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Action plan for management of LHHA in Kenya – Current status

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CTCN Technical Assistance Development of an action plan to improve the circularity of large household appliances in Kenya – activity 2 Current Status

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Executive Summary

The economic development of Kenya will undoubtedly lead to an increase in the 'consumption' of electric and electronic equipment (EEE) (among which fall the large household appliances LHHA) and consequently also to a rise in WEEE, waste from EEE. But the absolute level of LHHAs in society and therefore also the absolute level of discarded or otherwise end-of-life LHHAs is still rather low. The high value that LHHAs represent for consumers has resulted in an active repair sector and (partly) connected informal sector, that fulfills an appreciated function in dealing with goods and materials that are beyond repair.

Without being actively aware, households, distributors and (almost by definition) repairers already demonstrate circular behavior. Households stick to their equipment, invest in repair activities and either give away or sell equipment that is no longer in need. Distributors play an active role in refurbishing equipment that can be re-sold to the public. It are precisely these activities in combination with the economic circumstances in Kenya that lead to a rather 'circular' behavior of societal stakeholders. One of the challenges will be to maintain such behavior once economic conditions improve.

Though value retention processes (VRPs) are actively pursued, all stakeholders acknowledge the fact that national and county government should play a more active role in implementing and enforcing regulations and mechanisms that increase circularity of EEE by, for example, investing in skills for repair, providing incentives for value retention processes, establishing modern infrastructure that encourage segregation of waste for better management of e-waste and enacting specific laws for e-waste management which is lacking at the moment. The implementation of an EPR on LHHAs (with as a consequence the financial potential that may result) in 2022 may become an important driver for such changes. Such funds may be used for the much desired capacity building and for additional incentives for consumers to deal with worn out products more consciously.

The repair sector (and the connected informal waste sector) plays a crucial role in the circular infrastructure. The scale of the enterprises is generally small which hampers investments in equipment and knowledge building. From a business point of view, it will be advantageous to either increase volumes or (with the same goal) stimulate more intense cooperation between players in the value chain. This not only calls for collaboration among all stakeholders from the informal sector to the formal sector, but also for cooperation between and among counties, especially now that waste management is a responsibility at county level.

Kenya is still grappling with e-waste data gathering and processing. In the era of data revolution where data is considered as the most critical currency for development, stakeholders might be convinced to work together more closely to consolidate data. Increased transparency with respect to available spare parts, available capacities and repair and test equipment may lead to an interesting cooperation and business model for the sector.

Over the last few years, there has been an improvement in adoption and scale out of sustainable e-waste treatment option including recycling, refurbishment,

remanufacturing and re-sale. Rudimentary techniques of managing e-waste are still widely used including manual disassembly of WEEE without concern of the hazardous chemicals, heating printed circuits boards (PCBs) to recover solder and chips, melting and extruding flame-retardant plastics and burning plastics to isolate metals. With respect to LHHAs especially cooling devices require special attention: international regulations that also Kenya has adopted, require specific technologies to deal with cooling agents (freon) in a way that does not harm the environment. The investments required for such end-of-life treatment will also benefit from an increased scale of the operations.

Contents

1 Introduction

1.1 Objective of the study

The study aims to develop an action plan to improve the circularity of large household appliances (LHHA) in Kenya.

1.2 Scope of the study

The Technical Assistance Response Plan is clear about the broad scope concerning circularity: it stresses the importance of so-called Value Retention Processes (VRP's; see below) as an important driver for economic development and for prevention of environmental degradation. Therefore, the scope of this study explicitly extends beyond 'waste management' which is often regarded as the main activity when it comes to circular policies.

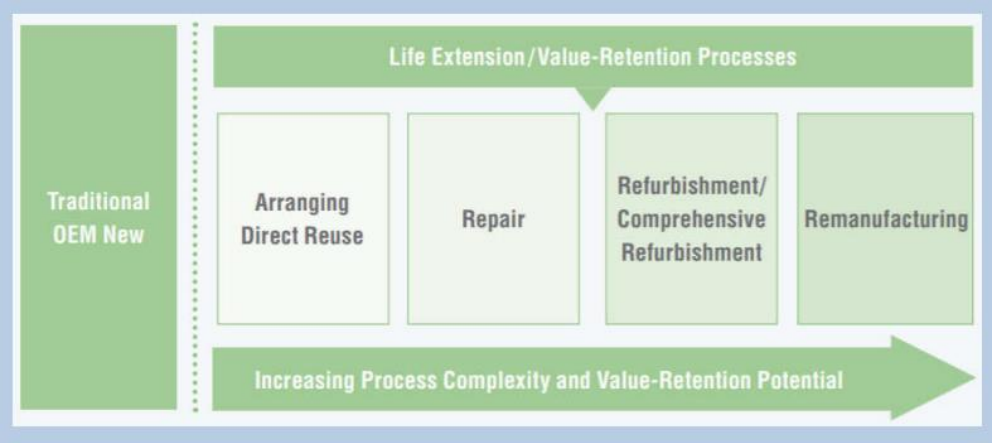

Figure 1 Overview of Value Retention Processes

The Technical Assistance Response Plan is also clear about the product scope, which concerns (primarily) only a part of the broad category of EEE (Electric and Electronic Equipment) i.c. Large Household Appliances which comprise[1]: large cooling appliances, refrigerators, freezers, other large appliances used for refrigeration, conservation and storage of food, washing machines, clothes dryers, dish washing machines, electrical cooking equipment, electric stoves, electric hot plates, microwaves, other large appliances used for cooking and other food processors, electric heating appliances, electric radiators, other large appliances for heating rooms, beds, seating furniture, electric fans, air conditioner appliances and other fanning, exhaust ventilation and conditioning equipment.

In later parts of the study we will discuss this scope more in depth, especially where the differentiation between these categories and a broader category of electronic products becomes a potential barrier for further development.

1 The categorization and composition is as per the stipulation of E-Waste Management Guidelines 2010.

1.3 Scope of this report

The terms of reference are documented in the Implementation plan (see Annex A). The implementation plan covers all activities up to the development of an action plan and conceptualization of a pilot project for an improved and circular waste management infrastructure for large household appliances.

This specific report concerns only the findings under activity 2: Analysis of the status quo of management of Large Household Appliances waste in Kenya

1.4 The circular economy framework

Kenya has articulated to adopt a circular economy concept as its preferred approach to stimulate 'value retention processes' among which a decent management of E-waste. While an explicit framework has not been specified for LHHA waste, the management of used LHHA (including 'waste') is assumed to fall under the general e-waste circular economy framework. While there are varied conceptual frameworks in the waste management regime, the Kenya e-waste management strategy 2019 has specifically highlighted the following principles as the country's preferred circular economy framework for e-waste:

1 Create an enabling environment for re-use and life time extension of Electric and Electronic Equipment (EEE), its components and other accessories
2 Promote activities aimed at resource recovery and recycling of e-waste materials into useful products
3 Embrace best available technologies and best available practices in e-waste management.

Figure 2. Kenya's circular economy framework for e-waste *Source: Kenya E-waste management strategy 2019*[2]

[2] Kenya E-Waste Management Strategy 2019. http://www.environment.go.ke/wp-content/uploads/2019/05/NATIONAL-E-WASTE-MANAGEMENT-STRATEGY-APRIL-29th-1.pdf

1.5 Methodology

This subchapter describes the study approach in assessing the current status of the circular economy in the e-waste sector in Kenya for developing an e- waste stream specific action plan as well as the tools required in execution of the study. The description will include sampling method, gender analysis, stakeholder analysis, ethical standards and (primary and secondary) data collection tools.

The project uses both qualitative and quantitative approaches. Primary and secondary data were collected through desk research, key informant interviews, focal group discussions (such as round tables) and questionnaires.
The ethical considerations that were the basis for the execution of the study can be found in the Annex B.

1.5.1 Research Instruments and Tools description

The project has made use of the following research instruments and tools:

1 *Consolidated List of Published Research Articles / Documents* - The research will undertake a systematic literature review to identify the concept of CE, its principles, determinants, and used a consolidated list of published research on the topic.
2 *Interview guides* –Interview guides are used to ensure that all topics are covered during stakeholder consultations. Guides were used so that all interviewees covered similar discussion topics to allow comparison and analysis of results.
3 *Questionnaires* – Questionnaires are used to collect information from respondents, where applicable. Questionnaires had a mix of close-ended and open-ended questions. Open-ended, long-form questions offered the respondent the ability to elaborate on their thoughts. The data collected from the questionnaire were both qualitative and quantitative. In line with COVID19 restrictions and social distancing requirements, applicable, online platforms like Google Forms were used to administer the questionnaire.
4 *Statistical analyses* – to obtain a picture of the overall development of the Kenyan economy and the consumption patterns related to LHHA, global trade statistics were used;
5 *Photos* – Where possible and with permissions, photographs were taken as visual evidence of waste management.
6 *Registration forms for stakeholders* – During stakeholder consultations and workshops / webinars, stakeholders were asked to complete registration forms with their details including names, organisations, contact details, position in organisations and type of organisations as well as their role in Circular Economy. This information was regularly updated to develop and keep a database of organisations for referencing.

