MALAWI

Developing an E-waste NATIONAL POLICY AND REGULATORY FRAMEWORK FOR MALAWI

Report

Telecommunication Development Sector

Developing an e-waste national policy and regulatory framework for Malawi

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Executive summary

The objective of this project is to develop a national policy and regulatory framework, including a strategy and action plan for electrical and electronic waste (e-waste) management in Malawi. The development of this objective entails:

- An assessment of current e-waste treatment and a forecast of e-waste volumes and values related to specific electronic devices: mobile phones, computers and television (TV) sets.
- Laying the groundwork for mechanisms to control the import, reuse, recycling options and/or production of information and communication technology (ICT) devices (mobile phones, computers, screens and TV sets).
- The identification of activities and responsibilities for each stakeholder, both private and public, involved in the sound management of e-waste.
- The establishment of a financing model for the e-waste management system.

The report is divided into eight sections in addition to the executive summary, which gives an overview of the main findings and recommendations of this report.

Section 1 provides introductory information on Malawi geographic, political, and socio-economic characteristics. Section 2 describes the evolution of the information and communication technology, and telecommunication sector. Section 3 presents the existing legal and policy framework for e-waste. Section 4 describes the main components of an e-waste take-back system. Section 5 presents an international benchmark of e-waste policy, legislation and regulations in eleven countries from Africa, the Americas, Asia-Pacific, and Europe. Section 6 presents the estimations and forecast of e-waste for mobile phones, computers and TV sets in Malawi. Section 7 presents recommendations on the e-waste policy and regulatory framework for Malawi. Section 8 describes the action plan and next steps for Malawi to implement the recommendations on e-waste.

What is e-waste?

E-waste can be defined as any electrical and electronic equipment that is discarded or is intended to be discarded or is required to be discarded after use, including all components, sub-assemblies, and consumables that are part of the product at the time of discarding, provided they belong to one or more of the following categories:[1]

1. Temperature exchange equipment (refrigerators, freezers, equipment which automatically delivers cold products, and air conditioning equipment, among others).
2. Screens (televisions, LCD (liquid-crystal display) photo frames, and monitors, among others).
3. Lamps (straight fluorescent lamps, and fluorescent lamps, among others).
4. Large equipment (household appliances, IT and telecommunication equipment, and consumer equipment, among others).
5. Small equipment (household appliances; consumer equipment; luminaires; and equipment reproducing sound or images, among others).
6. Small IT (mobile phones, GPS (global positioning system), pocket calculators, routers, and personal computers, among others).

[1] Adapted from the European Union Directive 2012/19/EU Waste of electric and electronic equipment (WEEE).

If not properly disposed of or recycled, or if not treated properly, or handled without appropriate security measures, e-waste may harm the environment and public health:[2]

- Air: E-waste burned at low temperatures often generates toxins such as dioxins that are released into the environment. Fine particles can travel hundreds of thousands of kilometres and affect extended areas. The improper use of acids to extract precious materials from e-waste also contaminate the environment and travel long distances, being carried through winds.
- Soil: Heavy metals (lead, arsenic, cadmium, etc.) and flame retardants, which are all components included in electric and electronic equipment (EEE), leach directly from e-waste into the soil, contaminating groundwater and crops. In addition, the improper burning of e-waste to extract precious materials, produces ash contaminated by heavy metals and flame retardants that affect the soil.
- Water: Toxic chemicals used to extract precious materials are released into water sources. Acidification and toxification can extend to communities several kilometres away from improper and illegal e-waste treatment sites.

Depending on the degree of contact with improper e-waste treatment, health issues can range from irritations to life threatening disease. Sound government strategy, policy, and regulation will avoid negative effects on the environment and health associated with improper e-waste treatment.

Mobile phone, computer, and television e-waste forecasts for Malawi 2018-2022

It is estimated that in the next five years, between 8.69 and 11.66 million devices will become e-waste in Malawi, with mobile phones representing above 95 per cent of these devices due to the high mobile penetration and the exponential growth in the last decade. E-waste in terms of electrical and electronic equipment that has reached end-of-life (EoL) will grow at a compound annual growth rate (CAGR) of 14.3 per cent, between 2018 and 2022.

From 2018 to 2022, television sets will generate the most e-waste in terms of weight (76%), between 4.65 and 6.20 kilo-tonnes (kt). E-waste weight related to computer equipment will be relatively low for two main reasons:

- computer penetration is lower than for mobile phones, and television, thus the e-waste is lower; and
- there is a higher proportion of laptops, which are lighter than desktop computers, with about 65 laptops to every 35 desktops in 2014, and this proportion is increasing in line with international market behaviour, and the weight is expected to grow at a CAGR of 10.4 per cent between 2018 and 2022.

Due to the precious metals present in the components of mobile devices, these devices represent more than 80 per cent of the total value generated from e-waste.[3] Total value of e-waste for mobile phones, computers and TV sets from 2018 to 2022 will reach between USD 21.42 and USD 28.82 million, with a projected 13.6 per cent CAGR.

However, the e-waste collected is only a percentage of the e-waste generated and it varies greatly from one country to another, for example, from 24 per cent in Australia to 73 per cent in Switzerland. This high level of variation also exists across developing countries, for example, approximately 1 per cent of the e-waste generated in Honduras is collected, compared with 20 per cent in Turkey and 78 per cent in Bulgaria.

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2 Goodship, V., and Stevels, A., *WEEE Handbook*, (2012).

3 Estimates indicate that Malawi will generate between 1.21 and 1.64 kt of e-waste annually related to mobile phones, computers and TV sets, worth between USD 4.29 and USD 5.76 million see Table 22.

Key ICT e-waste devices (millions) and weight (kilo-tonnes (kt)) 2018-2022

Device	Total e-waste devices 2018-2022	E-waste devices annual average	Total e-waste (kt) 2018-2022	E-waste (kt) annual average
Mobile phones	8.41 – 11.24	1.68 – 2.25	0.92 – 1.22	0.18 – 0.24
Computers	0.11 – 0.19	0.02 – 0.04	0.50 – 0.79	0.10 – 0.16
TV sets	0.17 – 0.23	0.04 – 0.05	4.65 – 6.20	0.93 – 1.24
Total	**8.69 – 11.66**	**1.74 – 2.34**	**6.07 – 8.21**	**1.21 – 1.64**

Source: ITU

In the initial stages of e-waste collection in Malawi, the expected value of e-wasted collected due to mobile phones, computers and TV sets, was estimated to be below 10 per cent of the total e-waste value for these devices. Consequently, the first recommendation of this report is, by the end of 2022, to set the goal for e-waste collection at around half of the e-waste generated.

Key ICT e-waste value 2018-2022

Device	USD (millions) Total 2018-2022	USD (millions) annual average
Mobile phones	17.48- 23.37	3.50- 4.67
Computers	0.74- 1.18	0.15- 0.24
TV sets	3.20- 4.27	0.64- 0.85
Total	**21.42 - 28.82**	**4.29 - 5.76**

Source: ITU

Legislation and regulation on e-waste in Malawi

Although there is no specific legislation or regulation on e-waste management in Malawi, there is a growing concern regarding the impact this type of waste can have on the environment and public health. The Malawi Government has recognized the need to establish policies and regulations to manage e-waste as access to and usage of ICT and telecommunication services expand and as low quality, second hand or used EEE enters the country.

However, the Malawi Environmental Management Act does establish a legal framework for waste management of hazardous waste. Under the Act, the Environmental Affairs Department (EAD), part of the Ministry of Natural Resources, Energy and Environment, coordinates waste management, including the operation of a waste disposal site or plant, and requires entities to obtain a licence to handle, store, transport, classify or destroy such waste, and a permit to import and export hazardous waste. The Act also contains provisions for minimizing pollution. It implements a 'polluter pays' principle and places the responsibility of preventing discharge or emission of any pollutant into the environment, including the removal or disposal of any pollutant, on the polluter.

The Malawi National Waste Management Strategy (2017-2022)[4] recognizes e-waste as a significant, emerging waste stream in Malawi, due to the adoption of ICT across all sectors and the inflow of low quality EEEs into the country. It also presents the challenges Malawi faces, along with most countries in Africa, with respect to e-waste, including the lack of:

- a specific policy or legal framework on e-waste management;

[4] http://web.unep.org/environmentassembly/malawi

- legislation covering the import of e-waste products;
- public awareness of e-waste;
- e-waste and environmental expertise and institutional capacity;
- infrastructure for appropriate e-waste management; and,
- financial resources to implement the basic intervention needed to manage e-waste.

The strategy highlights e-waste management as an area requiring further governmental assessment.

International benchmark on e-waste practices

Examples and best practice on e-waste strategy from 11 countries are provided in the table below and form the basis for recommendations for a Malawi e-waste strategy.

Africa

- Ethiopia
- Ghana
- Rwanda
- Tanzania
- Uganda

Europe

- Germany
- Switzerland
- United Kingdom

Asia-Pacific

- Australia
- Singapore

Americas

- United States of America (California)

The best practices for e-waste management include:

- defining e-waste before phasing in additional types of EEE;
- establishing a management structure with a mix of responsibilities for government and third-party organizations (TPOs)[5];
- utilizing the extended producer responsibility (EPR) principle;
- establishing a legal framework to comply with Basel Convention obligations;
- implementing e-waste education and awareness programmes to inform the public.

The table below summarizes benchmark countries, whether the country has a formal take-back system[6], the stakeholder responsible for take-back system management and financing, in addition to education and awareness initiatives.

[5] Generally, a third-party organization refers to EEE importer(s) and/or manufacturer(s) that manage a take-back programme, are responsible for e-waste from source (public and private sectors and individuals) and e-waste management and recycling. It may also be created by a national authority to manage the system under licence, or a combination of both.

[6] A formal take-back system is the regulated collection and processing of e-waste, for example, the EU Directive, which assigns responsibility for the financing and collection of end-of-life electronics.

Benchmark countries overview

Country	Formal Take-Back System	Management	Financing	Education and Awareness
Africa				
Ethiopia	No	Informal	Informal	Informal
Africa				
Ghana	Yes	Government	Producers/Importers	Government
Rwanda	Yes	Third-party	Producers/Importers	Government, Producers/Importers
Tanzania	No	Informal	Informal	Informal
Uganda	Yes	Third-party	Producers/Importers	Government
Asia-Pacific				
Australia	Yes	Third-party and Government	Third-party and Local Governments	Government, Producers/Importers
Singapore	Yes	Third-party	Government, Recyclers	Producers/Importers
Europe				
Germany	Yes	Third-party	Producers/Importers	Government, Producers/Importers
Switzerland	Yes	Third-party	Producers/Importers	Government, Producers/Importers
United Kingdom	Yes	Third-party	Producers/Importers	Government, Producers/Importers
The Americas				
United States (California)	Yes	Government	Society	Government

Source: National regulators and third-party organisations

The next table shows the amount in kilograms per inhabitant (kg/inh) of e-waste generated for each of the countries listed in 2016. The total in kilo-tonnes (kt) is also shown per country, as well as the volume (kt) collected by a take-back system and the percentage collected of e-waste generated (%).

E-waste generated and collected by a take-back system

Country	E-waste generated in 2016 (kg/inh)*	E-waste generated in 2016 (kt)	E-waste collected (kt) and percentage of e-waste generated (%) in 2016
Africa			
Ethiopia	0.5	49	N/A
Ghana	1.4	39	N/A
Rwanda	0.5	6	N/A

Country	E-waste generated in 2016 (kg/inh)*	E-waste generated in 2016 (kt)	E-waste collected (kt) and percentage of e-waste generated (%) in 2016
Tanzania	0.8	38	N/A
Uganda	0.6	25	N/A
Asia and Oceania			
Australia	20.9	182	43 (24%)
Singapore	17.9	100	N/A
Europe			
Germany	22.8	1884	631 (33%)
Switzerland	22.2	184	134 (73%)
United Kingdom	24.9	1632	663 (41%)
The Americas			
United States (California)	N/A	N/A	79

Source: Based on the Global E-Waste Monitor 2017

* kilogram per inhabitant (kg/inh)

E-waste policy and strategy for Malawi: Recommendations

With no formal or informal e-waste treatment and recycling systems, and limited e-waste policies and regulations in Malawi, the following recommendations offer a sound and responsible e-waste management approach.[7]

E-waste policy for Malawi

The main policy objective for Malawi e-waste should promote a safer environment and protect health through effective, efficient and responsible e-waste management practices.

The Malawi Environmental Management Act provides a legal framework to enable the Government of Malawi to enact specific e-waste management regulations, this Act directs the Environmental Affairs Department to coordinate waste management.

Specific policy objectives

The specific objectives of the e-waste policy:

1. Establish a phased approach to including EEE into the e-waste management system. The initial phase will include specific e-waste categories and products and, once the e-waste management system is in place and running smoothly, additional e-waste categories and products should be incorporated.
2. Include the extended producer responsibility (EPR) principle in the regulatory framework. Since there are no manufacturers in Malawi, EPR should apply to importers of EEE and EEE parts and components.

[7] See section 7 for more details on the e-waste policy and strategy recommendations for Malawi.

3. Provide a management structure and implement a financing mechanism for the sustainability of the e-waste take-back system.
4. Implement a national take-back system to collect, process, dismantle, and export e-waste to locations with adequate facilities and tools, such as refineries, to treat e-waste, consistent with Malawi international obligations.
5. Create and implement awareness and education programmes on the importance of responsible use, reuse, and recycling of equipment from purchase to e-waste, for Malawi citizens.
6. Comply with international treaties and regulations, primarily the Basel Convention, to both export e-waste and avoid the import of second hand or used EEE near its EoL or with obsolete technology.
7. Create quality jobs in the recycling sector while ensuring compliance with technical standards for the protection of the environment and those involved in the collection, transportation and processing of e-waste.

E-waste strategy for Malawi

The generation of e-waste in Malawi is currently low in all e-waste categories, compared to other economies, especially ICT e-waste such as mobile phones, computers and TV sets. It is not recommended to establish an expensive e-waste treatment facility, such as a metal or plastic refinery, since the volume of e-waste will not be sufficient to cover the costs of such infrastructure.

Initially, e-waste should be collected and transported to specific storage sites for future export to locations with adequate infrastructure to further treat the e-waste. In the medium- to long-term, further study could assess if the increase in volumes of e-waste justifies building more complex infrastructure.[8]

While it is not financially viable to establish an e-waste treatment facility, it is essential that Malawi implement a take-back system for e-waste. The following subsections present a summary of the specific recommendations necessary to establish and operate an effective take-back system.

E-waste: scope of products

Malawi has no e-waste recycling infrastructure and is currently developing e-waste policies and regulations. It is recommended that the initial e-waste scope of products should be limited to mobile phones, computers, TV sets and similar devices (groups 2 (screens) and 6 (small IT) of the EU WEEE Directive). These types of EEE are growing exponentially and will become a significant part of the Malawi e-waste stream in the near-term due to their short lifecycles. It should be noted that these e-waste devices need a similar, if not the same, treatment when they reach their EoL. The training required to handle these devices is similar. Further, these types of devices can be stored in the same location and similar standards would apply, except for possible hazardous e-waste, such as cathode-ray tube (CRT) screens.

Once the e-waste management system is effectively treating screens and other small electronic devices, Malawi should gradually expand the scope of products in phases to include all EEE. This phased approach will allow Malawi to incorporate lessons learned from the initial narrow scope of products and adjust or build capacity in the take-back system where needed to accommodate additional types of e-waste.

It is also recommended that further studies determine other products to be introduced, how the system should be enhanced, the different collection methods, the handling and recycling treatments, how to include them in subsequent phases on the existing system, and how to include new

[8] Based on the volumes of e-waste from Malawi and neighbouring countries, it is recommended to develop a regional study to assess the feasibility of a regional solution to the e-waste problem. A regional solution will benefit from higher economies of scale on e-waste volumes, with the potential of making the recycling process financially viable.

stakeholders or third parties (e.g., air conditioning, refrigerators, and large equipment (appliances) retailers) introduced by new types of e-waste.

Management of the e-waste take-back system

The e-waste take-back system should include government and stakeholders that have specific functions and responsibilities, such as a third party organization (mainly from among the EEE importers) which would take responsibility for the system, and which follows the extended producer responsibility (EPR) principle:

- **Government:** Create a government e-waste technical committee with representatives from the Environmental Affairs Department, the Ministry of Information and Communications Technology (Ministry of ICT), Malawi Communications Regulatory Authority (MACRA), the ministry responsible for local government, Ministry of Civic Education, Culture and Community Development, the Malawi Revenue Authority (MRA), and the Malawi Bureau of Standards (MBS). There are seven initial functions of such a technical committee:
    1. Create and implement awareness and education activities and programmes on the responsible disposal of e-waste (led by the EAD in consultation with the Ministry of Civic Education).
    2. Develop technical standards for e-waste collection, transportation, storage and disassemble or de-manufacturing (led by the MBS).
    3. License collectors, transporters, handlers and exporters of e-waste based on, among other factors, the standards developed by the MBS.
    4. Grant approval of the TPO and decide which stakeholders should comprise its membership (EAD).
    5. Monitor e-waste collection (led by the EAD in consultation with the Ministry of ICT and MACRA)
    6. Monitor EEE imports and e-waste exports (led by the MRA)
    7. Levy enforcement actions (led by the EAD)

The EAD will lead this committee and actively collaborate in all the functions of the committee, working with the other government bureaux.

- **Third-party organization:** The private sector involved in the importation of EEE must create a non-profit association, referred to in this report as a third-party organization (TPO). The TPO will be responsible for collecting e-waste from source, e.g., business and government offices, households and other locations such as e-waste bins, and transporting it to the appropriate storage location designated by the government. In addition, the TPO is to operate the storage location, tasked with dismantling, shredding and packing e-waste for export to international treatment facilities.

The TPO should be composed of EEE importers that represent at least 90 per cent of all EEE imports to Malawi, including EEE parts.[9] It is important that the main importers, (those with the highest market share of EEE imports), are part of the TPO. It is not essential for comparatively small importers to be included since their impact on e-waste is marginal.

The TPO is responsible for:

a. Designing the take-back system, including the collection, transportation, dismantling, shredding and storage of e-waste, and its eventual export. The TPO may decide to directly collect, transport

[9] The 90 per cent threshold could be modified once a more detailed analysis is done on the imports of EEE.

and store e-waste, in which case it will need to apply for a licence, or it could hire other third parties to do so through a competitive, open, fair and transparent process.

b. Funding the collection and transportation of e-waste, either by performing those tasks for itself or enlisting licensed e-waste collectors and transporters, and funding the operating expenses, costs and security of the storage facility.

c. Funding e-waste education and awareness programmes and activities of their own initiative and from obligations imposed by the government.

d. Developing educational and awareness programmes on e-waste disposal methods for consumers, jointly with the government.

e. Setting initial and periodic goals for e-waste collection and exports measured in tonnes per year for the various categories of EEE.

f. Establishing the financing system of the TPO based on the market share of revenue for each importer that is part of the TPO.

g. Developing the administrative framework of the TPO, e.g., the rules that will govern the TPO, its organogram, TPO management and staff and their functions and responsibilities, the TPO location and its contact information.

Financing model for the e-waste take-back system

Similar to the overall management of the e-waste take-back system, the financing of the system must be the responsibility of the TPO. The importers of EEE that comprise the TPO should be required to meet the costs associated with the collection, transportation, storage and exports of e-waste.

Placing full responsibility with the TPO incorporates EPR principles because importers will have the incentive to minimize the increase in the price of EEE to finance the take-back system so as not to negatively affect sales and profits. Likewise, the design of the take-back system management will need to be more efficient and effective, so costs do not rise above an acceptable level.

Finally, importers will internalize the costs of the take-back system through efficiently pricing EEE to the consumer since competition in the market will discipline prices. Note that any financial method will ultimately affect consumer prices, either via a tax, fee or an increase in price through the recommended method. However, placing financial responsibility with the TPO would have the lowest impact on the consumer.

E-waste collection and transportation licensing

- **E-waste collection**: All three forms of e-waste collection, permanent drop-off locations, drop-off events and door-to-door pick-up, should be implemented by various stakeholders.
    - *Permanent drop-off locations*: drop-off bins for e-waste should be located in government offices, so government officials can easily access them and deposit their e-waste. Retailers of EEE should also locate drop-off bins within their premises for consumers to easily access and drop-off e-waste when replacing their EEE. Once the bins reach their capacity, e-waste collectors should empty them and transport all the e-waste to the designated storage facility.
    - *Drop-off events*: drop-off events should be organized by the government and the TPO, jointly with licensed e-waste collectors, once or twice a year in different locations across Malawi, e.g., the main three cities in the northern, central and southern regions. These events could also serve as a key component of the awareness and education programme strategy so to reach these communities.
    - *Door-to-door pick-up*: a regularly scheduled door-to-door pick-up scheme like the solid waste pick-up scheme should not be implemented due to its high costs. However, making door-to-door pick-up an additional collection channel should be promoted. E-waste collectors

should have a contact number that anyone can call to schedule an e-waste pick-up. Limiting the number of pick-ups each household can arrange to four per year would prevent abuse.

All three types of e-waste collection must comply with the technical standards developed by the EAD and the MBS. Based on these technical standards, the EAD should license e-waste collectors. Only those e-waste collectors that are duly licensed may collect e-waste through the mechanisms described above.

- **E-waste transportation**: E-waste transportation should be performed by the same entity responsible for collection and it should be done in compliance with the technical standards developed by the EAD and the MBS. The purpose of the technical standards developed by the EAD and the MBS will be to reduce the risk of accidentally damaging e-waste during collection, loading and transportation, as such damage may create health and safety hazards as well as affect the ability to salvage valuable materials from the e-waste.

E-waste storage, and manual dismantling and mechanical shredding

- **E-waste storage:** Storage facilities for e-waste should be constructed by the government in, at least, the two most populous cities of Malawi, Blantyre, and Lilongwe. Management and administration of such facilities, including operating costs, should be responsibility of the TPO.

The location selected for such facilities must allow for future expansion, if necessary, and comply with technical standards developed by the EAD and the MBS.

- **Manual dismantling and mechanical shredding:** Manual dismantling should focus on the basic separation of e-waste device parts and components, *e.g.*, plastic, circuit boards, screens, etc. Once e-waste has been dismantled, mechanical shredding will fragment some components into smaller parts. Technical training for the manual separation and mechanical shredding of components should be provided in compliance with the technical standards set by the MBS and the EAD, and financed by the TPO. Once separated and fragmented, e-waste parts and components should be stored in compliance with technical standards and made ready for export to other e-waste facilities for further treatment (e.g. refineries).

Education and awareness

The Ministry of Civic Education, Culture and Community Development and the EAD must develop a communication strategy to raise awareness on how to handle e-waste and the consequences of improper disposal. It should also develop awareness activities and programmes jointly with the TPO and EEE retailers. Sound education and awareness strategies are critical to the successful implementation of the e-waste strategy, since the source of e-waste, such as households, businesses, and government, need to know how to responsibly dispose of e-waste in order to feed the stream of e-waste processing.

The strategy should include:

- a basic explanation of e-waste, including its definition and some examples;
- the importance of properly disposing of e-waste and the consequences for not doing so on public health and the environment;
- actions that should be undertaken by consumers to reduce e-waste (3R policy: reduce, reuse, recycle);
- what to do with e-waste, explaining the means available for households to properly dispose of e-waste;
- information on e-waste drop-off locations, drop-off events and the contact numbers for e-waste pick-up;
- contact information for additional questions and information.

E-waste monitoring and enforcement

Effective monitoring of the entire e-waste management system is essential to securing a successful outcome, such as meeting volume targets for collecting e-waste and properly treating e-waste in Malawi to protect the natural environment and health.

The EAD must overlook the monitoring process at each stage of e-waste generation, including:

- Households, government and business: EAD should monitor whether information on how to properly dispose of e-waste is reaching households, governments and businesses.
- E-waste collection, transportation and storage: EAD should monitor that e-waste is being collected, transported and stored in compliance with MBS technical standards.
- EEE imports and e-waste storage and exports: EAD should periodically monitor the imports of EEE, the amount of e-waste initially stored and later exported, jointly with the MRA. It is important to monitoring whether e-waste collection targets are being met and provide data for making any necessary adjustments to the overall take-back system to comply with such targets.

Based on the monitoring of compliance with technical standards, the EAD must have enforcement capability, including the ability to impose penalties and rescind licences it granted. Regarding the TPO, importers that do not comply with regulations could be banned from importing EEE.

Transboundary flow of e-waste

Malawi must comply with the international treaties on hazardous waste to which it is a party by exporting all e-waste to legally established extraterritorial refineries for further treatment. This means complying with the Basel Convention, which entered into force in Malawi in 1994. The most direct method for compliance is to issue an e-waste regulation under the Environment Management Act, which provides a baseline (*e.g.*, Article 39) for Malawi compliance with the Basel Convention. This regulation should contain provisions that implement the Basel Convention framework of consents and permissions with respect to the transboundary flow of e-waste.

Malawi must also determine the level of e-waste processing that will occur domestically vis-à-vis outside of the country so that it can streamline the required export processes to the countries with the requisite e-waste processing facilities. In this regard, it is key for Malawi to implement international cooperation agreements with the objective of facilitating e-waste exports and complete e-waste processing.

