UGANDA COMMUNICATIONS COMMISSION

FINAL REPORT

END OF LIFE (EOL) MANAGEMENT OF COMMUNICATIONS EQUIPMENT (PHASE 1)

Strategy and Research
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ABBREVIATIONS AND ACRONYMS

ARF	Advanced Recycling Fees
ATC	American Tower Company
CE	Circular Economy
CEDARE	Centre for development for the Arab Region and Europe
EAC	East African Community
EACO	East African Communications Organization
EC	European Commission
EEE	Electrical and Electronics Equipment
EMG	Environment Management Group
EoL	End of Life
EPR	Extended Producer Responsibility
ESM	Environmentally Sound Management
EU	European Union
E-waste	Electronic waste
FGD	Focus Group Discussions
FM	Frequency Modulation
GHG	Greenhouse Gas
HS	Harmonized Standard
ICT	Information and Communications Technology
ISP	Internet Service Provider
ITU	International Telecommunications Union
Kg/Inh	Kilogram per Inhabitant
KII	Key Informant Interview
LDC	Least Developed Countries
MEA	Multilateral Environmental Agreement

MFPED	Ministry of Finance, Planning and Economic Development
MoICT&NG	Ministry of ICT and National Guidance
MUK	Makerere University Kampala
NEMA	National Environment Management Authority
NITA-U	National Information Technology Authority Uganda
NPA	National Planning Authority
NSCEW	National Steering Committee on E-waste
OECD	Organization for Economic Co-operation and Development
PACE	Partnership for Action on Computing Equipment
PBB	Poly Brominated Biphenyls
PIT	Project Implementation Team
POPs	Persistent Organic Pollutants
RoHS	Release of Hazardous Substances
SAEWA	South African E-waste Alliance
Telcos	Telecommunications Companies
TV	Television
UIXP	The Uganda Internet eXchange Point
UBC	Uganda Broadcasting Corporation
UCC	Uganda Communications Commission
UNBS	Uganda National Bureau of Standards
URA	Uganda Revenue Authority
UTL	Uganda Telecom Limited
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
UNU	United Nations University
WEEE	Waste Electrical and Electronics Equipment

EXECUTIVE SUMMARY

The continued growth of the Information and Communications Technology (ICT) sector in Uganda has led to the increased entry of communications equipment. Uganda has seen an increase in a number of Licensed Communications Operators in broadcasting, telecommunications and internet service provision who import equipment to keep up with rapid technological advances, to remain competitive. Policy and regulatory directives have further contributed to the influx of equipment into the country. Ultimately, all these communications equipment reaches its End of Life (EoL) and is due for disposal. This equipment including all components and sub-assemblies at their EoL become electronic waste (e-waste), which when not properly managed or treated can lead to several human health and environmental threats.

Proper equipment EoL management is crucial to the e-waste management lifecycle, to minimise the dangers arising from e-waste. Equipment EoL management should not only be considered as a means of mitigating e-waste risks but also as an avenue for opportunities such as employment and recovery of raw materials.

The Uganda Communications Commission (UCC) commissioned this study on EoL management of communications equipment and products to guide its regulatory intervention on the sustainable EoL management of communications equipment throughout their life cycle; from manufacture to distribution through to acquisition and use until they ultimately turn into e-waste. Currently, UCC under its mandate type approves communications equipment before it is deployed in the country. However, there is no subsequent follow-up action taken in the EoL management of this equipment.

The overall objective of the study is thus to assess the current EoL management practices for communications equipment to inform the regulatory interventions towards ensuring that communications equipment and products are managed appropriately right from import through to EoL.

This report provides the output of the study on EoL management of communications equipment in Uganda (phase one) which focuses on core and access network equipment for the telecommunications and broadcasting

service providers. Phase two of the study shall follow and shall focus on consumer/ end-user devices.

It was established that;

Import volumes of electrical and electronic equipment (EEE) have been growing at an annual average of 22% over the last seven years. This has been informed by increased demand and shorter replacement cycles. Of these, 88% of the communications equipment and their components is acquired through purchase while 6% is acquired through donations. It was further established that 79% of acquired equipment could be controlled at its EoL through compliance schemes such as the Extended Producer Responsibility (EPR) and take-back systems. On the other hand, most donations are usually used or second-hand equipment, implying that these too reach their EoL much faster than the new equipment.

95.8% of the operators are primarily in control of the management and operation of their equipment, either entirely or in partnership with contractors. As such, they are accountable for the entire equipment life cycle including EoL. It is worth noting that contractors or vendors manage only 4.2% of equipment.

It was established that 43% of the Operators understand the EoL concept. Of these, 32% were broadcasters and 71% from the Telcos. This calls for greater awareness. Relatedly, the decision that equipment had reached its EoL was driven by, decisions of the technical or engineering department (39.6%) on account of damaged, malfunctioned, not upgradable equipment, etc; deprecation (24%) as well as prevailing standards and regulatory practices (19%).

The study revealed that communications equipment is to a greater extent used beyond its recommended life span. This was attributed to; replacement of equipment parts and components as well as regular equipment maintenance. 22% of the Operators had annual maintenance schedules while 50% maintained their equipment beyond a year. 9.3% of Operators only maintained their equipment when it has broken down.

About disposal mechanisms for equipment that had reached its EoL, 35% of operators kept their equipment in storage, 32% returned to the seller, 24% sold off to other parties while 8.1% are discarded. The "return to vendor" strategy is mainly with the Telcos, while all the Operators do store equipment because of either; the anticipation for other use or replacements of spare parts from within

the dysfunctional equipment or not knowing where to dispose of the equipment. Only 25.8% indicated that they do sell to designated e-waste handlers and recyclers within and outside of the country.

Regarding the financial allocation to EoL management, 57% of the Operators had a budget allocated to EoL related activities, while 42.9% had no budget for EoL. It was further observed that 75% of operators with budget were less than the recommended 5% minimum.

Operators revealed that the major considerations made about EoL practices included; danger of sanctions from the regulator (28%), fear of loss of reputation (21%)and perceived decline in service quality (21%) due to use of obsolete equipment.

The Operators have adopted some best practices for EoL management such as; takeback agreements with manufacturers/vendors, using licensed collectors for batteries, regular equipment maintenance, swaps and upgrades. These need to be promoted.

There is no country level database/inventory for e-waste, implying quantifiable data on e-waste is currently not available.

Building partnerships is a crucial ingredient to successful EoL management. Neither the regulator nor the policymakers can independently drive successful EoL and e-waste management campaigns. Replicating international experiences and success stories may not be the only feasible solution to EoL management. However, home-grown approaches for EoL management should also be developed and executed.

The different categories of EEE do not necessitate a "one size fits all" approach for effective management through their EoL, but rather specific considerations for similar categories depending on the stakeholders as well as on country/region basis.

The policy and regulatory environment for EoL management and e-waste are evolving, and should, therefore be nurtured. As such, the EoL management of communications equipment in Uganda requires a holistic and ultimately comprehensive approach that will allow for an easy entry point to tackling the rapid technology advancements.

Based on the findings, this study puts forward the following recommendations to improve EoL management in Uganda. The recommendations have been classified into two categories, as below;

The immediate recommendations include;

1. The regulatory capacity of UCC should be strengthened with respect to
    a. Type approval of communications equipment to consider a follow through the entire life cycle of communications equipment.
    b. Review of Operators' licensing conditions to provide for EoL management of communications equipment
    c. A reliable database on quantities and technical specifications of communications equipment.
2. Design and implement a countrywide awareness campaign on EoL management of communications equipment targeting all key players.
3. Need to applaud, support and popularise the emerging good practices among the Operators to build capacity for home-grown solutions.
4. Develop an inventory for EEE quantities, e-waste stock (generated and projected), licensed e-waste handlers (collectors and recyclers/disposing centres).
5. Need to define and develop a permanent collaboration mechanism for EoL management of EEE among key players and stakeholders.
6. Commission further research on EoL management and widely disseminate the findings

The intermediate to long-term recommendations include;

1. Develop and enforce strict laws on EoL management.
2. License and certify national e-waste recyclers, and ensuring that the licensing policies and regulations cater to EoL management.
3. Leverage on trained e-waste handlers to train their counterparts (whether informal or formal).
4. Legislation, regulations and policies should be reviewed to incorporate EoL management of EEE, keeping in due cognisance of the circular economy (CE) to protect human health and the environment.

5. Collaborate with the private sector in the establishment of designated collection and disposal centres in different regions of the country.
6. Design and implement incentives regime for actors across the e-waste management value chain.

1. BACKGROUND

1.1 Introduction

In the last two decades, there has been a tremendous increase in importation, distribution and uptake of electrical and electronics equipment (EEE) in Uganda. Specifically, with the Information and Communications Technology (ICTs) equipment in the government, the private sector and at the individual level. This has mainly been due to the elimination of trade barriers in the importation of ICT equipment, liberalisation of the telecommunications sector in 2006, and the development of e-initiatives to improve service delivery. The rapid uptake of the ICT equipment and the evident obsolescence rate due to technology advancement, replacement rate and short life cycles have in turn led to an enormous increase in generation of e-waste, which is now considered as one of the fastest growing solid waste in the world.

In Uganda, despite the government's endorsement of the national e-waste management Policy, Strategy and Guidelines that were developed with an overall objective to ensure the safe management of e-waste in Uganda, the country still faces the challenges of lack of an e-waste management facility and formal e-waste recyclers. Open dumping remains the most prevalent disposal method while most of the obsolete equipment remains piled up in homes and storage facilities, which still poses a health and environmental risk because;

(i) EEE contains hazardous materials,

(ii) Disposal of e-waste poses risks to human health, safety and environment, and,

(iii) Capacities for effective management of e-waste is still lacking or inadequate in most countries, especially in the developing world.