1.5.2 Identification of stakeholders

The project used a participatory approach in establishing the key stakeholders for the project. Calls were made to key stakeholders as well as a stakeholder roundtable was conducted as an entry point to kick start the assignment. Table 1 provides an overview of all included groups and their relation to LHHA management system.

Table 1. Overview of stakeholders in e-waste sector Kenya

Category	Relation to e-waste management system
National Government & line Agencies in Environment Sector	The Ministries have been involved in the development of policies and regulations as well as assessing investment opportunities in the waste sector, therefore, have a broad understanding of the sectors. The expertise of the ministries benefited the study by providing policy recommendations for the adoption of circular economy measures.
Local Authorities	Responsible for waste collection and disposal
Companies	Targeted businesses included recyclers, producers, logistic partners in the waste management value chain. Overall, the parties form the Company' group regard bigger organizations and not SMEs. These parties are all part of the waste value chain and therefore crucial pins in the potential transformation to more circularity.
Enterprises	Enterprises regard the smaller and medium parties that are involved in waste management. Many of these are also part of the informal sector as they are not formally registered. Nevertheless, they play a crucial role in the waste value chain.
Civil Society Organizations	Civil Society are important players due to their role as policy reviewers and lobbyers for change, through research and the provision of recommendations. Moreover, NGOs and Civil Society have been instrumental in supporting the creation of innovations as well as creation of businesses within the waste management value chain.
Academia	Parties from academia are important due to their role as knowledge providers, steering and directing the public debate and proposing directions for change.
Households	Households are of course crucial stakeholders as well, as prime waste generators but also as victims of the negative consequences of inadequate waste management (health effects and pollution of their environment).

1.5.3 Survey and Sampling Method

A purposive sampling method was adopted to obtain deep information about the way distributors and repair companies deal with LHHA. In addition, a sample of households in Nairobi City was surveyed to investigate the LHHA 'management' at household level. Since economic and climatological conditions vary widely in the country, households were clustered into three demographic types low density, medium density and high-density suburbs respectively. Furthermore, the survey (and the sampling method) was set out in various wards and sub-counties in Meru, Kisumu, Mombasa and Nairobi. Further information about the sample sizes and the distributions over income groups and geographic area is reported in chapter 5.

Category	Sample size
Households	966
National Government Ministries	1
Government Agencies in Environment Sector	1
County Government	4

NGOs/CSOs	18
Producers and Distributors	28
Recyclers	1
Repair shops	48
Total	1067

1.5.4 Analysis of policies, strategies, past and ongoing initiatives and projects

Key initiatives, policies, strategies and stakeholders relating to waste management were analysed with an eye on their relationship to circular economy principles. Desktop research was carried out to assess policies, past and ongoing projects and initiatives on e-waste management and circular economy in Kenya. This included online search of information from key government departments, institutions such as the Ministry of Environment and Forestry, National Environmental Management Agency, local authorities, NGOs, companies and business associations. Strategic documents and project reports were analysed in terms of their aims in relation to waste management, scope, effect/ impact, stakeholders involved and roles.

1.5.5 Gender aspects in waste sector in Kenya

The status of gender mainstreaming in e-waste management was assessed as a cross-cutting issue, therefore, the assessment pays special attention to gender along the e-waste management value chain. A circular e-waste management system is one that is not only sustainable, but also inclusive in nature. The following parameters were considered:

- Gender of owner in e-waste enterprise
- Percentage of female workers in waste enterprise
- Training, technical and business capacity
- Registration of the enterprises (registration, licensing, certification)

1.5.6 Ethical Standards

The consultants have sought and will seek ethical approval to conduct research from all relevant authorities and stakeholders. This will include permission to consult youths staying with parents at household level and relevant government departments and waste enterprises. The purpose of the study will be explained including procedure for data collection and handling. Information confidentiality will be explained and adhered to. No person will be allowed to access raw data except the project team members. All the findings and presentations will be shared with CTCN/ NDE (see Annex B).

2 General background: Kenyan economy and the imports of LHHA

2.1 Demographics and economic context

The population of Kenya has grown from less than 10 million in 1960 to over 50 million people in 2020 (Figure 3)[3]. According to Kenya's 2019 National Census with population projected to reach 60.4 million by 2030[4].

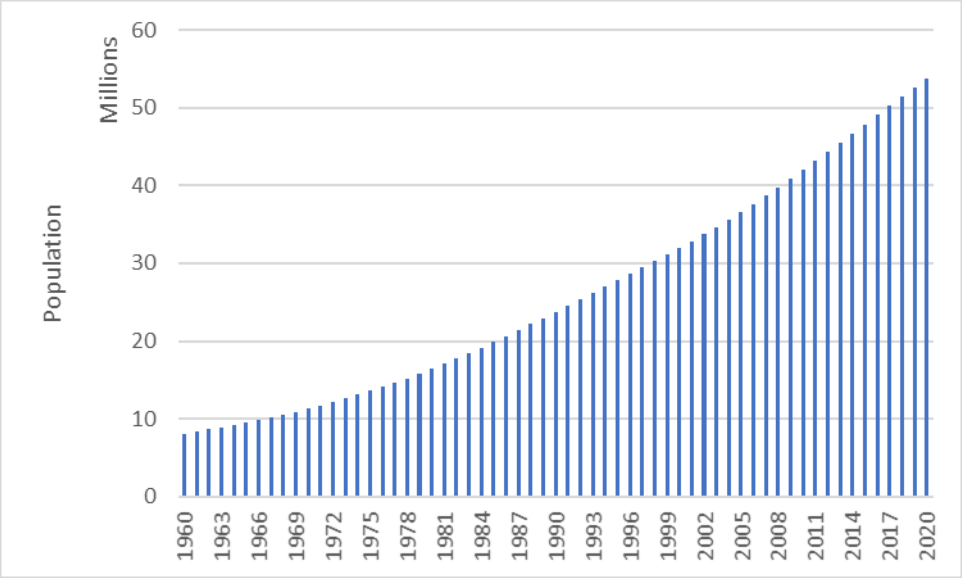

Figure 3. Kenya population trend between 1969 and 2019 ;Source: (KNBS, 2019)[5]

In the same period the annual population growth has fallen from between 3 and 4% per year to 2,25% in 2020.

[3] Data from https://data.worldbank.org/indicator/; visited 9 December 2021

[4] Source Kenya National Bureau of Statistics (2019). Kenya Population and Housing Census Volume I: Population by County and Sub-County. https://www.knbs.or.ke/?wpdmpro=2019-kenya-population-and-housing-census-volume-i-population-by-county-and-sub-county

[5] Kenya National Bureau of Statistics (KNBS) (2019). Kenya Population and Housing Census Volume I: Population by County and Sub-County. https://www.knbs.or.ke/?wpdmpro=2019-kenya-population-and-housing-census-volume-i-population-by-county-and-sub-county

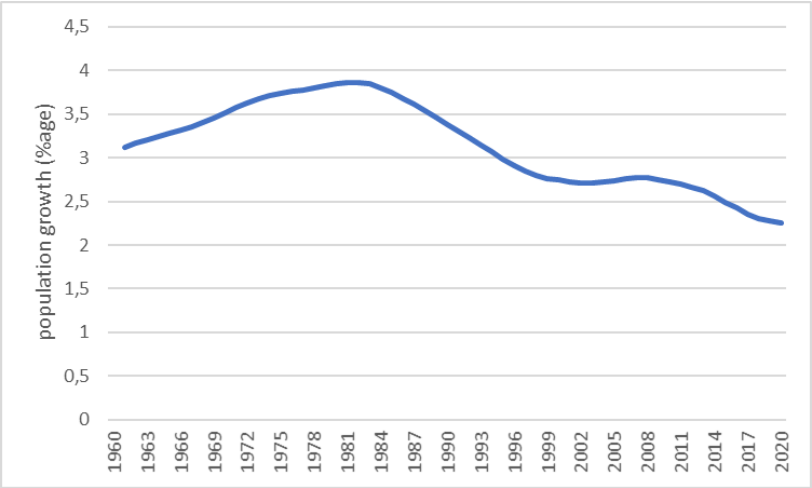

Figure 4 Population growth in Kenya (source: Worldbank)

The World Bank (2016)[6] estimated that around 27 percent of Kenyans live in urban areas with an urbanization growth of 4.3 percent a year and it's estimated that about half of the population will be living in urban areas by 2050.

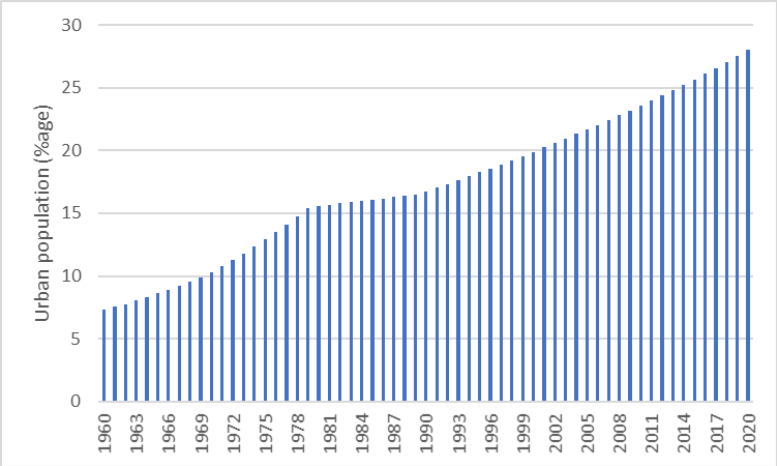

Figure 5 Development of urbanization in Kenya

The rate of urbanization is further projected to vary among urban areas as shown in Table 2 below.

