FINAL REPORT

END OF LIFE (EOL) MANAGEMENT OF COMMUNICATIONS EQUIPMENT- (PHASE II)

UGANDA COMMUNICATIONS COMMISSION

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UGANDA COMMUNICATIONS COMMISSION

communication for all

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

ADM	Analogue to Digital Migration
CRT	Cathode Ray Tube
EAC	East African Community
EACO	East African Communications Organization
EEE	Electrical and Electronic Equipment
EoL	End of Life
EU	European Union
e-waste	Electronic Waste
FGD	Focus Group Discussions
GDP	Gross Domestic Product
GPS	Global Positioning System
HS	Harmonized Commodity Description and Coding System
ICT	Information Communication Technology
IOT	Internet of Things
ISO	International Organization for Standardization
ITU	International Telecommunication Union
ITU-D	International Telecommunication Union-Development Sector
ITU-T	International Telecommunication Union-Telecommunication
Kg	Kilogram
KII	Key Informant Interviews
LCD	Liquid Crystal Display
LED	Light Emitting Diodes
LGs	Local Governments
MDAs	Ministries Departments and Agencies
Mt	Metric Tons
NDP	National Development Plan
NDP	Ugandan National Development Plan
NEMA	The National Environment Management Authority
NRM	National Resistance Movement
ODK	Open Data Kit
POM	Project Object Model
PoPs	Persistent Organic Pollutants
PPDA	Public Procurement and Disposal of Public Assets Authority
RoHS	Restriction of Hazardous Substances
SDGs	Sustainable Development Goals
SIP	Strategy and Investment Plan
SQ	Survey Questionnaire
TV	Television
UBOS	Uganda Bureaus of Statistics
UCC	Uganda Communication Commission

UGX	Ugandan Shilling
UK	United Kingdom
UN	United Nations
UNBS	Uganda National Bureau of Standards
UNU	United Nations University
URA	Uganda Revenue Authority
WEEE	Waste Electrical and Electronic Equipment

EXECUTIVE SUMMARY

Uganda is experiencing a rapid increase in Information and communication technology (ICT) usage where the number of ICT devices in use, such as smartphones has been growing significantly over the past two decades. ICTs are accelerators for economic development, social, and cultural transformation through their numerous opportunities and services. The Government of Uganda through various frameworks such as Uganda Vision 2040 has clearly earmarked ICT as one of the key pillars to spur socioeconomic transformation to a competitive upper middle-income country by 2020.

ICTs have become an integral element of people's daily activities with many households owning either a radio, television, set top box computer/laptop or a phone. Generally, access to ICT is an indicator of a country's social and economic development. The proliferation of ICT and digital technologies is expected to go on for the next few years with the new developments of Internet of Things (IoT), digitalization and automation of many services and processes.

This technological evolution has an implication on the increasing volumes and generation of electronic waste (e-waste) with multiple devices owned, but provides opportunities for all players in the e-waste eco-system; producers, users, e-waste collectors, recyclers, and policymakers.

The uptake of these ICT technologies has led to an increase in the number of ICT equipment coming into the country and this trend is expected to continue. Ultimately, all this ICT equipment reaches its End of Life (EoL) and is due for disposal. This equipment including all components and sub-assemblies at their EoL become e-waste, which when not properly managed can lead to several human health and environmental threats.

The Uganda Communications Commission (the Commission) as a key stakeholder in the ICT sector has a role in ensuring that proper equipment EoL management is adhered to, in order to minimize the dangers arising from e-waste and exploit the opportunities ensuing from best practices of e-waste management.

The overall objective of the study was to inform the UCC regulatory function of ensuring that end-user communications equipment and products are appropriately managed right from import through to EoL. This report provides the output of the study on EoL management of end-user ICT equipment in Uganda.

The study scope was limited to the following end user communications devices; (a) Handheld devices; such as mobile phones, tablets, iPads; (b) Portable devices; such as notebooks, laptops; (c) Stationary devices; such as computers, monitors, Televisions sets, set top boxes, fixed phones, radios. The study focuses on individual and institutional/corporate end users.

User pattern for end user communications devices is a direct correlation to the rate of e-waste generation. In regards to duration of use for end user communications devices, the study established that; 3.8% of the end users use their devices for less than two years and these are mainly the mobile devices, 55.3% use their devices between two and 5 years, while 40.8% use their devices for more than 5 years and these are mainly desktops, radios and TVs. Overall, an estimate of 15% of the users, use the various devices beyond the manufacturers lifespan. This is mainly attributed to repairability, functionality and affordability.

The study further established that 66.34% of the end users had definite responses to what they do to their devices when malfunctioned or obsolete (16.5% sell as used or second hand, 14.6% take them for repair, 16.4% store them, 7.9% donate them to family or friends and 8% sell them as spare parts) while 33.6% had diverse responses with a very small percentage of them who indicated that they throw them away in the main waste streams.

The study also established that 84.8% of the device retailers, 94.8% of the device repairers and 82.4% of the e-waste handlers do not have any formal training on e-waste management and rely on their tacit knowledge and experience in executing their tasks, while 92.6% of the retailers, 83.2% of the device repairers and 93.6% of the e-waste handlers do not have or are not aware of any e-waste management guidelines. Most of the retailers of second hand devices (72.6%) also widely accept swaps which complicates the process of device inventory and e-waste management. Whereas the plastics, electronic components and batteries of devices should be sorted separately, many of the e-waste handlers (79.4%) do not sort e-waste from other sources of waste. Adequate awareness and training is crucial for effective e-waste management.

Trends of importation for end user communications devices including parts, accessories and assemblies over the last five years show that phones are the major end user communications devices imported into the country ranging from an estimate of 3 million in 2014/15 to 7 million in 2018/19, followed by TVs, Radios and Computers. The importation of phones is reflected in their increased uptake and short replacement cycles, which subsequently contributes to the generation of e-waste. The import quantity of computers and associated accessories has also had a steady increase for the last five years. The findings also show that that the import quantity for decoders, dishes and antennas has also steadily increased followed by the flat television screens (Liquid Crystal Display (LCD) and Light Emitting Diodes (LED) TVs), while there has been a 93% importation reduction in the number the Cathode Ray Tube (CRT) TVs in the last 5years since 2014/15. The increase in importation for decoders, dishes and antennas may be attributed to the regulatory directive of the analogue to digital migration in June 2015, while the decrease of the importation of CRT monitors may be reflected in the phasing out of brand new CRT monitors on the market or an increase in life style purchase from the CRT to the flat screen monitors (LED and LCD) as per the study findings, which have also reduced in purchase price.

An average of 4500 tonnes per year of e-waste was projected for the years 2018 to 2022 from end user communications devices as per the study scope. This estimate of e-waste generated in the specific years is projected from the imports for the years 2014/2015 to 2018/19, considering the assumption of period of use and findings from

the study; i.e. 85% of the equipment is expected to become e-waste within the required period of 4 years (as per manufacturers' recommended lifetime) while 15% is expected to become e-waste in 6 years (average use of device beyond its lifetime).

Uganda has made tremendous strides towards EoL/e-waste management with an e-waste policy, strategy and guidelines in place. Delivery of Uganda's national e-waste management framework is a joint responsibility of Government, development partners, the private sector and consumers. Implementation of the Uganda's national e-waste policy has been constrained by weak institutional structures for delivery of national e-waste priorities, inadequate financing and weak partnerships (public private partnership) among others. However, the multi-agency collaboration arrangement (the National Steering Committee on E-waste Management) has enabled development of a National E-waste Management Framework 2018-2022, to operationalize the e-waste policy and guidelines in place**.**

It is noteworthy that a national e-waste collection center is in its final stages of establishment under the collaboration by NEMA and Luwero Industries Limited (a subsidiary of the National Enterprise Corporation).

Based on the findings of the study, the following recommendations should be considered to address the various challenges related to management of end user communications devices at their EoL;

1. Strengthening the regulatory capacities of the various institutions with specific key roles on EoL/e-waste management of end user communications equipment and overall EEE equipment, keeping in due cognizance of the cross cutting issues of e-waste management and the need for multi stakeholders collaborations. This include among others;
    a. Regulating and licensing operations of EEE device repairers and e-waste handlers/recyclers as means of enforcing standards and improving e-waste management,
    b. Incorporating sustainable strategies as an approach to address product and equipment obsolescence through formalising schemes such as the extended producer responsibility (EPR) principle and take-back system in the national regulatory framework. Since Uganda does not manufacture EEE, EPR would then apply to importers, vendors, agents, etc,
    c. Type approving end user communications devices/EEE to consider a follow through the entire device life cycle, keeping in due cognisance of the circular economy (CE) to protect human health and the environment such as; having access to information regarding materials recovered from waste to economic operators to facilitate their contribution towards the CE.
    d. Verifying and certifying equipment at points of entry (pre-import) to ensure conformity and adherence of their EoL to the set standards *(similar to vehicle inspection),* as well as to cater for circularity,
    e. Defining an appropriate and immediate EoL management strategy for end user communications devices taking in due cognizance of the

elimination of counterfeit devices and the other regulatory directives such as the ADM among others,

f. Initiating the implementation of the e-waste policy and guidelines,
g. Adopting the international classification of e-waste in terms of similar functionality, weight, and lifetime attributes among others through reviewing the e-waste policy and guidelines to enable the e-waste generated in-country to be quantified and subsequently managed,

2. Designing and implementing a country wide awareness campaign on EoL management of end user communications devices/EEE (including the interpretation of the existing laws, policy and guidelines) targeting all key players,
3. Training on EoL and e-waste management practices. This should be provided to sector stakeholders and consumers by using already existing local capacity, Consideration of integrating into the civic education programmes or ICT courses at higher education to create an enlightened citizenry as afar as addressing challenges of e-waste is concerned,
4. Applauding, supporting and popularizing the emerging good practices on EoL management among the various stakeholders such as the take back arrangements by some retailers, in order to build capacity for home-grown solutions,
5. Defining and developing a permanent collaboration mechanism for EoL management of EEE among key players and stakeholders,
6. Government should spearhead the establishment of an e-waste facility capable of collection, dismantling and recycling through;

    a. Developing strategies of attracting private sector investment and partnership in sustainable e-waste supported centers to collect, manage and recycle e-waste.
    b. The operationalization of the national e-waste collection center,
    c. Designing and implementing an incentives regime for actors across the e-waste management value chain,
    d. Establishing an inventory for EEE and e-waste in the country,
    e. Developing and putting into operation e-waste management ordinances by local governments that streamline service providers including introduction of mandatory sorting of e-waste from other waste to ensure it is appropriately handled.

1. BACKGROUND AND CONTEXT OF THE ASSIGNMENT

World over, Information Communication Technologies (ICTs) are a good catalyst for; social, economic and cultural transformation through their numerous opportunities and services. In recognition of the unique opportunities, ICT's provide as accelerators for social transformation. The government of Uganda through various frameworks such as the Uganda Vision 2040 has clearly earmarked ICT as one of the key pillars to spur socioeconomic transformation of the country from a predominantly peasant and low-income country to a competitive upper middle-income country by 2020. The importance of ICT has further been echoed within the Ugandan National Development Plan (NDP) II, the ICT sector Strategy and Investment Plan (SIP) 2015-2019 as well as the NRM Manifesto 2016-2021 among other frameworks.

At global and regional levels, frameworks such as global Sustainable Development Goals (SDGs) and the African agenda 2063 have earmarked ICTs as pillars for socioeconomic transformation [b-DeGhetto, 2013]. It is well documented that ICT developments in the recent past have witnessed a rapid expansion providing new opportunity for investment and jobs, mainly for the youth. Studies continue to show that development and application of ICTs continue to transform the way people live and work, from provision of: entertainment services like games, to ubiquitous education, e-governance services, business intelligence and healthcare, among others. Studies by the International Telecommunication Union (ITU) show that an increase in Internet access directly contributes to a country's Gross Domestic Product (GDP) [b-ITU 2018]. In context ICT has been defined as any device, tool, or application that permits the, collection, visualization and exchange of data through interaction or transmission. Studies show that locally and internationally, ICTs have impacted on a number of sectors including but not limited to: the financial sector, manufacturing, trade, education, health, hospitality, governance and agriculture.

The dynamic forces of change in: advancement in ICT, social behavior of the population, changing habits of employee and employers, adoption of e-services by government, population on the move etc, are pushing countries to think innovatively in terms of how to manage consumer electronic technologies at end of life (EoL). In Uganda, like most countries, the recent generation of electronic waste (e-waste) is mainly due to the enormous use of ICT equipment and products (both new and used). This increased use of ICTs wholly or partially is a result of the regulatory interventions in line with ensuring accessibility, affordability and usage of communications services. In addition, several regulatory interventions like the Analogue to Digital Migration (ADM), and technological advancements have increased the rate of generation of e-waste.