Until recently, obsolete EEE or EEE that has become dysfunctional to the owner was classified as **electronic waste (e-waste)**. However, this does not define the equipment to have reached its end-of-use for that particular need but can be used for another need if passed on to another user. Today, the sustainable and responsible disposal of 'e-waste' is referred to as End-of-Life (EoL) management.

End of life (EoL); refers to the description of stages including the socioeconomic and environmental issues therein and proper procedures (reuse, recycle, refurbishment or treatment) for management of EEE (obsolete, dysfunctional) through to its final disposal. Inadequate EoL management does affect not only

the environment and adverse effects on health but also has an enormous impact on resources (systematic depletion of its resource base of secondary equipment). EoL management applies the "waste hierarchy" to minimise the generation of waste through the utilisation of alternatives such as reuse, recycling, and material recovery before considering the possibility of final disposal.

Management of e-waste has become a global concern due to its adverse effects on human health and the environment. EEE contain components such as; cathode ray tubes (CRTs) screens, circuit boards, computer old motherboards, batteries, mobile phone coatings, switches, printed circuit boards, liquid crystal displays (LCD), monitors, etc. These components contain hazardous or toxic substances such as heavy metals like cadmium, mercury, antimony and lead, arsenic, Zinc which when disposed of improperly contaminate air, soil and water. These contaminated sources affect the growth of plants and aquatic life as well as have adverse health effects on human. Primitive recycling and incineration of components for material recovery also produce toxic fumes that are usually persistent organic pollutants (POPs) such as polybrominated biphenyls (PBB) which pollute the atmosphere and contribute to greenhouse gases (GHG) emissions, as well as sludge from melting processes that contaminate soil and water.

Studies done by Herat and Agamuthu, 2012, have shown concentrations of some heavy metals in nearby freshwaters sited near recycling centres in Canada and China, while the concentration of lead and cadmium were found in human placentas in women that were leaving near one of the recycling centres in China.

In Nigeria and Ghana, a high concentration of copper, lead and Zinc are found around the areas where informal recycling and refurbishing activities are centred. There are also marginalised, or vulnerable communities such as the young children and old women are actively involved in e-waste scavenging and crude recycling, making them prone to increased health risks (Manhart et al., 2011).

On the other hand, EEE comprises of recyclable components like plastics, metals, as well as valuable components like the rare minerals (gold, tantalum

and silver). The recovery of such components saves energy at manufacture stages and prevents the exhaustion of the precious minerals from the earth.

It is against this background that UCC rolled out a study on EoL management of communications equipment and products, aimed at establishing the current EoL management practices of Operators in the communications sector, in line with best practice and industry standards. It is anticipated that findings from this study will inform the development of a sustainable approach that will guide its regulatory intervention in this area. The study shall be conducted in two phases; i.e. Phase 1; on communications equipment[1] and Phase 2; on communications products[2].

This report documents the findings of phase 1 of the study, which focused on communications equipment. Phase 2 shall build on the lessons learnt to inform a holistic approach to EoL management of communication equipment and end user devices.

Definitions: For this study, the following terms shall have the corresponding meanings;

- **Communications equipment**: core and access network equipment for Operators for the telecommunications and broadcasting sub-sectors.
- **Operator:** A person licensed to provide a telecommunications or broadcasting service in Uganda,
- **Primary stakeholders** are those organisations, groups or individuals that are in the communications and EEE business such as; Core and access network providers/owners, equipment manufacturers, vendors and sellers, retailers, etc.
- **Secondary stakeholders** are those institutions, groups or individuals that have direct responsibility, interest or impact in the EoL management of the EEE, and can therefore directly affect its success, such as; regulators, policymakers, researchers, academia, consumers, recyclers, etc.

[1] Core and access network equipment for telecommunications and broadcasting
[2] End user communications devices

1.2 Objectives of the study

The overall objective of this study is to understudy current EoL practices in the Communications sector to inform policy and regulatory interventions geared at ensuring that communications equipment and products are managed appropriately right from import through to EoL.

Specifically, the study shall;

a. Analyse the existing portfolio and market for communications equipment/products, related stakeholders, and existing EoL management strategies,
b. Identify and determine the sustainable EoL management of communications equipment/products,
c. Propose sustainable EoL management opportunities based on existing initiatives and systems in the country.

1.3 The scope of the study

The major activities of this study phase included;

(i) Assessing the existing communications equipment by functional use in Uganda,

(ii) Estimating the import value and volumes of communications equipment,

(iii) Identifying and evaluating the current practices for EoL management of communications equipment,

(iv) Benchmarking best practices in EoL management of communications equipment (national, regional and internationally),

(v) Recommending measures for maintaining an adequately updated inventory of communications equipment and adequate EoL management strategies.

1.4 Report layout

Chapter 1 of the report gives a background of the study including objectives and scope. Chapter 2 presents the methodology that was used for the study, chapter 3 reports on policy, legal and institutional frameworks of EoL management of communications equipment at International, Regional and

National levels as well as country/regional best practices. Chapter 4 presents the study findings and results as well as the analysis. Chapter 5 provides the conclusion and recommendations from the study.

2. METHODOLOGY

2.1 Study Design

A collaborative approach between UCC and academia was adopted for data collection towards the design and execution of this study. The mixed method was also used to analyse the qualitative and quantitative approaches simultaneously. The research and data collection work was broken down into two stages; the first stage was to acquire, compile and compare data for import of communications equipment and the second stage was a review of the literature on EoL/e-waste management.

The study was designed to benefit from both primary and secondary sources. The major secondary data source was identified as the Uganda Revenue Authority (URA), which provided data on the importation of EEE. This data included: volume, value and importer of communications equipment. The design of study required that primary data be sought from the communications Operators (the Telecommunication Operators and Broadcasters), recyclers and collectors (formal and informal), ICT Policymakers, Regulators, Academia, and Development Partners The Telecommunications Operators (Telcos) included the; Infrastructure providers, communications equipment manufacturers/vendors, Internet Service Providers (ISPs) and managed services, while the Broadcasters include the Television (TV) and Radio Broadcasters.

2.2 Study tools and instruments

Two categories of instruments were designed to collect data from different respondents, namely: interview guides (checklists) and questionnaires.

2.3 Stakeholder identification and engagement

Several stakeholders were identified and engaged during the study. These were grouped into two broad categories; Primary and secondary stakeholders. The secondary stakeholders included the; the ICT policy maker (Ministry of ICT and National Guidance -MoICT & NG), government agencies (URA, UNBS, NITA-U, NEMA, UCC) and academia. While the primary stakeholders included the; Telcos, broadcasters, the e-waste handlers and collectors.

2.4 Data Collection and Analysis

Primary data collected was posted, processed and analysed using EPIData, CSPro, SPSS and Excel. Data analysis was mainly quantitative to extract information that could only be interpreted statistically without divulging characteristic features of the individual respondent. This was done to avoid the temptation of breaching consensus on non-disclosure agreed with respondents during data collection.

Secondary data obtained from URA was synthesised to filter the information necessary for adequate prescription of the communications equipment imported into the country. The filtered and aggregated data included; harmonised standard (HS) code, the year of importation, names of importers and exporters, as well as volumes and values of imports. Emphasis was placed on trend analysis.

2.5 Limitations

Some of the respondents preferred to remain anonymous, while others were reluctant to give all information for fear of reprimand by the regulator. This meant that emerging best practices could not be attributable to the respective champions. Aggregation of information denied the researchers the opportunity to expound on how some practices manifest and advantages accruing from such practices.

The lack of harmonised definition of communications equipment by the URA made it difficult to track the equipment under the study definition of communications equipment. Notably, some importation is in parts and accessories, which is not only specific to either Operator or end user equipment.

3. EOL MANAGEMENT OF COMMUNICATIONS EQUIPMENT

3.1 Policy and Legal Framework

Management of EoL is being guided by the various policy, legal and regulatory frameworks in place at international, regional and national levels. This section, therefore, provides highlights to some of the existing frameworks and implementation mechanisms in place.

3.1.1 International frameworks on e-waste

There are international, regional, and national regulatory regimes (e.g. global treaties, Multilateral Environmental Agreements (MEAs), statutes, laws, regulations, international standards) that regulate the interaction between activities associated with the environmentally sound EoL management of ICT equipment with the purpose of reducing the adverse impacts of these activities. They aim to provide appropriate protection to human health and the environment from unsound practices as well as to support the economic performance of the EoL management.

At the 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 (March 1999).

It emphasises, amongst other principles, environmentally sound management[3] (ESM) of hazardous and other wastes. The Convention stipulates some specific requirements, including the following:

- the minimisation of the generation of hazardous and other wastes;
- the reduction of transboundary movements of hazardous and other wastes subject to the Basel
  Convention to the minimum consistent with the environmentally sound and efficient management of such wastes;

[3] ESM is defined as taking all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner, which will protect human health and the environment against the adverse effects, which may result from such wastes.

- specific conditions and a detailed control procedure for any proposed transboundary movement of hazardous and other wastes;
- Cooperation to promote the transfer of technology and use of low-waste technologies.