[6] World Bank. 2016. Kenya Urbanization Review. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/23753 License: CC BY 3.0 IGO.

Table 2. Projected population (in thousands) of some major urban centres in Kenya (UNDESA, 2014) [7]

Urban centre	1990	1995	2000	2005	2010	2015	2020	2025	2030
Nairobi	1,380	1,755	2,214	2,677	3,237	3,915	4,792	5,870	7,140
Mombasa	476	572	683	802	940	1,104	1,326	1,619	1,973
Nakuru	168	194	224	256	293	335	396	482	589
Eldoret	116	141	173	213	261	321	397	489	598

Kenya is a lower middle-income country with an estimated national GDP of USD 78.97 Billion in 2017, USD 87.7 Billion in 2018 and USD 95.5 Billion in 2019 as shown in Figure 6. There was, however, a drop between 2020 and 2021 attributed to the current economic slowdown as a result of COVID-19 pandemic. The country registered an economic growth rate averaging 5.6 % for the period from 2014 to 2019 as a result of a sound macroeconomic environment, political stability, heavy investments in public infrastructure and growth in domestic demand[8]. At first glance, Kenya's GDP growth appears to be very steady. In fact, a closer look finds that the GDP growth was 5.9% in 2016, 4.9% in 2017, 6.3% in 2018 and 5.4% in 2019, which meant a decrease of 0.9% compared to 2018 (KNBS, 2020)[9]

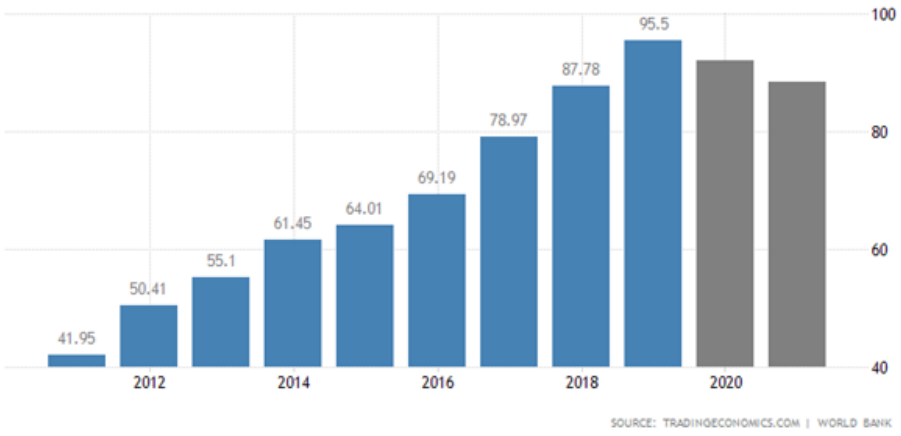

Figure 6 Kenya's GDP Source: Tradingeconomics.com (World Bank)[10]

On a per capita base the development of national income is given in Figure 7.

[7] UN Department of Economic and Social Affairs - Population Division. (UNDESA). (2014). World Urbanization Prospects: The 2014 Revision. New York, USA: United Nations

[8] Kenya Institute for Public Policy Research and Analysis (KIPPRA): 2020. Kenya Economic Report. Creating an Enabling Environment for Inclusive Growth in Kenya. https://kippra.or.ke/wp-content/uploads/2021/02/Kenya-Economic-Report-2020.pdf

[9] Kenya National Bureau of Statistics (2020), Leading Economic Indicators.

[10] https://tradingeconomics.com/kenya/gdp.

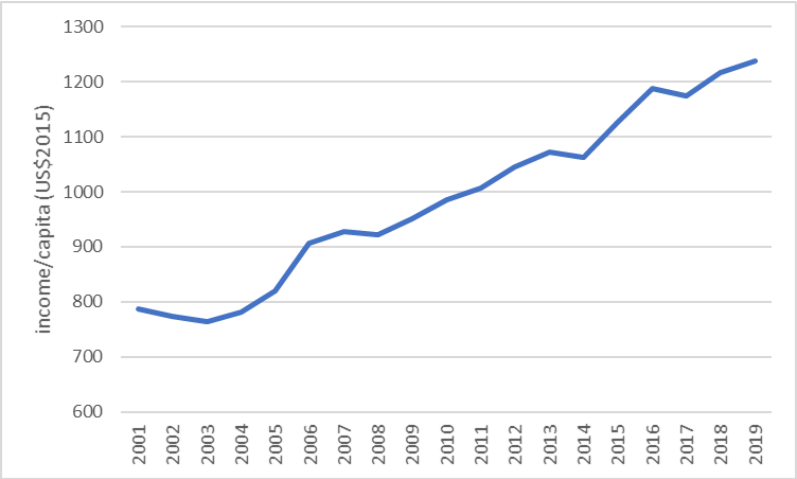

Figure 7 Development of income per capita in Kenya (source: Worldbank)

2.2 Access to electricity, water and sanitation

The access to electricity and basic services like sanitation and water are obviously closely connected to penetration of electric household appliances in the Kenyan society. Therefore we briefly analyze the development of the access to such services in this section.

There is great variability in access to basic services between urban areas of different population sizes, as well as between urban and rural areas with access to services such as water, sanitation, and electricity being generally better in more populous urban areas (World Bank, 2016)[11]. According to (KNBS, 2014) only 2.5% of the urban population had access to private (own-household) improved sanitation in 2014[12]. A similar assessment by (JMP, 2015) shows a slightly higher figure, estimating access to improved sanitation facilities at 31% in 2015. Shared facilities are predominant in urban areas with 50% of urban dwellers using such facilities according to KNBS (2014)[13] and 48% according to JMP (2015)[14]. Over the years, access to sanitation services has improved (KNBS, 2019)[15], meaning that two in three households (65%) have access to improved sanitation facilities with variations in access at county levels from 8% in Wajir to 87% in Nairobi. These disparities in access to sanitation services are further illustrated in Figure 8.

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[11] World Bank. 2016. Kenya Urbanization Review. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/23753 License: CC BY 3.0 IGO.

[12] Kenya National Bureau of Statistics (KNBS) 2014. Kenya Demographic and Health Survey. https://www.knbs.or.ke/?wpdmpro=2014-kenya-demographic-and-health-survey

[13] Kenya National Bureau of Statistics (KNBS) 2014. Kenya Demographic and Health Survey.https://www.knbs.or.ke/?wpdmpro=2014-kenya-demographic-and-health-survey

[14] Joint Monitoring Programme (JMP) for Water Supply and Sanitation Kenya. (2015). Estimates on the use of water sources and sanitation facilities.

[15] KNBS. (2019). 2019 Kenya Population and Housing Census: Volume IV. Distribution of people by socio-economic characteristics. https://www.knbs.or.ke/?wpdmpro=2019-kenya-population-and-housing-census-volume-iv-distribution-of-population-by-socio-economic-characteristics

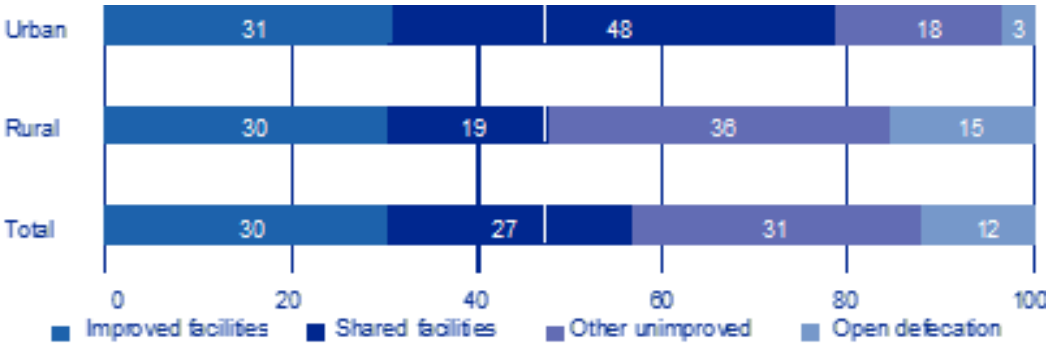

Figure 8. Access to basic sanitation in % in Kenya Source: (JMP, 2015)[16]

The distinction between rural and urban population with respect to the access to electricity is enormous: up to 90% of urban population has access, whereas in rural areas just over 50% have access to electricity. Besides the obvious relation with income, these difference will of course have a significant influence on the penetration of LHHAs in society.