It is worth noting that most efforts by government and other players in the ICT sector have largely focused on the integration of ICT in various business processes. Whereas considerable efforts have been invested in making ICT devices such as; computers, phones, televisions and radios available, accessible and affordable to end users, little attention has been paid to the EoL management of this devices

At the regional and global level, there has been rapid development of approaches and frameworks of managing consumer ICT devices EoL. These include; advancements in e-waste processing methodologies, technologies, and schemes in light of the expanding

global market for reused devices and implementation of the circular economy principles that largely focus on developing new business models. It is observed that a number of factors including; economic, environmental, and social factors that influence EoL management practices in various societies drive these approaches and frameworks.

At the country level, the challenge of e-waste management is increased by weak systems of electronic device importation quality control, resulting into high percentage of sub-standard and counterfeit devices being imported into the country. As the country contends with the growing e-waste challenge, there is need for development of a comprehensive regulatory framework to guide the management of EoL and e-waste to ensure health, safety and environmental protection.

In line with the Uganda Communications Commission (UCC) methods of work, which are premised on evidence based decision-making practices; UCC undertook the first phase of study on EoL management of communications equipment and products. Phase I of the study focused on communications equipment, i.e. core and access network equipment for telecommunications and broadcasting. Therefore, there was need to complete phase II, which is focusing on end user ICT/communications products (simply referred to end user communication devices) including but not limited to; computers, phones, radio receivers, set top boxes and television sets.

1.1. Structure of Report

The rest of the report is organized as follows; section 2 presents the study objectives and scope, section 3 discusses the study design and methodology, section 4 presents the analysis of the state of policy and legal environment, section 5 presents the synthesis of the global and regional trends in e-waste management, section 6 presents a discussion of study findings, section 7 presents the estimates of stock of end user communications devices for the years 2014 to 2019, and projections of e-waste volumes in the country, the report ends with a conclusion and recommendations in section 8.

2. STUDY OBJECTIVES AND SCOPE

2.1. Study objectives

The main objective of this study was to establish the current practices in management of EoL of end user communications devices and e-waste at large by various categories of users. The study was also meant to provide propositions on regulatory remedies/interventions for adoption by various stakeholders including; communications service providers, government MDAs, importers, retailers and consumers among others. Accordingly, the following were established as the key specific objectives of this study;

1. Estimate the existing stock of end user communications devices in the country as of December 2018,
2. Identify and evaluate the existing end user communications devices EoL management initiatives being undertaken in the country and highlight successes and existing gaps,
3. Examine the existing EoL management strategies and practices various end users are implementing,
4. Establish global and regional trends in end user communications devices EoL and e-waste management,
5. Evaluate the appropriateness of the current legal and regulatory frameworks in the management of end user communications devices EoL and e-waste management,
6. Provide recommendations on best practices at; policy, regulatory and strategy levels for sustainable ICT consumer devices EoL/e-waste management in Uganda.

2.2. Scope and key deliverables

The study scope was limited to the following end user communications devices: (a) Handheld devices; such as mobile phones, tablets, iPads; (b) Portable devices; such as notebooks, laptops; (c) Stationary devices; such as computers, monitors, Televisions sets, set top boxes, fixed phones, radios. The study focused on individual and institutional/corporate end users of communication devices described above. The institutional or corporate end users spoke on behalf of the institutional or corporate body.

3. STUDY DESIGN AND METHODOLOGY

3.1. Study design

A mixed method of data collection and analysis was used which was largely quantitative in nature but also sought qualitative information. The quantitative methods gathered data from individual and corporate end users of communications devices, while the qualitative data was generated from the sector opinion leaders, policy makers, industry leaders, Local Governments, among others. The qualitative method utilized was highly a participatory enquiry to identify factors that influence the challenges of adequate EoL management of end user communications devices in Uganda. The qualitative method thus employed the; Key Informant Interviews (KII), Appreciative Inquiry Methodologies and Focus Group Discussions (FGDs).

An extensive literature review was conducted using both primary and secondary sources to gather facts about trends in the region and Uganda in particular. In addition, regional and international benchmarking case studies were analyzed to gain an in-depth appreciation of best practices and emerging trends in end user communications devices EoL management and e-waste management in general.

3.2. Stakeholder mapping

The study was designed to be nationally representative covering all the four regions of the country, i.e. Central, Eastern, Northern and Western as the key enumeration areas as per Uganda Bureaus of Statistics (UBOS). The sampling approach was stratified, multi-stage purposive random, with sampling performed in several steps.

To establish the desired sample size scientifically, the Cochran formula was used which indicated an ideal sample size given a desired level of precision, desired confidence level, and the estimated proportion of the attribute present in the population. The study considered the largest possible set of respondents in line with the study scope, i.e. the mobile phone subscribers, also basing on theory that they have a shorter life span amongst the other devices considered in this study scope and therefore more likely to generate more e-waste or reach their EoL faster than other devices. Thus, the study used 25.4 million mobile phone subscribers (UCC, June 2019) to represent the population size and the desired degree of precision of 3% and confidence level of 95%, which gave the estimated logical sample size of 1,068 respondents. The stratification explored the various elements such as; rural and urban, age groups, levels of education, individual and corporate users, among others. The categorization of respondents in consideration of the target sample size of 1068 is shown in Table 3-1: *Respondent categorization*

Table 3-1: Respondent categorization

Respondent Category	**Level Importance**	**Number of Targeted (complete)**	**Data Collection Method**
Individual End-Users	High	700	Survey Questionnaire (SQ)
Corporate Users			
Private sector	High	90	SQ

Civil Society Organizations	Medium	60	Key Informant Interview (KII) & SQ
Public Sector Organizations (MDAs)	Medium	40	KII or SQ
Device Retailers	High	60	KII & SQ
Device Maintenance and repair shops (e-waste handlers/recyclers)	High	70	SQ or Focus Group Discussions (FGDs)
Policy Makers	High	48	KII
Total number of stakeholders targeted		**1,068**	

Data was collected using the android ODK Collect application found on Google play store, and the data collected was posted on a separate server, which was equipped with real-time data synchronisation schemes and data visualisation. The data collection mobile app was equipped with geo-location service which mapped the data sources in real-time. A dashboard and a data visualisation service for the study were developed, where data collection activities were monitored as well as quality assurance. This involved; the data delivery infrastructure management, the regional team field supervisors, the overall quality assurance management and the lead researchers. A data collection secretariat was setup, which coordinated and managed the quality assurance.

4. POLICY, LEGAL AND REGULATORY FRAMEWORKS ON E-WASTE MANAGEMENT

Management of EoL/e-waste is being guided by various policy, legal and regulatory frameworks in place at International, Regional and National levels. These aim to provide an appropriate protection to human health and the environment from unsound practices as well as to support the economic performance of the EoL management. This section provides highlights to some of the existing frameworks and implementation mechanisms in place.

At International level, the Basel Convention on the control of transboundary movements of hazardous wastes and their disposal is the most widely adopted regulation on e-waste management. The objective of the convention is to protect human health and the environment against the adverse effects of hazardous wastes. Currently, 183 parties have ratified the convention including Uganda, which ratified in March 1999.

At the Regional level, the European Union (EU) has adopted the EU Waste Electrical and Electronic Equipment (WEEE) directive as its main legislations on e-waste management. Others include; the Release of Hazardous Substances (RoHS) directive and Directive 2008/34/EC of the European Parliament. Other relevant conventions include the; Stockholm Convention on Persistent Organic Pollutants (PoPs) and the Rotterdam Convention on hazardous chemicals.

The Bamako convention on the ban on the import into Africa and the control of Transboundary Movement and Management of Hazardous Wastes within Africa is a treaty of the African Nations prohibiting the import of any hazardous wastes including radioactive wastes. The Bamako convention is a response to Article 11 of the Basel convention, which encourages parties to enter bilateral, multilateral and regional agreements on hazardous waste.

In Africa, many countries are at various stages of establishing specific e-waste regulations and policies. In most countries, e-waste is under the hazardous waste regulation, while some countries have developed specific regulations and policies such as Ghana, Kenya South Africa, Malawi and Rwanda

Uganda has made progress in bringing the issues of e-waste to the forefront. In October 2012, the government of Uganda approved a policy specific to e-waste management. The key strategies of the policy include; establishment of the e-waste management infrastructure, awareness and education, legal framework, human resource development, resource mobilization and development of an E-waste fund. Subsequently, an e-waste strategy was endorsed in 2013 with an objective to guide the implementation of the policy. The strategy includes an implementation and monitoring

framework, with targets and progress indicators, implementing agencies and respective timelines and deliverables. The national e-waste guidelines were endorsed in 2016, as a reference document for handling and disposing of e-waste in the country.

Table 4-1 below indicates a summary of the legal and regulatory frameworks for e-waste management in Uganda.

Table 4-1: Legal and Regulatory framework of e-waste management in Uganda

Law/Regulation	Relevant provisions/clauses for e-waste	Remarks
The Constitution of the Republic of Uganda, 1995	The Constitution lays the legal foundation on basis of which several public policies and legislations are formulated/enacted. Under section XXVII on "the environment"; obliges the State to promote sustainable development and public awareness of the need to manage the land, air and water resources (environment) in a balanced and sustainable manner for the present and future generations.	This section is by extension the legal basis for e-waste management among other environmental aspects in Uganda.
The National Environment Act, Cap 153, 1995	The National Environment Act Cap 153, Laws of Uganda enacted in 1995, stipulates the principles of environmental management and the rights to a decent environment. In relation to e-waste management, sections 51 – 65 of the Act, address management of dangerous materials and processes, management and minimisation of waste, management of hazardous waste, illegal traffic	The Act was not specific to e-waste management.
National Environmental Management Act (NEA), 2019	This is a new bill, which was enacted by His Excellence (H.E) The President of the Republic of Uganda in March 2019. The Act empowers the respective Minister to draft and present to Cabinet the e-waste management regulations.	This new bill recognizes e-waste separate from hazardous waste.
The National Environment (Waste Management) Regulations of 1999	These regulations apply to all categories of hazardous and non-hazardous waste.	The waste management regulations are not specific to e-waste management
The Occupational Safety and Health Act CAP 2006	The Occupational Safety and Health Act of 2006 consolidates, harmonises, updates the law relating to occupational safety and health, and repeals the Factories Act of 1964. It makes provisions for the health, safety, welfare and appropriate training of persons employed in work places.	This law can apply to e-waste handlers, collectors, recyclers.
Public Procurement and disposal of public assets Act, 2003	The Act establishes the Public Procurement and Disposal of public assets Authority (PPDA). This body is responsible for regulating the procurement and disposal of public assets from public institutions.	The PPDA does not have specific regulation or guidelines on disposal of communications devices.
Uganda Communications Act 1, 2013	This Act establishes the Uganda Communications Commission (UCC). The Act provisions and mandates the Commission to type approve communications equipment	Type approval is a deterrence to dumping and stockpile of e-waste.

	imported into the country. Some of the regulations relevant to e-waste management that have been developed and functional under this Act include; 1. The Communications (Telecommunications and Radio Communications Equipment Type Approval) Regulations, 2. The Telecommunications (Licensing) regulations.	
Local Government Act 1997, Cap 243	The Local Government Act (Cap 243) provides for decentralized governance and devolution of central government functions, powers and services to local governments that have their own political and administrative set-ups. The local governments are responsible for the protection of the environment at the district level. According to Section 9 of the Act, a local government is the highest political and administrative authority in its area of jurisdiction and shall exercise both legislative and executive powers in accordance with the Constitution.	Districts have powers to oversee implementation of development activities through respective technical and political offices such as those strategies for waste management responsible for water, production, engineering, natural resources and environment, health and community development.
National e-waste policy of Uganda (2012)	The key strategies of the policy include; establishment of the e-waste management infrastructure, awareness and education, legal framework, human resource development, resource mobilization and development of an E-waste fund.	The policy facilitated the development of the e-waste strategy was endorsed in 2013 with an objective to guide its implementation. The strategy includes an implementation and monitoring framework, with targets and progress indicators, implementing agencies and respective timelines and deliverables. The national e-waste guidelines were endorsed in 2016, as a reference document for handling and disposing of e-waste in the country. A strategic work plan (2018-2022) on e-waste management was endorsed in 2017 to operationalize the e-waste policy and guidelines in place.
The Local Governments (Kampala City Council) (Solid Waste Management) Ordinance.	Has provision of collection, storage and disposal of solid waste	No specific mention on e-waste but consideration of it under solid waste.