Waste electrical and electronic assemblies or scrap containing specific components that are listed in Annex VIII of the Basel Convention. These can be considered as hazardous waste4 (Entry A1180) or non-hazardous waste. They include;

- Electronic assemblies consisting only of metals or alloys.
- Waste electrical and electronic assemblies or scrap (including printed circuit boards) not containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB-capacitors, or not contaminated with Annex I constituents (e.g. cadmium, mercury, lead, polychlorinated biphenyl) or from which these have been removed, to an extent that they do not possess any of the characteristics contained in Annex III (note the related entry on list A A1180).
- Electrical and electronic assemblies (including printed circuit boards, electronic components and wires) destined for direct reuse, and not for recycling or final disposal.

However, it has been observed that there is no clear distinction between waste and non-waste about used ICT equipment and the Basel Conventions Control Mechanism. The lack of clarity in defining when used equipment is considered as waste has led to some situations where such equipment was exported, in particular to developing countries, for reuse and discovered to be waste rather than functional equipment. This further poses disposable challenges.

Also, the frequent presence of hazardous substances and components in this equipment or waste and a shortage of adequate installations to treat these in an environmentally sound manner have led to severe problems for human health and the environment in the countries receiving this e-waste.

The European Union has adopted the European Union (EU) Waste Electrical and Electronic Equipment (WEEE) directive as its main legislation on e-waste management. Others include; the Release of Hazardous Substances (RoHS) directive and Directive 2008/34/EC of the European Parliament and of the

Council of 11 March 2008 amending Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). The OECD Decision C (2001)107 final, on the other hand, applies to shipments of green-listed wastes for recovery. Other relevant conventions include the; **Stockholm Convention** on PoPs and the **Rotterdam Convention** on hazardous chemicals.

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

- ISO9000:2005. International consensus guidance on good quality management practices.
- ISO 14001:2004. This standard is designed to address the balance between profitability and reducing
- Environmental impact through an effective Environmental Management System (EMS).
- ISO/IEC 27001:2005: Offers guidelines and general principles for initiating, implementing, maintaining, and improving information security management in an organisation. The objectives outlined provide general guidance on the commonly accepted goals of information security management.

The United Nations has further developed the recommendations on the Transport of Dangerous Goods and Model Regulations based on Industry-specific standards and guidance's, e.g. TL 9000 Quality Management Systems. These cover design, development, production, delivery, and service in the communications industry; it also specifies measurements for companies to help evaluate the effectiveness of quality implementation and improvement programs).

Other standards that exist include;

- WEEELABEX (WEEE Label of Excellence). European standard, which emerged between 2009 and 2012 as part of a project co-financed by LIFE + (European Union - EU environmental program). The organisation responsible for implementing this standard is the "WEEE Forum Association". It is made up of three (3) documents: collection, logistics and treatment and is available in seven (7) languages.

- The Responsible Recycling ("R2") Standard for Electronics Recyclers, which was designed by the EPA (Environmental Protection Agency) of the United States. It is a voluntary standard and Managers or electronics recyclers from anywhere in the world can be certified.

- PACE (Partnership for Action on Computing Equipment) Guidelines: The following guidelines and documents are available: Environmentally sound management of used and end-of-life computing equipment; Environmentally sound testing, refurbishment, and repair of used computing equipment; Environmentally sound material recovery and recycling of end-of-life computing equipment; Transboundary movement of used and end-of-life computing equipment

3.1.2 Policy and Regulatory frameworks on E-waste in Africa

Within Africa, there has been a significant effort towards developing frameworks to guide the management of EoL of equipment and waste. The most common framework is the Bamako convention.

The Bamako Convention is specific for the control of transboundary shipment of hazardous waste into Africa. Uganda acceded to the convention in May 1999. It was developed due to the failure of the Basel Convention to prohibit trade of hazardous waste to less developed countries (LDCs). This was done following the realisation that many advanced nations were exporting toxic wastes to Africa. It thus covers a broader scope of prohibitions compared to the Basel Convention (Bamako Convention).

The purpose of the convention is to;

- To prohibit the import of all hazardous and radioactive wastes into the African continent for any reason;
- To minimise and control transboundary movements of hazardous wastes within the African continent.
- To prohibit all ocean and inland water dumping or incineration of hazardous wastes.
- To ensure that the disposal of wastes is conducted in an "environmentally sound manner".

- To promote cleaner production over the pursuit of a permissible emissions approach based on assimilative capacity assumptions
- To establish the precautionary principle.

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 as regards 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. The EACO held three awareness workshops on e-waste management; In Kenya (2015), Uganda (2017) and in Rwanda (2018). The workshops are geared towards ensuring a multi-stakeholder collaboration in the effective management of e-waste.

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

In Africa, many countries are at various stages of establishing specific e-waste regulations and policies. In most states, e-waste is under hazardous waste regulation, while some states have developed specific regulations and policies. Some of these include;

a) Ghana has an e-waste law,
b) Kenya has a draft regulation on e-waste management,
c) South Africa and Malawi have an e-waste strategy,
d) Rwanda has an e-waste policy.

3.1.3 Uganda

Uganda has made progress in bringing the issues of e-waste to the forefront. Various policies have been put in place in an attempt to inform the management of E-waste in Uganda. These include; following the adoption of

the National e-waste management policy, strategy and guidelines in 2012, 2013 and 2016 respectively by the Government of Uganda.

- National E-waste Management Policy 2012
- E-waste Management Strategy 2013
- E-waste Management Guidelines 2016
- The National Environment Act, 2005[4]
- The National Environment (Waste Management) Regulations, which details the management of waste including the transboundary movement of waste.
- Draft ICT Policy 2004
- Uganda Communications Act of 2013

3.2 Implementation of EoL management

Several initiatives have been undertaken to ensure the proper management of EoL of EEE. This is being done to mitigate the negative impact on societies arising from improper management of the e-waste.

3.2.1 International and Regional initiatives on EoL/e-waste management

The International Telecommunications Union (ITU), a specialised 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 in various areas, which include e-waste and circular economy. It further raises awareness of the role of ICT in tackling environmental challenges.

Specific to EoL/e-waste management the ITU through the Standardization and Development Sectors is addressed through the study groups below;

a) **ITU-T**[5] : Study group 5 (Environment, Climate Change and the Circular Economy), Question 7 – Circular economy include e-waste.
b) **ITU-D**[6]: Study group 2 (ICT services and application for the promotion of sustainable development), Question 8 – Strategies and policies for the purpose of disposal or reuse of telecommunications/ICT waste material.

[4] New Bill 2018 is underway (Has been passed by the Parliament of Uganda, pending endorsement by H.E the President of Uganda
[5] Standardization sector of the ITU

The United Nations, under its United Nations Environment Management Group, has strengthened collaboration among United Nations Organizations towards tackling the challenge of e-waste. The Environment Management Group **(EMG)** is a United Nations (UN) System-wide coordination body on the environment and human settlements, established in 2001. It is reported that over 150 e-waste initiatives having been undertaken since 2004 within by various UN organisations.

The United Nations University (UNU) and the ITU further conducted a study on the global e-waste statistics in 2016**.** This study was undertaken 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 44.7metric tons (Mt) or 44,700 kilograms (kg). This is an equivalent of 6.1Kg per inhabitant (kg/inch) of e-waste annually. They further revealed that this amount of e-waste is expected to increase to 52,200 kg or 6.8 kg/inch by 2021. Furthermore, the study looked at current waste management practices and informed that approximately 2 Mt are thrown into the residual waste in developed countries which most likely ends up in the landfill, while almost 9 Mt of e-waste are documented to be collected and recycled and this corresponds to 20% of overall e-waste generated.

Also, **the Sustainable Recycling Industries (SRI) program** builds capacity for sustainable recycling in developing countries. The program is funded by the Swiss State Secretariat of Economic Affairs (SECO) and is implemented by the Institute for Materials Science & Technology (Empa), the World Resources Forum (WRF) and ecoinvent. It builds on the success of implementing e-waste recycling systems together with various developing countries for more than ten years. The SRI has three linked programs i.e.

a) **Life Cycle Inventories**: SRI develops necessary data for the assessment of environmental and social life cycle performance for industrial activities through the improvement of local and regional expertise in Brazil, India, Egypt and South Africa.
b) **Recycling Initiatives**: SRI improves local capacity for sustainable recycling together with private and public institutions, as well as the informal sector in Colombia, Egypt, Ghana, India, Peru and South Africa.

[6] Development sector of the ITU

c) **SRI Roundtable**: SRI facilitates a stakeholder consultation for the development of sustainability criteria for secondary materials.

The **Southern African E-Waste Alliance (SAEWA**) is an initiative in Southern African that provides constructive solutions to problems associated with responsible handling and disposal of e-waste. The SAWEA comprises two institutions i.e.

- **Desco Electronic recyclers** that provide proper recycling of electronics and various green solutions, to ensure appropriate management of e-waste
- **EWaste Africa** that manages the disposal of light bulbs including recycling

Within the North African Region, The Basel Convention Regional Centre (BCRC), located in Cairo, Egypt, has been coordinating e-waste interventions in the Middle East and North Africa. It provides training in environmentally sound management of e-waste, disseminates information, and promotes technology transfer for e-waste management. The BCRC further supports public-private initiatives to deal with e-waste and other hazardous waste and the development of national strategies that assist in the implementation of the Basel Convention in the Arab States.

Also, the Centre for Environment and Development for the Arab Region and Europe (CEDARE) is also looking at e-waste, as well as climate change concerns. The need for a recycling and "take-back" programme for end-of-life products is being addressed by the respective national governments with the assistance of civil society and the private sector, mostly multinational companies. These include

- **EnviroServ** based in the United Arab Emirates (UAE) that collaborates with governments on e-waste management and recycling,
- **RecycloBekia** is an electronic waste recycling company based in Egypt and serving the Middle East and North Africa (MENA) region. It offers green recycling of electronic waste and safe data destruction services.