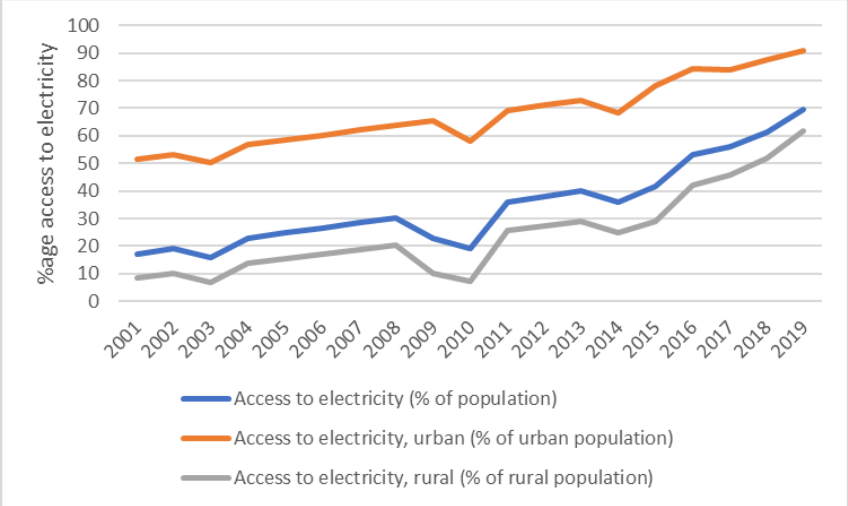

Figure 9 Access to electricity (source: Worldbank)

2.3 Imports of Large Household Appliances (LHHA)

When discussing 'circular behaviour' and Value retention potential concerning LHHAs (either repair, refurbishment or recycling activities), it is important to start at the source: what is the total value of LHHAs imported and in use and how will that develop over the years.

Statistical trade data from the UN (Comext) provide insight in the trade volume for most of the items within the scope of this study.

[16] Joint Monitoring Programme (JMP) for Water Supply and Sanitation Kenya. (2015). Estimates on the use of water sources and sanitation facilities.

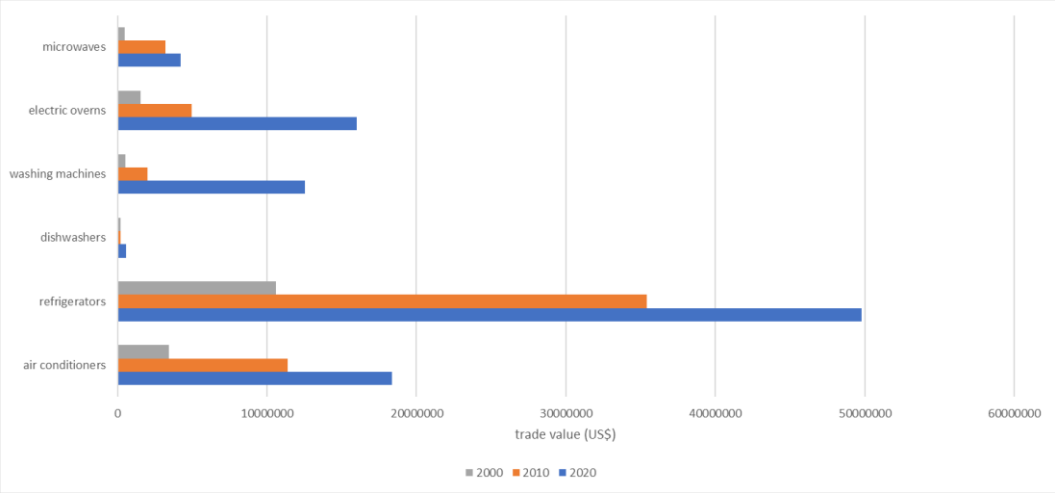

Figure 10 Imports of various LHHAs[17] (source: Comtrade-UN)

The trade volume of these items increases strongly over the last two decades. This is of course coupled to the population growth but more importantly with the growth in GDP/capita. Clearly, the category of refrigerators is the most dominant electric household appliance (in trade volume), followed by electric cooking devices, washing machines and air conditioners. Dishwashers and microwaves represent only a small trade volume.

Since refrigerators are the most dominant appliance, we analyzed the origin of these appliances. China is by far the biggest producer for Kenyan washing machines, followed by India, Thailand and Turkey. In case a form of Extended Producer Responsibility is implemented these countries of origin need to be taken into account.

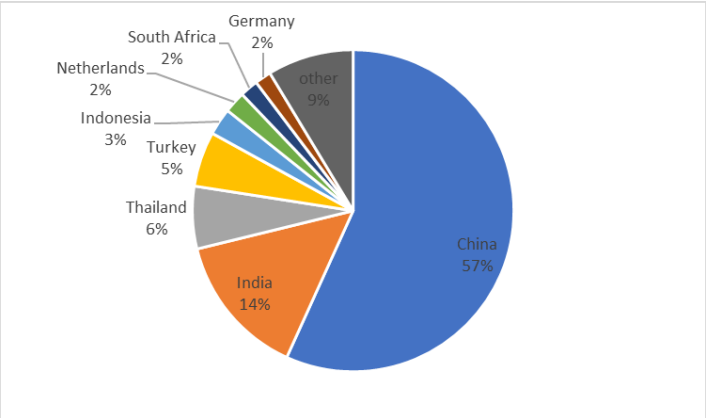

Figure 11 Country of origin of imported washing machines (source: Comtrade-UN)

[17] For clarity the most important items from some categories are shown. The full category listing is as follows: 851660 Electric ovens other than microwave ovens; electric cookers, cooking plates, boiling rings, grillers & roasters; 8415 Air conditioning equipment, machinery; 8418 Refrigerators, freezers and heat pumps; 842211 Dish washing machines (domestic); 8450 Household, laundry-type washing machine, washer-drier; 851660 Electric cooking, grilling & roasting equipment

Though the number of electric household appliances steadily increases, the average degree of penetration is still very low, as can be concluded from the 2019 census report (Volume IV KPHC 2019-specifically Page 462 and onwards -Table 2.36: Percentage Distribution of Conventional Households by Ownership of Selected Household Assets by Area of Residence, County and Sub County). On

Table 3 Distribution of household equipment in Kenya (source: 2019 census report)

Table 2.36: Percentage Distribution of Conventional Households by Ownership of Selected Household Assets by Area of Residence, County and Sub County

		Selected Household Assets										
County / Sub-County	Conventional Households	Stand alone Radio	Desk Top Computer/ Laptop/ Tablet	Functional Television*	Analogue Television**	Internet	Bicycle	Motor Cycle	Refrigerator	Car	Truck/ Lorry/ Bus/ Three Wheeler truck	Tuk Tuk
Kenya	**12,043,016**	**56.9**	**8.8**	**40.7**	**4.7**	**17.9**	**15.0**	**9.2**	**8.8**	**6.3**	**0.9**	**0.5**
Rural	7,379,282	58.5	3.0	26.9	3.4	6.9	15.6	10.8	2.4	3.5	0.7	0.4
Urban	4,663,734	54.4	18.0	62.5	6.7	35.4	13.9	6.7	19.1	10.8	1.2	0.7

average only 9 % of Kenyan households owns a refrigerator. The penetration differed strongly between rural and urban areas: 19% of the urban households was found to own a refrigerator.

According to the outcome of a roundtable in July 2021 other appliances with relatively high penetration include: electric cooking appliances, electric heating appliances, electric stoves, microwaves.

2.4 Forecasts of Large Household Appliances quantities

The action plan is aimed at stimulating value retention processes among which recycling of LHHA-waste. The viability of business cases will partly depend on the scale with which used or spent LHHA comes on the ‘market’. Therefore it is of interest to consider the potential growth of sales volumes. Both in the past decades and in the future a significant growth is expected for the LHHA under study.
The growth of LHHA consumption is coupled to the GDP growth of the country. For comparison, we plotted the trade volume for a number of items for a number of countries with different GDP: Rwanda (GDP of 798$/capita), Kenya (1,206$/capita), Namibia (4,211$/capita), Greece (17,700$/capita) and The Netherlands (52304$/capita).

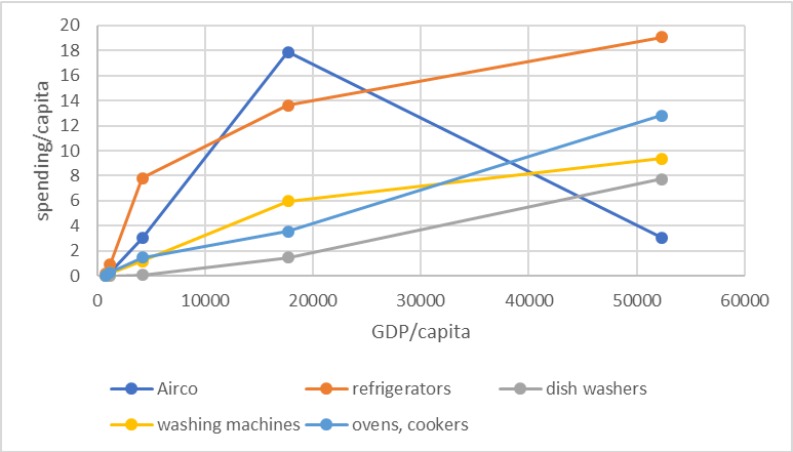

Figure 12 Spending on LHHA versus GDP/capita

It is obvious that a growth in GDP has a marked influence on the spending of LHHA. Remarkably the spending on air conditioners follows a different path related to the climatological conditions in The Netherlands as compared to Greece. Besides spending capacity it is of course the sheer penetration of electricity in Kenya that will stimulate the consumption of these devices.
With the use of such relations and an estimate of the growth of GDP, we should be able to estimate a growth path for the trade volume of LHHAs in the coming years. Self-evidently there will be a significant period before this growth path will have a marked influence on the VRP and end-of-life activities given the expected lifetime of such assets.