Laws, policies and regulations are of prime importance to take stock of preparedness for dealing with it e-waste, through defining appropriate mechanisms such as; control on point of entry, reuse and or production as well as the rational and environmental sound processes for recycling and disposal of electrical and electronics equipment (EEE).

5. GLOBAL AND REGIONAL TRENDS IN EOL AND E-WASTE MANAGEMENT

The United Nations (UN), under its United Nations Environment Management Group has strengthened collaboration among United Nations Organizations towards tackling the challenge of e-waste. It is reported that over 150 e-waste initiatives having been undertaken since 2004 within by various UN organisations.

The International Telecommunications Union (ITU), a specialized agency of the United Nations on ICTs, has set a target under the "Connect 2020 Agenda" of reducing the volume of e-waste by 50% by 2020. The ITU also conducts Research and Development as well as develops standards in various areas, which include e-waste and circular economy. It further raises awareness on the role of ICT in tackling environmental challenges.

Specific to EoL/e-waste management, the ITU through the Standardization and Development Sectors is addressing e-waste issues through the study groups; **ITU-T**[1]: Study group 5 (Environment, Climate Change and the Circular Economy), Question 7 – Circular economy include e-waste and **ITU-D**[2]: Study group 2 (ICT services and application for the promotion of sustainable development), Question 8 – Strategies and policies for the purpose disposal or reuse of telecommunications/ICT waste material.

The United Nations University (UNU) and the ITU further conducted a study on the global e-waste statistics in 2016**.** This study was conducted to raise awareness about the global e-waste situation, by among others estimating the quantities available. The study revealed that all the countries in the world combined generated a staggering 44.7million metric tons (Mt). This is an equivalent of 6.1Kg per inhabitant (kg/inh) of e-waste annually. The study further revealed that this amount of e-waste is expected to increase to 6.8 kg/inh by 2021. Furthermore, the study looked at current waste management practices and informed that, of the 44.7 million MT, approximately 2 Mt are thrown into the residual waste in developed countries which most likely ends up in the land-fill, while almost 9 Mt of e-waste are documented to be collected and recycled and this corresponds to 20% of overall e-wasted generated.

Data on e-waste generation will contribute to the achievement of several goals of the 2030 Agenda for Sustainable Development, and will address targets related to environmental protection and health, employment and economic growth among others. Global political targets on adequate management on e-waste have also been set; the connect 2020 agenda on reducing e-waste by 50% in 2020, increasing the

[1] Standardization sector of the ITU
[2] Development sector of the ITU

global e-waste recycling rate by 30% by 2023 and raising the number of countries with an e-waste legislation by 50% by 2023.

The International Organization for Standardization (ISO) has also provided standards that cover the management of EoL of EEE. These may not be specific to communications equipment but contain applicable principles for the management of EoL and e-waste in general.

The East African member states under the East African Communications Organization (EACO); a regional body comprising of the national ICT regulators, operators and service providers in the telecommunications, postal and broadcasting sub-sectors, have put in place a number of initiatives for e-waste and its management. These include; development of an East African e-waste management policy model framework in 2013 to guide member countries in developing their own e-waste management policies; the development of the regional e-waste management strategy in 2017 that spells out the priorities strategies along with specific actions to management e-waste in the East African Region; establishment of Regional and national steering committees on e-waste management in 2016, and creating awareness on sustainable management of e-waste in so far four countries of the region.

The East African Community (EAC) is further developing the EAC Electronic Waste Management Framework and Management of Plastic and Plastic Waste Disposal.

Delivery of Uganda's national e-waste management framework is a joint responsibility of Government, development partners, the private sector and consumers. Implementation of the Uganda's national e-waste policy has been constrained by weak institutional structures for delivery of national e-waste priorities, inadequate financing and weak partnerships (public private partnership) among others.

However, the multi-agency collaboration arrangement (the National Steering Committee on E-waste Management) has enabled development of a National E-waste Management Framework 2018-2022, to operationalize the e-waste policy and guidelines in place**.** The NEMA working with other stakeholders including Ministry of ICT and National Guidance and UCC have come up with a framework to streamline the management of e-waste in Uganda.

6. STUDY FINDINGS

6.2. Respondents background

A total of 1,171 respondents did respond to the study out of the target of 1,068 representing a response rate of 109.5%. Data was collected from over 80 districts across the country by over 40 enumerators as illustrated in Figure 6-1 which is a plot of GPS locations where data was collected.

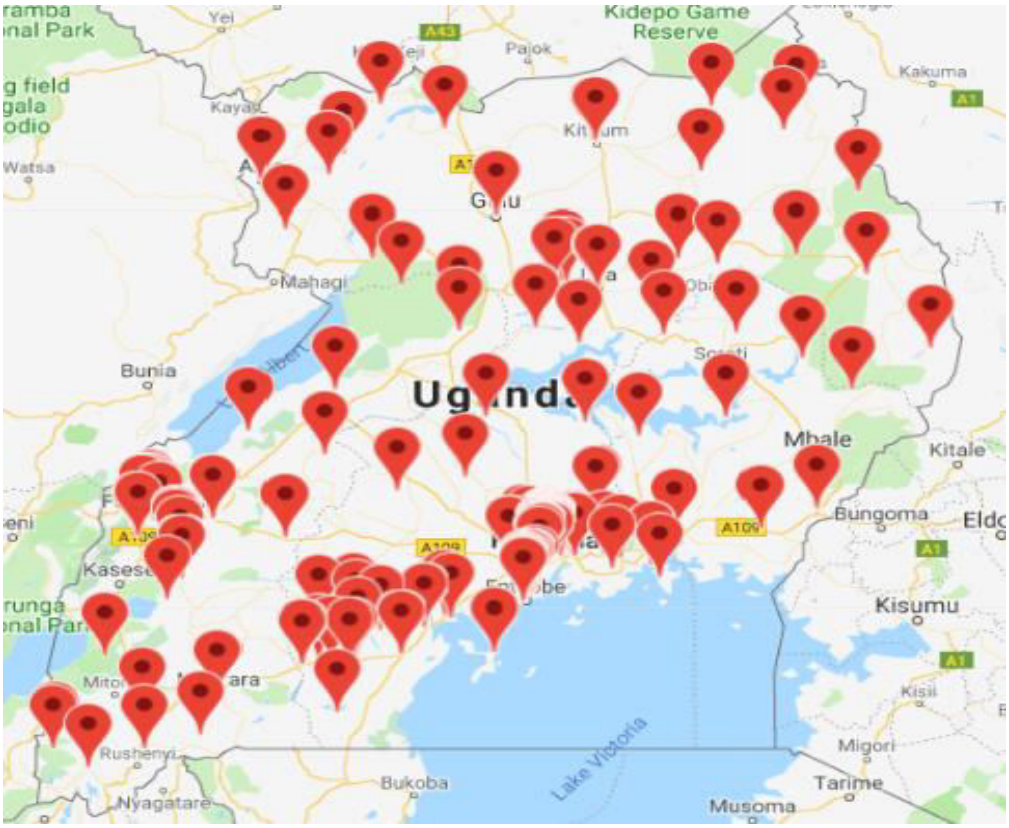


Figure 6-1: GPS collection were data was collected

6.3. Demographics of respondents

In terms of regional representation, the Central region had 470 (40.14%) followed by Western 269 (22.97%), Northern 248 (21.18%) and Eastern 184 (15.71%) regions respectively. Overall, the Central region had the highest number of respondents, given the fact that it is the commercial center of the country with more potential to generate e-waste (Figure 6-2). With regard to gender, 687 (58.67%) of the respondents were males while 484 (41.33%) were female as illustrated in Figure 6-3. Given the fact that men are known to traditionally own and control access to communications devices, this means the respondent's stratification is logical and can be relied on to make logical deductions.

In regards to age, 31.08% of the respondents were aged from 18-25 years, 45.69% were aged 26-35 years, 19.90% were aged 36-50 years and 3.33% were older than 50 years as shown in Figure 6-4. In terms of education level, 36.5% of respondents were

degree holders, followed by diploma level at 35.3% as indicated in Figure 6-5. It was observed that, nearly 71.7% of respondents have attained higher education inherently reflecting greater exposure to civil education and are more likely to follow instructions of operating communications devices. It is therefore, fair to note that the respondent profile of this study conforms to known trends of; communications device ownership, access, and usage hence their opinions could be relied on to make conclusion which are representative of the entire population.

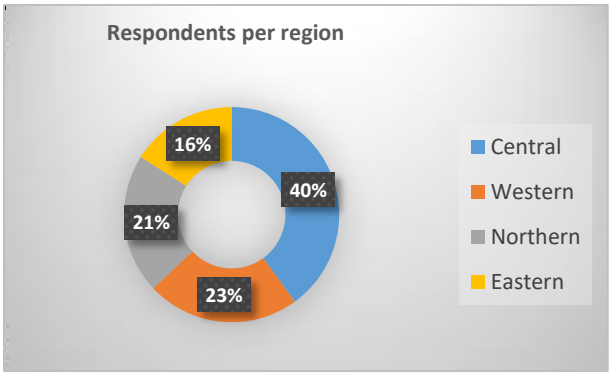


Figure 6-2: Respondents per region

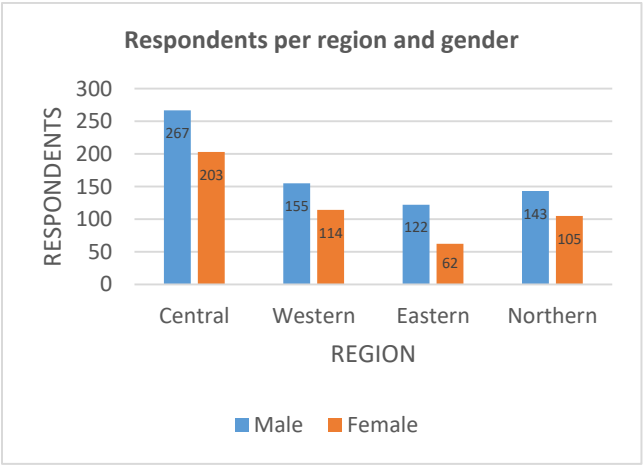


Figure 6-3: Respondents per region and gender

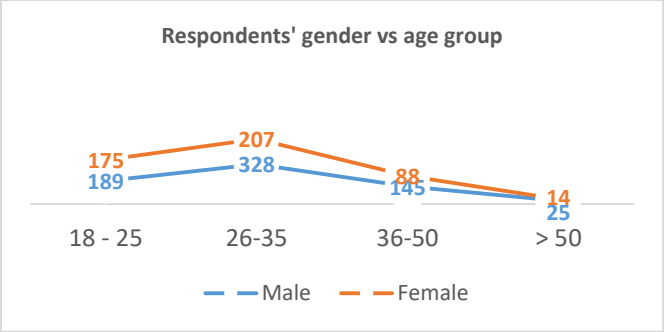


Figure 6-4: Respondents' gender Vs age group

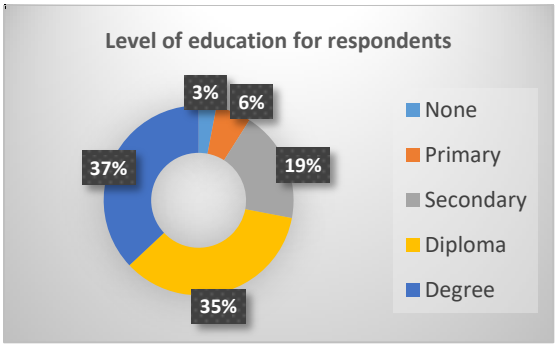


Figure 6-5: Level of education for respondents

Given the fact that different entities play different roles in the EoL management of end user communications devices and overall management of e-waste in conformity with industry best practices, the respondents to the study were categorized into six categories; Individual End User, Private Sector Representative, Civil Society Organization Representative, E-Waste Handlers, Device Repairs, Device Retailers, and Government Ministry, Department or Agency (MDA). Figure 6-6.