3.2.2 Country-specific initiatives in Africa

This section looks at some of the best practices in EoL management that have been adopted by some countries in the African Continent.

Kenya

The WEEE (Waste Electrical and Electronic Equipment) centre in Kenya was launched in 2010 as the first recycling facility in East Africa. The WEEE Centre provides e-waste collection, dismantling and automated processing services in Nairobi and several other major cities in Kenya. WEEE Centre primarily sources e-waste from the private & public sector and through collection campaigns are aimed at individual households. The WEEE centre partners with other companies across the globe where some hazardous material like batteries are shipped to for adequate treatment and disposal.

Kenya has also created an enabling environment for the informal sector in e-waste management. The E-Waste Initiative Kenya (EWIK) is a Kenya based NGO with core business of e-waste management specifically from the informal sector. The NGO has created green jobs through public-private partnerships (PPPs) and working with the communities.

Rwanda

Through a PPP Agreement, the Government of Rwanda and Enviroserve Rwanda Green Park established the Rwanda e-waste recycling and dismantling facility in 2017. The overall objective of the project is to offer an "EoL" solution for EEE, allowing sustainable use of ICTs in the country, by preventing a negative impact of electronic waste on the health or the environment once the equipment has reached its end-of-life. The facility will collect, sort, decontaminate, dismantle e-waste to recover fractions that can be reused or recycled locally and for precious portions that cannot be retrieved by this facility will be shipped to be treated in an environmentally sound manner at the Enviroserve Recycling Hub in Dubai.

Egypt

Egypt has three main recycling companies;

- Egyptian Electronics Recycling Company (EERC) established to operate in cooperation with public and private organisations together with informal e-waste dealers;
- RecycloBekia recycling company which offers green recycling of e-waste and safe data destruction services
- Dr Weee recycling company, which also developed a mobile App to educate people about the need to reduce, recycle, and provide awareness on e-waste management.

The EERC organises monthly collection events and provides various e-waste recycling services including, label tracking system and video verification, recycling incentives (monetary compensation for some products), issue certificate of disposal for e-waste, etc.

Tunisia

In 2008, Tunisia conducted an in-depth assessment by the National Environmental Agency to improve the data available on e-waste in the country. The country also studied the opportunity to introduce a 5% eco-tax on EEE that would generate funds in support of the nascent e-waste management system. Tunisia has one indigenous waste management company, i.e. **Collectun D3E Recycling** that collects, transports and recycles the electronic waste from IT equipment, telecommunications and household appliances. This Company has received support from KOICA, GIZ and the African Development Bank

Nigeria

Nigeria put in place a legal framework to increase the monitoring capacity of public authorities and regulate the collection, treatment and disposal of e-waste. The Nigeria Guide for Importers of Used EEE is also in place to strengthen enforcement mechanisms against illegal trade of e-waste. The country further defined a legal framework in 2012 to implement the EPR and required that all importers, exporters, manufacturers, assemblers, distributors, and retailers, of various brands of EEE products, shall subscribe. In particular, manufacturers, importers, distributors or retailers are responsible for the take-back of EoL EEE and for the set-up of collection sites from where manufacturers and producers of EEE ensure "environmentally sound management of e-waste".

Cameroon

In 2012, Cameroon also introduced the EPR with the Joint Order by the Ministry of Environment, Nature Protection and Sustainable Development (MINEPDED) and the Ministry of Commerce (MINCOMMERCE), establishing specific conditions for the management of e-waste. The Joint Order compels producers, retailers and municipalities to "take measures" to prevent WEEE from being mixed with municipal waste. For each category POM, producers must set up an individual or collective scheme, approved by the Environmental Ministry, or pay a fee to an organisation licensed by the Ministry of Environment. This association would cover the additional

costs of collection in agreement with the municipality. Producers and distributors must also register with the Ministry of Environment, specifying their POM.

Ghana

Ghana is home to the most extensive electronic waste dump site in West Africa, known as Agbogbloshie. Most of the e-waste from Europe has over time been dumped in this location due to its proximity to Europe. Importation is done by formal and informal businesses based in Europe and other parts of Africa.

The Hazardous and Electronic Waste Control and Management Act, Act 917 (2016) has been in place but not fully implemented. This Act informs the management of e-waste and sanctions for illegal imports based on the Basel Convention.

Ghana has begun implementing a collection of Advance Recycle Eco Fee on all electrical and electronic equipment, under the Fifth Schedule of Act 917, imported from all exporting countries. Also, plans are underway to establish a recycling facility at Agbogbloshie, in fulfilment of section 31 of Act 917.

Malawi

The Malawi Communications Regulatory Authority (Macra) has developed a strategy (2017) that will help in the management of e-waste in the country. The country currently has no mechanism to dispose of e-waste or refineries that would be used for recycling purposes. The strategy is expected to address these.

3.2.3 EoL management initiatives in Uganda

In Uganda, some initiatives and best practices have adopted towards effective EoL management. These are included but not limited to the following;

The National Steering Committee on E-waste management (NSCEW) was established in 2016 to coordinate the implementation of the National e-waste policy, guidelines and standards. The NSCEW is composed of various key stakeholder of e-waste management and is chaired by the Ministry of ICT and National Guidance and the National Environmental Management Authority (NEMA) as the Secretary.

In undertaking its work, the NSC has thus developed a 5-year strategic work plan on e-waste management to streamline the management of e-waste in Uganda.

Work is also underway towards the establishment of an e-waste management facility in Uganda.

There are no specific standards purposely developed to address electronic waste (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; the ***US 662:2008***, *Code of practice for inspection and acceptance of audio, video and similar electronic apparatus* and the ***US 735:2008***, *Code of practice for repair and service of electrical and electronic machines/devices.*

Type approval of communications equipment is a good essential step to ensuring that communications equipment imported into the country are suitable for the purpose and will delay getting into the waste stream. The 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, therefore, type approves communications equipment in accordance with Section 5 (k) of the Uganda Communications Act 2013. This is done to among others, protect communications equipment from any harm or damage, and to protect the general 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.

E-waste handling in Uganda is mostly informal. There are no specialised handlers in the Country. E-waste is 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. The waste handlers are licensed by the National Environment Management Authority (NEMA). The handlers have noted challenges such as; limited space for the storage of e-waste, high e-waste transportation costs transportation of e-waste is costly. There is also no formal inventory of e-waste for Uganda. There is also limited information on the transboundary movement of e-waste.

However, Uganda has created partnerships and collaborations with development partners and other institutions such as UNDP, UNIDO and Microsoft in e-waste management. These collaborations have led to initiatives such as; the

study that was conducted an assessment study on e-waste specific to computer in 2008, the development of the e-waste policy, guidelines and strategy, and the proposed establishment of the manual dismantling plant, the establishment of a refurbishment pilot project for secondary computers, etc.

3.2.4 E-waste management compliance schemes

a) The Extended Producer Responsibility (EPR) concept

EPR is a concept where manufacturers and importer of equipment and products should bear a significant degree of responsibility for the environmental impacts of their equipment and products throughout the product life-cycle including upstream impacts inherent in the selection of materials for the equipment and products, impacts from manufacturers 'production process itself, and downstream impacts from the use and disposal of the equipment and products.

EPR has been generally successful in Europe. Some countries in Africa have also adopted the concept while others are putting in place mechanisms to effect it. It has to be noted though, that in some countries it has not been so successful especially in cases of inadequate understanding of environmental costs and lacking the quality of collection services to the public. EPR success requires cooperation between governments, producers and waste management organisations with clear national legislation to support the scheme.

The impacts of EPR are more predominant in product design where environmentally conscious designs are becoming more common, and there is a reduction in hazardous materials contained in products, especially from Europe. Many products are also designed to be recyclable.

b) Take back system

The take-back system necessitates strong and effective reuse and recycling infrastructure. It is a means of a solution whose primary functions are collection, processing, system management and financing scheme. Different countries and organisations work with different system models to take back.

c) E-waste inventory

An e-waste inventory is a useful e-waste management tool as it helps to quantify and characterise e-waste. It can be regarded as a fundamental source for e-waste statistics for a sector/region/country and hence used in the prediction of

volume/weight of e-waste for the future. The inventory can also be used to identify waste streams by indicating sources and destination of e-waste. Information from the inventory can be used as a basis for investments into e-waste management and inform on progress and challenges in e-waste management.

d) Advanced Recycling Fee (ARF)

The ARF is a concept where the consumer is charged in advance a non-refundable recycling fee when purchasing EEE. The ARF gives the recycler confidence that there will be compensation in the service provision, which depicts fairness. It, however, requires a clear definition of the type of equipment imported into the country for those countries that do not manufacture like Uganda.

4. STUDY RESULTS ON EOL MANAGEMENT OF COMMUNICATIONS EQUIPMENT IN UGANDA

4.1 State of importation of communications equipment in Uganda

This section documents the status of communications equipment in Uganda and how it is expected to degenerate into the waste stream. It looks at the trends in the importation of communications equipment over the past five years. It further estimates how much of the equipment is anticipated to have reached its EoL. The analysis is based on import data of communications equipment obtained from URA. Data was filtered based on HS[7] codes for equipment.