In addition to banning the import of all hazardous waste from developed countries to comply with the Basel Ban Amendment, Malawi should also ban all imports of second hand or used EEE that depend on obsolete technologies (e.g., CRT screens, analogue TV sets, first generation mobile phones, and other similar EEE), or that have been in use longer than a specific number of years, and for example, could potentially become e-waste in the short-term. In doing so, Malawi should also increase its monitoring and surveillance of EEE imports into Malawi to restrict and penalize the wrongful import of banned second-hand, or used, EEE.

Malawi should also block the import of certain products containing mercury (*e.g.*, particular types of batteries and fluorescent lamps), as listed in Annex A of the Minamata Convention, and closely monitor the import of EEE containing mercury (*e.g.*, LCD monitors).

In addition, it is suggested that becoming a party to the Bamako Convention and the Durban Declaration present an opportunity for Malawi to work collectively on e-waste imports and collaborate on e-waste management best practices with other African nations

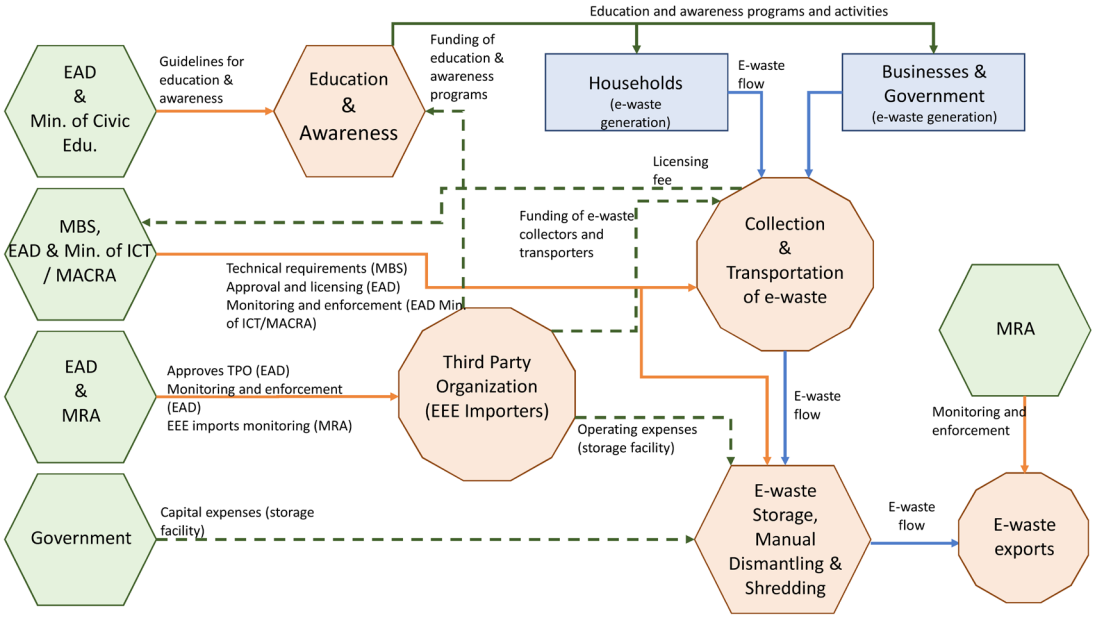
E-waste strategy for Malawi: summary

The following figure summarizes the e-waste strategy for Malawi. At its core, an e-waste take-back system is established based on EPR principles where importers of EEE will be responsible for the EoL

of the EEE they import through a TPO. The TPO will design the collection, transportation and storage schemes for e-waste that must then be approved by the Malawi Government e-waste technical committee. The TPO may directly perform the collection, transportation, storage, dismantling and shredding activities by itself, or contract other entities through a transparent and fair process.

The government must be involved in all stages of the e-waste process through establishing guidelines for education and awareness, licensing e-waste collectors and transporters, drafting the technical standards to which licensees must comply, monitoring e-waste volumes and compliance with targets, enforcing e-waste regulations and provisions, and monitoring e-waste exports and compliance with international treaties and regulations.

E-waste strategy for Malawi



Source: ITU

1. Malawi overview

This section provides a summary of the geographic, political and socio-economic context of Malawi.

1.1. Geographic context

The Republic of Malawi is a landlocked country in southeast Africa, surrounded by Tanzania in the north and northeast, Zambia in the west and Mozambique in the east, south and southwest.[10] It has an area of over 118 000 km^2. Its capital city is Lilongwe, located in the central region, and houses most of the government agencies. The Malawi primary commercial city is Blantyre, located in the southern region. Its most prominent feature is Lake Malawi, one of the largest and longest lakes in Africa, stretching 580 km from north to south and located between Malawi and the Tanzania/ Mozambique borders.

[10] National Statistical Office of Malawi, *Survey on Access and Usage of ICT Services in Malawi 2014*, at 12 (2015).

The climate of Malawi is subtropical with a rainy season from November to April, a cooler period from May to August and a hotter season from September to November.[11] The predominant vegetation is savannah woodland. Much of Malawi is a large plateau situated between 3 000 and 4 000 feet above sea level with rolling hills in the Nyika and Vwanza plateaus in the north and the Great African Rift Valley forming part of the landscape in the south. Malawi suffers frequent droughts and floods. Over the last 36 years, the country has experienced eight major droughts, affecting 24 million people.[12] In 2015, a devastating once-in-500-year flood impacted more than 1.1 million people.

1.2. Political context

Malawi gained independence on 6 July, 1964 and approved the Malawi Constitution on 16 May, 1994.[13] The Constitution establishes executive, legislative, and judicial branches. The executive is comprised of a president, who names first and second vice presidents and a cabinet. The legislative branch consists of the National Assembly, a unicameral 193-member body of directly elected representatives, and a Senate of 80 seats. In practice, the Senate has yet to be implemented. Members of the legislature and the president have five-year terms. Similar to the United Kingdom, the judiciary consists of a Supreme Court of Appeal, a High Court divided into three sections: general, constitutional, and commercial, magistrate courts and an industrial relations court.

Malawi has three regions (northern, central, and southern) that are divided into 28 districts, with most of the population living in rural areas. A substantial portion of local governments affairs are centrally managed by the federal government, which appoints regional administrators and district commissioners. The federal government has the responsibility to ensure that local governments are adequately funded, the power to prepare budgets for all local governments, and the authority to audit their accounts.

1.3. Socio-economic context

Malawi is one of the world's forty-seven least developed countries (LDCs), a group of countries defined as low-income countries that are suffering from long-term impediments to growth. LDCs have low levels of human resource development and are vulnerable to both socio-economic, and environmental shocks.[14]

Malawi is primarily agricultural as 84 per cent of its 18 million inhabitants (annual growth rate of 2.9%) in 2016[15] lived in rural areas.[16] The agricultural sector represents the highest contribution to the Gross Domestic Product (GDP), 30 per cent for 2015-2016, and is expected to be higher in 2017 due to weather patterns with increased rainfall. Thus, the Malawi economy is dependent on rain-fed agriculture, with corn being the staple crop.[17] The main export is tobacco, followed by tea and sugar, and its main imports include food and chemical products, e.g., petroleum.

In 2016, Malawi GDP was USD 5.44 billion, and its GDP-per capita was USD 301. The annual GDP growth rate was 2.8 per cent in 2015 and 2.5 per cent in 2016, and is expected to rebound to 4.5 per cent for 2017. However, poverty and inequality remain high in Malawi. Malawi had a human

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11 The Malawi Project, https://www.malawiproject.org/about-malawi/

12 World Bank Group, Open Knowledge Repository, *Malawi Drought 2015-2016: Post-Disaster Needs Assessment*, at xvii, (2016), https://openknowledge.worldbank.org/handle/10986/25781.

13 www.malawi.gov.mw/images/Publications/act/Constitution%20of%20Malawi.pdf; and Malawi Country Profile, United Nations, www.mw.one.un.org/country-profile/.

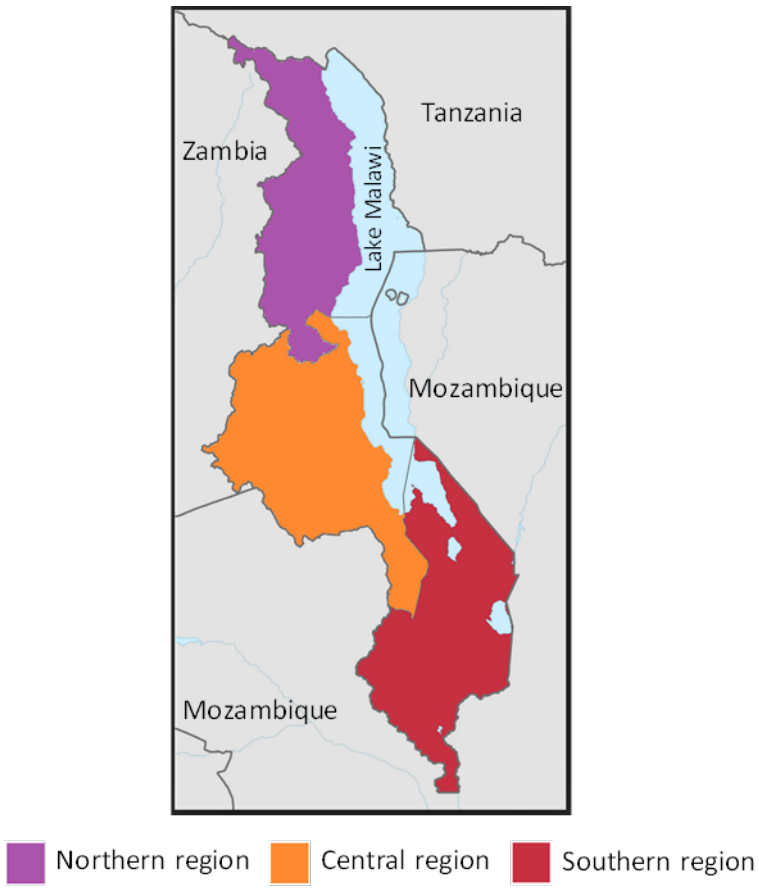
14 See ITU, at: www.itu.int/en/ITU-D/LDCs/Pages/Who-are-the-LDCs.aspx

15 World Bank https://data.worldbank.org/country/malawi. According to the National Statistical Office of Malawi, information provided by MACRA, Malawi population reached 16.8 million in 2016.

16 World Bank, www.worldbank.org/en/country/malawi/overview and https://data.worldbank.org/country/malawi.

17 The Malawi Project, www.malawiproject.org/about-malawi/.

Figure 1: Northern, central and southern regions of Malawi



Source: Malawi National Statistical Office (NSO)

development index (HDI) value of 0.476 in 2015 indicating that Malawi is in the low human development category, positioned at 170 out of 188 countries.[18]

The country was also hit hard by drought in 2015 and 2016, which left 6.5 million people food-insecure, and contributed to two consecutive years of declining economic growth and high inflation rates.[19] Following successful humanitarian efforts in 2016 and 2017, supplying food to 6.5 million people, the economy has stabilized, and inflation has decreased from 21.7 per cent in 2016 to a projected 9.6 per cent in 2018.[20]

With the support of several international organizations, "Malawi has been able to make important economic and structural reforms and sustain its economic growth rates over the last decade. Nevertheless, poverty is still widespread, and the economy remains undiversified and vulnerable to external shocks."[21]

18 World Bank, www.worldbank.org/en/country/malawi/overview and UNDP, "Human Development Report 2015 for Malawi," http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/MWI.pdf

19 World Bank Group, Open Knowledge Repository, Malawi Drought 2015-2016: Post-Disaster Needs Assessment, at iv.

20 International Monetary Fund, Database, World Economic Outlook, Inflation Rate, Average Consumer Prices (Oct. 2017) www.imf.org/external/datamapper/PCPIPCH@WEO/WEOWORLD/VEN.

21 The World Bank, www.worldbank.org/en/country/malawi/overview

2. ICT/telecommunication sector overview

This section presents the evolution of the ICT/telecommunication sector in recent years in Malawi. Data for the analysis has been provided by ITU and MACRA. The analysis focuses on mobile and fixed services, *e.g.*, mobile and fixed broadband, mobile penetration, Internet usage, and computer (PC) and television (TV) set penetration, among other data, especially products and services related to mobile phones, PCs and TVs, since e-waste generated from these devices is the main objective of this study.

2.1. Mobile services

Mobile cellular subscriptions, both prepaid and postpaid, reached 7.2 million by the end of 2016, representing a penetration of 42.5 per cent (42.5 subscriptions per 100 inhabitants).[22] Mobile subscriptions have been consistently growing since the mid-to-late 1990s, when two mobile providers, still present in the market today, launched services: Telekom Networks Malawi (TNM) in 1995 and AIRTEL in 1999.[23] Currently there are two additional mobile providers, Malawi Telecommunication Limited (MTL) and Access Communication Limited (ACL), although TNM and AIRTEL comprise the majority of the mobile market, above 95 per cent market share. [24]

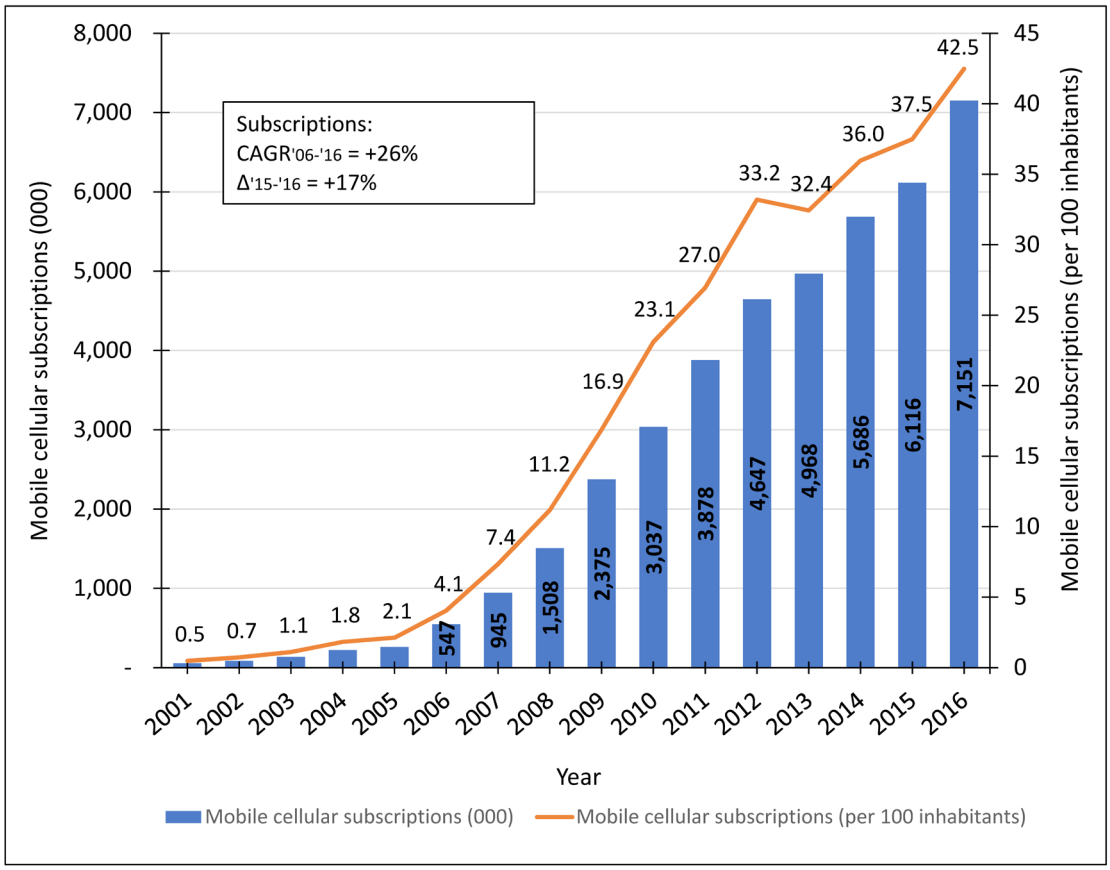
The compound annual growth rate (CAGR) of mobile subscriptions in the last decade, since 2006, is 26 per cent. Between 2015 and 2016, mobile subscriptions increased by 17 per cent, representing more than one million subscriptions, which is the highest number of mobile subscriptions added since mobile services began being offered in Malawi (see Figure 2).[25]

Mobile broadband has been present in Malawi since 2009, when third generation (3G) technology was launched. Fourth generation (4G), LTE networks have been deployed commercially since 2017. By the end of 2016, mobile subscriptions reached a penetration of 18.5 per cent, and 3G technology covered 42 per cent of the population, while LTE/WiMAX covered 15.8 per cent of the population.[26]

Mobile cellular subscriptions in Malawi are expected to continue growing in the coming years. The mobile market has not yet reached saturation, and there still is space for mobile providers to acquire first-time mobile service customers, considering that current mobile cellular subscription penetration in Malawi is 42.5 per cent, lower than the African average of 74.6 per cent. Similarly, mobile broadband penetration in the Africa region is slightly higher than that of Malawi, 22.9 per cent compared to 18.5 per cent. Although electricity constraints (electricity access is around 10 per cent) have hindered the deployment of mobile networks, the government has made electricity generation and access a top priority and has developed several strategies and plans to overcome this barrier,[27] allowing rural areas to gain coverage from mobile providers.

[22] Data provided by MACRA.
[23] TNM, Annual Report 2016, at 10; TeleGeography, Airtel Malawi registers 3.5 M subscribers (Sept. 8, 2015).
[24] NSO, Survey on Access and Usage of ICT Services in Malawi-2014, at 19 (2015).
[25] Data provided by MACRA.
[26] ITU, *Measuring the Information Society, Vol. 2*, at 111 (2017).
[27] Some of these plans are: Malawi Integrated Resource Plan (2017), Malawi Renewable Energy Strategy (2017), and National Energy Strategic Plan (2017), among others. Source: Thokozani Nelson Malunga, *Country Report for Malawi*, Department of Energy Affairs (2017): http://eneken.ieej.or.jp/data/7475.pdf

Figure 2: Mobile cellular subscriptions



Source: MACRA

2.2. Fixed broadband services

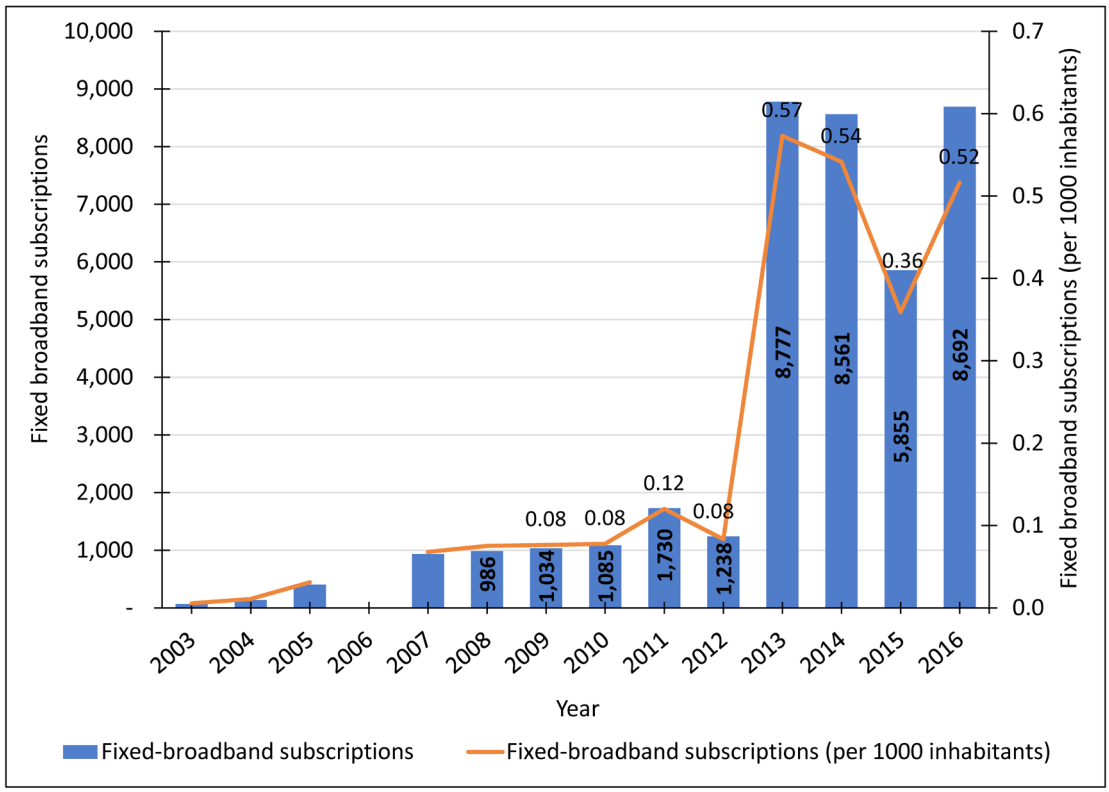
Fixed broadband subscriptions, offered either through wired or wireless technology, are characterized by downstream speeds equal to or greater than 256 kilo-bits per second (kbit/s).[28] MTL is the incumbent operator providing fixed broadband services through ADSL, fixed wireless broadband and optical fibre technologies for business and government customers in urban areas.[29]

There is not a clear trend of fixed broadband subscriptions in Malawi. Since 2013 fixed broadband subscriptions have been constant, on average 8 600, except for 2015 when approximately 5 900 subscriptions were reported. Since 2007, and until 2012, fixed broadband subscriptions have been on average 1 200, with a peak in 2011 of 1 700 subscriptions (see Figure 3).

Fixed broadband subscriptions per 1 000 inhabitants is 0.52, a low figure when compared to the Africa region which is almost eight times higher at 4.[30] Although there seems to be a substantial opportunity for fixed broadband providers to expand their service to the near 3.6 million existing households in Malawi in 2016, the lack of electricity in rural areas where 84 per cent of households reside,[31] and the growth of mobile broadband subscriptions as the only means to access the Internet, hinder the prospects for future growth of fixed broadband subscribers.

[28] ITU, *World Telecommunications/ICT Indicators Database* (2017), (citing the definition of fixed broadband as well as the fixed technologies used to access the public Internet, including cable modem, xDSL, fibre-to-the-home/building, satellite broadband and terrestrial fixed wireless broadband).
[29] ITU, *Measuring the Information Society, Vol. 2*, at 111 (2017).
[30] *Id.* Note that ITU presents this indicator per 100 inhabitants.
[31] Percentage of rural households based on the percentage of rural population.

Figure 3: Fixed broadband subscriptions



Source: ITU

Based on the Survey on Access and Usage of ICT Services in Malawi 2014, 6.5 per cent of households had an Internet connection by 2014, which is nearly 220 000 households. Of the 220 000 households with an Internet connection, 1.8 per cent accessed Internet through modem/ISDN,[32] 0.5 per cent through ADSL,[33] 17.2 per cent through dongles,[34] 1.1 per cent through wireless broadband, and, the majority, 79.3 per cent through mobile networks using a smartphone.[35]

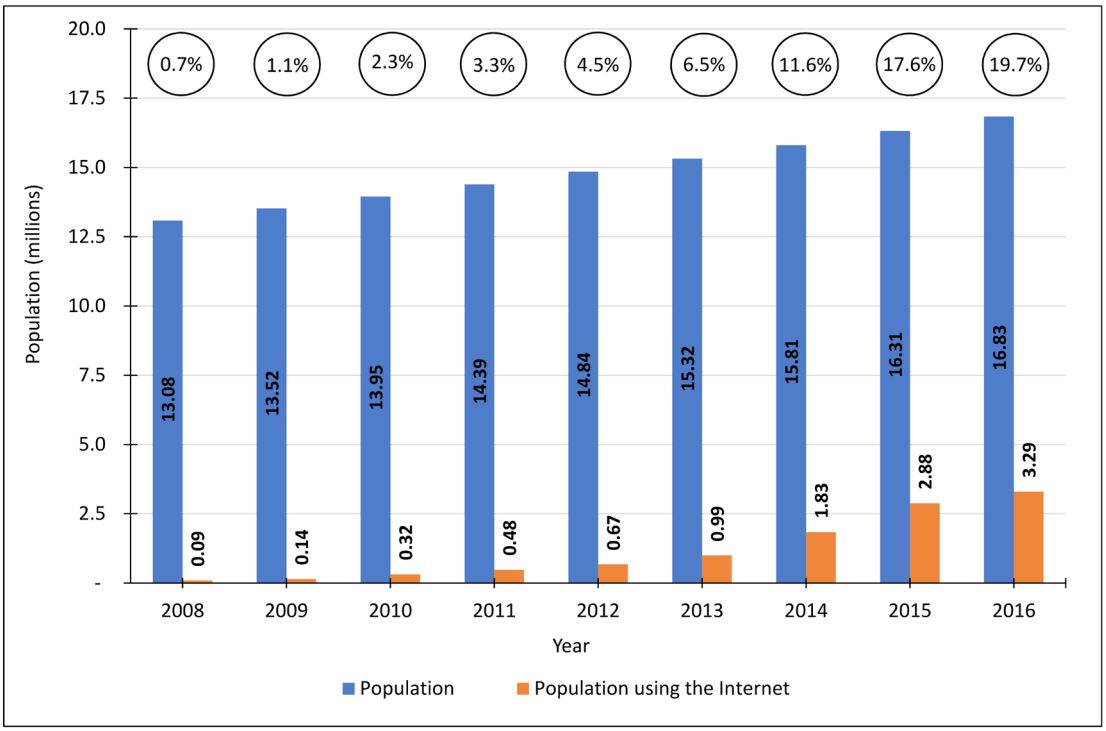
2.3. Internet usage

Indicators of mobile and fixed Internet access suggest that in Malawi access the Internet is mainly through mobile networks. As described in the last section, mobile broadband subscriptions are considerably higher than fixed broadband subscriptions, with a penetration of 18.5 compared to per cent 0.05 per cent (subscriptions per 100 inhabitants).[36] In addition, mobile broadband networks cover more population due to lower deployment costs compared to fixed broadband. Thus, even though the number of fixed Internet[37] subscriptions is low, Internet usage based on population and households is considerably higher.