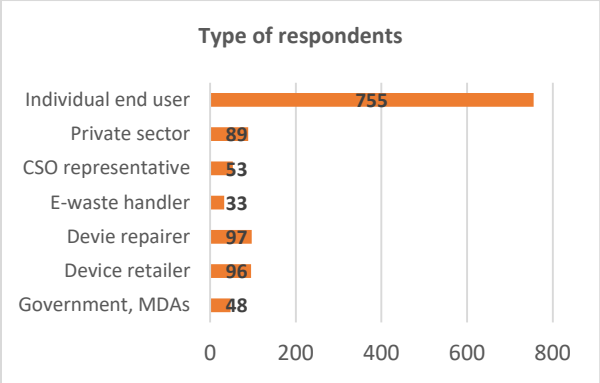


Figure 6-6: Type of respondents

E-waste handlers had the least number of respondents to the study. Majority of e-waste device handlers were from the Central region followed by the Eastern, Western and Northern regions. These trends are logical and imply that the opinions generated can be relied on to make informed conclusions. It is well known that most of e-waste handling in the country is concentrated in the capital city and surrounding towns.

6.4. End user EoL management strategies and practices

6.4.1. Duration of device usage

The length of time a person used an end user communications device has a direct correlation on the rate of e-waste generation. The study sought to establish user patterns in terms of duration of use of a given end user communications device visa vie its known expected lifetime. The respondents were asked to indicate how long they had been using any of the following devices; Phone, laptop computer, desktop computer, and television set and radio receiver (Figure 6-7).

The study results in regards to phone use indicated that 32.7% use the phones for

utmost 2 to 5 years, 21.6% use phones for more than 5 years. Generally, the results show that 70% of the respondents use their phone for a duration of 2 to 5 years. It is documented that the average lifetime of a phone is between 2-3 years. Thus, the findings conclude that the majority of respondents to the study (70%) did use the phones within the expected lifetime.

A study by UCC indicated that over 30% of all mobile phones used in Uganda are counterfeits (UCC, 2013). Counterfeit phones have a short life span because of the compromised quality during manufacturing. The Commission is planning to address the withdrawal or use of counterfeit phones in the country in 2020. This is expected to have an implication on disposal and hence require adequate planning.

Respondents were asked how long they use their laptops. 19.6% of the respondents use laptops for more than 5 years, followed by 18.8% who use them for 5 years and 14.3% for 2 years. It is clear that 38.4% of the respondents indicated to have been using their laptops for 5 or more years. Literature indicates that an average EoL for a laptop is 3-5 years and largely affected by the battery life, which have an average EoL of 4 years.

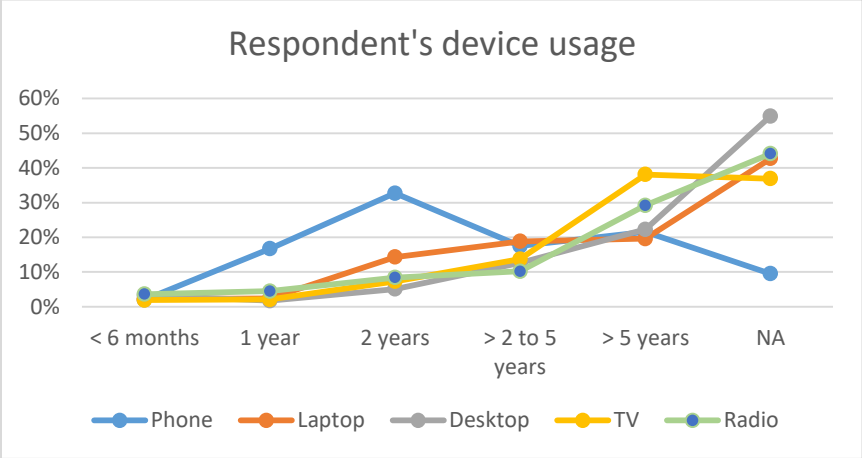


Figure 6-7: Devices usage by the respondents

In regards to desktop computers, 22.3% of the respondents indicated that they have used their computers for more than 5 years followed by 12.6% who have used the computers for more than 2 years to 5 years. It is clear that 34.9% use the desktop computer for 5 or more years. It is documented that the recommended lifetime for desktop computers is 3-5 years and hence a significant number of the respondents were abiding with the set out EoL recommendation for these devices.

For public offices such as government and its agencies, the Public Procurement and Disposal of Public Assets Authority (PPDA) is in charge of disposing off all public assets which include as well end user communications devices from any specific public institution/office. The PPDA has guidelines for procurement/disposal. However, while the PPDA will determine the method of disposal of the public assets, it does not determine when the assets shall/have reached its EoL for any given public institution.

This can therefore mean; it is not known whether the end user communications devices disposed of by PPDA have reached its EoL or can still be used by other users.

The respondents to the study were asked about how long they have used their televisions sets. 51.8% indicated to have used the television for 5 years or more, 38.1% indicated to have used the television for more than 5 years, 13.7% indicated to have used the television for more than 2 years to 5 years. It is estimated that the average life span of a TV is 30,000 hours for a CRT monitor and 40,000 hours for a LCD screen, which equates to approximately 4 and 5 years respectively. Therefore, it is not a surprise that majority of the respondents used the televisions for 5 and more years because this is within the manufacturer set life span of the device.

Furthermore, respondents were asked about how longer they have used their radios. 29.1% of the respondents indicated to have been using the radios for more than 5 years and 10.2% for more than 2 year to 5 years. It is also known from literature that the average lifetime of a radio receiver is 5-7 years. Therefore, a significant number of respondents did use the radios within their recommended lifespan.

The study results also indicated a significant number of respondents who did not know the length of time they have used the end user communications devices. This can be interpreted to mean they have used a device for a long time and hence could not easily tell for how long they were using them. This fact is true in several rural areas of the country where the data was collected. One of the respondents indicated that;

> *"My parents gave me the Radio and I have been using it for several years. I do not know how long they were using it for but I guess for many years too. I have only repaired it twice but still working for some [illegible]"*

6.4.2. Management of devices no longer in use

The study sought to establish the management of end user communications devices that are no longer in use by the respondents. They were diverse responses to this question. However, 16.5% of respondents both corporate and end users indicated that they sell the devices, 16.4% of the respondents indicated that they keep them in their stores, and 7.9% of the respondents indicated they give the devices to friends or family (Figure 6-8). When respondents were asked on what they do with broken or malfunctioned communications devices, 14.6% of respondents indicated that they take their devices for repair, 9.8% indicated they put them in storage, 8.0% indicated they sell them off as spare parts (Figure 6-9). The rest had multiple responses to the question. It is very clear from the results that there is no clear structure of how EoL is managed and most actions taken by users only prolong the problem as opposed to providing a sound solution. Given the end users' practices, it is fair to conclude that a significant number of these devices end up being used beyond the manufacturers recommended lifespan, which could expose users to hazardous chemicals and pollution to the environment. Furthermore, the continuous recycling/reuse of the devices might be attributed to limited awareness of dangers of these devices but also

limited practical options to end users on management of device EoL and e-waste in general.

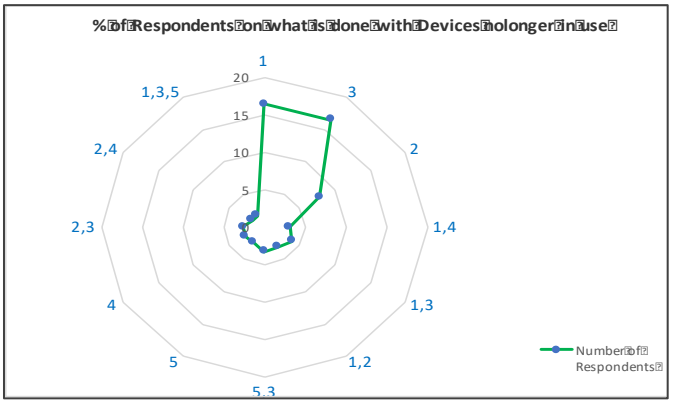


Figure 6-8: Percentage of respondents regarding devices not in use

Note: 1-Put into storage, 2-Give to a friend, 3-Sell on as second-hand, 4-Throw into the bin and 5-Swap at a local shop

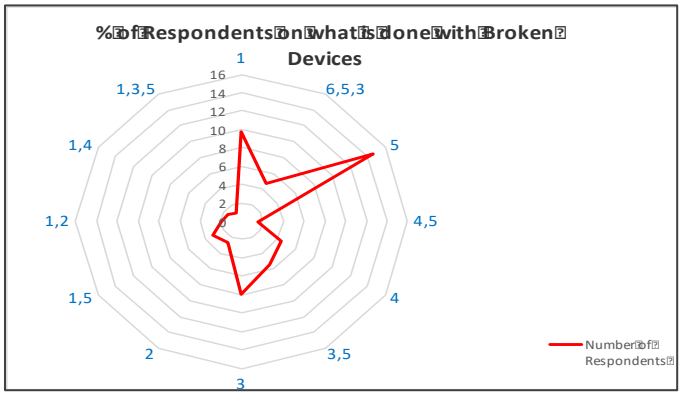


Figure 6-9: Percentage of respondents regarding broken devices

Note: 1-Put into storage, 2-Give to a friend, 3-Sell on as spare parts, 4-Throw into the bin, 5-Take to for repair and 6-Swap at a local shop

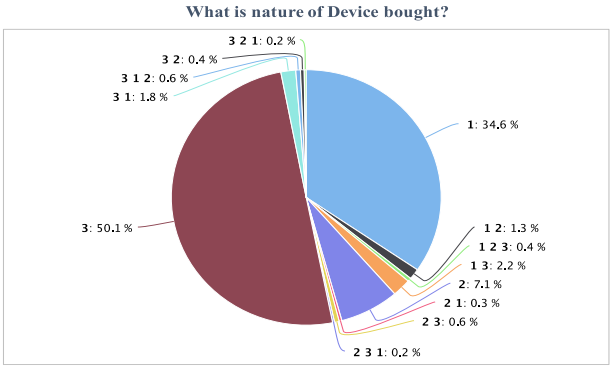


Figure 6-10: Device EoL Management Practices

Note: 1-Brand new, 2-Second Hand, 3-Both Brand new and Second hand

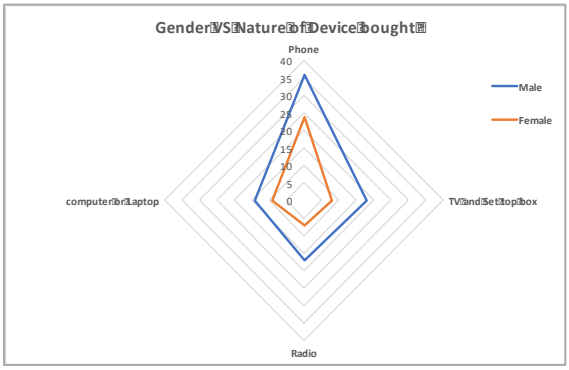


Figure 6-11: Gender Vs nature of device bought

They are more reasons which inform one's decision on what to do with a device that is no longer in use, as highlighted by one of the respondents when asked why she does not dispose of her laptop, which she was no longer using.

> *"This was my first laptop that I bought during my studies 8 years back, and have very fond memories with it despite that it is not working anymore. I like to keep it with me to remind my children, the struggles I went through to make it in life. It is in my family museum."*

The above reasoning indicates that there are diverse reasons that inform individual actions on management at EoL. Some of the reasons could be attributed to culture and beliefs, attachment to one's device (which could also be attributed to initial purchase price), lack of awareness of the dangers, limited access to disposal facilities.

Uganda does have an e-waste policy (2012), strategy (2013) and guidelines (2016) in place. However, these have not been translated into effective implementation nor effectively been communicated to the adequate target audience. The country still faces the challenges of lack of an e-waste management facility and formal e-waste recyclers.

There are no specific standards purposely developed to address e-waste in Uganda. However, two standards developed by the Uganda National Bureau of Standards (UNBS) have the potential to contribute towards the collection, separation and recycling of e-waste; US 662:2008, Code of practice for inspection and acceptance of audio, video and similar electronics apparatus and US 735:2008, Code of practice for repair and service of electrical and electronic machines/devices.

Since some of the devices (computers and phones) have a considerable short life span of about 3 years, it was necessary to investigate the level of consumption of used devices in this category, which accelerates the accumulation of e-waste in the country. Respondents were asked which class of communications devices they normally buy in terms of new or used. Majority of the respondents, 58.3% (both corporate and individuals) indicated that they buy both new and used devices, 34.6% indicated they buy only new and 7.1% indicated that they buy only used devices (Figure 6-12). These

figures indicate that there is still a large market for used communications devices within the country and this could be attributed to several reasons; i.e. poverty levels resulting into low purchasing power for the citizens, lack of awareness as some people still believe that new devices are expensive compared to used ones which is not necessarily the truth. In 2009, the Government of Uganda imposed a ban on the importation of used computers with objectives among others to combat the accumulation of e-waste in the country. Concerns were raised regarding the stifling of economic activities in line with the digital divide due to the lack of affordability of new computers. This caused a resistance on the ban from traders and stakeholders and subsequently led to conducting an impact assessment of the ban by Government. Key findings indicated that the ban did not reduce the importation of used computers in the country. However, the ban also increased the importation and affordability of high value branded new computers.