4.1.1 Trends in Importation of communications equipment

Import volume of communications equipment has increased steadily over the past decade as indicated in Figure 4-1. Trends of importation of communications equipment and components over the last seven years (2009/10 – 2016/17) show that the major equipment units and components imported include; base stations, batteries, amplifiers, and transmission apparatus (fibre optic cables, coaxial cables, etc). This increase in import volume is reflected in the uptake of communications equipment and shorter replacement cycles, which in turn contributes to the growth of e-waste.

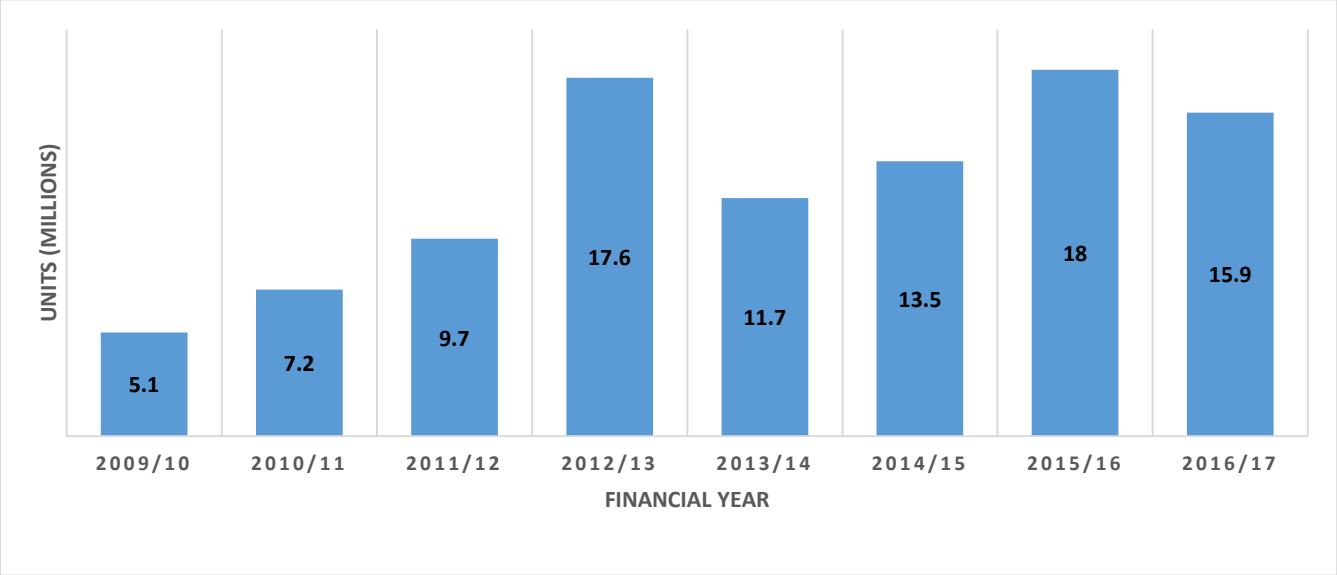


Figure 4-1: Trend of importation of communications equipment

[7] Harmonized Commodity Description and Coding System

The import bill for communications equipment has soared over the past decade.

The data on the importation of communications equipment obtained from URA indicates that equipment worth UGX 4,031 Billion were imported into the country between 2010/11 and 2016/17. Of these, telecommunications equipment was worth UGX 2,896 Billion, accounting for approximately 72% of the communications equipment imports.

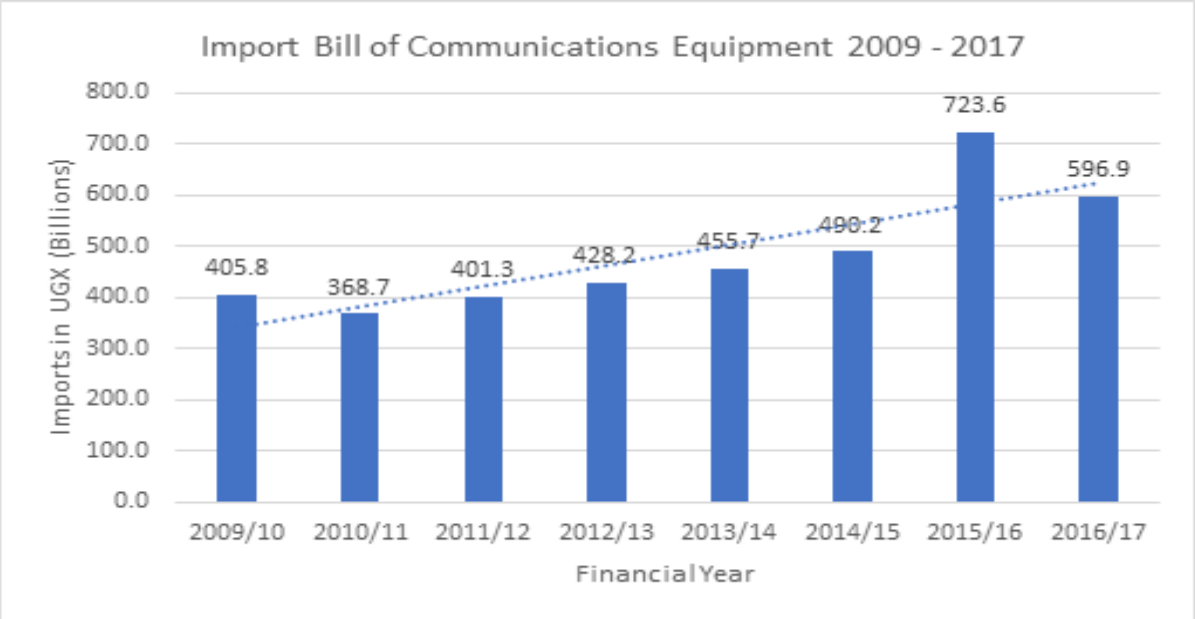


Figure 4-2: Percentage change in import value of communications equipment

4.1.2 Mode of acquisition of Communications equipment

The study sought to establish the method of acquisition of communications equipment. Findings reveal that 88% of the communications equipment and their components are acquired through purchase, 6% is acquired through donations and 6% through other means that were not clarified by the Operators.

Of the acquisitions via purchases, 50% is purchased directly from the vendors, 29% from authorised dealers and 9% is bought off the shelf. It was also established that 6% of broadcasters' equipment is acquired through donations.

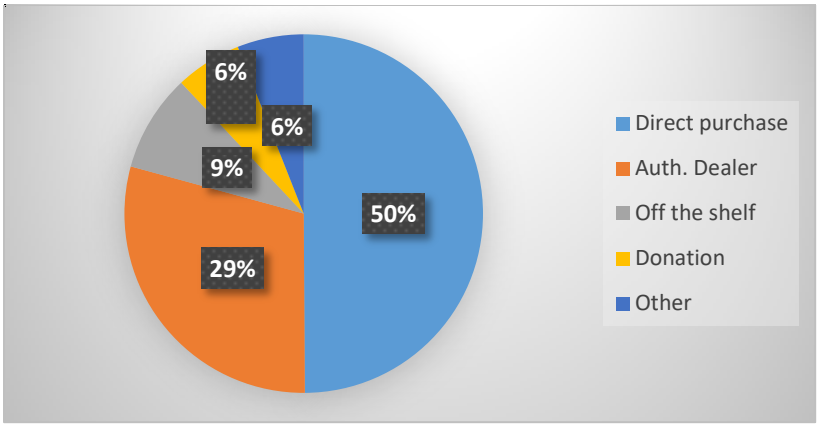


Figure 4-3: Acquisition of communications equipment

The mode of acquisition determines the EoL management of equipment. 79% of acquired equipment (sourced from the manufacturers/vendors and authorised dealers) can be controlled at its EoL through compliance schemes such as the EPR and take-back system. On the other hand, the EoL management of 21% of acquired equipment (purchased off the shelf and through donations) is left to the discretion of the buyer/user. It was further noted that most donations are usually used or second-hand equipment, implying that these too reach their EoL much faster than the new equipment.

4.1.3 Ownership and management of communications equipment

The study established that all the Operators own the core equipment for their networks. Despite the emergence of new infrastructure delivery measures, the study noted that the operators are in ownership of their core equipment. This choice of ownership is driven by the desire to be in control (operate, maintain, repair, etc.) of the business. About the management of the equipment, it was established that some operators opted to outsource the management of the non-core equipment. Table 4-1 summarises the management/operational models of communications equipment by the operators.

Table 4-1: Management of equipment

Nature of operation	Broadcasters	Telcos	Total (%)
Our selves/in-house	72.7%	36.4%	**50.0%**
Contractors/vendor	0.0%	20.0%	**4.2%**

Mix of in-house & contractors	27.3%	43.6%	**45.8%**

The operators are mostly (95.8%) in control of the management and operation of their equipment, either entirely or in partnership with contractors. As such, they are accountable for the entire equipment life cycle including EoL.

4.2 Awareness and interpretation of equipment EoL

The level of awareness and the interpretation of equipment EoL among Operators is vital for establishing the practices being implemented. Figure **4-4 indicates the respondents understanding and interpretation of communications equipment EoL.** It was found that 43% of the Operators understand the EoL concept, while 57% do not understand the concept.

For those that were aware of EoL, 17% interpreted it as when the equipment has reached its end of useful life and 26% when the equipment is no longer serving its original purpose.

On the other hand, for those that were not aware of EoL, 38% referred to it as when the equipment is malfunctioned or damaged but can be repaired or have some of its parts replaces, while 19% referred to it as equipment not upgraded.