2.5 Imports of electronic goods

Though the action plan is clear about the scope of this study (LHHAs), electronic goods and ICT equipment are more abundantly present in the Kenyan society. The 2019 census report is clear evidence for that (see Table 3). Therefore we compared the import of these goods to the LHHA import (already presented in Figure 10). The results are given in Figure 13.

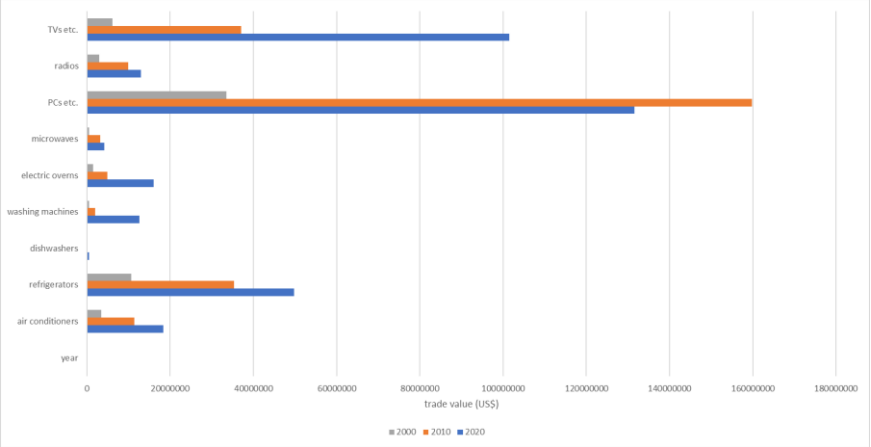

Figure 13 Spending on ICT, electronic equipment and LHHA

Indeed the much bigger use of such equipment is reflected by the much higher spending by Kenyan households. This spending behaviour also seems to be reflected by the equipment that is presented to repair shops. The VRP and waste

management of electronic equipment may lead to synergies with the management of LHHA.

3 Policies and strategies relating to e-waste management

The e-waste sector is governed and regulated in Kenya by the county governments, the Ministry of Environment and Forestry and governmental agencies such as NEMA. A number of conventions, regulations, policies, strategies and guidelines have been put in place to manage e-waste. In addition, there are other general regulatory frameworks that don't explicitly address e-waste but are applied to ensure sustainable management of e-wastes as they form part of the total solid waste stream in the country.

The Kenya Constitution 2010 gives the right to every Kenyan to a clean and healthy environment under Article 42. In addition, Article 69 obligates the government to eliminate any processes that are deleterious to the environment, including e-waste. Further, the Constitution legislates that any Convention that the country has ratified becomes part of the national laws. In this regard, there is recognition of international conventions regulating hazardous waste. Examples of these conventions are the Basel Convention on the control of transboundary movements of hazardous wastes and their disposal, and the Bamako Convention, which aims at introducing preventive measures and guaranteeing appropriate disposal of hazardous waste in Kenya.

In 2010, NEMA formulated the National e-waste Guidelines to assist the government, the private sector, learning institutions and other stakeholders to manage e-waste effectively for enhanced environmental conservation.
The principal legislation guiding environment management in Kenya is the Environmental Management and Coordination (Amendment) Act (EMCA) 2015, which prohibits handling, transportation and disposal of waste without valid licenses issued by the National Management Authority (NEMA). E–waste is currently categorized as hazardous waste under EMCA cap 387. Environmental (Impact Assessment and Audit) Regulations, 2019 and legal notice 31 of 2019 considers establishment of an e-waste recycling center as a high-risk project which must undergo a comprehensive Environmental Impact Assessment (EIA).

EMCA (e-Waste) Regulations 2016 provides that those who introduce e- waste such as waste from large household appliances and accessories into the country, bear the cost of their processing or refurbishing at end-of-life to preserve human health and the environment instead of leaving the burden to the public. The regulations require the importers to state the quantity of e-waste imported by commodity type. Section 11 provides for segregation of e-waste from other forms of waste and delivery of the same to licensed refurbish companies, collection centers or recyclers and compliance with regulations 8 of the EMCA (Waste Management) Regulations of 2016 on the mode of transport used.

The National E-Waste Management Strategy 2019 is a five-year plan covering the period 2019/20 to 2023/24. The strategy proposes, among others, cash incentives for consumers, tax exemptions for companies that help collect and manage the waste and Public-Private Partnerships (PPPs) to build robust and sustainable infrastructure to facilitate an environmentally friendly e-waste management system.

Under the Public Procurement and Disposal Act 2015, Public institutions have to invite competitive tenders for disposal of computers and other EEE as scrap in line with procurement procedures. Section 165(2) of the Act prescribes that electronic waste shall only be disposed of to persons licensed to handle the respective waste.

Kenya Vision 2030[18] recognize that Kenya cannot attain high economic and social development without prioritizing environmental management, especially the reduction of pollution by diverse wastes. In this regard, waste management including e-waste was prioritized as a flagship project. The third medium term plan (2018-2022) prioritize e-waste as an emerging waste category with an emphasis on support to SMEs to manage the waste.

The above shows that Kenya has described an impressive set of regulations that set the ground for an effective system of integral management of product put on the market and of products at the end of their first life. However, there is no effective enforcement of the above described regulations as well as there are gaps in regulatory framework related to e-waste management and disposal. For instance, Kenya's legislative frameworks on e-waste management does not take into account that e-waste management is being largely done by the informal sector. Again, Public Procurement and Disposal Act 2015 is silent on consideration of the end-of-life effects of EEE procured and fails to provide further guidance in case the recyclers fail to bid for purchase of used EEE and e-waste. Additionally, it is observed that there is lack of specific regulatory framework for e-waste management. However, efforts to enact the e-waste regulations took place in 2013 which has since been shelved.

At the end of 2021, Kenya drafted an e-waste regulation under EMCA, awaiting government approval (in December 2021 this is still draft form). The Extended Producer Responsibility (EPR) Regulations 2021, developed by Kenya, is expected to be enacted in 2022, after having been finalized with the review from the Attorney General's office. E-waste is one of the goods subject to EPR, according to the EPR regulations 2021. Producers of Electrical and Electronic Equipment (EEE) must form or join a Producer Responsibility Organization as shareholders and implement an EPR Scheme. The existence of a regulation alone does not assure compliance so it should still be accompanied by effective enforcement. Once this regulation is approved, implemented and enforced, it will change the landscape. Of course setting up the PRO and creating funds for proper management of dismantling, disassembly and recycling will create new market opportunities in the entire value chain. This landscape change should have a profound influence on the direction of future pilots for management of LHHA waste.

3.1 Relation between waste and Kenya's NDC and SDGs

Kenya is a signatory to the Paris agreement which seeks to catalyze global response to climate change. Articles 3 and 4 of the Paris Agreement require each Party to prepare, communicate and maintain successive (updated every 5 years that should be more ambitious than the previous one) nationally determined

[18] Kenya Vision 2030 is the long-term development blueprint for the country that aims to transform Kenya into a newly-industrialising, middle income country providing a high quality of life to all its citizens in a clean and secure environment by 2030. http://vision2030.go.ke/wp-content/uploads/2018/05/Vision-2030-Popular-Version.pdf.

contributions (NDCs). NDCs represent a country's pledges on climate action that seek to limit global warming to well below 2°C, preferably to 1.5 °C, over pre-industrial levels.

Kenya prepared and submitted its updated NDCs in December 2020 which seeks to abate GHG emissions by 32% by 2030 relative to the business as usual (BAU) scenario of 143 $MtCO_2eq$. The contributions described in this submission build upon Kenya's initial NDC, Kenya's National Adaptation Plan (NAP) 2015-2030, new policies and national plans, and reflect subsequent work as captured in Kenya's second National Climate Change Action Plan (NCCAP) 2018-2022 and the national Inventory Report (NIR).

Kenya's second national communication to United Nation Framework Convention on Climate Change (UNFCCC) positions the waste sector as the least contributing sector relative to the total country's emissions of GHGs (representing 2% as shown in Figure 14). Although the waste sector contribution to total greenhouse gas emissions is the lowest, it has been on an upwards trajectory over the years as described by climate watch (CAIT) in Figure 15. Looking into the future, Kenya's NDC baseline indicates that absolute emissions from the waste sector are projected to grow from 2.6 $MtCO_2e$ in 2015 to 5.2 $MtCO_2e$ in 2030 while their contribution to total national emissions is expected to increase to 4% (excl. Land Use and Land Use Change and Forestry -LULUCF) (MENR, 2017)[19].