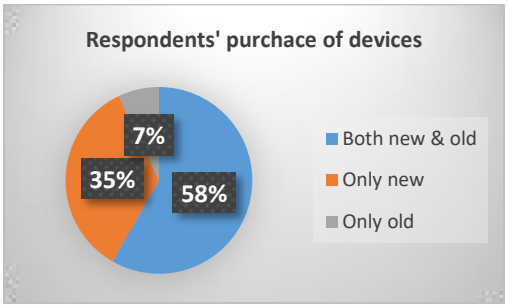


Figure 6-12: Respondents' purchase of devices

The study further noted that most used end user communications devices are never checked when they reach their EoL before being re-circulated in the population or market.

One of the student who responded to the survey stated the following in relation to the purchase of used communications devices;

> *"The used radio system from UK is more durable and cheaper than these other new radio systems from China. I have seen friends radio fail to work after a few months, but mine is still booming."*

It is clear from this study that some end users believe with testimonies that used end user communications devices from European countries are of a high quality and hence longer life span than a significant number of new devices on market especially from Asia. However, such end users are not aware how long these devices have been in use and when they will reach their EoL. This calls for massive sensitization of the public on the issues that evolve around used devices but also substandard new devices and their EoL. In addition, legislation should be made to regulate importation of both used and new end user communications devices in order to eliminate potential impacts of substandard/counterfeit/fake devices into the country.

Type approval of communications equipment is a good basic step to ensuring that communications equipment imported into the country are good for the purpose and

will delay to get into the waste stream. Effectiveness of type approval can be enhanced through follow-up activities to ensure that the equipment is used and serviced as recommended and thus are timely decommissioned and properly disposed. Uganda Communications Commission (UCC) type approves ICT/communications equipment to; protect communications equipment from any harm or damage and to protect the public from harmful emissions from faulty or obsolete communications equipment. The process of type approval thus complies with national and international regulatory standards and requirements.

6.4.3.Device repairs cost and level of awareness of materials used

The cost of repairs on any equipment will affect the decision by an individual to prolong the life of the device or not. Studies show that, level of awareness of hazards caused by expired materials in end user communications devices can influence an individual's plan of action for EoL management. Therefore, this study sought to establish the level of awareness of materials used in devices by respondents. The results described in Figure 6-13 show that about 42.5% of the respondents do not know anything about the materials in the devices, followed by 33.9% who have some little information about the materials used in the devices. The results also revealed that majority of the respondents who do not know anything about the materials used in the end user communications devices were male as compared to the females.

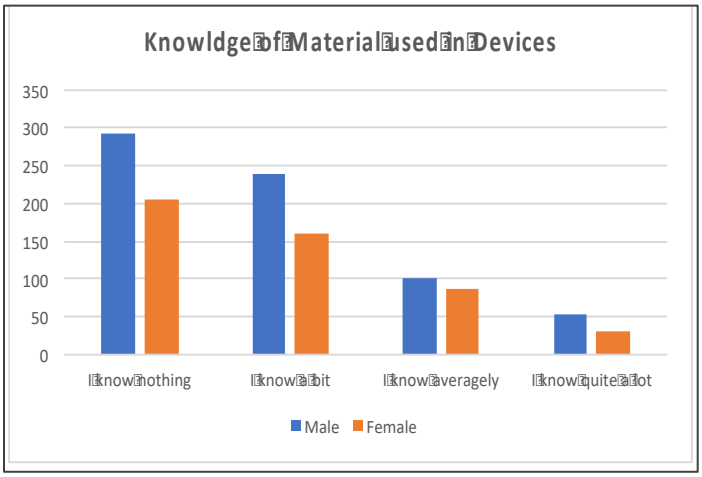


Figure 6-13: Respondents' knowledge of material used in devices

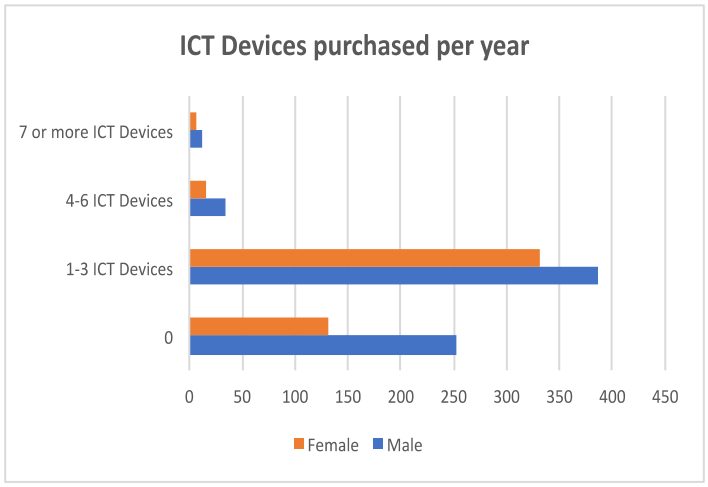
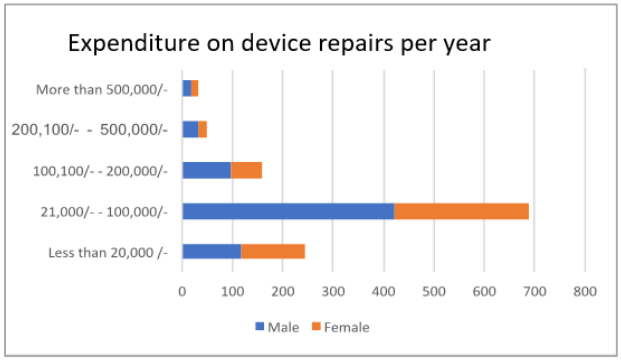


Figure 6-14: Respondents' number of devices purchased per year



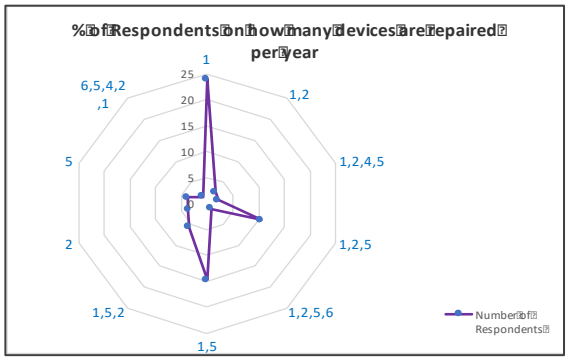


Figure 6-15: Respondents' purchase and repair of devices

Note: 1-means 0 devices, 2-means 1 – 3 devices, 3-means 4 – 6, 4-means 7 – 9 and 5-means 10 or more

The study investigated the annual average expenditures on device repairs to estimate the level of need and market trends as far as device repair and long prolonging practices are concerned. The results show that 58.7% of the respondents spend UGX 21, 000 – 100,000 /= per year on device repair, followed by 20.8% who spend less than UGX 20,000 on device repairs annually (Figure 6-15). It was observed that 61.6% of respondents who spend UGX 21,000 – 100,000 were males compared to the 38.43% females.

Respondents were asked what issues made them decide on whether to repair or not. The results showed that 24% of respondents indicated that the cost of repair compared with the cost of replacing with a new device informs their decisions on repairs while 14.8% of the respondent's decision are informed by availability of new devices or repair services. The results show that generally, most of the respondent's decision to repair communications devices is influenced by multiple factors with exception of 34.6% of the respondents whose decisions are dictated by one factor only. It was noted that the cost of repair compared with replacing with a new device was the

overwhelming factor that informs decisions of respondents. This is a clear indicator that the significant percentage of respondents prefer to prolong the lifetime of their devices and only replace them as a last resort. This observation was well echoed by one respondent who indicated the following about device repair;

> *"I have owned this radio for over 10 years and still working fine. Sometimes power outrages spoil it but I take it to the local technician to be repaired since I cannot afford to buy a new radio now."*

The above statement clearly indicates that the cost of repair in comparison with cost of a new device greatly influences ones' decision on what to do about the broken device. It should also be noted that e-waste policies and manufacturer recommendations were the least considered in making a decision on whether to repair or not. Usually the manufacturers of end user communications devices provide instruction in the user manual about how to dispose of the devices that have reached their EoL, but this study revealed that often time users choose either not to read or follow the provided instructions.

6.4.4.E-waste disposal guidelines and policy awareness

The study sought to establish the level of awareness of e-waste regulatory environment among the respondents, but also to establish factors they consider when disposing off end user communications devices. The analysis results revealed that respondents consider multiple factors when disposing off their end user communications devices. Availability of replacement (12%), availability of a replacement and repair service (10.5%), availability of repair services (7.7%), technology and brand (7.2%); were considered as the most significant factors as illustrated in Figure 6-16.

Therefore, the most significant factors are availability of replacement and repair services. It is thus crucial for any e-waste management framework to integrate the available of repairs services and lower the barriers of accessing new devices.

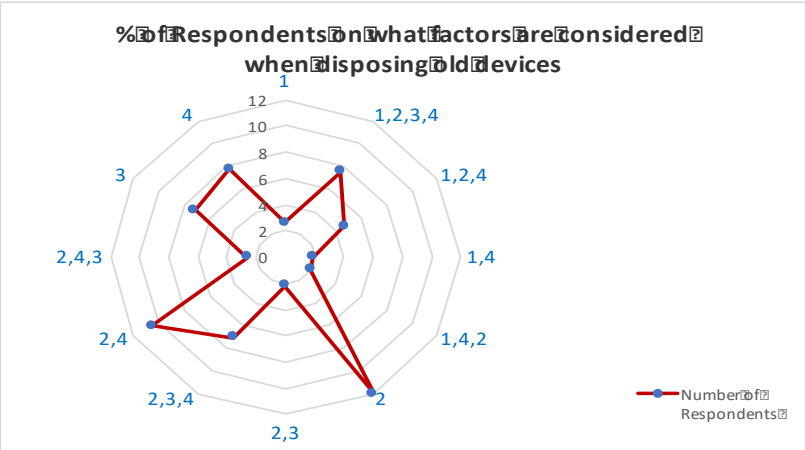


Figure 6-16: Factors considered when disposing of old devices

Note: 1 (emotional attachment), 2(availability of replacement), 3 (technology and brand), 4 (availability of repair services), 5 (waste management regulations)

Respondents were also asked whether they had or were aware of any e-waste management guidelines, which guided their actions when disposing off the end user communications devices. The results show that 87.98% of the respondents indicated that they do not have any e-waste management guidelines. This was true for both e-waste handlers and the end users. Of these; 87.98% respondents, 57.7% were males. While the country has a national e-waste policy, the results show that 88.13% of the respondents are not aware that the policy exits. These results point to the fact that there has been inadequate sensitization of the public/citizens regarding adequate e-waste management.

One of the respondents from the CSO in Gulu noted;

> *"These e-waste guidelines have never existed and once the devices are spoilt we just give to scrap or throw it to the bush. If these guidelines exist, how do you enforce them onto the rest of the people using the devices at their homes?"*

The respondent was probably ignorant about the environment act, regulations and e-waste policy in place. However, the fact is that sensitization of the citizens about the e-waste management is still inadequate.

The study sought to establish from respondents' generic practices of e-waste and EoL management within their community. 59.7% do not know or could not comment with authority on how e-waste is managed within their community, 12.8% of the respondents indicated that generally devices that are spoilt or have reached their EoL are collected and put in long term storage, 5.2% indicated the devices no longer needed by users are sold for spare parts, 4.2% indicated to be selling devices to scrap buyers, 3.8% dispose the e-waste into a waste bins and 3.4% collected by garbage collectors as indicated in Figure 6-17.

