.3 Private Sector Investment in Recycling Infrastructure

There is the need to design and administer a co-financing mechanism to attract private sector investment in certified e-waste recycling facilities across Ghana. Building on the original plan to replicate the Agbogbloshie Recycling Centre in four additional urban centers, the government of Ghana will partner with private recycling companies, local investors, and development finance institutions to establish regional e-waste processing hubs in Kumasi, Takoradi, Tamale, and the Volta Region. These hubs will be privately operated but publicly licensed, with the Fund providing partial capital grants and performance-linked subsidies in exchange for compliance with environmental and occupational health standards.

8.4 Innovative Approaches to Collection and Handling

Collection remains the most stubborn bottleneck in Ghana's e-waste system. Households and businesses accumulate nonfunctional electronics for years, unsure where or how to dispose of them responsibly. The informal collection that does occur is fragmented and often ends in primitive recovery methods. The policy intent is to disrupt this pattern through a combination of technology, incentives, community engagement, and institutional coordination.

8.4.1 A National E-Waste Take-Back and Drop-Off Network

The EPA has established a national take-back system to create a networkin partnership with mobile network operators, electronics retailers, and the Metropolitan, Municipal and District Assemblies (MMDAs). Designated e-waste drop-off points, identifiable, conveniently located, and regularly serviced will be installed at electronic retail outlets, district offices, schools, and community centres across all sixteen regions. Retailers who participate will receive Fund incentives and a public endorsement program that serves as a market differentiator. This national network will be formally linked to regional processing hubs, creating a reliable material flow from household to recycler.

8.4.2 A Digital Traceability Platform

Building on the digital transaction management approach used in the GIZ pilot incentive scheme where the Poimapper database enabled transparent tracking of e-waste flows, the EPA is developing an e-registry as part of the broad EPR framework to be deployed as a national e-waste traceability platform. This digital system will track e-waste from collection through final recovery or export, providing real-time data on material volumes, regional collection rates, and operator performance. The platform will also underpin the Fund's financial disbursement system, ensuring that payments to collectors and processors are triggered by verified delivery rather than reported estimates. Accessible via smartphones and web portals, the platform will make Ghana's e-waste data the most reliable in sub-Saharan Africa, a benchmark for regional partners and international development institutions.

8.4.3 Safe Handling Standards and Occupational Health Integration

The decade of health research chronicled in this report paints a sobering picture: e-waste workers in Ghana carry disproportionate burdens of heavy metal exposure, respiratory illness, and occupational risk. The Government of Ghana is committed to ensuring that the next decade of e-waste work is also a decade of health recovery. All Fund-supported collection and recycling facilities will be required to meet occupational health and safety standards established in partnership with the Ghana Health Service (GHS) and the EPA. The Fund will co-finance on-site health screenings, the provision of appropriate personal protective equipment, and training in safe dismantling techniques. Workers in the formal and semi-formal e-waste sector will also be enrolled in the National Health Insurance Scheme as a condition of formalisation support, removing one of the most significant barriers to healthcare access faced by this vulnerable workforce.

8.5 Strengthening the Regulatory and Institutional Ecosystem

Financial resources and innovative programs will yield sustainable outcomes only if they are embedded within a robust institutional framework. The Fund will actively support, not merely depend on, the regulatory agencies that give Ghana's e-waste laws their teeth. Working with the Ghana Revenue Authority (GRA), the Customs Division, and the Ministry of Trade and Industry (MoTI), the EPA will support the development of a harmonized e-waste import control system that accurately classifies and tracks inflows of used electrical and electronic equipment at the country's ports of entry. This addresses one of the most persistent gaps identified during the decade, the lack of reliable national data on e-waste inflows that continues to undermine policy planning and enforcement efforts.

The EPA in collaboration with relevant institutions will commission and publish an annual State of E-Waste in Ghana report, consolidating data from the e-registry, import statistics, health surveillance, and environmental monitoring. This report will serve as the definitive national reference for policymakers, investors, researchers, and the public, ensuring that decision-making in the sector is always anchored to evidence rather than assumption.

8.6 Building Towards a Circular Economy for Electronics

Ghana's long-term ambition must go beyond managing e-waste as a problem and treat it as an opportunity. The metals, polymers, and rare earth materials embedded in discarded electronics represent genuine economic value, what practitioners call the "urban mine. The EPA has the mandate under Act 1124 to promote EPR and circular economy for electronics in Ghana: one where materials are recovered at the highest possible value, where reuse and repair are incentivised alongside recycling, and where Ghanaian businesses and entrepreneurs capture an increasing share of the economic returns from e-waste processing.

To this end, the Government of Ghana through the Fund will target Ghanaian entrepreneurs and small-to-medium enterprises working on e-waste repair, component harvesting, upcycling, and materials recovery technology to support the national system for e-waste management. Ghana has already demonstrated, through the work of GRATIS Foundation and the early ARC operations, that local ingenuity can design and fabricate appropriate recycling technology. This spirit of local innovation deserves structured, sustained support.

The Fund together with EPA will pursue strategic partnerships with universities, especially the University of Ghana, whose researchers have produced some of the most impactful e-waste health and socioeconomic studies over the past decade, to embed applied e-waste research into Ghana's national science and technology agenda. Research on safer dismantling techniques, low-cost processing technologies, and the health outcomes of formalisation will be prioritised for funding.

8.7 Conclusion: A Call to Collective Responsibility

The story of Ghana's first decade of e-waste management, at its heart, is about what is possible when committed individuals, institutions, and communities refuse to accept the status quo. It began not with a government program or international aid, but with a civil society organization and a proposal, a document that said: this problem is real, it is urgent, and here is how we can address it.

The Government of Ghana through MEST, EPA and the National E-Waste Management Fund carries that spirit forward. We are not starting from scratch. We are building on a decade of hard-won knowledge, established relationships, legal frameworks, and demonstrated proof of concept. What we need now is the collective will to scale, sustain, and ensure that every Ghanaian, from the household discarding an old television in Tamale to the recycler stripping cables in Accra is part of a system that is safe, fair, and built to last.

We call upon all stakeholders, government agencies, private-sector operators, development partners, civil society, academic institutions, and citizens, to join this next chapter. The Ministry (MEST), EPA and are open, accountable, and ready to work. Ghana's e-waste challenge is solvable. Together, we will solve it.

MEST, EPA and The National Electronic and Electrical Waste Management Fund
Accra, Ghana | 2026

A DECADE OF PIONEERING E-WASTE MANAGEMENT IN GHANA

2009 - 2019

Local Initiatives and the Strength of Partnerships
Ghana E-Waste Management