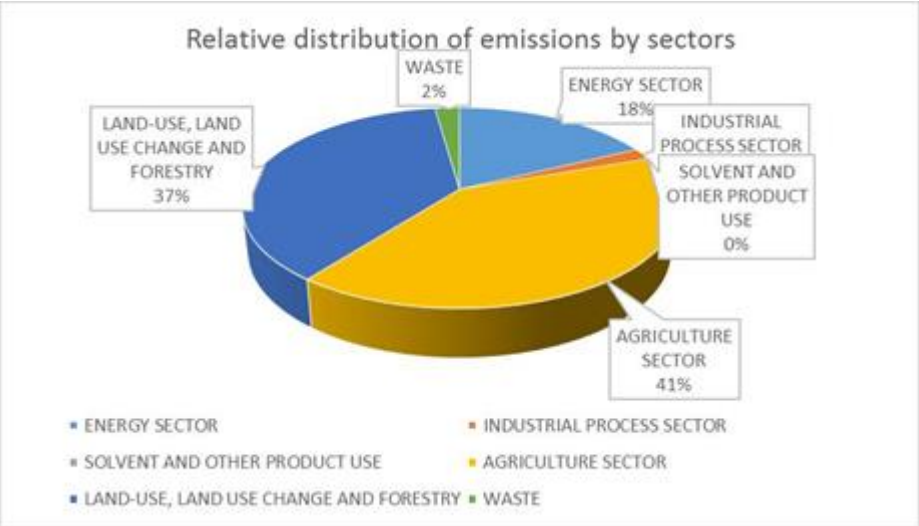

Figure 14. Relative distribution of emissions by sectors (GoK 2015[20])

[19] MENR. (2017a). Kenya's Nationally Determined Contribution (NDC) Update of Kenya's Emission Baseline Projections and Impact on NDC Target. Ministry of Environment and Natural Resources. http://www.starckplus.com/documents/ta/ndc/UpdateofKenyasEmissionBaselineProjectionsandImpactonNDCTarget.pdf

[20] Government of Kenya (2015). Second communication to the UNFCCC. https://unfccc.int/resource/docs/natc/kennc2.pdf

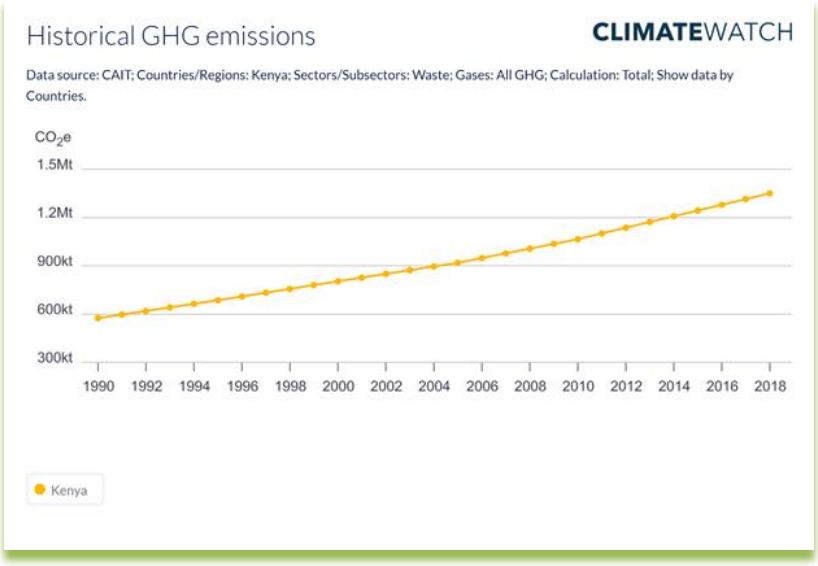

Figure 15. Kenya's historical GHG emissions in waste sector (WRI CAIT 2.0 2017[21])r

With the priority mitigation option fully implemented, the waste sector would be able to deliver 0.49 $MtCO_2e$ by 2030 and meet its 2030 sector emissions reduction target of reducing emissions by 0.4 $MtCO_2e$ (GoK, 2018)[22]. It should be noted (in the context of this report) that these emissions originate from the entire waste sector. The vast majority of waste-related emissions are caused by the ingredients in municipal solid waste, predominantly organic waste fractions. The e-waste sector does not contribute significantly to these emissions.

3.2 Financial organization of the current waste system

Nowadays, the waste management system in Kenya, including the e-waste system, is largely organized trough the informal sector[23]. The total amount of e-waste in Kenya is estimated as 0,8 kg/capita per year. With 47,8 mio habitants in Kenya, this amounts to 0,4 MT per year of e-waste. This e-waste stream has a value (worth of materials) of approximately 1,0 US$ per ton of e-waste or US$ 400,000 per year in total. If we assume that currently 13% of this stream will be collected and recycled, this results in a total recycled stream of 52,000 kg/yr. Added value is created by extracting major components (copper, aluminium) and by disposing other bulk components. The product value of raw materials from e-waste is estimated to be around 1,080 US$ per ton[24], or 1,08 US $ per kg of handled e-waste. For Kenya, this would result in a potential added value of 56,160 US$ per year (at an assumed recycle ratio of 13 %). Obviously, this added value is too small (and dispersed) to stimulate independent business activities.

[21] https://www.climatewatchdata.org/ghg-emissions?end_year=2018&gases=all-ghg&regions=KEN&sectors=waste&source=CAIT&start_year=1990

[22] Government of Kenya. (2018). National Climate Change Action Plan (Kenya): 2018-2022. Volume 3: Mitigation Technical Analysis Report (Vol. 3).

[23] The Global E-waste Monitor 2020, ISBN 978-92-808-914-0

[24] E-Waste statistics, https://www.alliancedsp.com/trash-talks-blog/e-waste-statistics/

Any regulation, that would prolong the useful life of LHHA, improve the integral management of end-of-life products recycle ratio or increase the value of the recycled product, would help to make a more solid business case.

3.3 Environmental impacts of the current e-waste system

E-waste is more complex than other waste streams and presents a challenging recycling problem due to material complexity and for being a combination of valuable metals (such as gold, copper) with low value materials such as plastic[25] or even hazardous ones like lead, cadmium, beryllium, or brominated flame retardants. If not managed properly, these hazardous components of e-waste have the potential to cause significant environmental and human health impacts[26][27]. Although these dangerous substances are usually only present in small amounts, they have great potential for causing serious environmental damage[28].Therefore, their release in the environment should not be overlooked. Improper e-waste handling and disposal expose people to highly toxic cocktails of heavy metals, brominated flame retardants, non-dioxin-like polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons (PAH), polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzofurans (PBDF) and dioxin-like polychlorinated biphenyls (DL-PCB)[29]. Most of these compounds are endocrine disrupters, and most are neuro- and immune-toxic as well. Other contaminants are poly brominated diphenyl ethers (PBDEs) which are flame retardants usually mixed into the plastic components of electronics and because they have no chemical bond with plastic, they are very likely to escape to the environment. Given the lipophilic characteristic of PBDEs, they cause bioaccumulation in organisms and bio-magnifications in food chains (Deng, W.J., *et al*, 2006)[30].

These health hazards are more likely to occur in a highly informal e-waste system as it is currently the case in Kenya. Any regulatory system to address and regulate a more formal e-waste system to generate a viable business case should also include proper risk, health and safety measures.

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[25] Anyango Tocho, J. and Mwololo Waema, T. (2013), "Towards an e-waste management framework in Kenya", info, Vol. 15 No. 5, pp. 99-113. https://doi.org/10.1108/info-05 2013-0028

[26] Otieno, Ibrahim & Omwenga, Elijah. (2016). E-Waste Management in Kenya: Challenges and Opportunities. Journal of Emerging Trends in Computing Information Sciences. Volume 6 No 12. 661.

[27] UNEP (2018). Africa Waste Management Outlook. United Nations Environment Programme, Nairobi, Kenya.

[28] Peernart, K., Ravi, N. & Ming, H. (2013). Electronic waste Management approaches: An Overview. E-Waste Management Journal, *33*, 1237 – 1250.

[29] Jackson Songa & Billy Lubanga "The Health Risk of Electronic Waste in Kenya: Challenges and Policies" Pinnacle Medicine & Medical Sciences ISSN: 2360-9516, Vol. 2 (7), 2015, Article ID pmms_213, 805-808, 2015.

[30] Deng, W.J., et al (2006) Atmospheric levels and cytotoxicity of PAHs and heavy metals in TSP and PM at an electronic waste recycling site in southeast China. Atmospheric Environment, 40(36): 69456955.

4 Practice of e-waste management in Kenya

4.1 e-waste in Kenya

The rapid adoption of household electric and electronic appliances fueled by rapid changes in technologies in which consumers replace their old household appliances with new appliances with latest technologies has resulted in an increase of the re-use market. Therefore, the electric and electronic appliances which would otherwise have been considered waste are hitherto returned into the consumption loop.

The exact situation concerning LHHA waste quantities in Kenya remains unclear, with scanty information about e-waste generation and treatment. Despite this, some information on e-waste generation with UNEP (2010) reports that Kenya generated 17,000 tons of e-waste; composed of 11,400 tons from refrigerators, 2,800 from TVs, 2500 from PCs, 500 from printers, and 150 from mobile phones. More recently, a report by Forti V et al. (2020) revealed that Kenya generated 51,000 tonnes of e-waste in 2019. However, the report doesn't provide information on the type of E-waste as well as quantity treated and disposed.

4.2 General picture of e-waste practices in Kenya

Separation at source is not common and this is mostly attributed to a lack of infrastructure for segregation of LHHA waste. At the policy level, the National waste management Act 2015 provides that all wastes should be separated. However, there is no penalty attached to non-compliance thus breeding laxity to separate waste and relevant authorities have also not been able to fully ensure there is separation of waste at source.