[32] Modem/Integrated Services Digital Network (ISDN), a dial-in access to Internet, normally with speeds below 256 kbit/s.
[33] Asymmetric Digital Subscriber Line.
[34] Dongle is defined in the Survey as a small piece of hardware that attaches to a computer, TV, or other electronic device in order to enable additional functions such as wireless broadband access or use of protected software, or other services. NSO, *Survey on Access and Usage of ICT Services in Malawi-2014*, at 96 (2015).
[35] NSO, *Survey on Access and Usage of ICT Services in Malawi-2014*, at 98 (2015).
[36] ITU, *Measuring the Information Society, Vol. 2*, at 111 (2017).
[37] Considering both broadband (downstream speeds equal or above 256 kbit/s) and non-broadband (downstream speeds below 256 kbit/s) access.

Based on ITU statistics, 19.6 per cent of the population (3.3 million), used the Internet in 2016. This indicator has been increasing constantly since 2008 (see Figure 4). The CAGR of people who used the Internet from 2011 to 2016 is 47 per cent. However, the growth rate in 2016 was the lowest in the last three years, at 14.5 per cent, compared to 57.1 per cent in 2015 and 84.7 per cent in 2014.[38]

Figure 4: Percentage of the population using the Internet (in circle)

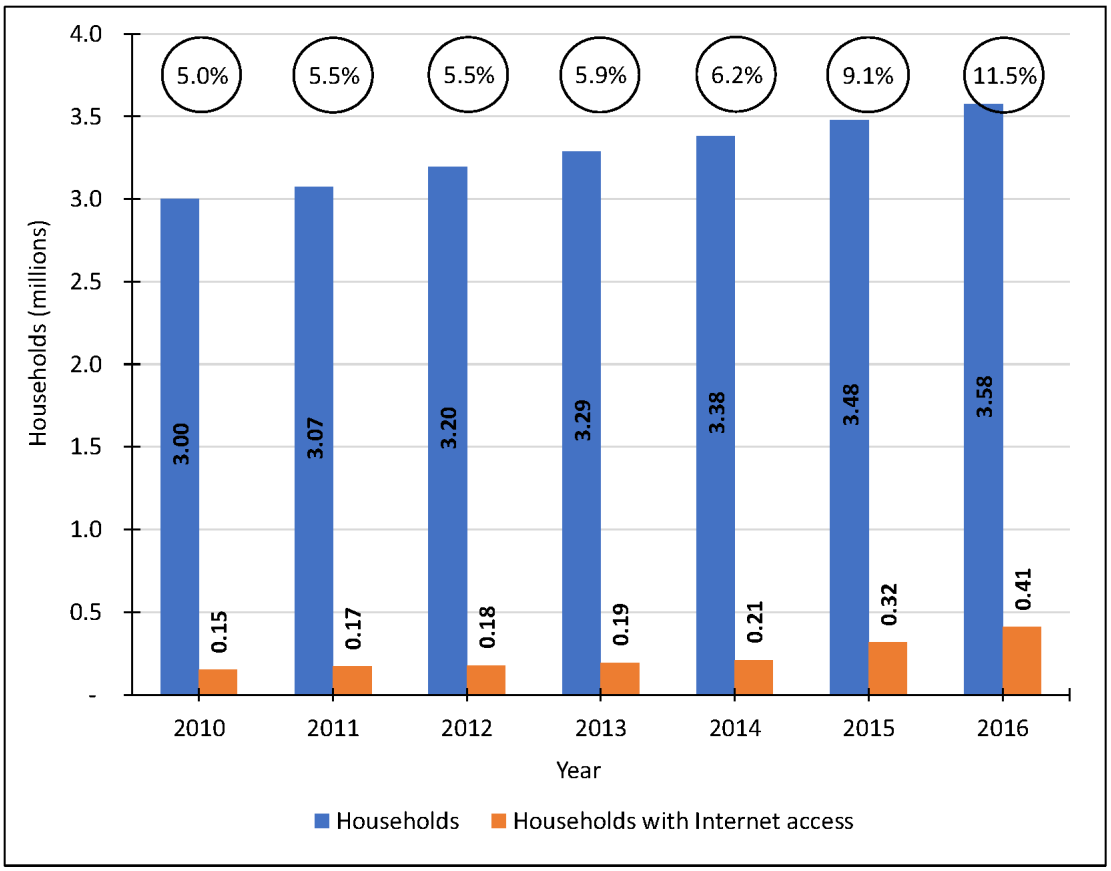


Source: MACRA and NSO

Similarly, the number of households with Internet access has been increasing constantly since 2010, from 150 000 to 410 000 at the end of 2016. This represents 11.5 per cent of all households in Malawi, although this figure is lower than the Africa average of 16.3 per cent. The CAGR of households with Internet access for this period is 18 per cent. The growth rate in the last three years has been 8.6 per cent for 2014, 50.2 per cent for 2015 and 29.5 per cent for 2016.

[38] Based on data provided by MACRA and the NSO.

Figure 5: Percentage of households with Internet access (in circle)



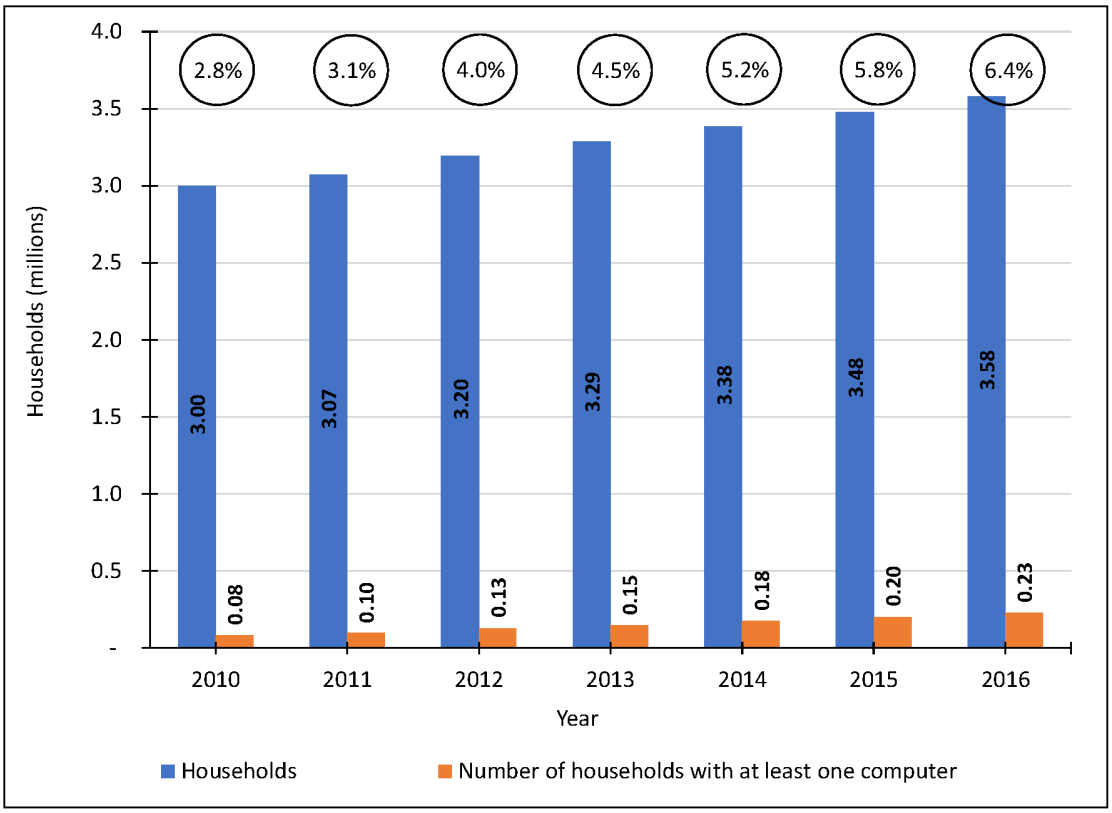
Source: ITU

2.4. Computers

Based on ITU statistics, 230 000 households had at least one computer in 2016, representing 6.4 per cent of all households. The number of computers has increased almost three-fold since 2010. The CAGR of the number of households with at least one computer is 18 per cent for this same period (see Figure 6). The number of households with at least one computer in 2016 is almost half of the number of households with Internet access, 230 000 compared to 410 000. Thus, almost half of the households with Internet access use a different device to access Internet.

ITU statistics do not differentiate between desktop or laptop computers. However, the Survey on Access and Usage of ICT Services in Malawi-2014 does differentiate between households that owned a desktop computer and those that owned a laptop in 2014. Comparing the data from ITU and the survey, show differences for 2014 data. While ITU data estimates that 5.2 per cent of households have at least one computer, the survey finds that 1.4 per cent of households have a desktop, 2.6 per cent have a laptop, and 1.0 per cent have both, desktop and laptop. Thus, for 2014, the survey estimates that 3.0 per cent of households have computers while ITU estimates 5.2 per cent.

Figure 6: Percentage of households with at least one computer (in circle)



Source: ITU

2.5. Television sets

Based on statistics from ITU, the proportion of households with a TV set has increased from 3.0 per cent in 2002 to 8.7 per cent in 2011. Since 2011, the only information source available with this data is the Survey on Access and Usage of ICT Services in Malawi-2014. According to this report, the proportion of households that own a TV set was 10.9 per cent in 2014. Note that since the first year when this data became available as an indicator in 2002, until 2016, eight data points are missing. In addition, this indicator has not increased constantly; between 2007 and 2008, and 2010 and 2011 it has decreased, while between 2010 and 2014 it seems to have stalled.

Although the data is not complete, it clearly shows the trend of an increasing percentage of households with a TV set. The CAGR between 2002 and 2014 is 11.4 per cent, reaching near 370 000 households with TV set in 2014. This evolution should likely have continued beyond 2014 given the low household penetration of TV sets and the increasing availability of TV set offers. Note that by 2014 there was one public TV broadcasting company and eight private TV broadcasting companies, for a total of nine TV broadcasting channel options.

Regarding digital terrestrial television (DTT), Malawi adopted DVB-T2, the European standard Digital Video Broadcasting- Terrestrial 2, in 2011.[39] Digital transmissions began in 2013 with an initial switch-off deadline of 31 December, 2014.[40] However, the first cities to shut-off analogue transmissions were Mzuzu and Zomba in 30 June, 2016, as part of a pilot phase.[41] Digital-to-analogue decoders

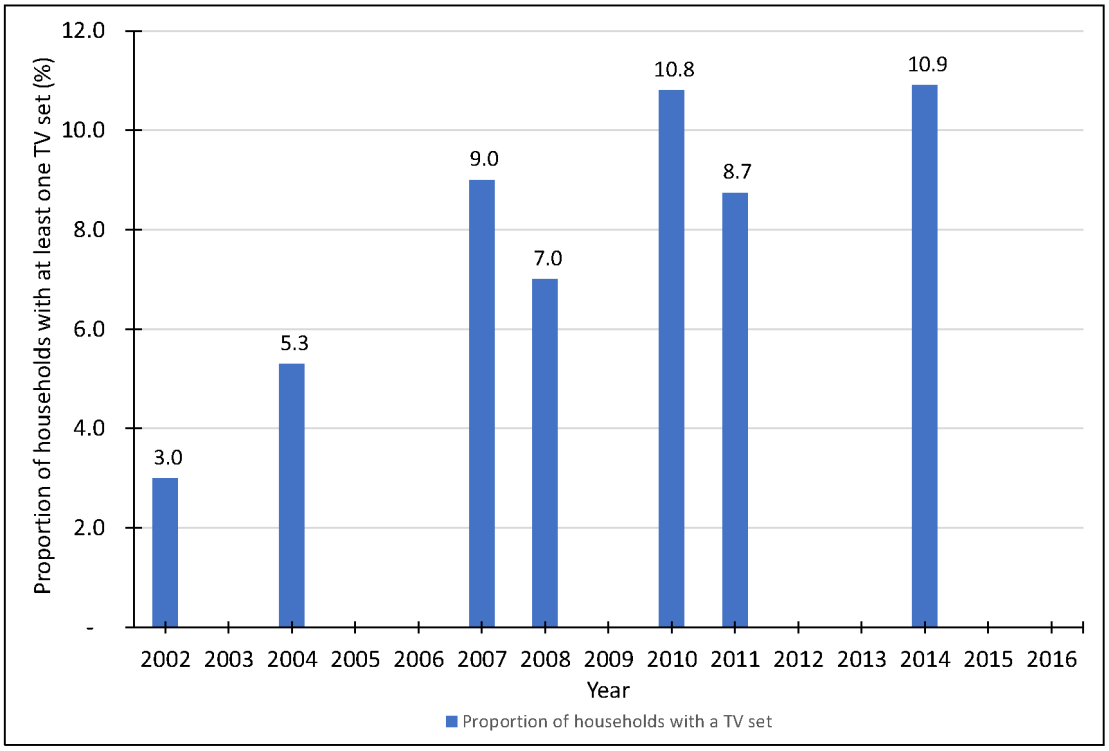
[39] DTV Status, http://en.dtvstatus.net

[40] MACRA, *The Malawi Digital Broadcasting Policy*: www.macra.org.mw/wp-content/uploads/2014/07/The-Malawi-Digital-Broadcasting-Policy.pdf.

[41] MACRA, *Public Announcement on Digital Migration* (2016): www.macra.org.mw/wp-content/uploads/2014/07/PRESS-RELEASE-ON-ANALOGUE-SWITCH-OFF-ZOMBA-AND-MZUZU-CITIES.pdf

have been imported to allow for analogue TV sets to be used with digital broadcasting transmissions, and the government has encouraged the population to keep using their analogue TV sets through the acquisition of these decoders. The analogue switch-off is expected to take place this year, 2018.

Figure 7: Proportion of households with at least one TV set (%)



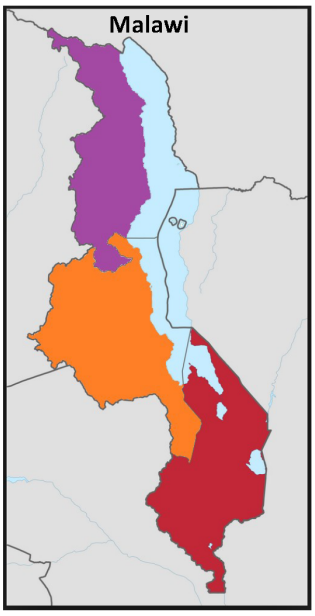
Source: ITU and NSO

2.6. Household access to ICT devices

Mobile phones have become the main ICT device to access ICT services. Forty-five per cent of households have access to mobile phones, compared to 10.9 per cent for TV sets, and 1.4 per cent and 2.6 per cent for desktops and laptops, respectively (see Figure 8). Urban households have a higher penetration of these devices compared to rural households. The greatest gap between urban and rural areas belongs to computer penetration, where urban penetration is 16.4 times higher than that of rural for desktops and 20.1 for laptops, followed by TV sets (7.5), and mobile phones (2.1). As described in section 1 above, the majority of the population in Malawi resides in rural areas, and although indicators for urban areas are significantly higher, when aggregated with rural data, the indicator decreases considerably.

The northern region has the highest household penetration for mobile phones and TV sets. Regarding desktop and laptop computers, all three regions are similar. The indicators showing the highest household access are primarily in the main cities, Blantyre and Zomba in the southern region, Lilongwe in the central region, and Mzuzu in the northern region.

Figure 8: Household access to mobile phones, TV sets and computers in 2014



Region		Mobile phones	TV set	Computer desktop	Computer laptop
Malawi	Total	45.5%	10.9%	1.4%	2.6%
	Urban	85.0%	46.3%	8.2%	16.1%
	Rural	40.2%	6.2%	0.5%	0.8%
Northern region	Total	57.5%	15.0%	1.2%	2.1%
	Urban	91.7%	50.0%	8.3%	10.0%
	Rural	54.7%	12.1%	0.6%	1.5%
Central region	Total	41.8%	9.6%	1.1%	2.6%
	Urban	86.3%	45.5%	7.1%	17.1%
	Rural	35.5%	4.6%	0.3%	0.6%
Southern region	Total	45.5%	11.0%	1.6%	2.1%
	Urban	82.9%	46.3%	9.1%	16.3%
	Rural	40.1%	5.9%	0.6%	0.7%

Source: MACRA and NSO

2.7. ITU Development Index

The ITU Development Index (IDI) has been published annually since 2009. The IDI combines 11 indicators related to ICT access (5 indicators), ICT use (3 indicators) and ICT skills (3 indicators). The main objectives of the IDI are to measure:[42]

- *the level and evolution over time of ICT developments within countries and the experience of those countries relative to others;*
- *progress in ICT development in both developed and developing countries;*
- *the digital divide: differences between countries in terms of their levels of ICT development; and*
- *the development potential of ICTs and the extent to which countries can make use of them to enhance growth and development in the context of available capabilities and skills.*

Malawi moved up two positions in the IDI in 2017 compared to 2016, from 169 to 167 out of 176 countries, and increased its IDI value from 1.58 to 1.74. In the Africa region, Malawi currently holds the thirtieth position out of 38 Africa economies, an increase of one position compared to 2016.

With regard to the ICT access sub-index, which includes mobile cellular subscriptions data and the percentage of households with a computer and with Internet access, Malawi holds the thirty-third position out of 38 Africa countries. Regarding the ICT use sub-index, which includes the percentage of individuals using the Internet, and the number of fixed-broadband and mobile-broadband subscriptions, Malawi holds the twenty-sixth place among the 38 Africa economies.[43]

Based on the IDI, Malawi is behind most of the Africa countries regarding access to and use of ICT/telecommunication services, which is consistent with the description of the different indicators presented in the sections above. However, the low penetration of ICT/telecommunication services allows for future growth opportunities that the government can take advantage of with the proper policies and strategies.

[42] ITU, https://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017/methodology.aspx.
[43] ITU, *Measuring the Information Society, Vol. 1* (2017).

2.8. Conclusions

Malawi ICT/telecommunication statistics present a sector with several challenges ahead as it works to increase access to and usage of ICT/telecommunication services. Most indicators are below World and the Africa region averages, which presents a great opportunity for ICT/telecommunication providers to expand their services to new customers, as the prices of such services decrease and household incomes increase. It is also a great opportunity for the government to establish and promote policies to reduce the digital divide by developing broadband policies and plans to connect people in rural and urban areas.

3. Legislation and regulation on e-waste

This section presents an overview of the existing legislation, regulations, and policies related to e-waste in Malawi, beginning with the legal foundation established in the Malawi Constitution and environmental policies implementing the constitution vision, and ending with the most recent policies, such as the latest Malawi National Waste Management Strategy, which highlights e-waste as a significant and emerging waste stream in Malawi due to more widespread penetration and use of ICTs and the inflow of low quality EEE.

3.1. The Constitution and environmental policies

3.1.1. The Constitution of Malawi

While not specifically addressing waste, Section 13(d) of the Constitution of Malawi obliges the government to adopt and implement policies and legislation providing for the responsible management of the environment to:

1. Prevent the degradation of the environment.
2. Provide a healthy living and working environment for the people of Malawi.
3. Accord full recognition to the rights of future generations by means of environment protection and the sustainable development of natural resources.
4. Conserve and enhance the biological diversity of Malawi.[44]

3.1.2. Environmental policies

To implement this provision, the National Environment Action Plan (NEAP), calls for the integration of environmental stewardship considerations into all national development programmes with the aim of achieving sustainable socio-economic development. The key objectives of the NEAP are to document and analyse all major environmental issues and identify measures to alleviate them, and to promote sustainable use of natural resources.[45] The NEAP is broadly framed and can be applied to any area pertaining to the environment, including waste management.

The National Environmental Policy (NEP) implements waste management policy in areas such as awareness and training, monitoring adherence to international treaties and agreements, and enlisting

[44] Constitution of the Republic of Malawi, Section 13(d), www.malawi.gov.mw/images/Publications/act/Constitution%20of%20Malawi.pdf.

[45] National Environmental Action Plan Vol. 1, Chapter 1: Introduction, 1994: https://cepa.rmportal.net/Library/government-publications/National%20Environmental%20Action%20Plan%20Vol%20I%201994.pdf/at_download/file

the resources of the private sector.[46] It calls for the creation of the institutions and legal framework necessary to implement the NEP.

3.2. The legal and regulatory framework

3.2.1. Legal framework

The Environmental Management Act establishes a legal framework for waste management and includes provisions on hazardous waste.[47] It requires entities to obtain a licence to handle, store, transport, classify or destroy waste, and a permit to import and export hazardous waste. The Act also contains provisions for minimizing pollution. It implements the polluter pays principle and places the responsibility of preventing discharge or emission of any pollutant into the environment, including the removal or disposal of any pollutant, on the polluter.

Under the Act, the Environmental Affairs Department, part of the Ministry of Natural Resources, Energy and Mining coordinates waste management and is responsible for licensing the storage, transportation, classification or destruction of waste; the operation of a waste disposal site or plant; the authorized generation of waste; and the import and export of hazardous waste.

3.2.2. Regulatory framework

The Environment Management (Waste Management and Sanitation) Regulations provide further rules on the implementation of the waste management framework established in the Act. It contains provisions addressing the following areas:

1. Establishing a duty for local authorities to prepare waste management plans; to operate and maintain a municipal sewage collection system; and to promote integrated waste management systems, including progressively upgrading landfills. This duty is overseen by the Ministry of Local Government and Rural Development.
2. Management of general or municipal solid waste, including waste separation at the source (*e.g.*, separating hazardous waste from general or municipal solid waste); the collection of general or municipal solid waste at such a frequency as to prevent excessive piling of waste; and the disposal of solid waste at a plant identified and maintained by a competent local authority.
3. Solid waste recycling and recycling facilities, including identifying the materials that can be recycled and the procedures for obtaining and maintaining a licence to operate a recycling facility.
4. Management of municipal solid liquid waste including obligations triggered by the discharge of effluent and municipal liquid waste into the environment.
5. Management of hazardous wastes, including labelling requirements for containers or packages of hazardous wastes; and the treatment and disposal of hazardous and infectious wastes.
6. Transporting and storage of waste, establishing the licensing process for any person transporting, handling or storing of wastes.
7. The licensing of waste disposal sites or plants, including carrying out environmental impact assessments, among other obligations as part of the conditions for installing a disposal site or plant.

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46 National Environmental Policy (as amended), 2004, www.sdnp.org.mw/environment/policy/NEP1.htm.

47 Environmental Management Act, 1996: www.ilo.org/dyn/natlex/docs/ELECTRONIC/45482/97715/F548493060/MWI45482.pdf. There are also sector specific laws (*e.g.*, Atomic Energy Act, Water Resources Act, and Fisheries Conservation and Management Act) that place the responsibility for the waste management of certain sectors with the relevant sector authority.

8. The transboundary movement of hazardous waste, based on the Basel Convention. These provisions implement the requirement of using proper documentation (*e.g.*, a movement document), notification procedures, and the methods for obtaining prior informed consent.

The Environment Management (Chemical and Toxic Substances Management) Regulations require any person in Malawi, whose undertaking includes the manufacturing, repackaging, importation, exportation, transportation, distribution, sale or other mode of handling toxic substances and chemicals, to obtain a licence.[48] Chemical wastes are defined as "any unwanted or waste chemical or chemical formulation generated from any process which can cause danger to both human health and the environment." The regulations also establish the notification procedures and the prior informed consent process for the transboundary movement of toxic substances chemicals in Malawi, as well as the licences required for entities to carry out their import and export.

Local authorities are required to prepare by-laws for the management of toxic substances and chemical wastes. These by-laws should ensure that the disposal method of chemical wastes is environmentally sound. The Regulations also place a duty on industries or medical facilities to not discharge any chemical wastes into the environment unless such wastes have been treated in accordance with acceptable international methods. There are also detailed procedures prescribed regarding the disposal or treatment of highly toxic or hazardous chemical waste.

3.3. E-waste under the current legal and policy framework

Most recently, the government issued the National Waste Management Strategy, which establishes "priorities to minimize the detrimental impact on human health and the environment associated with waste and to improve the management of waste in the country taking into consideration the [United Nations'] 2030 Agenda for Sustainable Development." Consistent with the Constitution and subsequently issued policies, the key priority areas of the strategy are to:

(a) formulate policies and enact legislation to reduce waste generation;

(b) promote responsible public behaviour on-waste management;

(c) promote waste segregation at source;

(d) reduce, reuse, recycle, and recover energy from the waste; promote waste treatment; and,

(e) establish environmentally sound infrastructure and systems for waste management.

The strategy recognizes e-waste as a significant, emerging waste stream in Malawi, due to the adoption of ICT across all sectors and the inflow of low quality EEEs into the country. It also presents the challenges Malawi faces, along with most Africa countries, with respect to e-waste, including the lack of:

- A specific policy or legal framework on e-waste management (provisions on the re-use or recycling of e-waste, the end-of-life product take-back, and the implementation of extended producer responsibility).
- Laws on the import of e-waste products (governing standards, certification, testing, labelling of second hand e-waste products prior to their import to prevent the country from being used as a dumping site).
- Public awareness on e-waste.
- E-waste and environmental expertise and institutional capacity.
- Infrastructure for appropriate e-waste management.
- Financial resources to implement the basic intervention steps needed to manage e-waste.