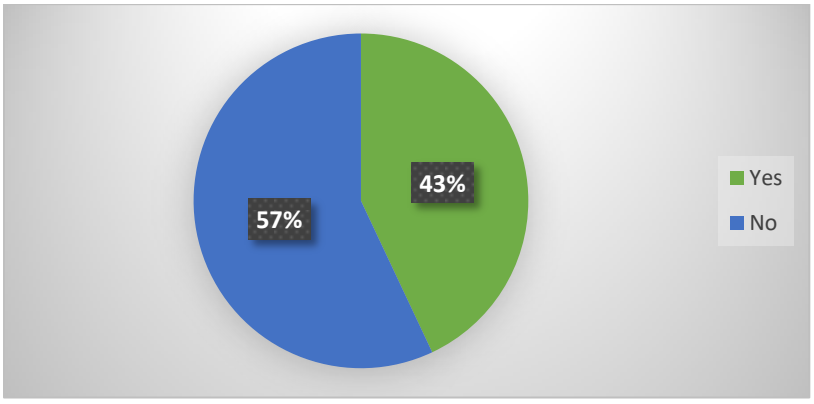


Figure 4-4: *Respondent's understanding and interpretation of equipment EoL*

Overall, increased awareness is required to ensure a harmonised understanding of EoL management. This will then determine the implementation of the required practices.

4.3 Factors determining EoL of communications equipment

EoL of communications equipment is determined by various factors. In the case of Uganda,

Figure 4-5 provides a snapshot of the key determinants. It was revealed that recommendations from the technical or engineering departments mostly inform the determination of EoL (39.6%). This is usually as a result of issues such as s; damaged, malfunctioned, not upgradable equipment, etc. The other factors that determine equipment EoL that were identified from this study were equipment depreciation (24%).

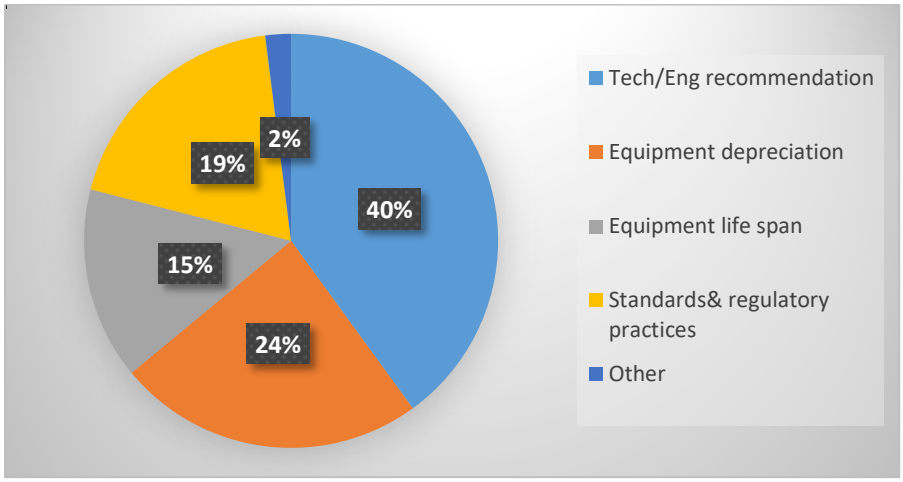


Figure 4-5: Basis of equipment EoL by Operator

Disaggregation of depreciated equipment revealed that (7%) is based on book values or while (17%) is amortized based on industry use in accordance with best practices. Other determinants of EoL include life span (15%), prevailing standards and regulatory practices (19%) and technology advancement (2%). Within the industry segments, it was established that while both Broadcasters and Telcos relied mainly on the technical recommendations from their engineering departments, broadcasters further emphasized prevailing standards while Telcos considered equipment lifespan as important.

It should, however, be noted that even with the consideration of life span or standards, most equipment is considered for EoL when dysfunctional or obsolete as would be recommended by the technical and engineering department, and this would, therefore, be the percentage considered for disposal.

The study established that communications equipment is to a greater extent used beyond its recommended life span. This was attributed to; replacement of equipment parts and components and regular equipment maintenance. The replacement of equipment, parts and components is dependent on the type and functionality. *Table 4-2*A indicates the average replacement cycle for selected communications equipment

Table 4-2: Average replacement cycle for selected communications equipment

Equipment	Industry Benchmark (years)	Ugandan Average lifespan (years)
Routers	3.5	5
Switches	3	5
Fibre	10	3
batteries		2
Cat 6 cables	10	5
Broadcasting consoles	6	2
Hard discs	4	4
computers	3	4

In regards to maintenance, the Broadcasters maintain (scheduled service, repairs, fault diagnosis) studio equipment on average every quarter, the TV transmitters are maintained on average monthly, and amplifiers every twice a year. The average maintenance of server rooms for the Operators is every six months while upgrades are done on average every five years. Figure 4-6 indicates the frequency at which the Operators replace equipment, parts and components on average.

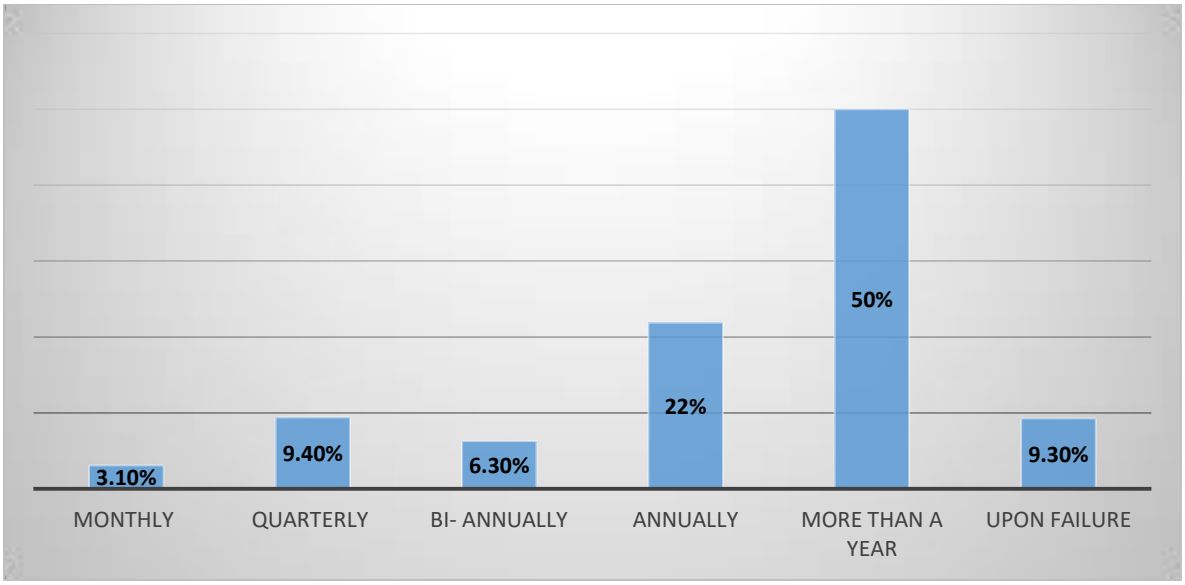


Figure 4-6: Frequency of replacing equipment

Equipment failure accounts for 43% for all replacements as indicated in Figure 4-7. This failure could result from a number of factors including wear and tear due to overuse, poor handling or exceeding the recommended lifespan and load. 27% of the equipment replacement is attributed to obsolescence. Other determinants for equipment replacement include; slow performance at 12%, equipment life expectancy with alarm notifications at 6.7%, Upgrades at 7.8% and Swaps at 3.3%

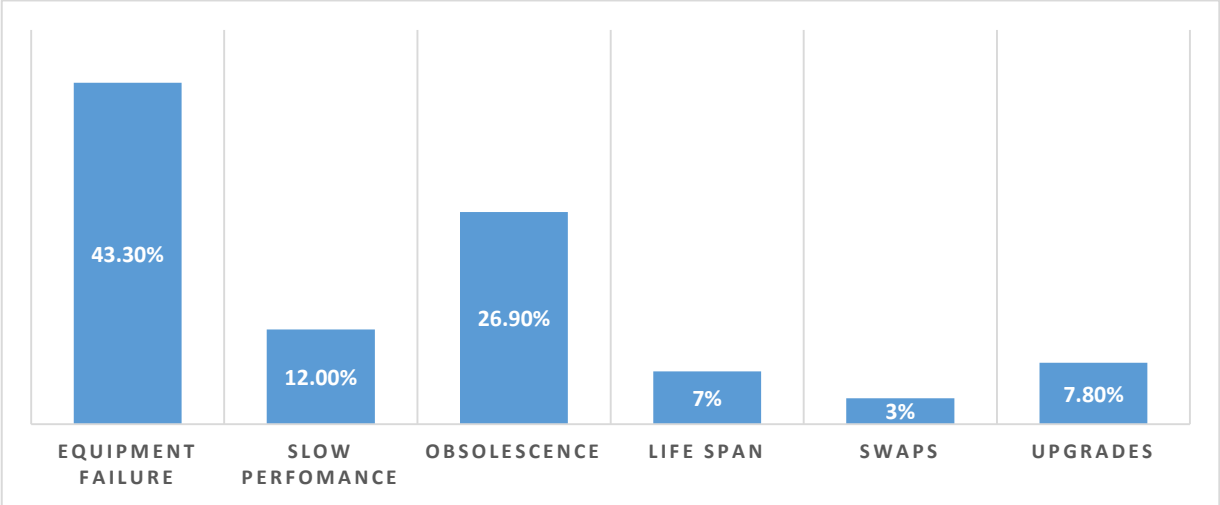


Figure 4-7: What informs the replacement of equipment

4.4 Disposal Mechanisms for Communications Equipment

The study established that the Operators handle or dispose of their obsolete or dysfunctional equipment and components in various ways as indicated in Figure 4-8.