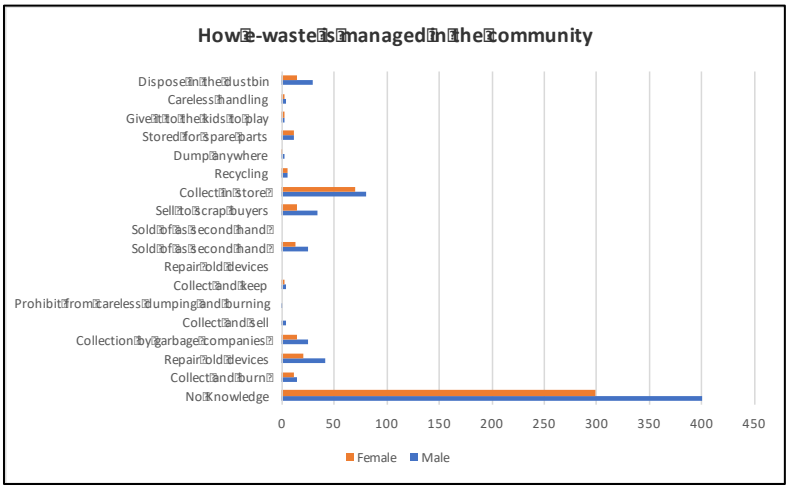


Figure 6-17: E-waste management in the community

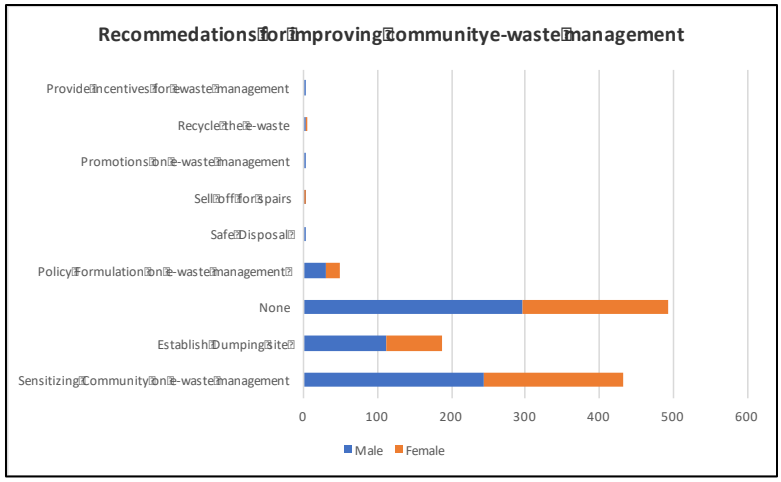


Figure 6-18: Respondents' recommendations on e-waste management in communities

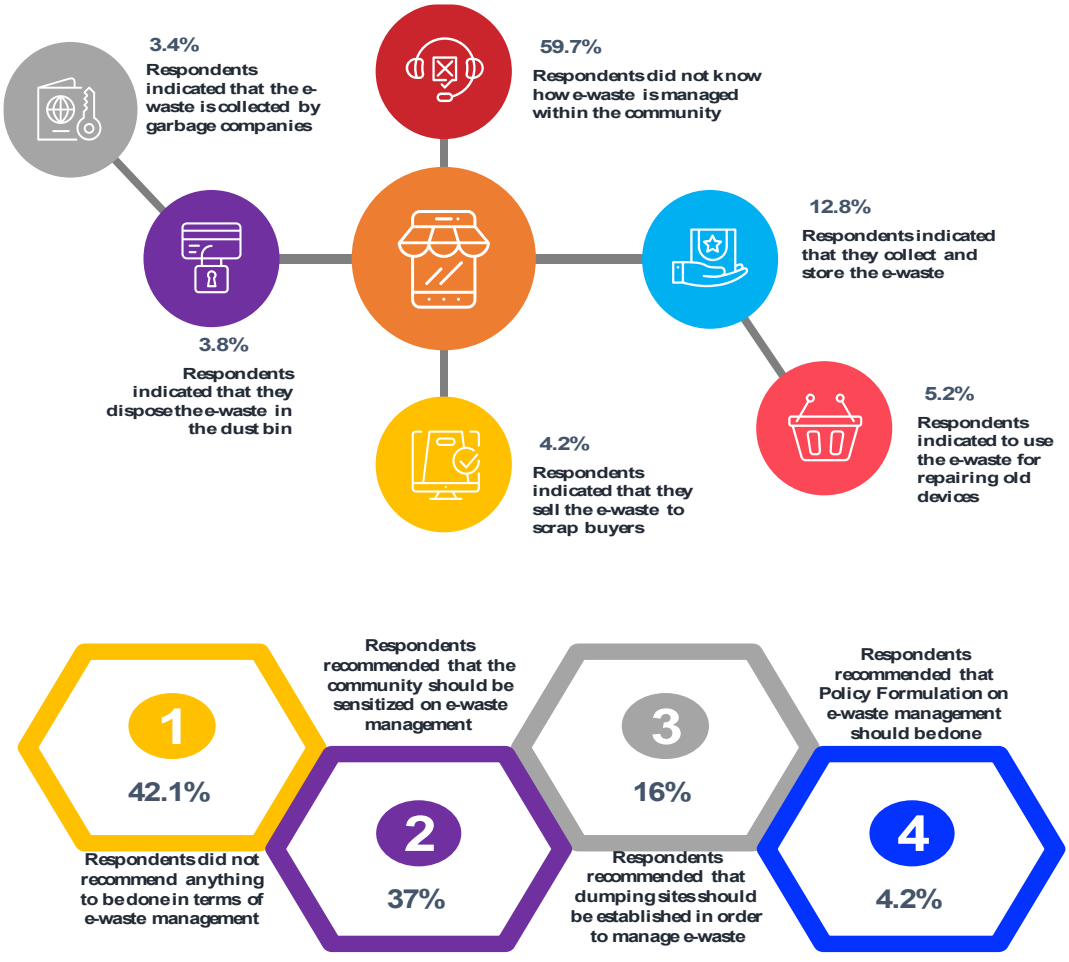


Figure 6-19: Summary of e-waste management within the community

From several respondents, it is clear that a significant number of devices no longer in use are improperly disposed of, or put in long term storage in homes and offices. One of the respondents described the situation as follows;

> *"I have kept my first phone with me although not working anymore because buttons and battery got spoilt. I treasure it as my first mobile phone and that is the reason I keep it. I have been keeping it in my drawer for 10 years now. It is a Nokia, you know!"*

Another respondent from Mbale indicated;

> *"At home, there is a television no longer in use and kept in the store but was bought 23 years back before I was born. However, my father does not want to throw it away despite the new one in the house."*

It is clear that the current practices of managing e-waste and device EoL are inadequate and inappropriate in addressing the challenge of e-waste. Therefore, awareness of policies and guidelines on management of waste need to be conducted across the country. The statement made by one of the respondents is clear that sensitization of the population is critical. Figure 6-20 below summarizes the current practices of e-waste management;

Figure 6-20: Summary of EoL management practices

6.5. End user EoL management initiatives

This section looks at some of the initiatives that the e-waste handlers and device repairers and retailers have put in place to manage end user communication devices at their EoL.

6.5.1. Practices by the e-waste handlers

It is worth noting that 8.03% of the entire study population was for e-waste handlers.

The results from the study show, that 79.4% of the e-waste handlers do not sort e-waste from other sources of waste. For example, a computer has plastics and electronic components that should be separated as a standard process at device disposal. Phone batteries have to be removed from phones and disposed separately. In terms of professional handling of e-waste, 82.4% of the e-waste handlers do not have any formal training in e-waste management. The study also revealed that 93.6 % of the e-waste handlers do not have any specific guidelines to follow when handling the e-waste but use their tacit knowledge and experience in executing their tasks. The study observed that mainly men (65%) in Uganda dominate e-waste management segment.

The e-waste handlers were asked to state some of the activities they undertake during e-waste handling and the following were the most significant activities; *selling components to scrap handlers, collection by local waste management team, selling off used devices, managing a team of component extractors, creating storage places for the e-waste, extracting usable parts, selling spare parts among others*. Therefore, the various actions of e-waste handlers requires different skill sets.

E-waste handling in Uganda is mostly informal, and generally handled together with other waste. Emphasis has primarily been placed on end-user devices, which are obtained through bidding or direct purchase at subsidised rates. NEMA licenses waste handlers.

The e-waste handlers were further asked what challenges they faced when handling the e-waste. The following were some of the challenges mentioned; *community ignorance on e-waste management, there are no designated places to dispose e-waste, limited training on waste handling, lack of recycling plants, e-waste received is not sorted, there is lack of expertise on e-waste management, there is lack of storage place for the e-waste, costs transportation of e-waste is costly there is uncontrolled citizens who just do what they wish in terms of disposing off e-waste and the business for e-waste management is unprofitable to run and hence not many people would want to start it.*

In order to formulate ideas for improving how e-waste can be managed, e-waste handlers were asked on what could be done to improve the management of e-waste in communities. The following were the most popular recommendations; people should be sensitized on how to manage e-waste and device EoL, place recycling plants in all regions of the country, provide special bins for e-waste collection centers in all towns, import only original and long-lasting devices, create e-waste collection centers within all regions, provide training to e-waste handlers, provide protective gear to e-waste handlers among others. Figure 6-21 summarizes the responses from e-waste handlers.

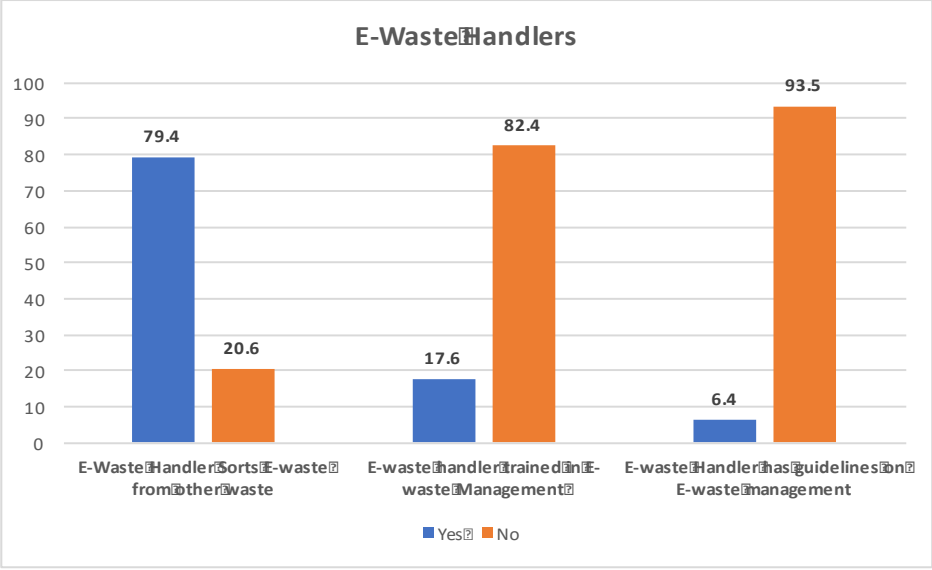


Figure 6-21: E-waste Handlers undertaking

One of the e-waste handlers hinted that;

> *"My entire workshop is becoming a disposal place for the spoilt electronics from the community. People bring and simply dump them here with hope of returning but they do not come back and hence do not have anywhere to put some of these electronics."*

Based on the comments provided by one of the respondents, it is clear that the need to have designated collection points is a valid one.

It was observed that, the national e-waste collection center is in its final stages of establishment under the collaboration by NEMA and Luwero Industries Limited (a subsidiary of the National Enterprise Corporation). NEMA has further held discussions with the PPDA on a proposed new criteria to be applied for e-waste disposal so as to facilitate rapid and sustainable disposal of e-waste by public agencies.

6.5.2.Electronic device repairers (technicians)

Device repairs play a critical role in management of EoL and e-waste. The study sought to establish opinions in this category in terms of awareness, skills and practices of their trade. These constituted 8.3% of the entire respondents' sample. In terms of training, the results indicate that 70.1% have received some form of training on repairing devices; however about 90% of this training was informal as they were not formal award received. While majority of device repairers indicate to have received some form of training, 94.8% of them indicated they do not have specific training in e-waste management. Probed further if they had guidelines on EoL and e-waste management, 83.2% indicated they do not have or are not aware of any guidelines for e-waste management (Figure 6-22).

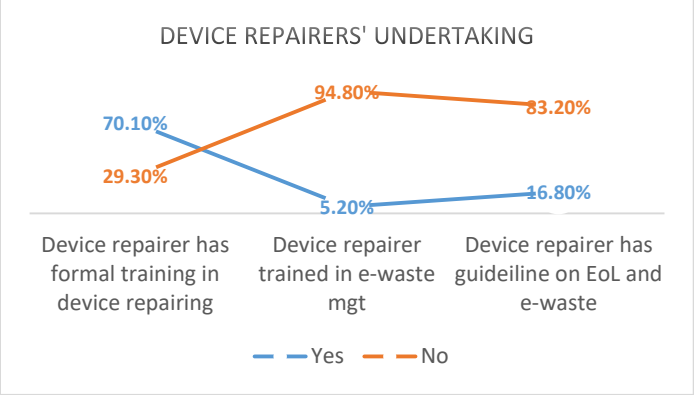


Figure 6-22: Device repairers' undertaking

The results indicate there is still less attention towards creating awareness of e-waste management through training. It is important that sensitization of repairers on how to handle e-waste is clearly undertaken within a developed framework so that uniformity in terms of what is done is clear.