[48] Environment Management (Chemical and Toxic Substances Management) Regulations, 2008, art. 3 and 4.

The strategy highlights e-waste management as an area requiring further governmental assessment to formulate properly calibrated interventions.

3.4. Conclusions

Although there is no specific legislation or regulation pertaining to e-waste in Malawi, there is a growing concern regarding the impact this type of waste can have on the environment and health. The Malawi Government has recognized the need for policies and regulations that directly and properly manage e-waste due to its increasing volumes as access to and usage of ICT/telecommunication services expand, and as low quality second hand or used EEE enters the country.

4. E-waste take-back system

For Malawi, and most developing countries, the continued increase in overall e-waste volumes significantly increases the burden on existing waste collection.[49] This causes strain on the often-insufficient infrastructure in place, leading to environmentally unsound recycling and disposal. In addition, the high costs of recycling e-waste, due to the complex management required to contain hazardous materials and the difficulty of separating highly comingled materials in complex products, can exceed the revenues generated from the recovered materials.[50]

Regarding end users, they are typically not aware that they should dispose of their obsolete e-waste separately or how or where they should dispose of their e-waste.[51] They also lack incentives to properly dispose of e-waste and will ignore collection and recycling systems if they need to pay for them. Even if disposal is performed at no cost, end users may still elect not to dispose of their e-waste in the proper channels if it is inconvenient or requires time and effort.

Tracking and tracing the transboundary movement of e-waste is also important, given that a significant amount of shipments of EEE is illegal. For the large quantities imported EEE that are legal, such imports are often the source of large volumes of e-waste, including broken and near end-of-life electronics.

Taken together, these factors underline the need for carefully crafted, operational systems to collect and process e-waste either through direct regulation or by providing the necessary incentives. These systems are also known as take-back systems.[52]

4.1. Components to take-back systems

Successful, environmentally sound e-waste management requires a holistic approach, accounting for not only socio-economic development, governance structures, geography, and trade links, but also microeconomic and psychological considerations reflecting consumer attitudes. In addition, e-waste management depends on a strong legal framework, robust collection mechanisms, sound recycling and recovery facilities, and processing infrastructure.[53] Given the complex, interrelated issues e-waste presents, a take-back system is a complex, interrelated structure with four key components:

1. Rules governing the system.

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49 United Nations University, *Regional E-Waste Monitor: East and Southeast Asia*, at 64 (2016) [hereinafter Regional E-Waste Monitor].

50 Duncan McCann and Annelaure Wittman, *Solving the E-Waste Problem, E-waste Prevention, Take-back System Design and Policy Approaches*, at 11 (Feb. 13, 2015)

51 Regional E-Waste Monitor at 66.

52 This section is primarily based on the Solving the E-Waste Problem (StEP) green paper, "E-waste Prevention, Take-back System Design and Policy Approaches," D. McCann and A. Wittman in 2015: www.step-initiative.org/publications.html

53 Regional E-Waste Monitor at 75-76.

2. The operational areas of collection and processing.
3. Financing of the system.
4. Controlling the transboundary flow of e-waste.[54]

4.2. Rules governing the system

The take-back system should clearly establish the stakeholder ultimately responsible for the success of the system and the enforcement of its rules, the products that should be targeted, and the roles and responsibilities of the various stakeholders.

4.2.1. Overall system management

The most important consideration while establishing a take-back system is to determine the stakeholder responsible for establishing and operating the overall e-waste take-back system, including approval of e-waste collectors and recyclers, collection of payments to finance the take-back system, reimbursing collectors, and enforcement. Where a waste management authority already exists, the government may grant the authority new responsibilities to oversee the take-back system and serve as the point of contact. The authority could be one or multiple government agencies, or a third-party organization, or both.

Government. Where a government agency manages the take-back system, it directly selects the recyclers and implements a financing mechanism, which has the benefit of preventing conflicts of interest within the private sector. Additionally, a government-established e-waste take-back system can be incorporated into any existing or future solid-waste recycling programme. Unfortunately, as with most government-run programmes, this type of framework may be inherently rigid, as governments naturally act slowly and prescriptively. Considering the tight margins that the entire recycling industry faces, the possibility of stifling innovative e-waste solutions must also be weighed against the benefits of more strict control.

Third-party organization. The other approach to establishing and maintaining an overall e-waste take-back system entails the government handing control of the take-back system over to a TPO, usually made up of private sector members selected by the government. Contrasting with a government controlled system, one run by a TPO has greater flexibility and can develop relationships with its members more easily. Additionally, business incentives such as cost reduction and the potential for revenue increases more directly motivate swift and effective action. TPOs also have their downsides, such as insufficient enforcement power and the potential for a myopic focus on its members at the expense of the overall system goal, which may drive the e-waste programmes away from their original intent.

Table 1 outlines the pros and cons of the two aforementioned options based on StEP's "E-waste Prevention, Take-Back System Design and Policy Approaches" report.

[54] Duncan McCann and Annelaure Wittman, Solving the E-Waste Problem, E-waste Prevention, Take-back System Design and Policy Approaches, at 11 (Feb. 13, 2015)

Table 1: Pros and cons of overall system management

Entity Responsible for System	Pros	Cons
Government	• Have powers of enforcement O Can levy fines O Can ban noncompliant producers • No potential conflicts of interest	• Not always most efficient economically, as this can lead to additional layers of administration • Can stifle (quick) innovation • Money flowing into and out of government departments can be problematic
Third Party Organization	• More flexible – can adjust rules and outcomes more easily • Easier for TPO than government to develop relationship with members • Business incentive as costs and programme can more easily be controlled and influenced	• Potential lack of enforcement mechanism • Can focus too much on their members and not have the wider community and environment as interested stakeholders • Potential conflict of interest

Table 2: Government and TPO in practice

	United Kingdom	Switzerland	Singapore	Italy	Japan	Colombia	Ghana	Uganda
Approval of collectors and processors	Gov.	TPO	Gov.	TPO	TPO	Gov.	Gov.	Gov.
Collection of payments	TPO	TPO	TPO	TPO	TPO	TPO	TPO	TPO
Reimbursing collectors and processors	TPO	TPO	Gov./ TPO	TPO	TPO	TPO	Gov.	TPO
Enforcement	Gov.	TPO	TPO	Gov.	TPO	Gov.	Gov.	Gov.

Source: StEP, "E-waste Prevention, Take-back System Design and Policy Approaches" and ITU Research.

4.2.2. Scope of products

Another crucial consideration is defining the scope of products encompassed by the e-waste take-back system. The methodology used to define types of e-waste include categorizing equipment of a similar function, material composition with respect to hazardous substances and valuable materials, reusability, and EoL attributes.[55] The United Nations University (UNU) adds that products within the same category should have comparable average weight and lifespan distribution, to streamline the quantitative analysis for similar products. The UNU asserts that large, or environmentally-relevant, e-waste products for which substantial data for analysis is potentially available, should be categorized separately. The UNU developed the UNU-KEYS as a classification framework with these attributes. The methodology implemented by the UNU-KEYS created 54 categories (encompassing approximately 900

[55] C.P. Bladé *et al.*, E-waste statistics: Guidelines on classifications, reporting and indicators. United Nations University, IAS-SCYCLE, at 12 (2015), https://i.unu.edu/media/ias.unu.edu-en/project/2238/E-waste-Guidelines_Partnership_2015.pdf.

products, clustered around 660 main product types) that can be grouped into six primary categories, according to the EU latest e-waste directive listed in Table 3.[56]

In addition to classifying e-waste, a government must decide whether to launch its e-waste management system encompassing the full suite of EEE products or incorporate types of EEE piecemeal through a phased approach. Certain governments (e.g., the EU, Switzerland, and Nigeria) launched their systems encompassing the full scope of EEE. The EU, for example, includes all equipment dependent on electrical currents or electromagnetic fields, contingent on it having a voltage rating of less than 1 000 Volts AC or 1 500 Volts DC.[57] Using such a broad scope is meant to increase accountability throughout the electronics industry and drive firms to implement recycling practices. Also, by using a technology neutral definition (not making the EEE definition dependent on particular technologies), the EU may retain the current definition as technology evolves.

Even though it uses such a broad definition, the EU divides e-waste products into six categories (see Table 3) to set precise recycling recovery targets, monitor the effectiveness of the take-back system by receiving key indicators reported by industry, and provide recyclers with a legally certain foundation for business models.[58] The most relevant categories for EEE to Malawi are category 2. 3, 4, 5, and 6. These categories cover TV sets, laptops, mobile phones, IT and telecommunication equipment, and video cameras. Notably, many of the minimum recycling targets are the same for each type of product.

Table 3: E-waste categories according to the EU

Category	Category	Examples
1	Temperature exchange equipment	Refrigerators, freezers, equipment which automatically delivers cold products, Air conditioning equipment, dehumidifying equipment, heat pumps, radiators containing oil and other temperature exchange equipment using fluids other than water for the temperature exchange.
2	Screens, monitors, and equipment containing screen having a surface greater than 100 cm^2	Screens, televisions, LCD photo frames, monitors, laptops, notebooks.
3	Lamps	Straight fluorescent lamps, compact fluorescent lamps, fluorescent lamps, high intensity discharge lamps- including pressure sodium lamps and metal halide lamps, low pressure sodium lamps, LEDs (light-emitting diode).
4	Large equipment (any external dimension more than 50 cm)	Household appliances; IT and telecommunication equipment; consumer equipment; luminaires; equipment reproducing sound or images, musical equipment; electrical and electronic tools; toys, leisure and sports equipment; medical devices; monitoring and control instruments; automatic dispensers; equipment for the generation of electric currents. This category does not include equipment included in categories 1 to 3.

[56] *Id.*; C.P. Bladé, *The Global E-waste Monitor 2017*, International Telecommunication Union, UNU, at 11 (2017).

[57] European Parliament, Directive 2012/19/EC on Waste of Electrical and Electronic Equipment (WEEE) (July 4, 2012), http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0019&from=EN.

[58] European Parliament, Directive 2012/19/EC on Waste of Electrical and Electronic Equipment (WEEE), Annex IV (July 4, 2012).

Category	Category	Examples
5	Small equipment (no external dimension more than 50 cm)	Household appliances; consumer equipment; luminaires; equipment reproducing sound or images, musical equipment; electrical and electronic tools; toys, leisure and sports equipment; medical devices; monitoring and control instruments; automatic dispensers; equipment for the generation of electric currents. This category does not include equipment included in categories 1 to 3 and 6.
6	Small IT and telecommunication equipment (no external dimension more than 50 cm)	Mobile phones, GPS (global positioning system), pocket calculators, routers, personal computers, printers, telephones.

Source: EU Directive 2012/19/EC on Waste of Electrical and Electronic Equipment

While the end goal of every system should be to cover all EEE, the initial scope of products covered may be reduced to address the country's most urgent concerns and objectives.[59] Most developing countries opt for a narrow scope initially and then gradually expand the EEE covered using a phased approach. Reasons for this are that a country has little or no e-waste recycling infrastructure; seeks to focus at first on particularly problematic product types (*e.g.*, China prioritizing the proper capture of hazardous chemicals and gases in refrigerators and air conditioners); or direct its attention to product types that comprise the most significant part of the waste stream or have relatively short lifecycles such as common household electronics like televisions, personal computers, and mobile phones. Even though this leaves a large portion of e-waste without an official take-back mechanism, at least at the beginning, a phased approach allows for the parallel iterative buildout of the infrastructure required to accommodate an expanding scope of EEE.

4.3. Extended producer responsibility

Extended producer responsibility (EPR) is the beating heart of a take-back system. It is a policy principle requiring EEE manufacturers to accept responsibility for all stages in a product lifecycle, including EoL management. The objectives of the EPR principles are:

1. Incentivizing manufacturers to improve the environmental design of their products and the environmental performance of supplying those products.
2. Achieving a high product utilization rate.
3. Preserving materials through effective and environmentally-sound collection, treatment, and reuse and recycling.

Optimally, manufacturers or producers should be responsible for the post-consumer phase of products (*e.g.*, EoL management), because most of the environmental impacts are predetermined when the product is designed.[60] However, it is important to recognize that EPR is not a policy in itself but a principle that can be implemented through various approaches.[61] Thus, incorporating EPR principles upstream from EoL management pays tremendous dividends and increases the effectiveness of the overall take-back system.

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[59] Duncan McCann and Annelaure Wittman, Solving the E-Waste Problem, E-waste Prevention, Take-back System Design and Policy Approaches, at 11 (Feb. 13, 2015)

[60] Panate Manomaivibool *et al.*, *Extended Producer Responsibility in a Non-OECD Context: The management of waste electrical and electronic equipment in India*, IIIEE, Lund Univ., at 3 (2007), http://portal.research.lu.se/ws/files/5524790/1270000.pdf.

[61] Duncan McCann and Annelaure Wittman, Solving the E-Waste Problem, E-waste Prevention, Take-back System Design and Policy Approaches (Feb. 13, 2015)

EPR regimes can assign responsibility individually, where producers are responsible for their own products, or collectively, where producers with the same product category fulfil EoL management as a group. All else being equal, a take-back system that places responsibility as close to the individual producer as possible is preferable as it creates a more direct incentive for a producer to improve its products. In practice, individual producer responsibility (IPR) is more complicated to administer. For countries developing new systems, it is often advisable to focus on collective EPR.

Challenges to establish EPR in developing countries

While all countries face various challenges to implementing an EPR regime, this section highlights the general challenges developing countries face.

No manufacturers

In developing countries where manufacturers do not produce, import, nor sell their products directly, an EPR policy cannot implement one of the main objectives of the EPR principles, to provide incentives for manufacturers to improve the environmental design and performance of their products. Although short of the complete principle, a common model to address this designates each local distributor and retailer importing EEE as the responsible party for e-waste management. Because these entities are the conduits through which EEE enters the market, they can be identified as they are legally registered and thus addressable through the legal framework.

Prevalence of 'no-brand' equipment

Another challenge to implementing EPR is the existence of a significant amount of equipment in the marketplace for which there is no brand owner. This is because the equipment is sold in the grey market or assembled domestically from components of various brands. The lack of a clearly-identifiable producer means that the government or TPO will not be able to collect any taxes or upfront fees to contribute to the financing of the take-back system. To address this, any company selling above a designated threshold or EEE can be required to register as a producer or legislation can be drafted broadly such that the definition of a producer captures the importer of EEE and the local manufacturer to ensure a level regulatory playing field.

Lack of formal treatment facilities

A major impediment in developing countries is a lack of treatment facilities compliant with international standards and the related collection infrastructure channelling e-waste to these facilities. Although a country may lack infrastructure, it is important to note that governments do not need to wait to implement the EPR principles in the take-back system until the country has the necessary facilities in place to apply the principle throughout the product life cycle. Building the necessary infrastructure can begin in parallel with the initial implementation of the EPR principles.

The government can take the lead in funding the necessary facilities, as is the case where the government creates the necessary facilities under a public utility model. Alternatively, the government can establish standards that the private sector uses as it finances and constructs facilities, as has been done in the EU and Japan. Hybrid approaches utilizing both government-controlled and market-driven standard-compliant operations have also been utilized, *e.g.*, China, where the government extends low interest rate loans to recyclers, and California, where the government issues recycling subsidies for facilities meeting the required standards.

Informal sector

An initial lack of infrastructure to fully implement and operate a take-back system correlates with a country having an active informal sector that collects, repairs, and resells used products second-hand and that recycles e-waste to receive compensation for reselling its valuable resources. The term 'informal sector' typically includes the part of a country's economy that is neither monitored by any form of legal authority nor taxed, although the exact nature of the sector may vary from country to country.

Because they do not have to comply with any standards or environmental regulations nor pay local taxes, members of the informal sector typically have lower treatment costs. Without intervention, members of this sector can offer higher compensation to collectors or legal owners of e-waste than they otherwise would if they had to incur the required compliance costs.

Also, members of the informal sector, not subject to licensing nor standards, are incentivized to target the collection and recycling of only the most highly valued e-waste, which is problematic in cases where environmentally sound treatment requires significant costs and where e-waste disposal does not offer any value from material recovery. In the first case, unsound treatment of e-waste will result in risks to public health and the environment, and, due to a lack of financial motivation, the informal sector will not collect the e-waste in the second case.

The establishment of a formal sector must account for the existence of the informal sector by, for example, identifying the informal actors already organized into associations or businesses, conducting education and awareness initiatives with members of the informal sector or initiating a registration process of informal workers. It must also comprehend the market incentives behind informal sector operations and integrate them into the overall solution.

4.4. The operational areas of collection and processing

4.4.1. Collection

In order to safely extract and recover valuable materials, and contain and neutralize hazardous elements, special consideration should be given to how e-waste is collected. This includes taking steps to ensure that the largest amount of e-waste possible is safely collected and that e-waste is not combined with other types of waste. This process is heavily influenced by country-specific factors and relies on the close coordination of the government, recyclers, and retailers.

To meet collection targets, collection infrastructure must be established or existing collection means must be formalized through the licensing of existing collectors and imposition of compliance obligations with respect to collection standards. A collection network combines various collection methods and stakeholders and is summarized in Table 4.

Table 4: E-waste collection methods

	Informal	Government	Retail	Commercial	Manufacturer
Permanent drop-off location	Located in specific markets or informal business locations	Co-located with offices or other waste drop-off locations	Located at retail stores	Located at company facilities	In most developing countries where manufacturers do not import or sell their products directly, manufacturers cannot provide a viable collection method.
Special drop-off	N/A	A one- or two-day event dedicated to e-waste generators dropping of e-waste at a location affiliated with the stakeholder			
Door-to-door pick-up	Collection from general public directly	Resident door to door collection	Collection upon delivery of new appliances	Direct pick-up, especially from other commercial entities	

Source: StEP Take-back System Report

Permanent drop-off locations. Permanent drop-off locations are facilities offering year-round collection services. This collection method is typically associated with government entities (*e.g.*, municipalities) because they are typically collocated with other types of waste. In addition, for example, a

retailer may offer bins or containers in stores for customers buying new EEE products to conveniently drop-off e-waste. Infrequent pick-ups and comparatively lower maintenance rates also allow for more predictable and scheduled pick-ups for collectors. Due to the infrequency of pick-ups, it is advisable that any permanent drop-off facility be capable of storing at least some e-waste.

Drop-off events. Special drop-off events are generally one- or two-day events each year held in dedicated, temporary (such as parking lots) or permanent (*e.g.*, government building) locations. These events also act as educate the public on e-waste recycling options and best practices. Widely notifying the public is key to maximize the effectiveness of drop-off events.

Door-to-door pick-up. Door-to-door pick-up is the costliest collection practice, even though it has the potential to collect equipment in better condition because the equipment has not endured potentially unsafe transportation to a facility or disposal in large bins at a permanent site or special event. Typically, however, requiring monthly door-to-door e-waste collection is not advisable. Households do not generate e-waste this frequently, and the cost of going door-to-door once a month would greatly outweigh the value in collecting it. Instituting a door-to-door collection system with less frequent pick-ups (*e.g.*, once per quarter or biannually) completely separate from bulk waste collection can provide the needed additional collection channel but at a pick-up frequency more in line with the amount of e-waste generated by households.

4.4.2. Storage and processing

Take-back systems require comprehensive monitoring and supervision of the storage and transportation of e-waste. Transport vehicles at the storage site and containers used for storage should be equipped to prevent damage to the equipment and support its reuse and recycling.[62] Storage facilities must comply with statutory specifications and standards to prevent pollution and other hazards due to damage, leakage, and explosive components. Storage sites should have, for example, impermeable surface to avoid spills from entering the soil; spillage collection facilities in the event of one, including impermeable pavement and sealed drainage system; weatherproof covering to avoid extreme weather; and metallic crates or wood boxes to store e-waste.[63]

Recycling operations seek to maintain or restore the maximum amount of material possible that is recovered from e-waste to its original level of purity and physical and chemical properties.[64] For e-waste to have the best chance to complete the recycling process, the recyclable materials should be as pure as possible, (well-separated from other materials that can impede the recycling process from a chemical or mechanical point of view); conditioned in a way that they can be easily transported and used in the manufacturing industry, which could involve shredding them into a precise size; sent in large quantities, reducing the cost of shipping in containers; or presented as non-shredded fractions (*e.g.*, certain end-processors seek entire, non-shredded mobile phones to maximize the precious metal content as it can decreased in the shredding process by dust generation). In addition to technical factors, the recyclability of materials also depends on economic considerations.[65]

Recycling operations are generally executed in two parts: i) pre-processing, which prepares the e-waste for material recovery, and ii) end-processing, consisting of material recovery prior to the incineration or landfilling of any remaining material.[66] These two steps may be summarizes as follows:

(1) Pre-processing

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62 Carole Mars *et al.*, Solving the E-Waste Problem, *Recommendations for Standards Development for Collection, Storage, Transport and Treatment of E-waste*, at 25 (June 2, 2014).

63 United Nations Environment Programme, *E-Waste Volume III, WEEE/E-Waste 'Take Back System* Annexure 5, (2012).

64 Carole Mars *et al.*, Solving the E-Waste Problem, *Recommendations for Standards Development for Collection, Storage, Transport and Treatment of E-waste* (2014).

65 Duncan McCann and Annelaure Wittman, Solving the E-Waste Problem, E-waste Prevention, Take-back System Design and Policy Approaches (2015)

66 Carole Mars *et al.*, Solving the E-Waste Problem, *Recommendations for Standards Development for Collection, Storage, Transport and Treatment of E-waste* (2014).

- De-pollution, which consists of removing hazardous parts, such as lead glass from CRT displays, CFC gases from refrigerators, light bulbs and batteries.
- Manual disassembly to recover materials from complex fractions instead of or prior to mechanical shredding.
- Shredding, also known as mechanical processing, consists of cutting the used equipment into small pieces so that material separation can be more easily achieved. This implies some specific machineries such crushing units, shredders, magnetic- and eddy-current- and air-separators, as well as systems to filter and treat gas emissions and liquid effluents.

(2) End-processing

- This final step consists of refining. It applies to metals, plastics and glass that are conditioned according to the requirements of the manufacturing industry interested in buying these secondary materials.[67]

Organizations that handle certain material recovery steps may not exclusively handle e-waste, such as metal refineries and plastic recyclers, so processing standards must also take into account these organizations. Processing standards should establish quality requirements and targets based on the level of recycling that can be achieved with existing technology, while maintaining technology neutrality.[68] This could include recycling targets for specific materials or weight-based recycling targets for entire programmes, as is the case in the EU.[69] Process-quality standards should accompany the targets and address environmental, health and process efficiency criteria.[70] Recyclers should be obliged to report on the quantities and qualities of the various output materials from recycling processes.

EoL standards should require operators to use incineration and final disposal of recyclable materials after reuse, refurbishment, recycling and when material options have been exhausted, except in specific cases where evidence indicates that treatment other than recycling yields better environmental results when considering the entire life cycle of the particular type of equipment. Standards should require operators to perform final disposal and incineration according to the best available technology. EoL standards must also clearly define hazardous materials and components and require them to be removed from e-waste for proper treatment where the hazardous materials or components cannot be controlled in later treatment processes; the materials or components hinder quality recycling; or the materials would otherwise end up in incineration or landfill sites. EoL standards must require recyclers to clearly demonstrate the removal of hazardous materials and components from the waste stream and the effective treatment of these materials to prevent pollution.

Countries typically perform pre-treatment by developing their own pre-processing facilities to separate basic material fractions. In addition, countries can to some extent perform the end-processing of certain materials, such as plastics and steel, domestically as they can be recycled with comparatively low technological investment. By contrast, the recovery process of precious metals, such as metals from printed circuit boards or cobalt from batteries, demands substantially higher investment and the economies of scale required to profitably administer the process are such that only a handful of these recycling facilities are required globally. Where a country lacks a requisite processing facility, or is developing its own processing capabilities, the country should streamline the legal and operational processes required for the export of the specific material fractions of WEEE to extraterritorial facilities to ensure that WEEE processing operates efficiently and effectively.[71]

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67 Duncan McCann and Annelaure Wittman, Solving the E-Waste Problem, E-waste Prevention, Take-back System Design and Policy Approaches (2015)

68 Carole Mars *et al.*, Solving the E-Waste Problem, *Recommendations for Standards Development for Collection, Storage, Transport and Treatment of E-waste* (2014).

69 European Parliament, Directive 2012/19/EC on Waste of Electrical and Electronic Equipment (WEEE), art. 11 and Annex V (2012).

70 Carole Mars *et al.*, Solving the E-Waste Problem, *Recommendations for Standards Development for Collection, Storage, Transport and Treatment of E-waste* (2014).

71 Kuehr, R., *Solving the E-Waste Problem, Guiding Principles to Develop E-waste Management Systems and Legislation*, StEP White Paper Series, United Nations University (2016).

4.5. Financing of the system

The take-back system, including its accompanying education and awareness initiatives, is financed by some combination of the following groups: the entire society (taxpayers), consumers, or producers. Independent of the entity that initially pays, consumers will ultimately incur the tax or fee, whether the tax is assessed at the device point of sale or passed through to consumers in the form of higher prices where the fee is internalized by producers. Table 5 provides a list of the three models and their full definitions.