Figure 4-8: How to deal with equipment at EoL

Returning the obsolete or dysfunctional equipment to the vendor/manufacturer or where the equipment was purchased is a good practice in EoL management of communications. Storage at premises or warehouse is a temporary measure, given that there should be outlined a clear process for final disposal. Discarding of and selling the equipment to other users cannot be categorised as proper EoL management practice. The "return to vendor" strategy is mainly with the Telcos, while all the Operators do store equipment because of either; the anticipation for other use or replacements of spare parts from within the dysfunctional equipment or not knowing where to dispose of the equipment. Some respondents also indicated the reservation to dispose of, but instead store for data protection and information security in some of the equipment.

For the Operators that sell off to others, 25.8% indicated that they do sell to designated e-waste handlers and recyclers within and outside of the country. While the other purely dispose, off to interested persons which would be referred to as informal in this case.

Considerable attention is required to establish the destination of this discarded equipment and equipment sold off to informal buyers. It is also essential to follow up on the equipment that is stored to ensure it is appropriately handled at its EoL.

4.5 The capacity of Serviced Providers to manage EoL of communications equipment

The study established that some Operators have catered for EoL during their business processes and have allocated a budget to this effect. 44% of the Operators have developed internal policies and put aside resources (human and financial) dedicated to environmental management including EoL. 29% of the Operators have provided for a storage area/facility for obsolete/dysfunctional equipment; whole 17% have a "Return to Vendor/Seller" policy and 5% take their equipment into designated e-waste handlers and recyclers. Having designated resources and policies related to EoL, "Return to Vendor" policy and recycler arrangement should be encouraged.

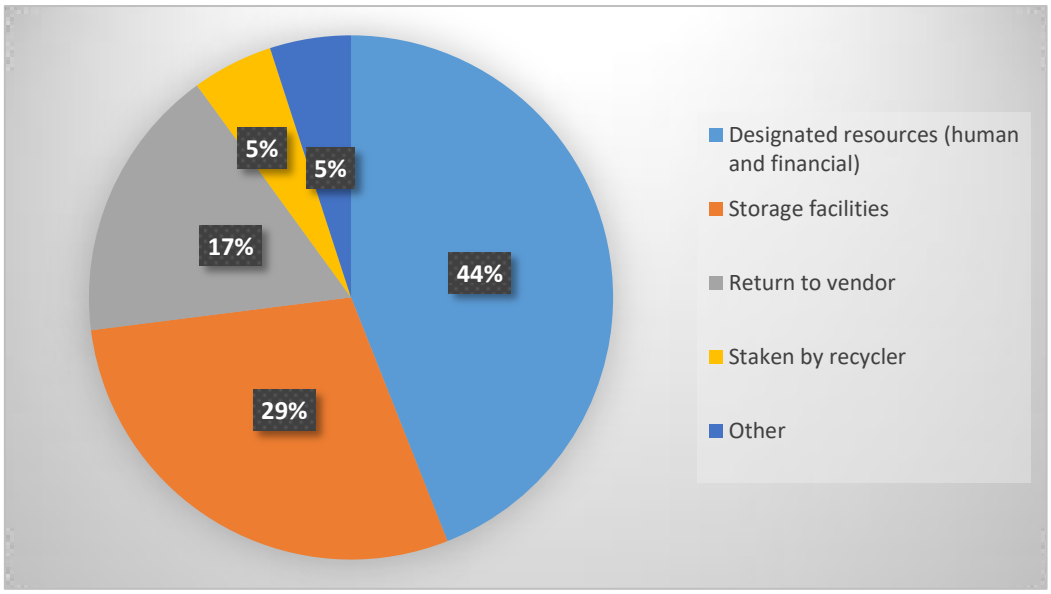


Figure 4-9: Capacity existing in the organization about EoL

Regarding the financial allocation to EoL management, 57% of the Operators had a budget allocated to EoL related activities, while 42.9% had no budget for EoL. The study established that budget allocation to EoL management is not a

priority to Operators. Figure 4-10 indicates the proportion of the budget allocated by the Operators on EoL related activities. Greater awareness is required to the Operators who have no budgets allocated to EoL. Budget allocation on EoL in an organisation defers by the size and nature of business of the organisation. Best practice recommends a 5-10% budget allocation for EoL.

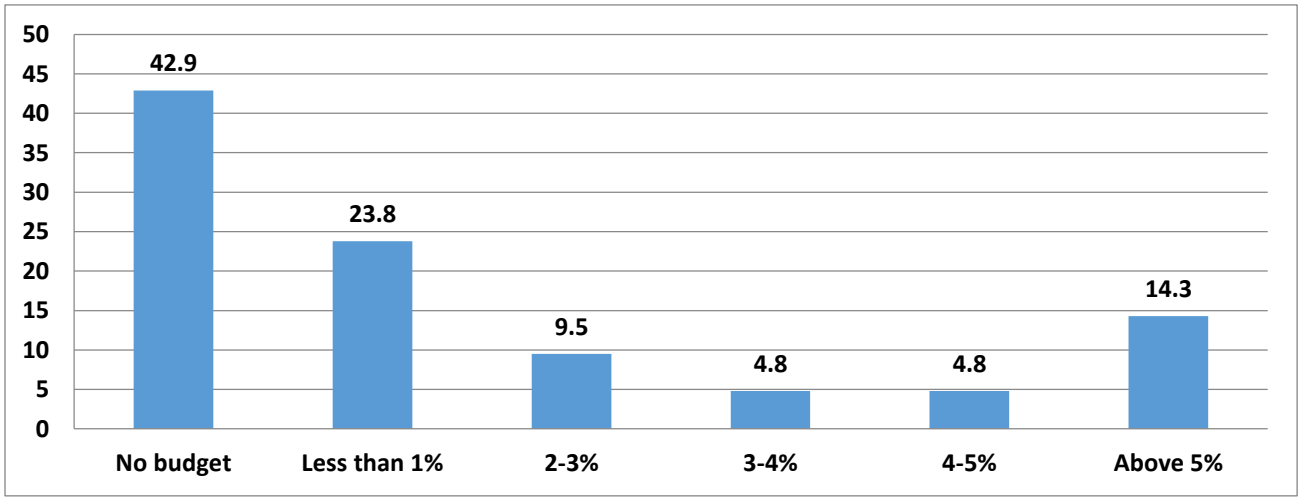


Figure 4-10: Proportion of budget allocated to EoL by the Operators

4.6 Risks to Operators for not observing proper EoL management practices

Operators acknowledged risks that exist to their organisations when they do not follow sound management of EoL of communications equipment. The risk associated with poor management of EoL of communications equipment include; danger of sanctions from the regulator, loss of trust and customers, the perceived decline in service quality and fear of being outwitted by rivals who comply with standard management practices.

Figure 4-11 indicates the perceived risk by Operators if they do not observe the proper EoL management practices.

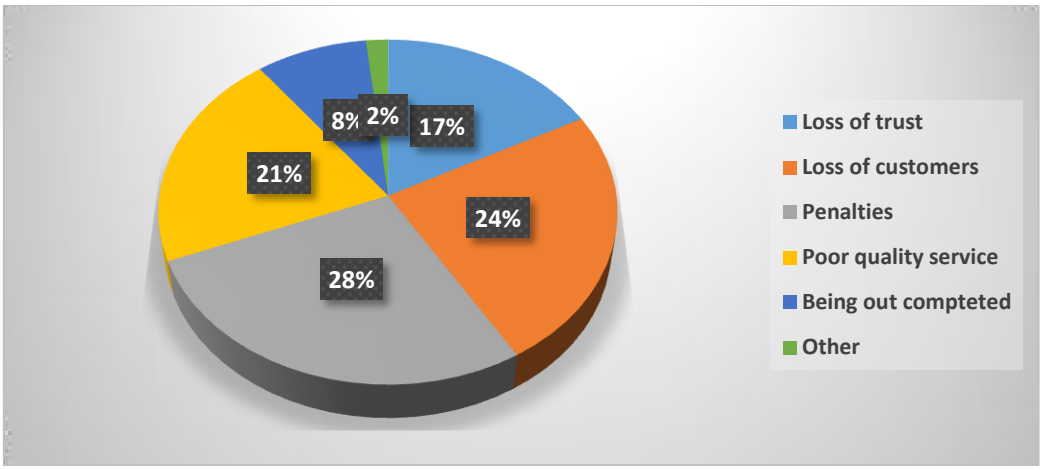


Figure 4-11: Perceived risk by Operators due to improper EoL management of communications equipment

4.7 Estimation of the stock of obsolete/dysfunctional equipment

With the lack of an updated inventory on e-waste generation in the country, the estimate of recycled and disposed of (and how) e-waste remains a challenge. However, the projections can be made from the import volumes (net weight of equipment and components), year of import, value, replacement cycles and life span.

There are various methods used to estimate e-waste generation from decommissioned, dysfunctional or obsolete equipment. One of the most common methods is the market supply or the "simple delay model" where the data of sales is combined with a life span of EEE (imported or manufactured). The assumption in this method is; the total amount of EEE sales in one-year supply becomes waste when their average life span ends. The estimation of life span considers; reuse, storage, recycling and disposal. The consumption and use method is another method of estimating e-waste quantities based on the stock levels of electronic devices.