The current e-waste management practices in Kenya includes both formal and informal practices with scanty information on the volumes collected and processed[31] It has been observed that most of the e-waste produced in developing countries is managed by the informal sector through crude means such as product reuse, crude 'backyard' recycling, disposal in landfills and burning in open fields[32][33]. This situation is alive in Kenya with varied informal collection and recycling activities taking place aimed at material recovery from e-waste.

There have been efforts to support and incorporate the informal waste sector in the wider e-waste value chain, acknowledging the role of informal sector in waste management. For Instance, E-waste Initiative Kenya (Ewik)[34] is a Kenyan based NGO dealing with electronic waste management specifically in the informal sector, providing a safe disposal option across the country through their networks.

31 The National E-waste Management Strategy 2019.

32 Osinbajo O and Nnorom I.C. (2007). The challenge of electronic waste (e-waste) management in developing countries. Waste Management and Research, 25(6): 489-501 **Error! Hyperlink reference not valid.** doi.org/10.1177/0734242X07082028.

33 Schluep, M., Terekhova, T., Manhart, A., Müller, E., Rochat, D. and Osibanjo, O. (2012). Where are WEEE in Africa? In: Electronics Goes Green 2012+(EGG), pp. 1-6. Stuttgart: Fraunhofer Verlag.

34 https://ewik.org/about/

The formal e-waste actors have over the years invested in collection points where individuals and companies can deposit their LHHA wastes. The informal waste collectors usually move around informal areas as well as dumpsites to collect LHHA after which they dismantle and remove valuable materials for sale. Currently there is no incentive for individuals to take their LHHA for treatment since waste collecting and processing centers such as the WEEE center in Nairobi don't pay for the LHHA waste they receive. For this reason, people and organizations hold the LHHA waste with the hope that they will get a buyer or an incentive for disposal. LHHA waste that are not sustainably treated find their way in the dumpsite or burnt in open air.

There is a growing number of licensed entrepreneurs and organized groups which are recycling E-waste in the country, established individually or jointly or as registered companies or non-governmental organization. These are organized along the value chain from collection, transportation to the recycling centers. The established collection centers usually contract or sub contract the E-waste collectors normally known as 'scavengers' to supply them with the waste. One such organization is the Sintmund Group which is a licensed company operating advanced recycling facility for e-waste such as bulbs, batteries, fridges, freezers, cartridges, computers, among others.

4.3 WEEE in Kenya

In the Kenyan context, e-waste Management Regulations 2016 defines e-waste as electrical and electronic equipment waste resulting from electrical and electronic equipment including components and sub-assemblies thereof. The Step Initiative (2014) further posits that EEE becomes e-waste once it has been discarded by its owner as waste without the intent of reuse.

The current e-waste management practices in Kenya comprise both formal and informal practices with scanty information on the volumes collected and processed. A study by Anyango S.O and Munyugi L.K. (2018)[35] established that the volumes of e-waste handled by the formal companies were low compared to the anticipated volumes of e-waste. In fact, Otieno I., & Omwenga E., (2016)[36] posits that in urban areas, where most of the e-waste is generated, formal private waste management companies cover approximately 45% of the total urban households, 32 % of the corporate institutions, 50 % of the industries and 17 % of the commercial enterprises. Of these, about 81 % of the households served by private companies live in the high and middle-income areas of the city.

In this context, the informal sector handles significant amounts of E-waste while the rest ends up in illegal dumpsites, held by users, and burnt in the open. Although these numbers have not been documented. The informal sector is characterized by lack of proper skills and mechanisms to handle e-waste. At the same time, they are

[35] Anyango S.O and Munyugi L.K. (2018): E-Waste Management Practices: Policies Strategies and Regulations, In Selected National Institutions, Nairobi, Kenya. DOI: 10.9790/24021203018192.

[36] Otieno, Ibrahim & Omwenga, Elijah. (2016): E-Waste Management in Kenya: Challenges and Opportunities. Journal of Emerging Trends in Computing Information Sciences. Volume 6 No 12.661.

neither authorized nor registered with the Waste Management Unit of the National Environment Management Authority (NEMA) and the Department of Environment in respective counties. Notwithstanding this, they still engage in the collection, segregation, transportation, material recovery.

Some of the preferred but environmentally unfriendly techniques used to recycle E-waste by the informal sector include heating and manual removal of components from printed circuit boards, open burning to reduce volumes and recover metals, and open-acid digestion of E-waste recover precious metals (Florin-Constantin et al., 2019)[37].

Rapid changes in technologies in which consumers replace their old EEE with new ones of latest technologies have fuelled the reuse market. In this case, the EEE which would otherwise have been rendered E-waste remains in the loop. To reinforce this, Gatuguti B. (2018)[38] posits that reuse and refurbishing have always been the best means of waste management, especially considering that it saves the most amount of energy.

A growing number of licensed/formal and organized groups are closing the loop in E-waste management in the Country, established individually or jointly or as registered companies, Community Based Organizations (CBOs), and Non-Governmental Organizations (NGOs). These are organized along the value chain from collection, separation, transportation, recycling, remanufacturing, refurbishment and repair. The formal e-waste actors usually contract or subcontract the informal E-waste collectors, customarily known as 'scavengers,' which form part of the informal e-waste actors, to supply them with the e-waste. At the same time, others have invested in collection points at their treatment facilities and in other designated areas spread across the country.

4.4 Ongoing and past project related to the management of LHHA

Ongoing projects

- Waste Electrical and Electronic Centre (WEE Centre) is an initiative by computers for schools Kenya (CFSK) currently owned and operated by local entrepreneurs with sustained support from varied local and international partners. It provides e-waste collection, dismantling, and automated processing services in Nairobi and other major cities and towns in Kenya. It has parallel systems, one for repair and refurbishment and others for dismantling and recycling.
- E-waste Initiative Kenya (“Ewik”), an NGO in Kenya, provides safe disposal options across the Country through their networks, more so in informal settlements.

Past Projects

- In 2013, the government of Kenya developed E-waste regulations to streamline e-waste management in Kenya. It was however shelved and has never been passed into law.

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[37] Florin-Constantin. M, Maria-Grazie .G , Christia. M , Chukwunonye. E and Valerio.E. (2019): Waste Electrical and Electronic Equipment (WEEE): Flows, Quantities, and Management—A Global Scenario https://doi.org/10.1016/B978-0-12-816190-6.00001-7.

[38] Gatuguti B. (2018): Legal Framework for E-Waste Management; A Comparative Case Study of Kenya.

5 Dealing with LHHA in households and businesses – overview of survey results

In order to obtain a better understanding of the current attitude towards and 'management' of LHHA from procurement until the end-of-life phase an extensive survey was conducted among 966 households in 4 distinctly different counties in Kenya, as well as among 76 companies engaged in distribution and repair of LHHAs.
This chapter provides an overview of the results of this survey. An analysis of these results vis-à-vis national data -presented in earlier chapters- as well as intermediate conclusions will also be given in this chapter.

5.1 Survey among households

5.1.1 Size and geographical distribution of survey

In total the survey covered 966 households evenly distributed over 4 counties: Nairobi, Kisumu, Meru and Mombasa

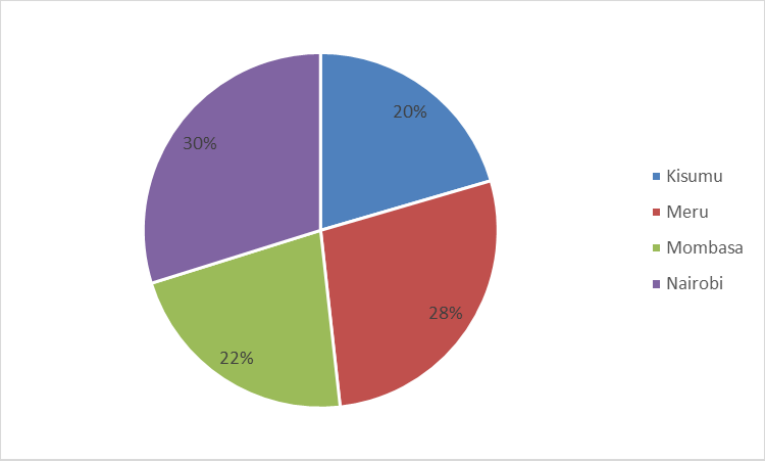

Figure 16 Distribution of survey over counties (total: 966 households)

Of these households 762 shared information about their household income. The results are given in Figure 17, differentiated over the counties and over various income groups.