Society. Under the first model, all citizens finance waste management through (i) contributing tax revenue or (ii) paying a nominal fee to cover the costs of the system. Under both models, producers of zero e-waste subsidize producers of significant e-waste as both pay the same amount for waste management services.

A key consideration for using tax revenue is that the government must commit to fiscally allotting the necessary resources to establish and operate the take-back system. This avenue runs the risk that government spending priorities may change over time such that it directs needed resources away from the system.

Collecting a nominal fee does not depend on government general tax revenue and its fiscal prioritization of e-waste to finance the take-back system. Instead, it solely depends on a fee charged to all households to manage not only e-waste, but other types of waste as well, such as solid waste. The difficulty arising from using a fee is that precisely estimating it for all households is quite difficult and can be significantly under- or over- estimated. Thus, such a fee generally requires adjustment over the course of years to reach an equilibrium point, in other words, the point where the revenues from the fee are equal to the costs of operating the take-back system.

Table 5: Financing models

Finance model	Description	Level of government involvement required
Society	a. Requires general tax revenues to be diverted to meet the costs associated with the take-back system.	High
	b. A fee is charged to all households.	High
Consumers	Mandates that the consumer either pay to discard the product or pay a fee when purchasing the new product, which would be collected in a centrally-managed fund.	High
Producers/importers	a. Requires producers/importers to meet the costs associated with the solution.	Low
	b. An environmental levy is imposed on importers of EEE.	High

Source: TMG Research[72] and StEP Take-back System Report

Consumers. The second financing model entails levying a tax on EEE products at the point of sale to end users. This places the burden squarely on those contributing to the problem based on the 'polluter pays principle.'[73] That said, because EEE goods benefit society (*e.g.*, economically and with respect to innovation), increasing the price of those goods through such a tax may negatively affect

[72] Juan Manuel Roldan, *E-waste management policy and regulatory framework for Saint Lucia*, Telecommunications Management Group, Inc., at 48 (Feb. 6, 2017).

[73] Duncan McCann and Annelaure Wittman, Solving the E-Waste Problem, E-waste Prevention, Take-back System Design and Policy Approaches (2015). Similar to pollution taxes, the burden of paying the tax falls on those producing the waste.

their affordability for many individuals, particularly in developing countries. The decision of whether to use the consumer financing model is highly dependent on the economic situation and the government long-term goals, particularly if expanding access to and the use of EEE products is a high priority.

Also, it is difficult to estimate the amount of the tax to be imposed at the EEE product purchase. Like the household fee, the resources collected to fund the take-back system may be over- or under- estimated for years before being properly adjusted to reach the equilibrium point. In addition, due to the dynamic nature of demand for EEE goods it would be even more difficult to estimate a fixed fee in this case compared with nominal tax of the society model, where the number of households is either constant or increasing at a fairly predictable, minimal rate every year.

Producers/Importers. The third financing method flows from the above-mentioned EPR principle and the TPO-centric approach because it places the responsibility to finance the take-back system on producers, or importers, of EEE. While this financing method completely removes the regulator from the financial duties of e-waste management, it method does not necessarily eliminate the financial responsibility of consumers since producers, importers and retailers will transfer the cost downstream until it reaches the consumer, who will end up paying a higher price for EEE. In other words, the costs to manage the take-back system are internalized in the price the end user pays for each EEE product. However, the more the TPO-centric system is deployed optimally, the higher the likelihood that the increase in EEE price is minimal.[74]

4.6. Controlling the transboundary flow of e-waste

Given that transboundary flows of e-waste are an increasing concern in many countries, due to the increased adoption of EEE and the visibility of the negative impacts of unaccounted for e-waste, greater emphasis has been placed on compliance with international treaties, mainly the Basel Convention, which entered into force in Malawi in 1994.[75]

4.6.1. Basel Convention

The Convention provides that countries should minimize the production of hazardous waste, prioritize sound domestic waste management, and minimize the movement of hazardous waste between countries, especially from developed countries to developing countries. Countries are required to designate one or more competent authorities to receive notifications and grant consent under the Convention.[76] For the transboundary movement e-waste to be legal, the government of the exporter (which may in turn require the producer or exporter) must obtain written consent from the competent authority of the government of import before any exporting may take place. The government of the exporter may not allow the export to occur until it has received the written consent of the government of import and the government of import confirms the existence of a contract between the exporter and the disposer.

Among other obligations, the Convention requires countries to implement a licensing regime that prohibits the transportation and disposal of e-waste unless the entity doing such is duly authorized. E-waste must be packaged, labelled and transported according to generally accepted and recognized international standards and accompanied by proper documentation from the commencement of the transboundary movement to the point of disposal. Each party to the Convention must also ensure that

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74 An additional funding model, which is a slight variant on this third financing method, would be to impose environmental taxes on producers or importers to finance the take-back system.

75 *See generally* Basel Convention, On the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (as amended) (May 27, 2014), http://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf. There are currently 186 parties to the Convention. Note that the Nairobi Convention incorporated e-waste as a hazardous waste under the Basel Convention. Nairobi declaration on the environmentally sound management of electrical and electronic waste (Nov. 27-Dec. 1, 2006).

76 Basel Convention, art. 5.

e-waste is being exported to countries that have the capability to manage and process the e-waste in an environmentally sound manner.

In 2006, the Nairobi Declaration established the Basel Convention as the main global instrument for guidance regarding the sound management of hazardous e-waste.[77] The declaration further asserts that countries should implement take-back and recycling schemes; promote integrated waste management to reduce the harm caused by the hazardous components contained in e-waste by ensuring proper collection of EoL equipment and its separation from household or municipal waste; cooperate and exchange information on best technologies for e-waste management; and develop national, regional, and international cooperation to support the implementation of environmentally sound management of e-waste; among other objectives.[78]

More recently, in 2017, Malawi became a party to the Basel Ban Amendment, which prohibits the export of waste from a list of developed countries (primarily Organization of Economic Cooperation and Development (OECD) members) to developing countries.[79]

4.6.2. Other relevant international treaties

In addition to the Basel Convention and its supplements, in 2013, Malawi signed the Minamata Convention, a treaty that restricts the use of mercury (found in EEE such as LCD monitors and laptops) to goods from which it can be recovered or recycled, and limits the export of products containing mercury to cases where the receiving country has given prior express consent to the import.[80]

The Bamako Convention is a treaty to minimize the import of waste by Africa region countries.[81] It contains many of the same requirements as the Basel Convention. For example, it provides that the transboundary movement of hazardous waste may only occur where the state of export does not have the management capacity, or the ability to dispose of hazardous waste in an environmentally sound manner. Malawi is not a party to the Bamako Convention.

The Durban Declaration on e-Waste Management in Africa provides guidance on improving e-waste practices in the Africa region.[82] Among other recommendations, it provides that each country should develop an e-waste legal framework, including amending existing waste management legislation to allow for a regulation on e-waste management; collect and analyse data to facilitate e-waste management; and develop a qualified and efficient e-waste recycling sector. Malawi is not a signatory to the Durban Declaration.

Since the adoption of these instruments, concerns remain over the lack of adoption and implementation of the frameworks created by international treaties, specifically, the Basel Convention, but some countries such as Ghana are starting to implement e-waste-specific frameworks.[83]

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77 Nairobi ministerial declaration on the environmentally sound management of electronic and electrical waste, art. 1(e) (Dec. 1, 2006), *available at* http://www.basel.int/Portals/4/Basel%20Convention/docs/meetings/cop/cop8/NairobiDeclaration.pdf.

78 *Id.* art. 1.

79 The Basel Convention Ban Amendment, art. 1 (March 1994), *available at* www.basel.int/Implementation/LegalMatters/BanAmendment/Decisions/tabid/3597/Default.aspx

80 Minamata Convention on Mercury, arts. 3-4 (2013)*:* www.mercuryconvention.org/Portals/11/documents/conventionText/Minamata%20Convention%20on%20Mercury_e.pdf.

81 Bamako Convention on the ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (Jan. 29, 1991).

82 The Durban Declaration on e-Waste Management in Africa, at 1, (Oct. 9, 2008): https://www.empa.ch/documents/56164/286251/a592-2009-02-17-en-01+MM-Ewaste-Durban-declaration.pdf/72a28af9-6a96-4b99-8af7-d4953a5bacc7?version=1.0.

83 *See e.g.*, Abuja Platform on *E-waste, Economic Community of West African States* (2009), www.basel.int/Portals/4/Basel%20Convention/docs/eWaste/E-waste_Abudja_Platform_20090821.pdf.

5. International benchmark on e-waste management

This section contains examples and best practices with respect to e-waste from the following eleven countries around the world to be used as a benchmark for recommendations for Malawi.

Africa

- Ethiopia
- Ghana
- Rwanda
- Tanzania
- Uganda

Europe

- Germany
- Switzerland
- United Kingdom

Asia Pacific

- Australia
- Singapore

Americas

- United States (California)

The data collected for each country, to the extent available, includes:

- stakeholder(s) responsible for take-back system management;
- stakeholder(s) responsible for financing the system;
- official e-waste definition under the country's legal framework;
- framework for e-waste collection, transportation, storage, dismantling, shredding, recycling, and disposal;
- stakeholder(s) responsible for activities regarding awareness and education;
- amount of domestic e-waste generated;
- amount of e-waste collected via formal take-back systems.

5.1. Africa

5.1.1. Ethiopia

Although Ethiopia does not have a legal framework for e-waste nor a formal take-back system, per government policy, the Environmental Protection Authority (EPA) and the Ministry of Communications and Information Technology (MCIT) are the government agencies responsible for e-waste management in Ethiopia.[84] MCIT operates a "Demanufacturing Facility" (DMF) that collects WEEE from businesses, banks, and federal and regional government offices. The DMF hosts the Computer Refurbishments and Training Centre (CRTC), which aims to take back all of the computers currently distributed in Ethiopia at EoL. Mobile operators in the country maintain service centres where damaged phones can be handed in for repair or exchange. For its part, the EPA is formulating an e-waste regulation under the Environmental Pollution Control Proclamation of 2002 to formalize a legal framework in Ethiopia and expand the scope of current e-waste management (e.g., beyond business and government WEEE) to encompass additional types of EEE. The e-waste not collected by these programmes is disposed of informally.[85]

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[84] *See* Catherine Benson Wahlen, UNU, UNIDO Implementing Ethiopian E-Waste Management Project, IISD, SDG Knowledge Hub (May 29, 2013), *available at* http://sdg.iisd.org/news/unu-unido-implementing-ethiopian-e-waste-management-project/.

[85] Andreas Manhart *et al.*, Solving the E-Waste Problem (StEP), *E-waste Country Study Ethiopia*, at 24 (Apr. 10, 2013).

Ethiopia generates 0.5 kilograms of e-waste per inhabitant, totalling 49 kilo-tonnes in 2016.[86]

5.1.2. Ghana

Ghana enacted the Hazardous and Electronic Waste Control and Management Act in 2016 "to provide for the control, management and disposal of hazardous waste, electrical and electronic waste." The Ministry of Environment, Science Technology and Innovation is responsible for the overall management of the take-back system. The Ministry is to designate an external service provider (*e.g.*, a public agency, private manufacturer or TPO) to collect an e-waste levy that provides the primary source of funding for the system, including support for the construction of treatment facilities, monitoring and enforcement, and education and awareness programmes.[87] The levy is assessed to manufacturers, distributors and wholesalers with respect to all EEE imported or manufactured in the country. EEE manufacturers, distributors, and wholesalers are required to take back used or discarded EEE for recycling.

One of the primary objectives of the Act is to implement the framework established by the Basel Convention. The Ministry of Environment, Science Technology and Innovation is responsible to administer the framework (grant authorizations, serve as point of contact for notifications to and from other countries, etc.) on the advice of the Environmental Protection Agency. Because the Act was passed a year ago the e-waste take-back system has yet to be fully implemented. Currently, the vast majority of e-waste recycling and disposal is carried out by the informal sector.[88]

In 2016, Ghana generated 1.4 kilos of e-waste per inhabitant or 39 kilo-tonnes in total.[89]

5.1.3. Rwanda

According to the government, existing laws, regulations and policies in Rwanda do not sufficiently address e-waste management.[90] To rectify this, as part of its e-waste management policy, the government plans to develop the laws and regulations for e-waste management and develop and promote e-waste management standards, regulations, and operational guidelines for the sorting, collection, transportation, treatment and disposal of e-waste. The government also plans to stimulate private sector participation by attracting investments in the e-waste management industry and developing public private partnerships for e-waste management.

The government intends to form strategic partnerships with producers and retailers to finance e-waste collection, transportation and treatment through implementing extended producer responsibility principles and advanced recycling fees and an e-waste levy. In fact, under the policy, the private sector will be responsible to establish, operate, and finance the entire take-back system. Under the policy, the Ministry of Information Technology and Communications and the Ministry of Lands, Environment, Forestry, Water and Mines formed a steering committee to guide the formation of the take-back system. The take-back system has yet to be implemented.

Additionally, the policy states that e-waste awareness and education with the public generally, and through particular school programmes, are within the government remit. Regarding exports, the

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86 The Global E-Waste Monitor 2017, Annex 3.

87 Hazardous and Electronic Waste Control and Management Act, 2016, *available at* http://www.epa.gov.gh/epa/sites/default/files/downloads/publications/Hazardous%20and%20Electronic%20Waste%20Control%20and%20Mgt%20Act%20917.pdf. Under Article 37 of the Act, "'waste electrical and electronic equipment' means electrical or electronic equipment that is wastes, including all components, sub-assemblies and consumables which are part of the equipment at the time the equipment becomes waste."

88 Nathan Siegel, Trading in trash: Nairobi's e-waste entrepreneurs – in pictures

89 C.P. Balde *et al.*, *The Global E-Waste Monitor 2017, Quantities, Flows, and Resources*, Annex 3.

90 National E-Waste Management Policy for Rwanda, at 7 (Aug. 2016), *available at* http://www.fonerwa.org/sites/default/files/National%20E-Waste%20Management%20Policy%20for%20Rwanda.pdf.

national plan to implement the Basel Convention incorporates e-waste as a hazardous waste.[91] The Rwanda Environment Management Authority (REMA), under the direction of the Ministry of Lands, Environment, Forestry, Water and Mines, is responsible for administering the Convention notification and consent framework with respect to e-waste imports and exports.[92]

Rwanda generated 0.5 kilograms of e-waste per inhabitant in 2016, a total of 5.9 kilo-tonnes.[93]

5.1.4. Tanzania

In Tanzania, e-waste is managed through the solid and hazardous waste regulations prescribed under the Environment Management Act of 2004.[94] Although e-waste was inserted into the implementing regulation of the legislation, Tanzania lacks a formal e-waste take-back system.[95] In addition, there are no designated facilities for environmentally sound treatment or disposal, so the informal sector handles e-waste recycling and disposal.[96] The legal framework does not provide for a proper financing mechanism nor does not it clearly designate which among the government agencies is responsible for monitoring and inspecting e-waste imports and exports. Consequently, Tanzania cannot ensure the environmentally safe recycling and disposal, or transboundary movement of e-waste.[97]

Tanzania generated 0.8 kilograms of e-waste per inhabitant, or a total of 38 kilo-tonnes, in 2016.[98]

5.1.5. Uganda

Currently, there is no specific e-waste legislation in Uganda. However, the National Environmental Act (the general solid waste legislation) is broadly written and the government intends to incorporate e-waste regulation into the implementing policy.[99] Uganda also has a national e-waste policy and, in 2016, issued e-waste management guidelines.[100] Per the guidelines, the government is to collaborate with stakeholders to establish a TPO responsible for the collection and storage of e-waste and the entire recycling process.[101] Proceeds from the value obtained from the recycling of e-waste will be used to partially finance the take-back system. Advanced recycling fees assessed to importers, manufacturers, and consumers are to cover the majority of the costs associated with establishing and operating the take-back system.

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91 National Implementation Plan for the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, at 19, *available at* http://www.rema.gov.rw/fileadmin/templates/Documents/rema_doc/Climate%20change/National%20implementation%20plan%20for%20the%20Basel%20Convention%20on%20the%20control%20of%20transboundary.pdf.

92 Electronic Reporting System of the Basel Convention, Rwanda, http://ers.basel.int/ERS-Extended/FeedbackServer/fsadmin.aspx?fscontrol=respondentReport&surveyid=66&voterid=48401&readonly=1&nomenu=1

93 The Global E-Waste Monitor 2017, Annex 3.

94 The Environmental Management Act, 2004, *available at* http://www.tzdpg.or.tz/fileadmin/_migrated/content_uploads/Environmental_Management_Act_04.pdf; Environmental Management (Hazardous Waste Control and Management) Regulations 2009, Part VIII.

95 Daniel Koloseni & Faith Shimba, E-Waste Disposal Challenges and Remedies: A Tanzanian Perspective, at 334 (2012), available at https://cdn.intechopen.com/pdfs-wm/40496.pdf.

96 The United Republic of Tanzania, Vice-President's Office, Guidelines for Management of Hazardous Waste, at 3.4 (June 2013), available at http://www.nemc.or.tz/uploads/publications/en1468868703-GUIDELINES%20FOR%20MANAGEMENT%20OF%20HAZARDOUS%20WASTE.pdf.

97 Secretariat of the Basel Convention, Assessing if notifications, consents, and enforcement of transboundary movements of waste and take-back procedures for illegal traffic represent environmentally sound management, United Republic of Tanzania, at 16 (Dec. 2014).

98 The Global E-Waste Monitor 2017, Annex 3.

99 National Environmental Act, Cap. 153 (May 19, 1995), available at http://www.wipo.int/edocs/lexdocs/laws/en/ug/ug019en.pdf; Ministry of Information and Communications Technology, Guidelines for E-waste Management in Uganda, at 17 (Mar. 2016), http://kanagwa.com/wp-content/uploads/2016/05/e-waste-guidelines-uganda.pdf.

100 Ministry of Information and Communications Technology, Electronic Waste (E-Waste) Management Policy for Uganda (2012) https://www.ict.go.ug/sites/default/files/Resource/Electronic%20Waste%20Management%20Policy%20for%20Uganda.pdf.

101 Ministry of Information and Communications Technology, Guidelines for E-waste Management in Uganda, at 27.

Importers of EEE are to notify and obtain consent from the relevant authority to transport e-waste through Uganda; disclose the number of years equipment has been in used before importation; keep records of customers to facilitate waste collection; and have equipment inspected and certified by relevant agencies. Although a party to the Basel Convention, Uganda has yet to implement the consent and notification framework established by the Convention regarding WEEE exports.

The guidelines recommend that informal sector e-waste collectors be required to obtain a licence and transport e-waste in a responsible manner. The guidelines state that the Ministry of Information and Communications Technology is to take the lead in e-waste awareness programmes, with additional stakeholders such as learning institutions and other government organizations serving in a supplementary role to also create awareness and educate the public.

In 2016, Uganda generated 0.6 kilograms of e-waste per inhabitant, a total of 25 kilo-tonnes.[102]

5.2. Asia-Pacific

5.2.1. Australia

The Product Stewardship Act aims to reduce the impact that products and the substances contained therein have on the environment.[103] The Act allows for different types of waste management arrangements depending on the industry. They include waste management on a voluntary basis managed by industry, a co-regulatory basis managed by both the government and industry, and mandatory regulation managed solely by the government.

In 1998, the mobile industry formed MobileMuster, a voluntary mobile phone take-back system accredited under the Act in 2014.[104] The Australian Mobile Telecommunications Association (AMTA) manages MobileMuster on behalf of its mobile operator members, who fund the take-back system.[105] The initiative hosts over 3 500 public drop off points, 1 600 retail stores, and 1 411 workplaces across the country and collected 79.1 tonnes of mobile phone components in 2017. The initiative also provides education and awareness programmes with the aim of increasing awareness of mobile phone recycling.

Australia's environment ministers determined that the e-waste management of televisions and computers should be regulated, and the government adopted a co-regulatory approach under the Act in 2011.[106] The aim of the National Television and Computer Recycling Scheme is to assist households and small businesses with access to collection and recycling services for televisions, computers, printers and computer products.[107] The scheme supplements state, territory and local government e-waste management activities. Currently, manufacturers and importers of televisions and computers fund 50 per cent of the total costs of collection and recycling.[108] The remainder is funded by state governments. Over time, the Act increases the percentage funded by manufacturers and importers until the year 2026, when they will be responsible for 80 per cent of the costs. "Recycling Near You" and

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102 The Global E-Waste Monitor 2017, Annex 3.

103 Product Stewardship Act of 2011, No. 76, 2011, art. 4, https://www.legislation.gov.au/Details/C2011A00076.

104 MobileMuster, https://www.mobilemuster.com.au/about/

105 MobileMuster, Annual Report, 2017, at 1, https://www.mobilemuster.com.au/media/135343/mob_annualreport-2016-17final.pdf.

106 Department of Sustainability, Environment, Water, Population and Communities, Product Stewardship (Televisions and Computers) Regulations 2011, Fact Sheet (Nov. 24, 2011), www.environment.gov.au/system/files/resources/2e8c4c59-d307-4977-a895-e3bd084dfb60/files/fs-regulations.pdf.

107 Department of the Environment, National Television and Computer Recycling Scheme – Changes to the Scheme – Fact Sheet (June 10, 2015), http://www.environment.gov.au/protection/national-waste-policy/publications/factsheet-national-television-and-computer-recycling-scheme-changes.

108 Department of the Environment, National Television and Computer Recycling Scheme – product weights and recycling targets (July 1, 2015), www.environment.gov.au/system/files/resources/677d48ee-f53d-426c-a42b-04f9b19749d9/files/factsheet-national-television-and-computer-recycling-scheme-recycling-targets.pdf.

other online resources inform consumers about available collection points, provide a list of approved recycling service providers, and educate consumers on how the scheme operates.[109]

Australia generated 23.6 kilograms per inhabitant, totalling 574 kilo-tonnes of e-waste in 2016.[110]

5.2.2. Singapore

Currently, Singapore does not have specific legislation for e-waste management, and e-waste is classified as non-hazardous solid waste for local regulatory purposes.[111] However, the National Environment Agency (NEA) has formed a national voluntary partnership with interested stakeholders for e-waste, lamp and battery recycling. Existing voluntary measures by industry for e-waste collection, take-back, and recycling include:

1. REcycling Nations Electronic Waste (RENEW), a joint initiative by telecommunication company StarHub, e-waste recycler Tes-AMM, and courier firm DHL; Panasonic Heartland E-Waste Recycling Programme and SingTel-Nokia Recycling Programme; and recycling partner Cimelia Resource Recovery.
2. Project Homecoming, which is a joint multi-brand ink and toner cartridge recycling initiative led by Brother, Canon, Dell and Epson, and supported by recycler Tes AMM, the National Library Board (NLB) and the NEA.
3. Fuji Xerox collects used printers and cartridges from customers' offices for recycling and also recycles its own printing equipment.[112]

The objectives of the national voluntary partnership include:

1. Building public awareness of e-waste, lamp and battery recycling.
2. Providing consumers with convenient drop-off points.
3. Raising collection and recycling standards.
4. Getting feedback and data to support the development of a formal regulation.[113]

Under the partnership, EEE producers (e.g., manufacturers and retailers) are encouraged to implement schemes to collect the products that they sold when consumers discard them. For example, a home appliance retailer could provide take-back services for unwanted appliances upon delivery of the new product, and send the e-waste to a registered recycling service provider. Producers are also encouraged to spearhead e-waste recycling programmes.

The NEA role in the partnership is to provide funding support for recycling programmes, including up to 80 per cent of qualifying costs, which may include collection, recycling, education and other costs. Qualifying costs are evaluated on a case-by-case basis. Entities providing recycling services must register with the NEA to receive funding support.

Singapore became a party to the Basel Convention in 1996 and has strict regulations for transboundary movements, restricting the import and export of e-waste for final recovery and final disposal.[114]

In 2016, Singapore generated 17.9 kilograms of e-waste per inhabitant for a total of 100 kilo-tonnes.[115]

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109 National Television and Computer Recycling Scheme, Recycling Near You, http://recyclingnearyou.com.au/ewastescheme/
110 The Global E-Waste Monitor 2017, Annex 3.
111 Shunichi Honda *et al.*, *Regional E-Waste Monitor, East and Southeast Asia*, at 119 (2016).
112 Id. at 121; NEA, E-Waste Management, National Voluntary Partnership, http://www.nea.gov.sg/energy-waste/3rs/e-waste-management/national-voluntary-partnership#Partners
113 NEA, E-Waste Management, National Voluntary Partnership.
114 See for example: NEA, Change of Product Code Quantity Unit for Product Codes for E-Waste and Used Electronic Equipment (June 5, 2009), www.nea.gov.sg/docs/default-source/anti-pollution-radiation-protection/chemical-pollution/hange-of-product-code-quantity-unit-for-used-electronic-equipment-nbsp-.pdf?sfvrsn=0.
115 The Global E-Waste Monitor 2017, Annex 3.