6.5.3.Device retailers

Figure 6-23 shows the summary analysis of responses from device retailers on their undertaking as far as e-waste and EoL management is concerned. The findings show that; 92.6% of the device retailers do not have any guidelines on e-waste management, 84.8% have not trained in e-waste management and 69.4% are not aware of any

available regulations on importation of second hand devices. The findings also show that, 72.6% of device retailers participate in device swapping as part of their core business. For example, one retailer noted that;

> *"In our shop we allow phone users to bring back the phone we sold to them and we evaluate its current status. Then we value it and take it back, give a new phone to the user but request them to top up. We then sell the returned phone as a second-hand phone to those users who cannot afford*

The retailers do not consider the EoL for the returned devices but consider whether it is working and the value it can fetch them. What was interestingly discovered is this is not in the non-formal ways; an individual based on his judgement and business opportunity makes the decision. It is important for the retailers to assess the EoL of the devices using a formal procedure to inform their decision of buying second hand devices or not.

The study found that 77.6% of the retailers buy second hand devices locally. The results also shows that 41.8% of the retailers also indicated to import second hand devices from abroad (Figure 6-23). These results illustrate that buying and selling second hand end user communications devices in the country is still high and creates significant challenges of management of these at their EoL.

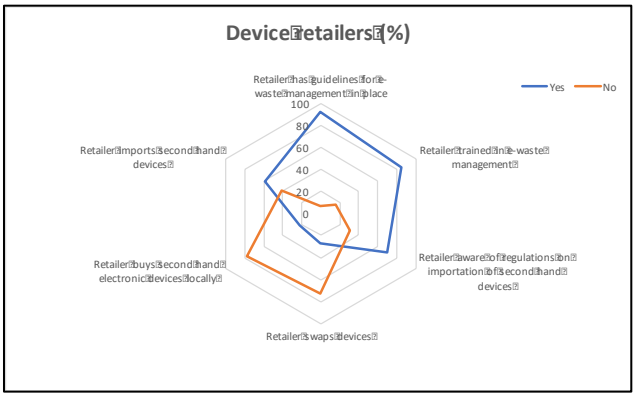


Figure 6-23: Device retailers' undertaking

6.5.4. Comparison of retailers, e-waste handlers and repairers regarding e-waste/EoL management

In order to understand the situation on ground in relation to e-waste management, the three stakeholders' information (*retailers, e-wasters handlers and device repairers*) was analyzed as indicated in Figure 6-24. In terms of training in e-waste management; 17.6% of e-waste handlers, 15.2% of device retailers and 5.2 % device repairers indicated to have received some training. This however does not tally with how they manage the devices at EoL. This could thus imply a significant gap in capacity building. Furthermore, it was noted that device repairers were more aware about e-waste management procedures and guidelines (16.8%), followed by retailers (7.1%)

and lastly the e-waste handlers (6.4%). It was very surprising to note that the device repairers who have received less training on e-waste management were the most aware of the availability of guidelines on e-waste management amongst all the categories of stakeholders. The e-waste handlers who were trained most amongst the three categories of stakeholders are the least knowledgeable of the availability of guidelines on e-waste management. It is the e-waste handlers supposed to be interacting with the e-waste guidelines but very few were aware about them. A question would arise; on what basis do they handle their day-to-day operations on e-waste handling, or are the trainings received from credible trainers?

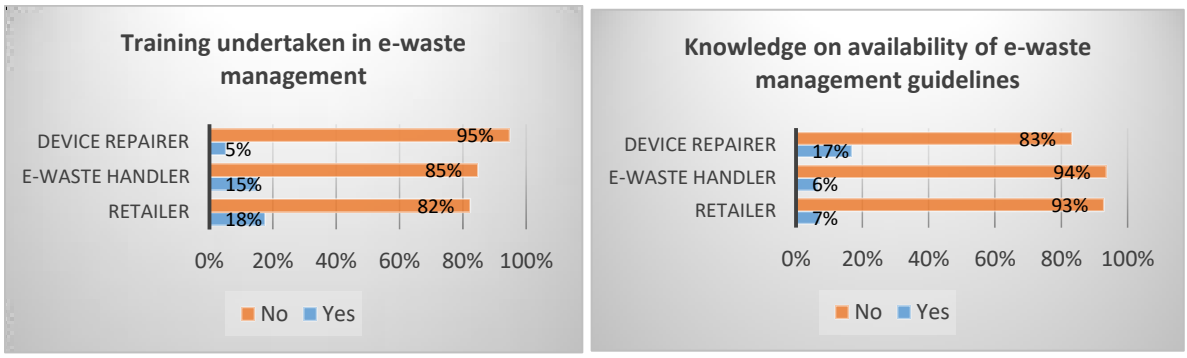


Figure 6-24: Comparison of three stakeholders (retailer, e-waste handler and device repairer)

6.5.5.Summary of challenges on EoL/e-waste management

Figure 6-25 below shows the summary of challenges of e-waste management according to the various stakeholders.

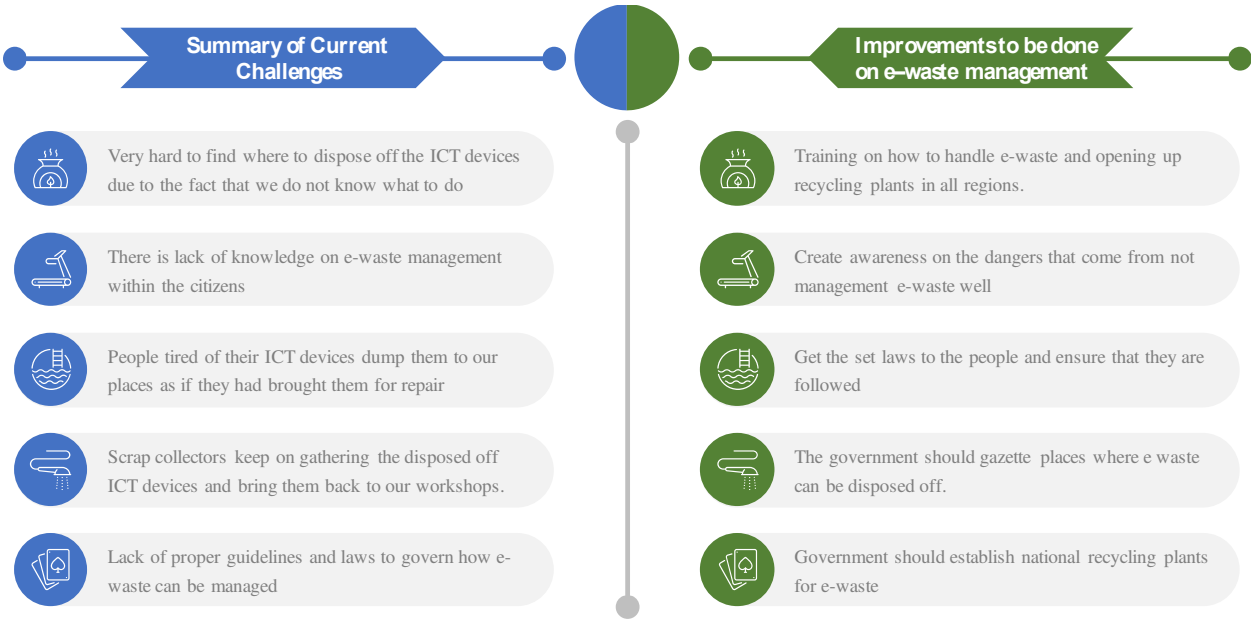


Figure 6-25: Summary of Challenges and Proposed solutions

7. ESTIMATE OF EXISTING STOCK OF END USER COMMUNICATIONS DEVICES IN THE COUNTRY

The study sought to estimate the existing stock of end user communications devices in the country which would then aid in estimating the amount of e-waste from these devices. The estimate of stock was for the equipment under the scope of the study.

Figure 7-1 indicates the estimate of the quantity of end user communications devices imported into the country for a series of 5 years; 2014/2015 to 2018/19, as received from the Uganda Revenue Authority (URA).

Product/device	2014/15	2015/16	2016/17	2017/18	2018/19
Computer/desktop/laptops	174,183	231,418	201,453	267,689	242,564
Telephones including cellular	3,757,741	3,325,353	5,044,692	6,755,980	5,379,105
CRT monitors and TV	109,832	91,021	80,450	17,306	7,859
LCD and LED TVs	179,196	131,998	109,795	133,241	137,315
Portable radios	122,769	270,656	288,343	313,362	345,808
Decorders/settop boxes	251,851	274,947	411,111	219,250	383,981
Total estimates of communications end user devices per year	**4,595,572**	**4,325,393**	**6,135,844**	**7,706,828**	**6,496,632**

Figure 7-1: Estimates of imports for end user communications devices for the years 2014/15 to 2018/19

7.1. Trends in importation of end user communications devices

The import volume has increased over the years for some end user communications devices as well as decreased for some as indicated in Figure 7-2. Trends of importation of end user communications devices including parts, accessories and assemblies over the last five years show that phones are the major end user communications devices imported into the country. These are followed by the importations of TVs, computers and lastly radios, despite their steady annual increase in importation. The importation of phones (Figure 7-3) is reflected in their increased uptake and short replacement cycles, which contributes to the generation of e-waste. Phones also have inbuilt radio receivers or as a downloadable radio or TV app. The import quantity of computers and associated accessories has also had a steady increase for the last four years. The average life span for a computer based on industry benchmark is 3 years while the Ugandan average life span is 4-6 years from the study findings.

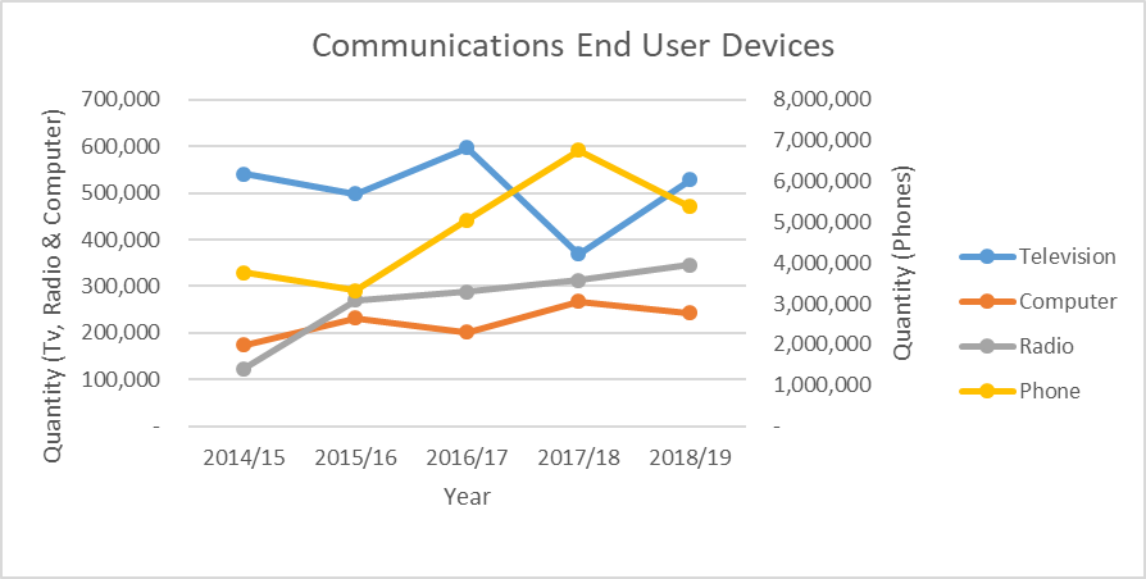


Figure 7-2: Quantity of end user communications devices imported for the years; 2014 and 2019

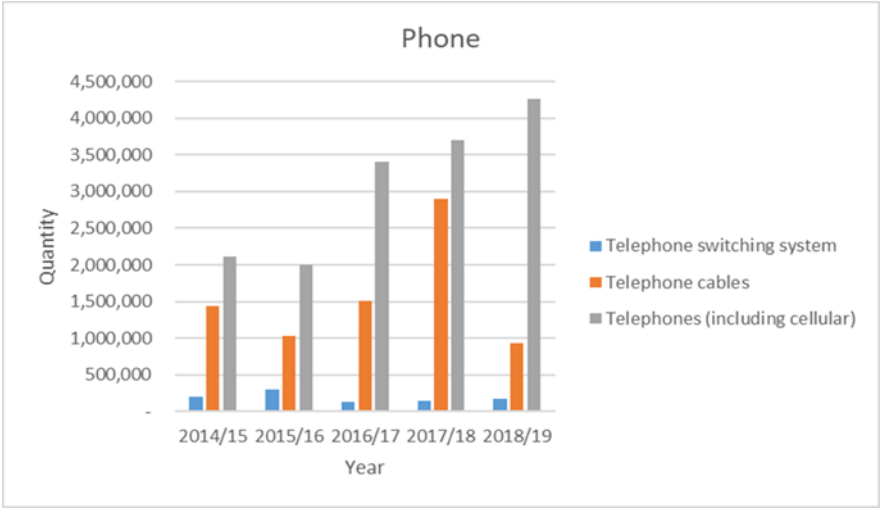


Figure 7-3: Quantity of importation of Phones for the year 2014 to 2019

Figure 7-4 indicates the import quantity of TVs and related accessories. The import quantity shows that decoders, dishes and antennas are mostly imported followed by flat screens (Liquid Crystal Display (LCD) and Light Emitting Diodes (LED) TVs) while the importation of the Cathode Ray Tube (CRT) TVs has decreased significantly over the 5 years by 93%. This decrease may be reflected in the phasing out of brand new CRT monitors on the market or an increase in life style purchase from the CRT to the Flat screen monitors (LED and LCD TVs) as per the study findings, which have also reduced in purchase price.