Take for instance, when we consider the import volume of broadcasting equipment (audio amplifiers, broadcast receivers, sound and video recording apparatus, colour reception apparatus, coaxial cables, consoles, etc). The total of import volume of the above equipment for the four years 2010 – 2013 is estimated at **24m,** as received from URA data. From the study results, the average years by which most of these equipment are replaced is 3-4 years. However, some equipment components therein like diodes, conductors,

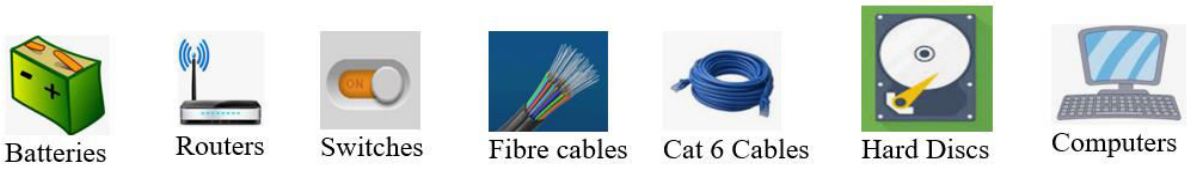
switches, batteries may be replaced within the functional equipment. Taking the assumption that all or most of this equipment was imported and used at that time, which would be possible for Operator equipment, this would then mean the same volume estimate has reached its EoL. The import volumes of broadcasting equipment are used, given the background from the study that established that a tiny percentage of the Broadcasters have a "Return to vendor" policy. This means that this equipment was either stored somewhere or had been discarded.

Since there is no direct data on the amount of communications equipment but instead what is imported, the estimates can be based on the information of stock levels but for each type of equipment. Table 4-3 shows the estimation of the replacement cycle of a selected sample of equipment for a telco company in Uganda. The replacement cycle is based on the average life span as per study findings.

However, for accurate results, this estimation of the e-waste values should incorporate the percentage of materials recovered and their value base on the market value recommended by the United Nations Environment Program (UNEP).

Table 4-3: Replacement cycle for selected equipment for a telco company

Equipment								**E-waste *(base on the Ugandan average life span as per Study findings)***								
2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
																
																
																
																
																
																
																



4.8 Recommended priority areas for Government intervention in EoL management

Respondents provided recommendations towards initiatives that government agencies can undertake to ensure proper management of E-waste. Figure 4-12 details the proposed interventions.

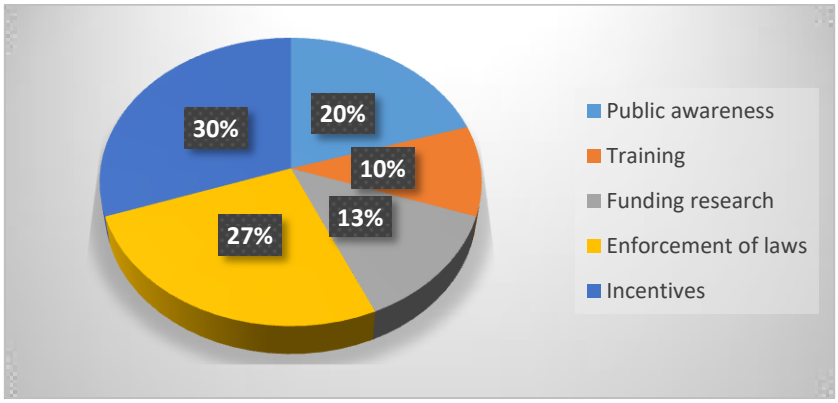


Figure 4-12: Priority areas for government intervention

The top three recommendations included; Provision of incentives to actors across e-waste management value chain (30%); development and enforcement of strict laws on e-waste management (27%), and hosting of public awareness programmes about EoL management of communications equipment (20%). These interventions address significant binding constraints in the e-waste management value chain, namely;

a) Limited awareness and appreciation of e-waste management,
b) non-enforcement/limited compliance with e-waste management laws and
c) Limited support from the government for development of e-waste management infrastructure.

The respondents further called for strict enforcement of e-waste management regulations including the imposition of hefty fines on actors that fail to comply with the requirements of the national E-waste Management policy and regulations. Other priority interventions required include funding research on e-waste management and training human resource in equipment EoL & e-waste.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Based on the findings of the study, the following key messages obtained:

1. The majority of the communications Operators do not mind where or to whom they dispose of decommissioned or obsolete equipment. Subsequently, many of the old equipment find their way to unlicensed scrap dealers and informal recyclers that cannot manage waste in an environmentally sound manner.

2. Most of the Operators especially the Broadcasters do not have a budget line for EoL management of their equipment. This is mainly attributable to a low appreciation of the importance of EoL management. Also, the Operators keep obsolete or malfunctioned equipment with the hope of reuse of some of the components therein.

3. There are some best practices in EoL of communications equipment in Uganda. These include take-back agreements with manufacturers, using licensed collectors for batteries by some companies, regular maintenance of equipment, swaps and upgrades, management contracts, and return to the vendor agreements. These need to be promoted.

4. There is no country level database/inventory for e-waste. This means that there is a lack of reliable e-waste data. Indeed, the amounts of e-waste continue to grow based on the increasing quantities of imports of communications equipment into the country with no clear indication that these leave the country after they reach their EoL. There is need to set up an inventory (even at sector level) as this will be a significant source of e-waste statistics that can be used to inform on EoL management practices, the effectiveness of policies, investment opportunities etc.

5. The levels of awareness about EoL management and e-waste also vary across different players. Various players pursue different disposal strategies/approaches or none at all. In fact, due to lack of awareness, most of the services providers do not have a budgetary allocation to EoL management related activities. 42.9% of respondents indicated that their organisations have no budget allocation for EoL management. Of those with the budget, the majority have it set at less than 1%.

6. Building partnerships is a crucial ingredient to successful EoL management challenges. Neither the regulator nor the policymakers can independently drive successful EoL and e-waste management campaigns. Therefore, an integrated approach is needed for successful EoL and e-waste management. This would be the basis for the formation of a permanent collaborative mechanism between key stakeholders.

7. While benchmarking on international experiences and success stories is important, replicating these may not be feasible especially between developed and developing countries. Home-grown approaches for EoL management of EEE should be developed and executed. These should be informed by lessons learnt from countries that have been successful in the implementation of EOL management.

8. The policy and regulatory environment for EoL management of communications equipment and e-waste are evolving. For example, the national e-waste policy and strategy are in place; the National Environmental (waste management) regulations are under review with precedent to e-waste management therein. The policy measures such as the pre-shipment verifications of conformity (PVoC) have some positive implications on e-waste management especially about minimising stock of e-waste in Uganda. The critical challenge though in implementing EoL management practices is that current laws related to e-waste are not always enforced and there is a lack of a clear mandate on e-waste. Also, the lack of country-specific standards on e-waste means that equipment entry and disposal cannot be well regulated.

9. The EoL management of communications equipment in Uganda requires a holistic and ultimately comprehensive approach that will allow for an easy entry point to tackling the rapid technology advancements.

10. The different categories of EEE do not necessitate a "one size fits all" approach for effective management through their EoL, but rather specific considerations for similar categories depending on the stakeholders as well as on country/region basis. National provisions concerning the definition or interpretation of waste may defer, and the same material that is regarded as waste in one country may be non-waste in another country.

5.2 Recommendations

5.2.1 Immediate actions

1. The regulatory capacity of UCC should be strengthened with respect to
    a. Type approval of communications equipment to consider a follow through the entire life cycle of communications equipment.
    b. Review of Operators' licensing conditions to provide for EoL management of communications equipment. Communications services providers should provide compliance reports on the state of their equipment.
    c. A reliable database on quantities and technical specifications of communications equipment.
    d. Develop guidelines on e-waste management for the industry.
2. Design and implement countrywide awareness campaign on EoL management of communications equipment targeting all key players. At Operator level, awareness sessions should mainly focus on top management of telecommunications companies and media houses that influence decisions at strategic level. Training on EoL & e-waste management practices should be provided to sector stakeholders by using already existing local capacity.
3. Need to applaud, support and popularise the emerging good practices among communications Operators to build capacity for home-grown solutions.
4. An inventory for e-waste should be established, maintained and widely distributed to Operators across the country. This inventory should include a list of licensed e-waste handlers (collectors and recyclers/disposing centres, the current stock of e-waste including predictions and location of e-waste.
5. Define and develop a permanent collaboration mechanism for EoL management of EEE among key players and stakeholders. Establishing a phased approach of including EEE into the EoL or e-waste management system. The initial phase may consist of specific e-waste categories such as communications equipment and products, and once the national e-

waste management system is in place, other additional e-waste categories and products may be incorporated.

6. Commission further research on EoL management and widely disseminate the findings.

5.2.2 Medium to long-term recommendations

1. Develop and enforce strict laws on EoL management.
2. License and certify national e-waste recyclers, and ensuring that the licensing policies and regulations cater to EoL management.
3. Leverage on trained e-waste handlers to train their counterparts (whether informal or formal).
4. Legislation, regulations, and policies should be reviewed to incorporate EoL management of EEE, 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. Need to incorporate 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.
5. Collaborate with the private sector in the establishment of collection and disposal centres in different regions of the country. While it may not be directly financially viable to establish collection or disposal points, it is essential to define a take-back system, keeping in due cognisance the adoption of an incentive regime to actors across the EoL management values chain. Also, to note that different categories of EEE require different collection points and different management at their EoL.
6. Design and implement incentives regime for actors across the e-waste management value chain.

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