5.3. Europe

5.3.1. Germany

The Electrical and Electronic Equipment Act provides the legal framework underpinning the take-back system in Germany.[116] It implements EPR principles, placing responsibility for the complete life span of EEE products on EEE manufacturers, importers, and resellers by requiring them to collect and dispose of WEEE at their own expense and at no charge to consumers. The Act also enables the establishment of a TPO to operate the take back system, including implementing collection points and recycling facilities. The Federal Environmental Agency designated the Stiftung Elektro-Altgeraete Register (EAR) as the TPO responsible to implement and manage the take-back system, including registering producers and their EEE products (identifying business-to-consumer (B2C) and business-to-business (B2B) equipment separately); coordinating the provision of suitable containers and the collection of WEEE; monitoring and enforcing the Act; and raising fees from manufacturers, importers, and resellers of EEE to finance the system. The Federal Ministry for the Environment determines the fees.[117] To export WEEE lawfully, a firm must follow several EU regulations that implement the Basel Convention framework.[118]

In 2016, Germany generated 22.8 kilograms of e-waste per inhabitant, a total of 1 884 kilo-tonnes. Of that total, Germany collected around 631 kilo-tonnes (33%) into its take-back system for recycling. [119]

5.3.2. Switzerland

In 1998, Switzerland became the first country to implement EPR principles when it put in place an ordinance establishing a take-back system.[120] The objective of the ordinance is to ensure that WEEE does not enter municipal waste and is disposed of in an environmentally sound manner. The ordinance requires the public to dispose of WEEE with a manufacturer, importer, or to a disposal facility. Manufacturers, importers, and retailers are required to take-back WEEE, in most cases, free of charge to consumers. Each party responsible to take back WEEE is accountable for the disposal of the WEEE it does not reuse. Disposal must be performed in an environmentally sound manner. This take-back system is financed by an advanced recycling fee paid by manufacturers and importers of EEE for every product placed on the market in Switzerland.[121] This fee is included in the purchase price of all EEE.

Switzerland has three industry-established TPOs that collect, treat, and dispose of e-waste: The Swiss Association for Information, Communications and Organisational Technology (SWICO), Stiftung Entsorgung Schweiz (SENS), and Stiftung Licht Recycling Schweiz (SLRS).[122] The TPOs benefit from economies of scale, providing customers with over 500 collection points (including retailers) that accept any brand of electronic equipment.[123]

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116 Elektrogesetz (2005, as amended), www.elektrogesetz.com/elektrog.shtml. Under the Act, "Electrical and electronic equipment means: 1. Equipment which is dependent on electric currents or electromagnetic fields in order to work properly. 2. Equipment for the generation, transfer and measurement of such currents and fields which is designed for use with a voltage rating not exceeding 1000 volts for alternating voltage and 1500 volts for direct voltage."

117 Fee Ordinance to the Electrical and Electronic Equipment Act (Oct. 21, 2015), http://www.bmub.bund.de/themen/wasser-abfall-boden/abfallwirtschaft/wasser-abfallwirtschaft-download/artikel/elektro-und-elektronikgeraetegesetz-gebuehrenverordnung-elektroggebv/.

118 Elektrogesetz Section 12(4).

119 The Global E-Waste Monitor 2017, Annex 3 and 4.

120 Swiss Federal Office for the Environment, Ordinance, On the Return, the Take Back and the Disposal of Electrical and Electronic Equipment (as amended): http://raee.org.co/nuevo/wp-content/uploads/2014/06/VREG_engl.pdf.

121 SENS, Swiss Foundation for Waste Management: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjAsOSy-JfYAhWMRt8KHVVnBCkQFggxMAA&url=http%3A%2F%2Fwww.weee-forum.org%2Fsystem%2Ffiles%2Fmember%2Fsens_two_pager_070710_e.pdf&usg=AOvVaw1aUdrpXPdGhANHOX8suhG

122 Swiss Association for Information, Communications and Organisational Technology, www.swico.ch/de/home. Stiftung Entsorgung Schweiz, www.erecycling.ch/ Stiftung Licht Recycling Schweiz, www.slrs.ch/index-de.php?frameset=1

123 *See* SENS, Swiss Foundation for Waste Management.

In 2016, Switzerland generated 22.2 kilograms of e-waste per inhabitant, totaling 184 kilo-tonnes. The country's take-back system collected 134 kilo-tonnes (73%) of that total. [124]

Similar to the other countries that are parties to the Basel Convention, an exporter of WEEE needs to comply with the requisite notification and consent procedures and provide documentary evidence that the final disposal of the e-waste being exported will be done in an environmentally sound manner and has the prior consent of the importing country.[125]

Concerning education and awareness, in 2003, the State Secretariat for Economic Affairs (SECO) launched a global e-waste initiative called the "Knowledge Partnerships in e-Waste Recycling."[126] The programme includes advising other governments on the regulation and organization of take-back systems and recycling technologies.[127] The objective of the initiative is to not only protect workers' health and the environment but also to open up new opportunities for trade and create valuable jobs in the recovery of secondary resources from e-waste. In 2016, under this programme, SECO entered into a knowledge sharing agreement with Egypt to promote the recycling of electronic waste among small and medium-sized enterprises (SMEs).

5.3.3. United Kingdom

Producers (a term under the United Kingdom framework that includes manufacturers and retailers of EEE) are obliged to join a TPO, approved by the Environment Agency, and are responsible to finance the take-back system, whether carried out by the same TPO, a local government, or other entity.[128] Currently, there are 36 TPOs in the United Kingdom.[129] Collection is to be carried out at no charge to consumers.[130]

Opening a treatment facility or exporting WEEE requires formal approval from the Environmental Agency and, once approved, compliance with reporting and record keeping requirements. Exporters of WEEE, similar to Germany, are required to follow the EU regulations establishing the Basel Convention framework, including distinct obligations for exporting WEEE inside versus outside of the European Economic Area. "Recycle Now," a government programme, and "Recycle More," a private programme financially supported by TPOs, are initiatives designed to raise awareness and educate the public on WEEE and provide locations for e-waste collection points.[131]

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124 The Global E-Waste Monitor 2017, Annex 2 and 3.

125 Swiss Federal Council, Regulation on the transport of waste (as amended), art. 17 (June 22, 2005), https://www.admin.ch/opc/de/classified-compilation/20021080/index.html.

126 State Secretariat for Economic Affairs, Development cooperation for e-waste recycling: A Swiss contribution to the implementation of the Basel Convention, www.basel.int/Portals/4/Basel%20Convention/docs/convention/XX%20Anniversary/Press%20kit/Swiss%20Project%20leaflet.pdf.

127 World Resources Forum, Switzerland Signs Agreement with Egypt to Support E-waste Recycling (Mar. 15, 2016), https://www.wrforum.org/projects/sri/switzerland-agreement-egypt-e-waste-recycling/.

128 Secretary of State, The Electrical and Electronic Equipment Regulations 2013, arts. 11-12, and 14 (Dec. 10, 2013), http://www.legislation.gov.uk/uksi/2013/3113/pdfs/uksi_20133113_en.pdf. The United Kingdom follows the EU Waste Directive definition for EEE and WEEE. EEE means 'electrical and electronic equipment' that is dependent on electric currents or electromagnetic fields in order to work properly, and includes equipment for the generation, transfer and measurement of such currents and fields and designed for use with a voltage rating not exceeding 1 000 volts for alternating current, and 1 500 volts for direct current. WEEE is defined as electrical or electronic equipment, which is waste within the meaning of Article 3(1) of the Waste Directive including all components, subassemblies and consumables that are part of the product at the time of discarding.

129 Environmental Agency, List of approved compliance schemes for WEEE (Oct. 2017), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/651211/WEEE_approved_compliance_schemes_public_register.pdf.

130 Electrical and Electronic Equipment Regulations arts. 42 and 52.

131 WARP, 2.0 Raising public awareness of recycling and reuse, at 2, http://www.wrap.org.uk/sites/files/wrap/2.0%20Raising%20public%20awareness%20of%20recycling%20and%20reuse%20-%20Online.pdf; Recycle Now, https://www.recycle-more.co.uk; Recycle More, https://www.recyclenow.com/.

The United Kingdom generated 24.9 kilograms of e-waste per inhabitant, a total of 1 632 kilo-tonnes, in 2016. Its take-back system collected and recycled approximately 663 kilo-tonnes (41%) of that total. [132]

5.4. Americas

5.4.1. United States (California)

In 2004, the State of California enacted the E-Waste Recycling Act.[133] The Act establishes a take-back system for "covered electronic devices" defined as a "video display device [*i.e.*, television, computer, or DVD player with a CRT, LCD, or plasma display] with a screen greater than four inches, measured diagonally, which the Department of Toxic Substances (DTSC) has identified in regulation as a device that is presumed to be hazardous waste when discarded." The Act also establishes a financing mechanism for the take-back system- an advanced recycling fee of USD 5 to USD 7 (depending on the device screen size) collected by EEE retailers, including manufacturers who sell directly to consumers, at the point of sale.[134] The government uses the funds to compensate approved collectors and recyclers.[135] The California Department of Resources Recycling and Recovery (CalRecycle) administers and provides oversight for all of California state-managed waste handling and recycling programmes, including the take-back system established under the Act.[136]

Manufacturers are required to provide education and awareness outreach to consumers under the Act. The outreach is to inform consumers about how to return, recycle, and dispose of e-waste via a toll-free number, website, label on the device, information on the packaging, or information accompanying the sale of covered electronic devices.

To export e-waste, a firm must notify and obtain consent from the DTSC. It must also demonstrate, among other obligations, that the waste is being exported for the purposes of recycling or disposal; that the export is being conducted according to applicable United States or international law; and that the waste or device will be managed within the country of destination with facilities whose operations meet or exceed the level set by the OECD guidelines on environmentally sound waste management.

5.5. Benchmark summary

The examples from countries around the world indicate that best practices for e-waste management include:

- narrowly defining e-waste initially to prioritize certain EEE;
- formally establishing a management structure with a mix of responsibilities for both government and the TPO such as:
  - monitoring and enforcement, and
  - implementing and operating the take-back system;
- utilizing EPR principles even in countries where manufacturers do not directly produce or sell EEE;

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132 The Global E-Waste Monitor 2017, Annex 2 and 3.

133 CA Pub Res Code §§ 42460-42486 (2016).

134 Id. § 42464(a); California Department of Tax and Fee Administration, Tax Rates – Special Taxes and Fees, http://www.cdtfa.ca.gov/taxes-and-fees/tax-rates-stfd.htm#elecrecyclefee.

135 CA Pub Res Code § 42464(f). California has 421 approved collectors and 31 approved recyclers. CalRecycle, *Update on California's Covered Electronic Waste Recycling Program Implementation of the Electronic Waste Recycling Act of 2003*, at 2 (Feb. 2017).

136 CalRecycle, About CalRecycle, What We Do, http://www.calrecycle.ca.gov/AboutUs/WhatWeDo/default.htm

- establishing a legal framework such that the import and export of e-waste comply with the Basel Convention, the Basel Ban Amendment, Minamata Convention, and other relevant international treaties;
- implementing e-waste education and awareness programmes to inform the public.

These best practices are included in more detail as part of the recommendations for the Malawi e-waste strategy presented in this report.

Table 6 summarizes the benchmark countries, their region, whether the country has a formal take-back system, and the stakeholder(s) responsible for take-back system management, financing, and education and awareness initiatives.[137]

Table 6: Benchmark countries overview

Country	Formal take-back system	Management	Financing	Education and awareness
Africa				
Ethiopia	No	Informal	Informal	Informal
Ghana	Yes	Government	Producers/importers	Government
Rwanda	Yes	TPO	Producers/importers	Government, producers/importers
Tanzania	No	Informal	Informal	Informal
Uganda	Yes	TPO	Producers/importers	Government
Asia-Pacific				
Australia	Yes	TPO and Government	TPO and local governments	Government, producers/importers
Singapore	Yes	TPO	Government, recyclers	Producers/importers
Europe				
Germany	Yes	TPO	Producers/importers	Government, Producers/importers
Switzerland	Yes	TPO	Producers/importers	Government, Producers/importers
United Kingdom	Yes	TPO	Producers/importers	Government, Producers/importers
Americas				
United States (California)	Yes	Government	Society	Government

Source: National regulators and TPOs

[137] The status of each take-back system is based on the laws, regulations, and policies currently in place in the country. Whether the framework or legal structure created by a particular legal instrument has been implemented in practice is clarified in the sections immediately above. For example, Rwanda intends to implement a take-back system that is to be financed by advanced recycling fees and an e-waste levy on the private sector. While not yet implemented in practice, the table reflects that the policy is in place.

Table 7 includes data on the amount of e-waste generated and collected by the take-back system in each country.

Table 7: E-waste generated and collected by take-back systems (2016)

Country	E-waste generated (kg/inh)	E-waste generated (kt)	E-waste collected (kt) and as a percentage of e-waste generated (%)
Africa			
Ethiopia	0.5	49	N/A
Ghana	1.4	39	N/A
Rwanda	0.5	6	N/A
Tanzania	0.8	38	N/A
Uganda	0.6	25	N/A
Asia and Oceania			
Australia	20.9	182	43 (24%)
Singapore	17.9	100	N/A
Europe			
Germany	22.8	1884	631 (33%)
Switzerland	22.2	184	134 (73%)
United Kingdom	24.9	1632	663 (41%)
Americas			
United States (California)	N/A	N/A	79<?>

Source: The Global E-Waste Monitor 2017 (except California)

* Kilogram per inhabitant (kg/inh)

6. Forecast of e-waste volumes and values

In 2016, 44.7 million metric tonnes (Mt) of e-waste[138] were generated globally at a value of EUR 55 billion. This represents a 6.9 per cent increase over the 2014 level when 41.8 Mt were generated. On a kilogram per inhabitant (kg/inh) basis, 6.1 kilograms of e-waste was generated in 2016 compared to 5.8 kg/inh in 2014.[139]

Global e-waste generation is expected to swell to 52.2 Mt, which is an increase of 16.8 per cent on 2017 volumes, or 6.8 kg/inh, by 2021. Worldwide, only 20 per cent (8.9 Mt) of e-waste is properly collected and recycled. Africa generated the least amount of e-waste (2.2 Mt) compared to all other

[138] E-waste, as measured in this section, is comprised of six categories, including temperature exchange equipment, screens, lamps, large equipment, small equipment, and small IT. *See also supra* section 4.2.2.

[139] The Global E-waste Monitor 2017.

regions. Currently, there is no available, aggregate information on e-waste collection in Africa (see Table 8).

Table 8: E-waste generation worldwide in 2017

Region	E-waste (Mt)		kg per inhabitant	Collection rate
Asia	18.2	41%	4.2	15%
Europe	12.3	28%	16.6	35%
Americas	11.3	25%	11.6	17%
Africa	2.2	5%	1.9	-
Oceania	0.7	2%	17.3	6%
Total	**44.7**	**100%**	**6.1**	**20%**

Source: Adapted from the Global E-waste Monitor 2017

Sixty-seven countries, covering 66 per cent of the population, worldwide have implemented e-waste management legislation. However, not all countries with enacted laws enforce them. In the Africa region, only a handful of countries have enacted specific e-waste policies and legislation and each has done so relatively recently.

In 2016, Malawi generated 9 500 tonnes of e-waste, (4 per cent of all the e-waste generated in the Africa region), which is equivalent to 0.5 kg/inh. E-waste generated in Malawi has increased considerably since 2014, having more than doubled from 4 kt to 9.5 kt.

The following sections present the methodology used to estimate the current volumes and values of e-waste generated in Malawi from mobile phone devices, computers (desktops and laptops) and TV sets, as well as estimations for these values over five years (2018-2022).

6.1. Methodology

6.1.1. Simple delay model

The methodology used to estimate Malawi e-waste generation for mobile phones, computers, and television sets over the next five years, follows the simple delay model. This model is based on the product sales in a specific historical year shifted in time by a simple average lifespan of the product, for example, if mobile phones have an estimated average lifespan of four years, then the number of waste mobile phones in each year equals the number of mobile phones sold four years ago.[140]

Since there is no direct data on the amount of EEE sold each year, estimations are based on historical information on the stocks of each type of EEE, including the percentage of households that own a PC or TV set in each year, and the number of mobile phones per 100 inhabitants each year (see section 2). Additional assumptions regarding the number of PCs or TV sets per household, and the average lifespan of each type of EEE, among others, are detailed in the following sub-sections for each type of EEE. For all type of devices, lifespan estimations are based on a review of the relevant literature.

The sources of the historical information and data on which the estimations of e-waste volumes and values for the next five years are based, from 2018 to 2022, are the ITU Telecommunications/ICT

[140] *Regional E-Waste Monitor, East and Southeast Asia*, at 45. There are other methodologies, such as the distributed lifespan approach in which the e-waste generated in any particular year follows a Weibull distribution. However, there is not enough information available to use this methodology.

Indicators Database and the "Survey on Access and Usage of ICT Services in Malawi-2014" National Statistical Office (NSO) of Malawi.

Finally, the e-waste estimate does not include imports of externally generated e-waste, but rather only includes domestically generated e-waste. For this study, there was no information available on the externally generated e-waste imported to Malawi.[141]

6.1.2. E-waste volume estimations

The evolution of ICT device penetration follows an 's-curve,' therefore, a logistic function is used to estimate the volumes or stocks of mobile phones, PCs, and TV sets over time in Malawi. The logistic function used has the following form:

$$n(t) = \frac{K}{1+e^{-(p+qt)}} \quad (1)$$

Where:

- $n(t)$ is the device penetration either by population or households in year t;
- K is the target penetration in the long-run;
- q is the growth rate in any given year t as a function of the fraction of the population or households that does not own the device; and,
- p is the timing variable that, jointly with q, shifts the diffusion function, $n(t)$, forwards or backwards.

Reorganizing terms in (1):

$$\ln \frac{n(t)}{K-n(t)} = p + qt \quad (2)$$

Since $n(t)$ is known for a given number of years and the long-run variable K is assumed for each type of device based on market evolution, the left-side of equation (2) is known. Using an ordinary least squares (OLS) regression, p and q are estimated.

Once the $n(t)$ function is estimated for each type of device (the device penetration, the number of devices in the market), $N(t)$ is in turn estimated based on either the population or the number of households for each given year. Additional assumptions regarding the number of PCs and TV sets per household are detailed in the following sections. The estimated product sales for each device in year t is given by:

$$\text{Product sales in year } t = N(t) - N(t-1) \quad (3)$$

Based on the product sales in a given year for each type of device, the simple delay model is used to estimate the e-waste volumes.

[141] Information on imports of used EEE that have reached their EoL and are no longer useful for the purpose for which they were built (e-waste) was requested, however, no data was available.

6.1.3. E-waste value estimations

The estimation of the e-waste values for 2018-2022 incorporates the percentage of materials recovered[142] and the values of these materials based on 2017 prices from the London Metal Exchange[143] and the United Nations Environment Programme.

The percentage of materials recovered are based on the weight of each type of EEE (kilograms of a specific material recovered per tonne of EEE). In total, about 75 per cent of the initial weight could be recovered from PCs and TV sets, and about 70 per cent from mobile phones (see Table 9).

Table 9: Quantity of recoverable material from each tonne of ICT e-waste and value per kilo

Material	Mobile phones (kg)	Computers (kg)	TV sets (kg)	Price USD/kg (2017)
Plastic	375.00	174.38	93.62	0.23
Lead	3.75	45.49	1.56	2.56
Aluminium	-	106.15	9.36	2.06
Iron	22.50	151.64	202.84	0.27
Tin	7.50	7.58	-	19.33
Copper	112.50	53.07	26.53	6.85
Nickel	15.00	6.45	0.30	11.69
Zinc	3.75	15.16	2.34	3.17
Gold	0.30	0.01	0.01	36 785.04
Cobalt	30.00	0.12	-	74.00
Palladium	0.11	-	-	29 156.49
Silver	3.00	0.14	0.02	470.31
Chromium	3.75	0.05	-	3.23
Cadmium	3.75	0.07	-	1.30
Silica	112.50	188.64	413.49	0.05
Total recoverable weight per tonne	**698**	**750**	**750**	

Source: Based on various sources, United Nations Environment Programme, (2012) E-waste Volume III, WEEE/E-waste take-back system, and the London Metal Exchange.

Based on the weight of the materials recovered and the price per kilogram of each kind of material, the total value of materials recovered per tonne of e-waste of each type of EEE is estimated (see Table 10). Note that mobile phones are the most valuable type of e-waste, per tonne of e-waste.

142 United Nations Environment Programme, *E-Waste Volume III, WEEE/E-Waste 'Take Back System'* (2012).
143 London Metal Exchange, https://www.lme.com/

Table 10: Total recoverable value per tonne of ICT related e-waste

Material	Mobile phones	Computers	TV sets
Total recoverable value per tonne of e-waste	USD 19 100	USD 1 501	USD 689
Approximate value recovered per device	USD 2.1	USD 8.2	USD 18.5

Source: ITU based on the United Nations Environment Programme and the London Metal Exchange

Since the e-waste volumes for PCs and TV sets are based on the stock of devices in households, and the e-waste volume for mobile phones is based on number of devices per 100 inhabitants, the weight per device is needed to estimate the total weight of the e-waste generated from these devices (see Table 11).

Table 11: Representative weights of targeted devices: mobile phones, computers, and TV sets

Device	Weight (kg)
Mobile phones	0.11
Computers:	
- Desktop	10.4
- Laptop	3.0
TV sets	26.9

Source: United States Environmental Protection Agency

Television sets, in contrast to both computers and mobile phones, can vary widely in weight due to size and technology differences, such as the different screen areas for CRT TV sets versus flat panel TV sets. Due to the lack of information in terms of market shares for each kind of TV set, or the imports of the number of TV sets and their weights, the weight per TV set for this study is based on the United States Environmental Protection Agency report: *Electronic Products Generation and Recycling Methodology Review 2016*.[144]

6.2. Mobile phone devices

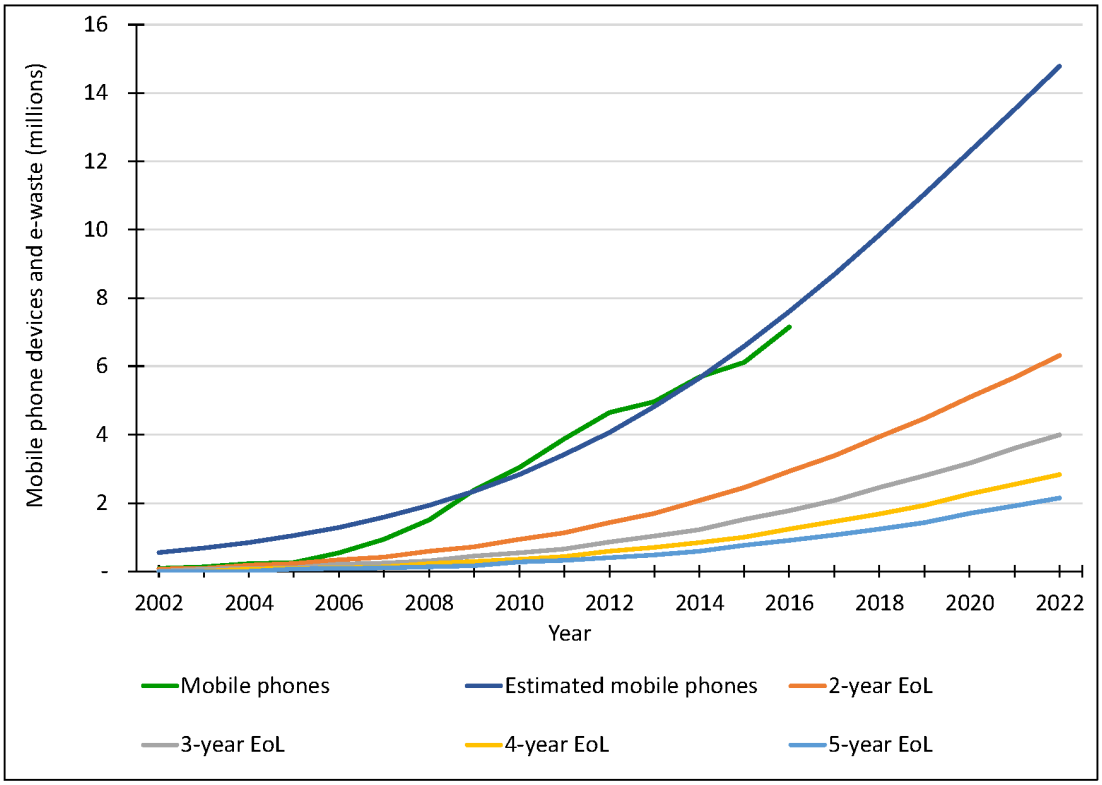
6.2.1. Volume of e-waste from mobile phone devices

Based on the described methodology, the stock of mobile phones is estimated through a logistic function assuming a long-run penetration (*K*) of 100 per cent (one mobile phone device per inhabitant). By 2022, the stock will be an estimated 14.8 million, an increase of 1.7 times the current stock of 8.7 million mobile phones.

The volumes of e-waste are estimated using the simple delay model for different EoL years or lifecycles, mainly from two to five years (see Figure 9).

[144] https://www.epa.gov/sites/production/files/2016-12/documents/electronic_products_generation_and_recycling_methodology_review_508.pdf.

Figure 9: Stocks of mobile phone devices and e-waste generated



Source: ITU

The National Statistical Office ICT survey,[145] indicates that 67 per cent of the population owns a mobile phone device for less than five years, while the remaining 33 per cent owns the device for five years or more (see Figure 10).

Although the NSO survey does not precisely inquire as to the EoL or lifecycle of mobile phone devices, since the end user could end his or her ownership by transferring the device, the survey does provide insight into the number of years a device is used. In addition, in developing countries, the EoL of ICT devices is typically higher than that of developed countries, where the average is below two years.[146] Based on this information, a four to five year EoL, on average, is assumed when estimating the e-waste generated from mobile phone devices.