The increase in importation quantity for decoders, dishes and antennas may be attributed to the regulatory directive of the analogue to digital migration in June 2015.

A decoder or set top box is a hardware device that allows a digital signal to be received, decoded and displayed onto an analogue television.

The average life span of a CRT TV is 30,000 hours or approximately 4 years and this can be prolonged when repaired and replacing malfunctioned parts, while that of an LCD is 5 years as well as for a set top box.

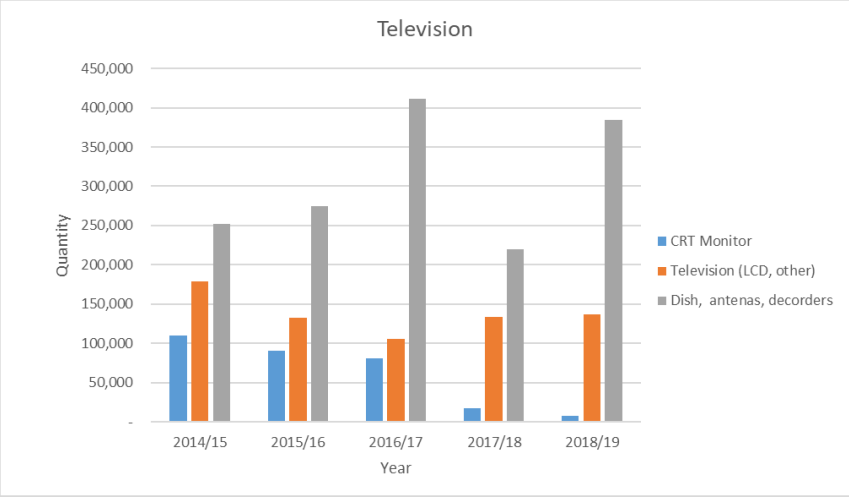


Figure 7-4: Quantity of importation of TVs for the year 2014 to 2019

7.2. Estimate of e-waste generation and volumes from end user communications devices in the country

In estimating the amount of e-waste from end user communications devices in the country, the study considered the classification of the six categories of EEE under the United Nations (*i.e. temperature exchange equipment, screens, lamps, large equipment, small equipment and small IT and telecommunications equipment*), but selected equipment as per the study scope from the categories; screens, small equipment and small IT and telecommunications equipment.

Currently, there is no updated inventory on e-waste generation and volumes in Uganda. The projections of e-waste from end user communications devices were thus estimated from the importation quantities, year of import, replacement cycle and life span. The measurement framework under the UN presents the classification of e-waste considering the harmonized commodity description system (HS Codes) and the European Union (EU) WEEE Directive reporting; the UNU (United Nations University) keys. The UNU keys are constructed such that the product/device groups share comparable average weights, material composition (including hazardous and valuable materials), EoL attributes and lifetime distributions.

Considering the devices for this study herein referred to as end user communications devices; the classification under the HS coding by the URA is linked with the UNU keys alongside the indication of average weight (Kg/unit) as per UNU and EU, 2012.

Table 7-1 indicates the estimates of e-waste generated for the years 2014/15 – 2018/19 that may be projected according to average life span, assuming that;

- The products are put on market (POM) and not re-exports.
- The average equipment life span incorporating the behavioural aspect of respondents drawn from the findings in the above section, to depict the manner in which users handle/manage their end user ICT/communications devices.

Considering;

- Weight =W, Time = t, Lifetime = Lt, average = Av. ;
- Lt of device according to international benchmark is 3 – 5 years, hence an Av. Lt of 4 years;
- An assumption based on study findings that 85% of the users replace their device within 4 years as per Av. Lt, while 15% use the device beyond it Lt to 5 – 7 years, an Av. Lt of 6 years.

Table 7-1: Estimates of e-waste volumes for project after product end of life

Product/device	UNU Key	Indications of Av. Wt/kg	Year (Quantity per year/volume (kg))									
			2014-15		2015-16		2016-17		2017-18		2018-19	
			Qty	e-waste vol(kg)	Qty	e-waste vol(kg)	Qty	e-waste vol(kg)	Qty	e-waste vol(kg)	Qty	e-waste vol(kg)
computers/desktops/laptops	302 - 303	3.0 - 8.8 (av. 5.9)	174,183	940,588	231,418	1,249,657	201,453	1,087,846	267,689	1,445,521	242,564	1,309,846
Telephone (including cellular)	305-306	0.4, 0.1,0.3 (av. 0.2)	3,757,741	751,548	3,325,353	665,071	5,044,692	1,008,938	6,755,980	1,351,196	5,379,105	1,075,821
CRT monitors and TVs	308	13	109,832	1,427,816	91,021	1,183,273	80,450	1,045,850	17,306	224,978	7,856	102,128
LCD, LED TVs	309	5.4	179,196	967,658	131,998	712,789	109,795	571,293	133,241	719,501	137,315	741,501
Portable radios	402	0.2	122,769	24,554	270,656	54,131	288,343	57,669	313,362	62,672	345,808	69,162
Decoder/Set top boxes	404	2.7	251,851	679,997	274,947	742,356	411,111	1,109,999	219,250	591,975	383,981	1,036,748
Total of estimates				4,792,161		4,607,277		4,881,595		4,395,843		4,335,205

From the table above, it is projected that between 2018 and 2022, there shall be an average of 4500 tonnes per year of e-waste from end user communications devices. The estimate of e-waste generated in the specific years is projected for after 3 or 4 years, considering the assumption of period of use. From the assumptions and

considerations above; 85% of the equipment will become e-waste within the required period of 4 years while 15% will become e-waste in 6 years.

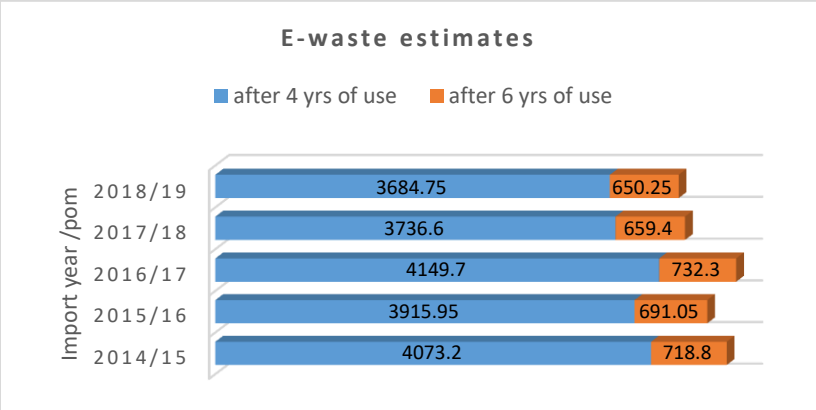


Figure 7-5: E-waste estimates for period 2018 -2022

In the coming years, the volume of e-waste from CRTs will reduce despite their higher average weight per product of 13 Kg, while that of phones with lower average weight per product of 0.2Kg will increase because of the import quantities based on demand and uptake.

8. CONCLUSION:

Uganda's development plans recognize technology as a proven accelerator for economic growth. It provides numerous opportunities and augmenting services in education, health, financial sectors and drives new applications. The proliferation of technology (e-products) has increased affordability, accessibility, and information processing abilities making it absolutely essential to our lifestyles. Current rates, coupled with multiple-device ownership, increasingly generate e-waste which puts the current e-waste eco-system to the test. While technology evolution has transformed social aspects and permeated cultural barriers, there is potential to [degrade] overrun the environment. Significant efforts from all stakeholders (producers or importers, users, e-waste collectors, handlers/recyclers, and policymakers) are needed to ensure a sustainable production and consumption system for EEE, particularly the phased management of e-waste.

The study established that sensitization and increasing awareness for retailers, device repairers, e-waste handlers and end-users of the emerging good practices on EoL management is immediately necessary. A collaboration mechanism for EoL of EEE management should be defined and developed among key players and stakeholders towards establishing a permanent framework. Strengthening regulatory and monitoring capacity at all levels from local government to national bodies like UCC, NEMA, URA, UNBS among others is essential. The process further involves establishing a countrywide inventory on e-waste management life cycles together with updates to the licensing of importers and manufacturers operational procedures in the medium term. Training various stakeholders such as repairers and recyclers (handlers) to and build capacity for homegrown solutions could follow. Ultimately, government and private sector need to explore partnerships to long-term investment including recycling facilities and the consideration of sustainable consumption with due cognizance of the circular economy.

Based on the findings of the study, the following recommendations should be considered to address the various challenges related to management of end user communications devices/EEE at their EoL;

1. Strengthening the regulatory capacities of the various institutions with specific key roles on EoL/e-waste management of end user communications equipment and overall EEE equipment, keeping in due cognizance of the cross cutting issues of e-waste management and the need for multi stakeholders collaborations. This include among others;
    a. Regulating and licensing operations of EEE device repairers and e-waste handlers/recyclers as means of enforcing standards and improving e-waste management,
    b. Incorporating sustainable strategies as an approach to address product and equipment obsolescence through formalising schemes such as the extended producer responsibility (EPR) principle and take-back system in the national regulatory framework. Since Uganda does not manufacture EEE, EPR would then apply to importers, vendors, agents, etc,

c. Type approving end user communications devices/EEE to consider a follow through the entire device life cycle, keeping in due cognisance of the circular economy (CE) to protect human health and the environment such as; having access to information regarding materials recovered from waste to economic operators to facilitate their contribution towards the CE.
d. Verifying and certifying equipment at points of entry (pre-import) to ensure conformity and adherence of their EoL to the set standards *(similar to vehicle inspection),* as well as to cater for circularity,
e. Defining an appropriate and immediate EoL management strategy for end user communications devices taking in due cognizance of the elimination of counterfeit devices and the other regulatory directives such as the ADM among others,
f. Initiating the implementation of the e-waste policy and guidelines,
g. Adopting the international classification of e-waste in terms of similar functionality, weight, and lifetime attributes among others through reviewing the e-waste policy and guidelines to enable the e-waste generated in-country to be quantified and subsequently managed,

2. Designing and implementing a country wide awareness campaign on EoL management of end user communications devices/EEE (including the interpretation of the existing laws, policy and guidelines) targeting all key players,
3. Training on EoL and e-waste management practices. This should be provided to sector stakeholders and consumers by using already existing local capacity, Consideration of integrating into the civic education programmes or ICT courses at higher education to create an enlightened citizenry as afar as addressing challenges of e-waste is concerned,
4. Applauding, supporting and popularizing the emerging good practices on EoL management among the various stakeholders such as the take back arrangements by some retailers, in order to build capacity for home-grown solutions,
5. Defining and developing a permanent collaboration mechanism for EoL management of EEE among key players and stakeholders,
6. Government should spearhead the establishment of an e-waste facility capable of collection, dismantling and recycling through;

    a. Developing strategies of attracting private sector investment and partnership in sustainable e-waste supported centers to collect, manage and recycle e-waste.
    b. The operationalization of the national e-waste collection center,
    c. Designing and implementing an incentives regime for actors across the e-waste management value chain,
    d. Establishing an inventory for EEE and e-waste in the country,
    e. Developing and putting into operation e-waste management ordinances by local governments that streamline service providers including introduction of mandatory sorting of e-waste from other waste to ensure it is appropriately handled.

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