The volume of e-waste with respect to the number of mobile phones and the weight generated thereby for the years 2018-2022 is depicted in Table 12 and Table 13.

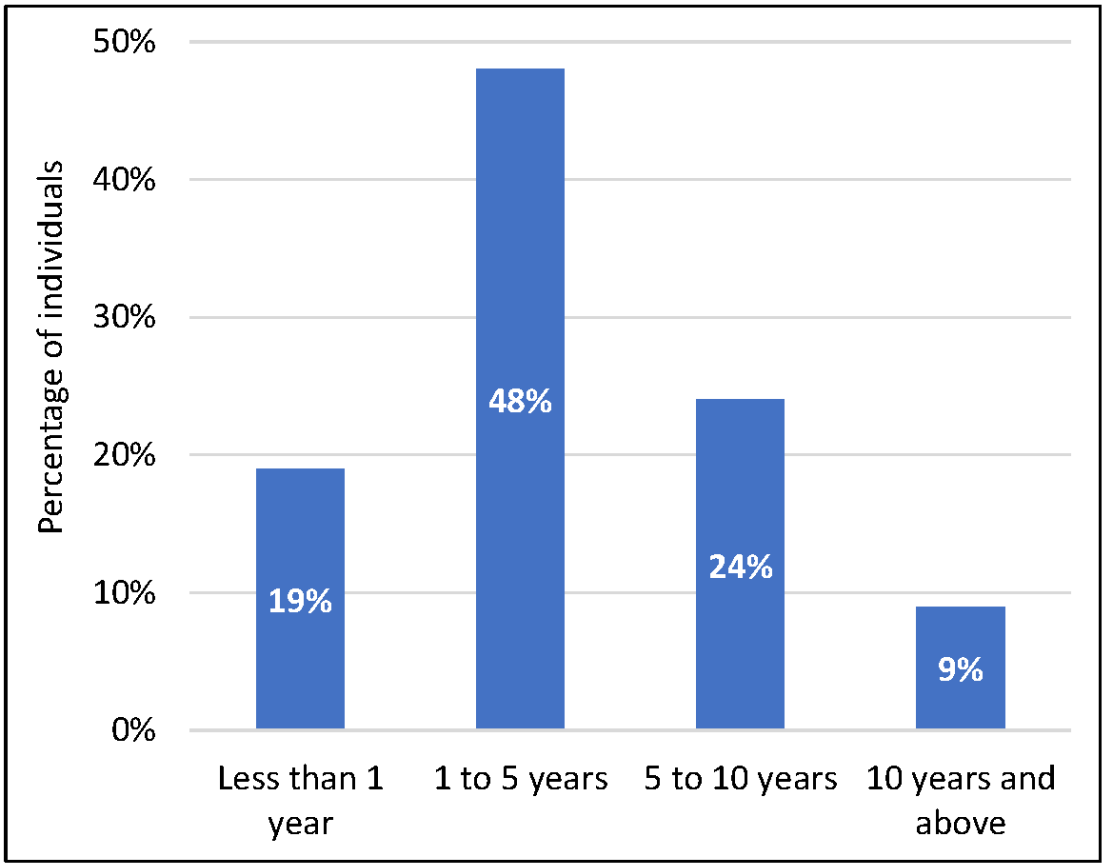
Table 12: E-waste due to mobile phones 2018-2022 (millions)

End-of-Life	Total e-waste	E-waste annual average	Minimum (year = 2018)	Maximum (year = 2022)
4-year EoL	11.24	2.25	1.68	2.83
5-year EoL	8.41	1.68	1.23	2.15

Source: ITU

[145] NSO, *Survey on Access and Usage of ICT Services in Malawi-2014*, at 21 (2015).
[146] C.P. Balde *et al.*, *The Global E-Waste Monitor 2017, Quantities, Flows, and Resources*, at 21.

Figure 10: Percentage of individuals by period of mobile phone ownership



Source: NSO

Table 13: E-waste weight due to mobile phones 2018-2022 (kilo-tonnes (kt))

End-of-Life	Total e-waste (kt)	E-waste annual average (kt)	Minimum (kt) (year = 2018)	Maximum (kt) (year = 2022)
4-year EoL	1.22	0.25	0.18	0.31
5-year EoL	0.92	0.18	0.13	0.23

Source: ITU

6.2.2. Value of e-waste from mobile phone devices

Based on the average recoverable value of USD 2.1 per mobile phone device (see Table 10), the e-waste value attributable to mobile phone devices is estimated in Table 14.

Table 14: E-waste value attributable to mobile phones 2018-2022 (USD millions)

End-of-Life	Total USD	Annual average value (USD)	Minimum USD (year = 2018)	Maximum USD (year = 2022)
4-year EoL	23.4	4.7	3.5	5.9
5-year EoL	17.5	3.5	2.6	4.5

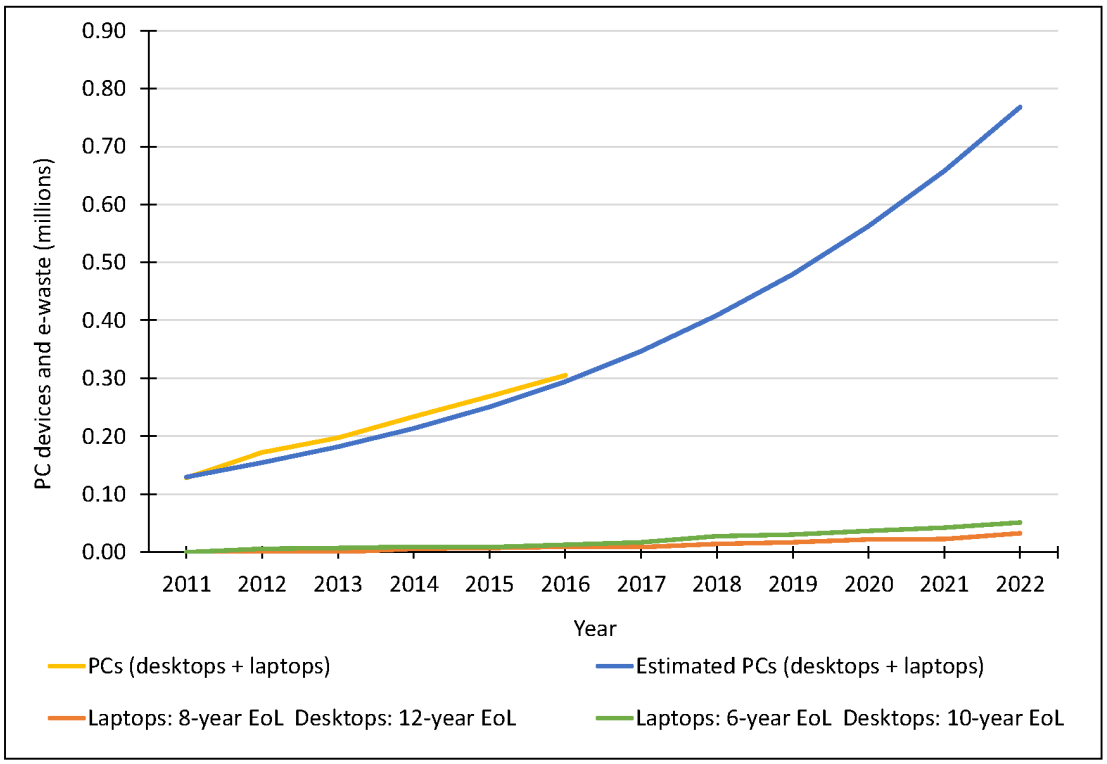
Source: ITU

6.3. Computer devices

6.3.1. Volume of e-waste from computer devices

Similar to the mobile phone forecast, the household stock of computers is estimated through a logistic function assuming a long-run household penetration (*K*) of 80 per cent (80 out of every 100 households possessing at least one computer). The volume of e-waste is estimated using the simple delay model for different EoL years or lifecycles (see Figure 11).

Figure 11: Stocks of computers and e-waste generated



Source: ITU

Based on the NSO ICT survey of households with at least one PC: 13 per cent have a desktop, 53 per cent a laptop, and 33 per cent have both.[147] In 2014, desktops contributed 35 per cent of the PC stock, and laptops the remaining 65 per cent. Based on international trends,[148] by 2022 the PC stock in Malawi is expected to be comprised of 26 per cent desktops and 74 per cent laptops.

Based on the above assumptions, the stock in 2017 is estimated to be 350 000 PCs and is expected to more than double by 2022, reaching 770 000 (Figure 11).

The lifecycle for desktops is between 3 and 12 years. Considering that ICT devices in developing countries have a higher lifecycle compared to developed countries, estimations of e-waste attributed to desktops should place the EoL in the upper band of the lifecycle span, from 10 to 12 years on average.

147 NSO, *Survey on Access and Usage of ICT Services in Malawi-2014*, at 89 (2015).

148 International Data Corporation, Shipment forecast of laptops, desktop PCs and tablets worldwide from 2010 to 2021 (in million units), https://www.statista.com/statistics/272595/global-shipments-forecast-for-tablets-laptops-and-desktop-pcs/. The trend indicates almost a 10 per cent decrease in desktop stocks from 2014 to 2022.

Similarly, the lifecycle for laptops is between 2 and 8 years, and the EoL for laptops estimated for Malawi is between 6 and 8 years on average.[149]

Based on 10- to 12-year, and 6- to 8-year lifecycles for desktops and laptops respectively, the lower and upper e-waste estimates for computers and their weight, are depicted in Table 15 and Table 16 for 2018-2022. Different weights for desktops and laptops were used in the estimations (see Table 11).

Table 15: E-waste devices due to PCs 2018-2022 (millions)

End-of-Life	Total e-waste	E-waste annual average	Minimum (year = 2018)	Maximum (year = 2022)
DT 10-year EoL LT 6-year EoL	0.188	0.038	0.027	0.051
DT 12-year EoL LT 8-year EoL	0.109	0.022	0.014	0.033

Source: ITU

Table 16: E-waste weight due to PCs 2018-2022 (kilo-tonnes (kt))

End-of-Life	Total e-waste (kt)	E-waste annual average (kt)	Minimum (year = 2018)	Maximum (year = 2022)
DT 10-year EoL LT 6-year EoL	0.79	0.16	0.12	0.21
DT 12-year EoL LT 8-year EoL	0.50	0.01	0.07	0.14

Source: ITU

6.3.2. Value of e-waste from computer devices

Based on the total recoverable value per tonne of PC-related e-waste, USD 1 501 (see Table 10), the e-waste value attributable to PCs is estimated in Table 17.

Table 17: E-waste due to PCs 2018-2022 (USD millions)

End-of-Life	Total USD	Annual average	Minimum (year = 2018)	Maximum (year = 2022)
DT 10-year EoL LT 6-year EoL	1.18	0.24	0.18	0.32
DT 12-year EoL LT 8-year EoL	0.74	0.15	0.10	0.21

Source: ITU

[149] Paul Teehan & Milind Kandlikar, *Sources of Variation in Life Cycle Assessments of Desktop Computers," Journal of Industrial Ecology*, at 189 (2012); United States Environmental Protection Agency, *Electronic Products Generation and Recycling Methodology Review*, (2016).

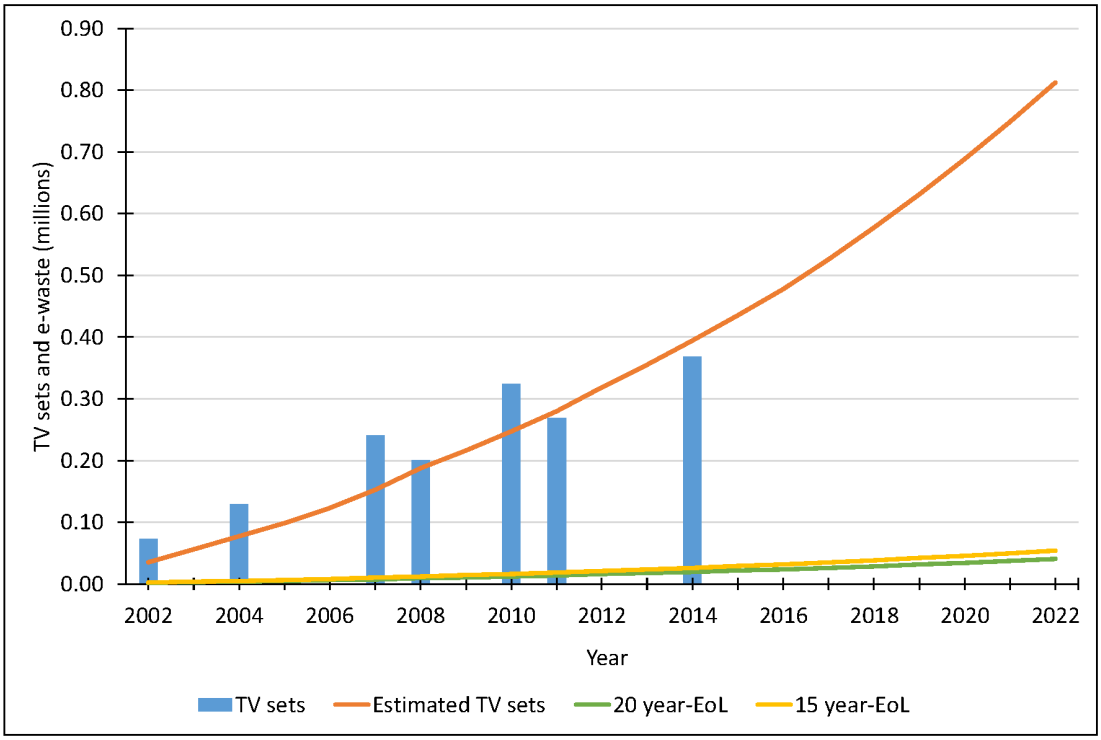
6.4. Television sets

6.4.1. Volume of e-waste from TV sets

Since there is no continuous data related to household TV set penetration (see Figure 7), the logistic model used to forecast mobile phone and computer penetration cannot be used to forecast the penetration of TV sets, therefore, a linear regression is used to estimate the number of households with at least one TV set in the following five years.

Considering the total number of households, and assuming only one TV set per household due to low household TV set penetration, the stock of TV sets and the e-waste generated, using a lifecycle between 15 and 20 years,[150] are estimated (see Figure 12). More than 525 000 TV sets are estimated to be in households in Malawi in 2017. By 2022, this figure is expected to grow to 813 000, a 54 per cent increase. The TV set trend is nonlinear due to household growth.

Figure 12: Stocks of TV sets and e-waste generated



Source: ITU

Based on the above assumptions, the e-waste in terms of the number of TV sets and their cumulative weight, are depicted in Table 18 and Table 19 for 2018-2022.

Table 18: E-waste devices due to TV sets 2018-2022 (millions)

End-of-Life	Total e-waste	E-waste annual average	Minimum (year = 2018)	Maximum (year = 2022)
15-year EoL	0.230	0.046	0.039	0.054

[150] Won Young Park *et al.*, *Efficiency improvement opportunities in TVs: Implications for market transformation programs*, Energy Policy 59 (2013) 361-372 (stating that lifecycles for TV sets vary between 7 and 15 years). United States Environmental Protection Agency, *Electronic Products Generation and Recycling Methodology Review*, (2016) (estimating the lifecycle for TV sets between 5 and 20 years).

End-of-Life	Total e-waste	E-waste annual average	Minimum (year = 2018)	Maximum (year = 2022)
20-year EoL	0.173	0.035	0.029	0.041

Source: ITU

Table 19: E-waste weight due to TV sets 2018-2022 (kilo-tonnes (kt))

End-of-Life	Total e-waste (kt)	E-waste (kt) annual average	Minimum (year = 2018)	Maximum (year = 2022)
15-year EoL	6.20	1.24	1.04	1.46
20-year EoL	4.65	0.93	0.78	1.09

Source: ITU

6.4.2. Value of e-waste from TV sets

Based on the average recoverable value per TV set of USD 18.5 (see Table 10), the e-waste value attributable to TV sets is estimated in Table 20.

Table 20: E-waste value of TV sets 2018-2022 (USD million)

End-of-Life	Total	Annual average	Minimum (year = 2018)	Maximum (year = 2022)
15-year EoL	4.27	0.85	0.71	1.00
20-year EoL	3.20	0.64	0.53	0.75

Source: ITU

6.5. E-waste forecast summary

It is estimated that in the coming five years, between 8.69 and 11.66 million mobile phones, computers and TV sets, will become e-waste in Malawi. Most of these devices will be mobile phones due to the high mobile penetration rate and the exponential growth the devices have experienced in the last decade, compared to computers and TV sets. As such, mobile phones will represent over 95 per cent of the total number of e-waste devices during this period, reaching between 8.41 and 11.24 million devices. E-waste in terms of EEE devices that have reached their end-of-life (EoL) will grow at a CAGR of 14.3 per cent, between 2018 and 2022.

TV sets will represent the largest e-waste stream in terms of weight during 2018-2022. Seventy-six per cent of total e-waste weight will be attributable TV sets, between 4.65 and 6.20 kt. On the other hand, e-waste weight related to computers is relatively low for two principal reasons. First, computer penetration is the lowest of all three devices under this study, and thus e-waste generation from computers is also low in terms of the number of computers projected to be e-waste. Second, there is a higher proportion of laptops to desktops, which are lighter. For every 100 computers, approximately 65 were laptops and 35 were desktops in 2014. The trend is expected to increase this proportion, in line with international market behaviour. E-waste weight will grow at a CAGR of 10.4 per cent between 2018 and 2022.

Table 21: Key ICT e-waste devices (millions) and weight (kt) 2018-2022

Device	Total devices (millions)	Annual average (millions)	Total weight (kt)	E-waste annual average (kt)
Mobile phones	8.41 – 11.24	1.68 – 2.25	0.92 – 1.22	0.18 – 0.24
Computers	0.11 – 0.19	0.02 – 0.04	0.50 – 0.79	0.10 – 0.16
TV sets	0.17 – 0.23	0.04 – 0.05	4.65 – 6.20	0.93 – 1.24
Total	**8.69 – 11.66**	**1.74 – 2.34**	**6.07 – 8.21**	**1.21 – 1.64**

Source: ITU

On average from 2018 to 2022, Malawi will generate annually between 1.21 and 1.64 kt of mobile phone related e-waste, computers and TV sets (Table 21), worth between USD 4.29 million and USD 5.76 million. Due to the precious metals included in the components of mobile devices, these devices represent more than 80 per cent of total value generated from e-waste. The total value of e-waste for the group of EEE devices under study during the next five years will reach between USD 21.42 and USD 28.82 million, and the CAGR for the upcoming five years will be 13.6 per cent.

However, e-waste collected, as a percentage of total e-waste generated, varies broadly among the countries analysed in the international benchmark, from 24 per cent in Australia, to 73 per cent in Switzerland. This high level of variation also exists across developing countries, as approximately 1 per cent of the e-waste generated in Honduras is collected, compared with 20 per cent in Turkey and 78 per cent in Bulgaria. Thus, in the initial stages of e-waste collection in Malawi, the expected value of e-wasted collected due to mobile phones, computers and TV sets, is estimated to be below 10 per cent of the total e-waste value for these devices. Thus, the first recommendation is to set the goal for e-waste collection so that by the end of 2022 around 50 per cent of the targeted e-waste will be collected.

Table 22: Key ICT e-waste value (USD millions) 2018-2022

Device	Total	Annual average
Mobile phones	17.48- 23.37	3.50- 4.67
Computers	0.74- 1.18	0.15- 0.24
TV sets	3.20- 4.27	0.64- 0.85
Total	**21.42 - 28.82**	**4.29 - 5.76**

Source: ITU

7. E-waste policy and strategy for Malawi

Based on the previous sections and the analysis described in this report, this section presents recommendations on the e-waste policy and strategy for Malawi in the first two subsections, respectively, and then summarizes the overall e-waste strategy in the final subsection. These recommendations are based on the non-existence of any type of formal or informal e-waste treatment and recycling in Malawi.[151] Therefore, recommendations pave the way for an e-waste strategy *ex nihilo*.

[151] Based in the interviews with various stakeholders in Malawi, there is no evidence of the existence of e-waste recyclers in Malawi.

7.1. E-waste policy for Malawi

In Malawi, a main policy objective for e-waste management will be to promote a safer environment and protect health through effective, efficient and responsible e-waste management practices that will allow for a sustainable development.

A sound e-waste policy will also help to achieve the ambitious 2030 Agenda for Sustainable Development adopted by the United Nations in 2015,[152] as it is directly related to the improvement of at least six sustainable development goals (SDGs): goal 3 relating to good health and well-being; goal 6 on clean water and sanitation; goal 8 pertaining to decent work and economic growth; goal 11 on sustainable cities and communities; goal 12 responsible consumption and production; and goal 14 regarding life below water. The specific targets in which a sound e-waste policy would support their achievement, are:

- *Target 3.9 refers to the reduction of the number of deaths and illnesses caused by hazardous chemicals and air, water, and soil pollution and contamination.*
- *Target 6.1 seeks to achieve universal and equitable access to safe and affordable drinking water for all.*
- *Target 6.3 aims to reduce pollution, eliminate dumping, and minimize release of hazardous chemicals and materials.*
- *Targets 14.1 and 14.2 refer to marine pollution and the protection of the marine ecosystem.*
- *Target 11.6 aims to reduce the adverse per capita environmental impact of cities, by paying special attention to air quality and to municipal and other waste management. Since most e-waste will be generated in cities it is particularly important to properly manage e-waste in urban areas, improve collection and recycling rates, and reduce the amount of e-waste that ends up in dumpsites. The move towards smart cities and the use of ICTs for waste management offer new and exciting opportunities.*
- *Target 12.4 aims to achieve environmentally sound management of chemicals and all waste throughout the life cycle, in accordance with agreed international frameworks, and to significantly reduce their release into air, water, and soil in order to minimize their adverse impacts on human health and the environment.*
- *Target 12.5 aims to substantially reduce waste generation through prevention, reduction, repair, recycling, and reuse. An increasing number of people on the planet are consuming growing amounts of goods (including ICT/Telecom goods and services), and it is critical to make production and consumption more sustainable by raising awareness levels of producers and consumers, specifically in the area of EEE.*
- *Target 8.3 aims to promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity, and innovation, and to encourage the formalization and growth of micro-, small-, and medium-sized enterprises. The sound management of e-waste can create new employment and contribute to economic growth in the recycling and refurbishing sector.*[153]

It is important to highlight that the Malawi Environmental Management Act provides the appropriate legal framework to enable the Government of Malawi to enact specific e-waste management regulations. This Act designates the Environmental Affairs Department (EAD), part of the Ministry of Natural Resources, Energy and Environment, to coordinate waste management in general; therefore, e-waste management regulations should be led by the EAD.

Specific policy objectives

[152] United Nations, The Sustainable Development Agenda, http://www.un.org/sustainabledevelopment/development-agenda/

[153] The Global E-waste Monitor 2017

It is recommended that objectives of the e-waste policy should:

1. Establish a phased approach to including EEE into the e-waste management system. The initial phase will include specific e-waste categories and products and, once the e-waste management system is in place and running smoothly, additional e-waste categories and products should be incorporated.
2. Include the extended producer responsibility (ERP) principle in the regulatory framework. Since there are no manufacturers in Malawi, EPR should apply to importers of EEE and EEE parts and components.
3. Provide a management structure and implement a financing mechanism for the sustainability of the e-waste take-back system.
4. Implement a national take-back system to collect, process, including basic dismantling, and export e-waste to locations with adequate facilities and tools, such as refineries, to further treat e-waste, consistent with Malawi international obligations.
5. Create and implement awareness and education programmes to sensitize the people of Malawi of the importance of responsible e-waste treatment, from purchase to e-waste (including policies to reduce, reuse, and recycle).
6. Comply with international treaties and regulations, primarily the Basel Convention, to both export e-waste and avoid the import of second-hand or used EEE near its EoL or with obsolete technology.
7. Create quality jobs in the recycling sector while ensuring compliance with technical standards for the protection of the environment and those involved in the collection, transportation and processing of e-waste.

7.2. E-waste strategy for Malawi

This subsection presents the overall e-waste strategy for Malawi, including the scope of products that would be included in an initial e-waste definition, implementation of a take-back system, education and awareness activities and programmes, and international obligations concerning transboundary flow of e-waste.

E-waste generation in Malawi is currently low in all e-waste categories, especially ICT e-waste such as mobile phones, computers and TV sets. Therefore, the primary recommendation is to not establish an expensive e-waste treatment facility, such as a metal or plastic refinery, since the volume of e-waste will not be sufficient to cover the costs of such infrastructure. It is recommended that initially e-waste should be collected and transported to specific storage sites for future export to locations that have adequate infrastructure to further treat the e-waste. In the medium- to long-term, a new study could be performed to assess if the volume of e-waste justifies building more complex infrastructure.[154]

While it is not financially viable to establish an e-waste treatment facility, it is essential that Malawi implement a take-back system for e-waste. The following subsections present the specific recommendations necessary to establish and operate an effective system.

7.2.1. E-waste: scope of products

Malawi has no e-waste recycling infrastructure and is currently developing e-waste policies and regulations. Limiting the e-waste scope of products to mobile phones, computers, TV sets and similar devices (see literals (a) and (b) below) will address primary needs, not least because use of this type of

[154] Based on the volumes of e-waste from Malawi and neighbour countries, it is recommended to develop a regional study to assess the feasibility of a regional solution to the e-waste problem. A regional solution will benefit from higher economies of scale on e-waste volumes, making the recycling process financially viable.

EEE is growing exponentially and due to their short lifecycles will become a significant part of Malawi e-waste stream in the near-term. In addition, this scope of e-waste devices need a similar, if not the same, treatment when they reach their EoL, therefore the training required to handle these devices is similar. Further, these types of devices can be stored in the same location and similar standards would apply, except for possible hazardous e-waste, such as CRT screens.

Once the e-waste management system is effectively treating mobile phones, computers, TV sets and similar devices, Malawi can gradually expand the scope of products in phases to include all EEE. This phased approach will allow Malawi to incorporate lessons learned from the initial narrow scope of products and adjust or build capacity in the take-back system where needed to accommodate additional types of e-waste.

Further studies should be performed to determine the products to be introduced and the manner in which the system should be enhanced in subsequent phases. These studies should also include the different collection methods; handling and recycling treatments that these types of e-waste need; and how to include them in the existing system, as well as how to modify the TPO to include new stakeholders, e.g., air conditioning, refrigerators, and large equipment (appliances) retailers.

The scope of products for the initial e-waste take-back system have the following descriptions and are classified under the following UNU-KEYS related to groups 2 and 6 of ANNEX III of the EU-WEEE Directive:

a. Screens, monitors, and equipment containing screens having a surface greater than 100 cm^2 (UNU-KEYS 0303, 0308, 0309, 0407, 0408); and,

b. Small IT and telecommunications equipment (no external dimension more than 50 cm). (UNU-KEYS 0301, 0302, 0304-0306, 0702).

Table 23. Initial scope of products UNU-KEYS[155]

UNU-KEY	Description
0301	Small IT equipment (e.g. routers, mice, keyboards, external drives and accessories)
0302	Desktop PCs (excl. monitors, accessories)
0303	Laptops (incl. tablets)
0304	Printers (e.g. scanners, multi functionals, faxes)
0305	Telecommunication equipment (e.g. (cordless) phones, answering machines)
0306	Mobile phones (incl. smartphones, pagers)
0308	Cathode ray tube monitors
0309	Flat display panel monitors (LCD, LED)
0407	Cathode ray tube TVs
0408	Flat display panel TVs (LCD, LED, plasma)
0702	Game consoles

Source: UNU, E-waste statistics: Guidelines on classification, reporting and indicators, (2015)

[155] United Nations University, *E-waste statistics: Guidelines on classification, reporting and indicators*, (2015), https://i.unu.edu/media/ias.unu.edu-en/project/2238/E-waste-Guidelines_Partnership_2015.pdf.

Based on the scope of products, the initial e-waste definition should be:[156]

- Electric and electronic equipment: Equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer or measurement of such currents and fields and designed for use with a voltage rating not exceeding 1 000 volts for alternating current and 1 500 volts for direct current.
- E-waste (initial definition): Any electrical or electronic equipment, which the holder discards or intends or is required to discard, including all components, sub-assemblies, and consumables which are part of the product at the time of discarding, and belong to one or more of the following categories as defined in ANNEX III of the EU-WEEE Directive:
    - Screens, monitors, and equipment containing screens having a surface greater than 100 cm^2 (UNU-KEYS 0303, 0308, 0309, 0407, 0408); and
    - Small IT and telecommunications equipment (no external dimension more than 50 cm). (UNU-KEYS 0301, 0302, 0304-0306, 0702).

7.2.2. Management of the e-waste take-back system

The management of the e-waste take-back system should be a mixed government and TPO approach. The government and the TPO will have specific functions and responsibilities.

Government responsibilities

A government e-waste technical committee should be established with representatives from the Environmental Affairs Department, the Ministry of Information and Communications Technology (Ministry of ICT), Malawi Communications Regulatory Authority (MACRA), the ministry responsible for local government, Ministry of Civic Education, Culture and Community Development, the Malawi Revenue Authority (MRA), and the Malawi Bureau of Standards (MBS). The functions of the committee are:

a. Create and implement awareness and education activities and programmes on the responsible disposal of e-waste (led by the EAD in consultation with the Ministry of Civic Education).
b. Develop technical standards for e-waste collection, transportation, storage and disassemble or de-manufacturing (led by the MBS).
c. Licence collectors, transporters, handlers and exporters of e-waste based on, among other factors, the standards developed by the MBS.
d. Grant approval of the TPO and decide which stakeholders should comprise its membership (EAD).
e. Monitor e-waste collection (led by the EAD in consultation with the Ministry of ICT and MACRA).
f. Monitor EEE imports and e-waste exports (led by the MRA).
g. Levy enforcement actions (led by the EAD).

The EAD will lead this committee and actively collaborate in all the functions of the committee, working with the other government authorities.

Third party organization responsibilities

The private sector involved in the importation of EEE will be responsible for creating a non-profit association, referred to in this report as a third-party organization (TPO). The TPO will be responsible for collecting e-waste from the source, such as business and government offices, households and other locations such as e-waste bins, and transporting it to the appropriate storage location designated

[156] Following the EU WEEE directive.

by the government. In addition, the TPO is to operate the storage location, tasked with dismantling, shredding and packing e-waste for export to international treatment facilities.

The TPO should be composed of EEE importers that represent greater than or equal to 90 per cent of all EEE imports to Malawi, including EEE parts.[157] It is important that importers with the highest market share of EEE imports are part of the TPO. It is not essential for comparatively small importers to be included since their impact on e-waste is marginal.

The TPO is responsible for:

a. Designing the take-back system, including the collection, transportation, dismantling, shredding and storage of e-waste, and its eventual export. The TPO may decide to directly collect, transport and store e-waste, in which case it will need to apply for a licence, or it could hire other third parties to do so through a competitive, open, fair and transparent process.

b. Funding the collection and transportation of e-waste, either by performing those tasks for itself or enlisting licensed e-waste collectors and transporters, and funding the operating expenses, costs and security of the storage facility.

c. Funding e-waste education and awareness programmes and activities of their own initiative and from obligations imposed by the government.

d. Developing educational and awareness programmes on e-waste disposal methods for consumers, jointly with the government.

e. Setting initial and periodic goals for e-waste collection and exports measured in tonnes per year for the various categories of EEE.

f. Establishing the financing system of the TPO based on the market share of revenue for each importer that is part of the TPO.

g. Developing the administrative framework of the TPO, including the rules that will govern the TPO, TPO management and staff and their functions and responsibilities, the TPO location, and contact information.

The TPO will be responsible for providing the government with a plan stating how the TPO will address each of the seven responsibilities, and this plan must be delivered within six months of the creation of the TPO. To be effective the plan must be approved by the government e-waste technical committee after being assessed based on principles transparency, fairness, and feasibility. It is important to note that by implementing a TPO, the EPR specific policy objective is being accomplished since the responsibility of EEE when the EoL is reached, is being extended to the importers of EEE in Malawi.

The government e-waste technical committee may suggest modifications before approving the TPO plan for the take-back system. Once the TPO is established, the government must periodically evaluate and audit the TPO plan and its implementation, taking necessary actions, such as requesting modifications, where needed.

7.2.3. Financing model for the e-waste take-back system

Similar to the overall management of the e-waste take-back system, the financing of the system must be the responsibility of the TPO. The importers of EEE that comprise the TPO should be required to meet the costs associated with the collection, transportation, storage, and exports of e-waste.

Placing full responsibility with the TPO incorporates EPR principles because importers will have the incentive to minimize the increase in the price of EEE to finance the take-back system so as not to negatively affect sales and profits. Likewise, the design of the take-back system management will need to be more efficient and effective, so costs do not rise above an acceptable level.

[157] The 90 per cent threshold could be modified following a more detailed analysis of EEE imports.

Finally, importers will internalize the costs of the take-back system through efficiently pricing EEE to the consumer since competition in the market will discipline prices. The financial method will ultimately affect consumer prices, either via a tax, fee or an increase in price through the recommended method, however, placing financial responsibility with the TPO will have the lowest impact on the consumer.

7.2.4. E-waste collection and transportation licensing

E-waste collection

All three forms of e-waste collection, permanent drop-off locations, drop-off events and door-to-door pick-up, should be implemented by various stakeholders.

- *Permanent drop-off locations*: drop-off bins for e-waste should be located in government offices, so government officials can easily access them and deposit their e-waste. Retailers of EEE should also locate drop-off bins within their premises for consumers to easily access and drop-off e-waste when replacing their EEE. Once the bins reach their capacity, e-waste collectors should empty them and transport all the e-waste to the designated storage facility.
- *Drop-off events*: drop-off events should be organized by the government and the TPO, jointly with licensed e-waste collectors, once or twice a year in different locations across Malawi, initially the main three cities in the northern, central and southern regions. These events could also serve as a key component of the awareness and education programme strategy to reach these communities.
- *Door-to-door pick-up*: a regularly scheduled door-to-door pick-up scheme, such as the solid waste pick-up scheme, should not be implemented due to its high costs. However, making door-to-door pick-up an additional collection channel should be promoted. E-waste collectors should have a contact number that anyone can call to schedule an e-waste pick-up. Limiting the number of pick-ups each household can arrange to four per year would prevent abuse.

All three types of e-waste collection must comply with the technical standards developed by the EAD and the MBS. Based on these technical standards, the EAD should license e-waste collectors. Only those e-waste collectors that are duly licensed may collect e-waste through the mechanisms described above. For permanent drop-off locations, e-waste collectors should be responsible to install bins in different government and commercial locations, closely collaborating with government offices and retailers, which should grant the requisite physical space.

E-waste transportation

E-waste transportation should be performed by the same entity responsible for collection and it should be done in compliance with the statutory standards and specifications developed by the EAD and the MBS. Such standards for e-waste transportation should include at least:

- protection against all types of weather;
- prevention of unauthorized access to e-waste in specific drop-off locations or during transportation;
- capacity to properly pack, accommodate, stow, stack, secure, and cover e-waste in specific drop-off locations, during loading or transportation, using appropriate tools;
- transportation of medium and small size e-waste in appropriate wooden or cardboard boxes or metal crates; and
- appropriate security measures such as multipurpose fire extinguishers.

The purpose of the technical standards developed by the EAD and the MBS will be to reduce the risk of accidentally damaging e-waste during collection, loading and transportation, as such damage may create health and safety hazards as well as affect the ability to salvage valuable materials from the e-waste.

7.2.5. E-waste storage and manual dismantling

E-waste storage

Storage facilities for e-waste should be provided by the government in, at least, the two most populous cities of Malawi, Blantyre and Lilongwe. Management and administration of such facilities, including operating costs and security, should be responsibility of the TPO.

The location selected for such facilities must allow for future expansion, if necessary, and comply with technical standards developed by the EAD and the MBS, which must include at least:[158]

- impermeable surfaces to prevent spills from entering the soil;
- spillage collection (this includes impermeable pavement and a sealed drainage system);
- weather proof coverings;
- appropriate wooden or cardboard boxes or metal crates to store e-waste;
- specific standards to store potential hazardous e-waste such as CRT screens; and
- security mechanisms and locks.

Manual dismantling and mechanical shredding

Manual dismantling should focus on the basic separation of e-waste device parts and components (plastic, circuit boards, screens, etc.). Once e-waste has been dismantled, mechanical shredding will fragment some components into smaller parts. Technical training for the manual separation and mechanical shredding of components should be provided. Once separated and fragmented, e-waste parts and components should be stored in compliance with technical standards and made ready for export to other e-waste facilities for further treatment.

Technical standards should include at least:

- steps to dismantle different types of e-waste devices;
- tools needed for dismantling and shredding and the proper training for how to use them; and
- safety gear.

7.2.6. Education and awareness

The Ministry of Civic Education, Culture and Community Development and the EAD must develop a communication strategy to raise awareness on how to handle e-waste and the consequences of improper disposal. It should also develop awareness activities and programmes jointly with the TPO and EEE retailers. Sound education and awareness strategies are critical to the successful implementation of the e-waste strategy, since the source of e-waste, such as households, businesses, and government, need to know how to responsibly dispose of e-waste in order to feed the stream of e-waste processing.

The strategy should include:

- a basic explanation of e-waste, including its definition and some examples;
- the importance of properly disposing of e-waste and the consequences for not doing so on the environment and public health;

[158] Sources: Annex 4 of the United Nations' (UN) "E-Waste Volume III, WEEE/E-Waste 'Take Back System,'" the EU directives related to e-waste management, and the United Kingdom's "Guidance on Best Available Treatment, Recovery and Recycling Techniques (BATRRT)," (2006): http://webarchive.nationalarchives.gov.uk/20130403043343/http://archive.defra.gov.uk/environment/waste/producer/electrical/documents/weee-batrrt-guidance.pdf.

- action that should be undertaken by consumers to reduce e-waste (3R policy: reduce, reuse, recycle);
- information on what to do with e-waste, especially the means available for households to properly dispose of e-waste;
- the locations of e-waste drop-off sites, drop-off events, the contact numbers for e-waste pick-up; and
- contact information for additional questions and information.

7.2.7. E-waste monitoring and enforcement

Effective monitoring of the entire e-waste management system is essential to securing a successful outcome, meeting volume targets for collecting e-waste and properly treating e-waste in Malawi, which will protect public health and the environment.

The EAD must overlook the monitoring process at each stage of e-waste generation, mainly including:

- Households, government and businesses: Ministry responsible for local governments, as well as the EAD, should monitor whether information on how to properly dispose e-waste is reaching households, governments and businesses.
- E-waste collection, transportation and storage: EAD should monitor that e-waste is being collected, transported, and stored in compliance with MBS technical standards.
- EEE imports and e-waste storage and exports: EAD and MRA should periodically monitor the imports of EEE, the amount of e-waste initially stored and later exported. This is important to monitoring whether e-waste collection targets are being met and provide data for making any necessary adjustments to the overall take-back system to comply with such targets.[159]

Based on monitoring of compliance with technical standards, EAD must have enforcement capability, not least the ability to impose penalties and rescind licences, and importers that do not comply with regulations could be banned from importing EEE.

7.2.8. Transboundary flow of e-waste

Malawi must comply with the international treaties on hazardous waste to which it is a party by exporting all e-waste to legally established extraterritorial refineries for further treatment. This means complying with the Basel Convention, which entered into force in Malawi in 1994. The most direct method for compliance is to issue an e-waste regulation under the Environment Management Act, which provides a baseline (*e.g.*, Article 39) for Malawi compliance with the Basel Convention. This regulation should contain provisions that implement the Basel Convention framework of consents and permissions with respect to the transboundary flow of e-waste.

Malawi must also determine the level of e-waste processing that will occur domestically so that it can streamline the required export processes to the countries with the requisite e-waste processing facilities. In this regard, it is key for Malawi to implement international cooperation agreements with the objective of facilitating e-waste exports and complete e-waste processing.

In addition to banning the import of all hazardous waste from developed countries to comply with the Basel Ban Amendment, Malawi should also ban all imports of second hand or used EEE that depend on obsolete technologies (e.g., CRT screens, analogue TV sets, first generation mobile phones, and other similar EEE), or that have been in use and have the potential of becoming e-waste in the short-term.

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[159] The link between the UNU-KEYS and the HS Code (harmonized system) to facilitate the follow-up of EEE imports and e-waste exports can be found at: http://i.unu.edu/media/ias.unu.edu-en/project/2238/UNU-KEYS-to-HS-Codes.xls. Source: United Nations University, *E-waste statistics: Guidelines on classification, reporting and indicators*, (2015), https://i.unu.edu/media/ias.unu.edu-en/project/2238/E-waste-Guidelines_Partnership_2015.pdf.

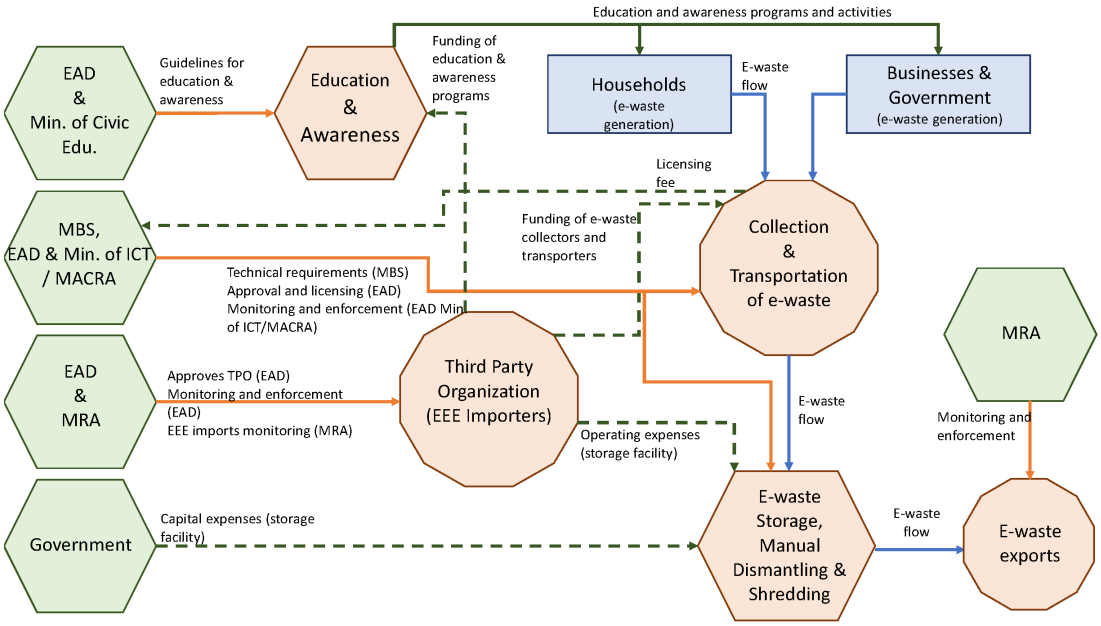
In doing so, Malawi should also increase its monitoring and surveillance of EEE imports into Malawi to restrict and penalize the wrongful import of banned second-hand, or used, EEE. Malawi should also block the import of certain products containing mercury (*e.g.*, particular types of batteries and fluorescent lamps), as listed in Annex A of the Minamata Convention, and closely monitor the import of EEE containing mercury (*e.g.*, LCD monitors). Lastly, going forward, becoming a party to the Bamako Convention and the Durban Declaration presents an opportunity for Malawi to work collectively on e-waste imports and collaborate on e-waste management best practices with other countries in Africa.

7.3. E-waste strategy for Malawi: summary

Figure 13 summarizes the e-waste strategy for Malawi. At its core, an e-waste take-back system is established based on EPR principles where importers of EEE will be responsible for the EoL of the EEE they import through a TPO. The TPO will design the collection, transportation and storage schemes for e-waste that must then be approved by the government e-waste technical committee. The TPO may directly perform the collection, transportation, storage, dismantling and shredding activities by itself, or contract other entities through a transparent and fair process.

The government must be involved in all stages of the e-waste process through establishing guidelines for education and awareness, licensing e-waste collectors and transporters, drafting the technical standards to which licensees must comply, monitoring e-waste volumes and compliance with targets, enforcing e-waste regulations and provisions, and monitoring e-waste exports and compliance with international treaties and regulations.

Figure 13: E-waste strategy for Malawi



Source: ITU

8. Action plan

This section presents a step-by-step action plan to implementing the e-waste strategy for Malawi. The various steps do not necessarily need to be developed in sequence. Some of the steps can be developed in parallel, such as steps 2 and 3 that concern the drafting of technical standards and education and awareness strategies. Some steps, including the building of the e-waste storage facility,

may also need more time than others to be developed. Other steps, require more administrative work, for example drafting regulations. However, regulations should be released for public consultation to ensure transparency and incorporate comments and proposals from all interested stakeholders, thus it would be necessary to include a timeframe for comment reception, analysis, and final drafting of regulations.

The following steps are not intended to be exhaustive, but rather to address the main activities that must be considered in the initial stages of developing the e-waste strategy. These steps should be read jointly with section 7. It is important to remember that during the implementation of the e-waste strategy, the following action plan will likely need to be adjusted. Finally, it is estimated that the overall action items described in Table 24 would take between 9 to 15 months to develop, depending on the willingness of the different stakeholders to cooperate.

Table 24: Action plan to develop the e-waste strategy for Malawi

Step	Activity	Responsible
1	**Initial regulatory action:** Draft the e-waste policy and create the government e-waste technical committee in accordance with applicable laws. The Environmental Affairs Department must act as the secretary of the committee and oversee all activities performed under the committee's direction. Include additional provisions to allow for the legal support and the resources required to fund the activities the government needs to undertake for the take-back system to be successful, *e.g.*, obligation to build the e-waste storage facility or facilities. Mandate, in accordance with applicable laws, the establishment of a non-profit association (third party organization) composed of importers of EEE related to the narrow e-waste definition, with the responsibility to treat EEE when it reaches its EoL.	Ministry of Natural Resources, Energy and Environment – Environmental Affairs Department
2	**Technical standards:** Draft technical standards for e-waste collection, transportation, storage, and treatment, *e.g.*, basic dismantling. Note that these standards must also comply with regulations on hazardous materials and components present in EEE.	E-waste technical committee –Malawi Bureau of Standards on recommendation from the Environmental Affairs Department
3	**Communication strategy:** Draft communication strategy and create awareness on e-waste. Include information on the negative impact on public health and the environment if e-waste is not disposed of responsibly.	E-waste technical committee – led by Environmental Affairs Department jointly with the Ministry of Civil Education
4	**Take-back system approval:** Assess and approve the take-back system designed by the non-profit organization of EEE importers and the rules that will govern the organization.	E-waste technical committee – led by the Environmental Affairs Department
5	**Storage facility:** Provide the storage facility or facilities for e-waste, complying with the technical standards developed for such purposes by the MBS, including the basic dismantling of equipment.	Environmental Affairs Department

Step	Activity	Responsible
6	**Licensing of collectors and transporters:** Depending on the take-back system designed and presented by the non-profit organization of EEE importers and approved by the e-waste technical committee, a collector and transporter of e-waste licence must be granted: a. to the organization if it plans to directly perform these activities; or, b. to the private entities that will perform these activities on behalf of and in close collaboration with the organization. The licence should require compliance with the technical standards and establish enforcement actions for a failure to comply with, among other obligations, the requirement that a specific number of e-waste collection bins to be deployed. The licensing fee should be based on an estimate of the administrative costs involved with issuing the licence.	Environmental Affairs Department
7	**Licensing of storage facility management:** The management and operation of the storage facility must comply with the technical standards developed by the MBS, including the standards for e-waste treatment (basic dismantling). Depending on the take-back system implemented, the licence of the e-waste storage facility must be granted: a. to the organization if it plans to directly perform this activity; or, b. to the private entity or entities that will perform these activities on behalf of and in close collaboration with the organization. The licence should require compliance with technical and security standards, and set enforcement actions for a failure to comply. The licensing fee should be based on an estimate of the administrative costs involved in issuing the licence.	Environmental Affairs Department
8	**Transboundary movement of e-waste:** This activity entails several components. a. Implement a regulation to ban (1) the import of obsolete technology, *e.g.*, CRT TV sets or screens, and (2) second-hand or used EEE above a specific age, near the EoL or unusable. b. License exporters of e-waste, in compliance with international regulations on hazardous transboundary movements (Basel Convention). c. Monitor EEE imports and e-waste exports, developing a periodical inventory of data on the quantities, weight, and value of both EEE imports and e-waste exports, following the UNU-KEYS classification scheme.	Environmental Affairs Department and Malawi Revenue Authority

Step	Activity	Responsible
9	**Monitoring:** Establish monitoring procedures to: a. Follow-up on progress with meeting e-waste collection goals. b. Detect non-compliance with regulations, *e.g.*, technical standards. c. Evaluate the impact of the outreach and awareness activities and programmes.	Environmental Affairs Department, the Ministry of Information and Communications Technology, and the Malawi Communications Regulatory Authority

Source: ITU

Acronyms

3G	*Third generation mobile technology*
4G	*Fourth generation mobile technology*
ACL	*Access Communication Limited*
CAGR	*Compound Annual Growth Rate*
CRT	*Cathode-ray tube*
DTT	*Digital Terrestrial Television*
DVB-T	*Digital Video Broadcasting - Terrestrial*
EAD	*Environmental Affairs Department*
EEE	*Electric and Electronic Equipment*
EoL	*End-of-Life*
EPR	*Extended Producer Responsibility*
EU	*European Union*
GDP	*Gross Domestic Product*
HDI	*Human Development Index*
ICT	*Information and Communication Technologies*
IDI	*ITU Development Index*
ITU	*International Telecommunications Union*
LCD	*Liquid-Crystal Display*
LDC	*Least Developed Countries*
LED	*Light-Emitting Diode*
MACRA	*Malawi Communications Regulatory Authority*
MBS	*Malawi Bureau of Statistics*
MRA	*Malawi Revenue Authority*
MTL	*Malawi Telecommunication Limited*
NEAP	*National Environment Action Plan*
NEP	*National Environmental Policy*
NSO	*National Statistical Office*
OECD	*Organization of Economic Cooperation and Development*
PC	*Personal Computer*
StEP	*Solving the E-Waste Problem*

TNM	*Telekom Networks Malawi*
TPO	*Third party organization*
TV	*Television*
UNU	*United Nations University*
USA	*United States of America*
USD	*United States Dollars*
WEEE	*Waste Electric and Electronic Equipment (e-waste)*

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