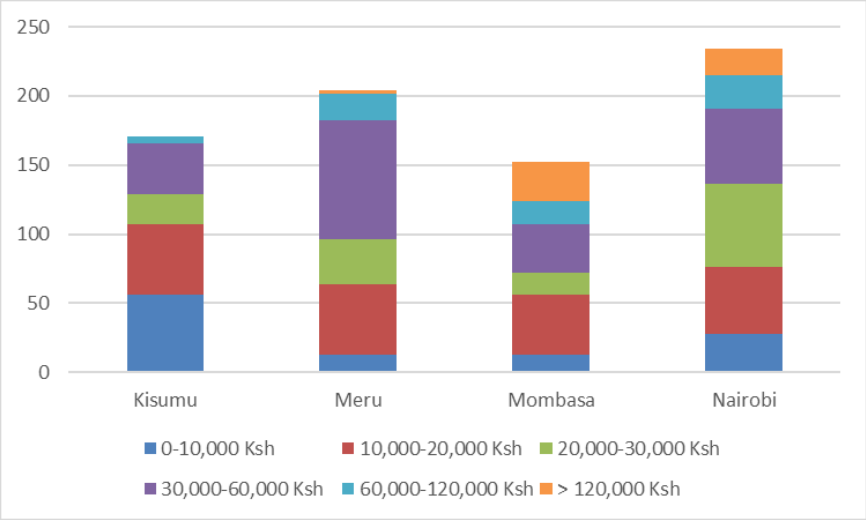

Figure 17 Income distribution among household survey

5.1.2 *Dealing with LHHA in households*

The vast majority of the surveyed households owned some form of LHHA. This significant ownership percentage demonstrates that the sample is not per se representative for the average Kenyan population. For, the census report quoted earlier retrieved an average of 8,8% of the population owning a refrigerator, and 19% of the urban population (see *Table 3*).

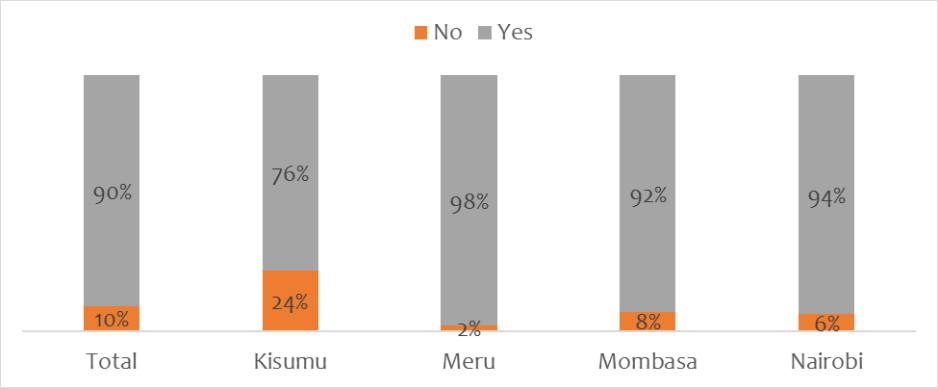

Figure 18 Ownership of LHHA in survey households

The distribution of types of owned LHHA is given in Figure 19.

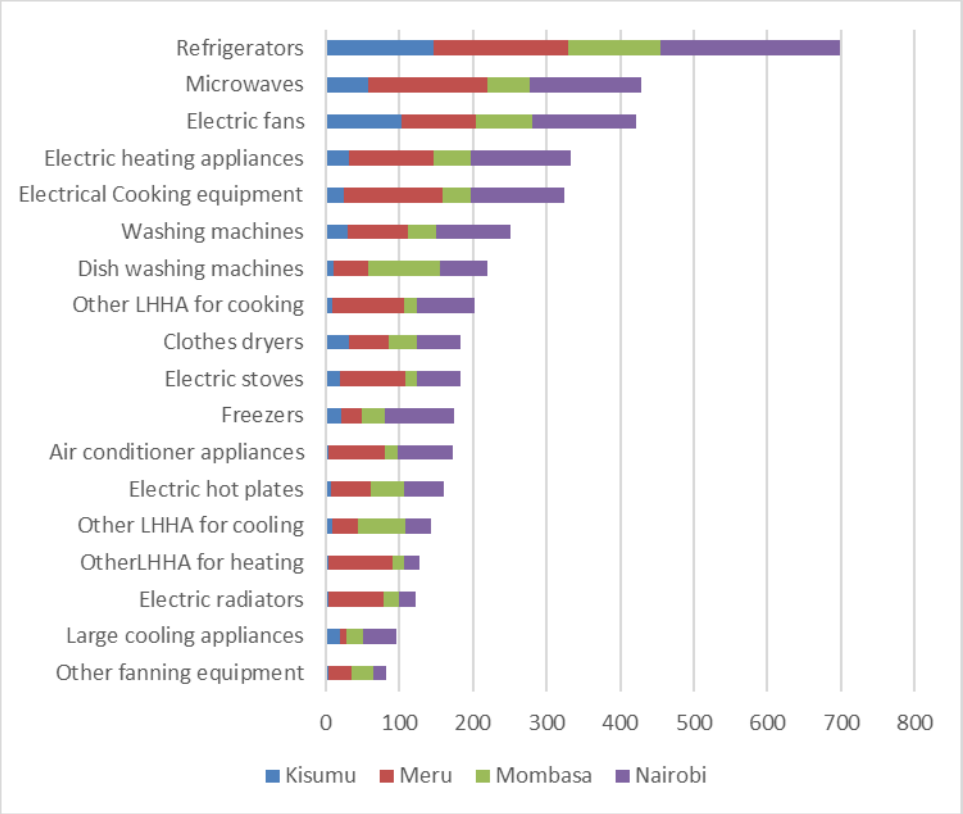

Figure 19 Types of LHHA owned by survey households

Over all countries refrigerators are by far the most owned LHHA.
Looking in more detail at these data, we see that there are remarkable differences in ownership between the counties. For instance, dishwashers were owned by almost half of Mombasa households, compared to 5-20% in other countries. Heating appliances were much more broadly owned in Meru and Nairobi, compared to Kisumu and Mombasa. Electric radiators were almost only found in Meru.

Table 4 Distribution of LHHA ownership in 4 counties

Appliance	Kisumu	Meru	Mombasa	Nairobi
Other fanning equipment	1,5%	12,3%	13,2%	6,3%
Large cooling appliances	10,1%	3,0%	10,8%	15,6%
Electric radiators	2,0%	28,0%	9,4%	8,0%
Other LHHA for heating	1,5%	32,5%	8,0%	7,3%
Other LHHA for cooling	4,5%	12,7%	31,1%	11,8%
Electric hot plates	3,5%	20,5%	20,8%	19,1%
Air conditioner appliances	1,5%	28,7%	8,0%	26,4%
Freezers	11,1%	10,1%	15,1%	32,6%
Electric stoves	9,6%	33,2%	7,5%	20,5%
Clothes dryers	15,7%	20,5%	17,9%	20,8%
Other LHHA for cooking	4,5%	36,6%	8,0%	27,4%
Dish washing machines	5,6%	17,2%	46,7%	22,2%
Washing machines	15,2%	30,6%	17,9%	35,1%
Electrical Cooking equipment	12,6%	49,6%	18,4%	44,4%
Electric heating appliances	15,7%	43,3%	23,6%	47,2%
Electric fans	52,0%	37,7%	36,3%	49,0%
Microwaves	28,8%	60,8%	27,4%	52,4%
Refrigerators	73,7%	68,3%	59,4%	84,4%

These differences will partly be related to the climatological circumstances in these counties. A clear relation between ownership and income level was not found.

The respondents was also asked whether they disposed of LHHA over the last 5 years. The answers gave detailed insight in how this question was interpreted, and what households actually did with their older household equipment.

Figure 20 provides an overview of the appliances that were ‘disposed of’ in the 5 years preceding the interview.

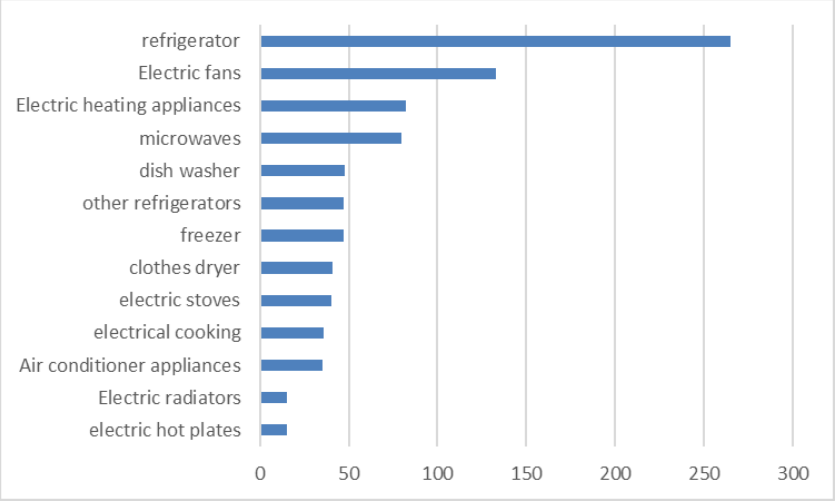

Figure 20 LHHA ‘disposed’ by survey households

For a number of specific items we analyzed the specific items more closely. From those results became clear that the respondents did not broadly speak of ‘waste’ that was ‘disposed of’ or ‘dumped’ but also (re)sold, repaired, given away, taken to rural homes or kept in store. Various terms were used during the interviews, such as Disposed, Threw it away, dumping, donated to scrap, gave out to private waste collection, Disposed to private waste collectors, throw in the garden to recycle decaying waste, Gave it out to scrap dealers, Repaired, Keep in store, still in the house, keep it in the garage , took it to rural area, Sold to Retailers, sold.

The results for these items is given in the following figures.

Clearly, much of what is ‘discarded’ is (re)sold, sometimes as scrap, sometimes to repair shops and other stores. Rather cheap appliances such as electric heaters are

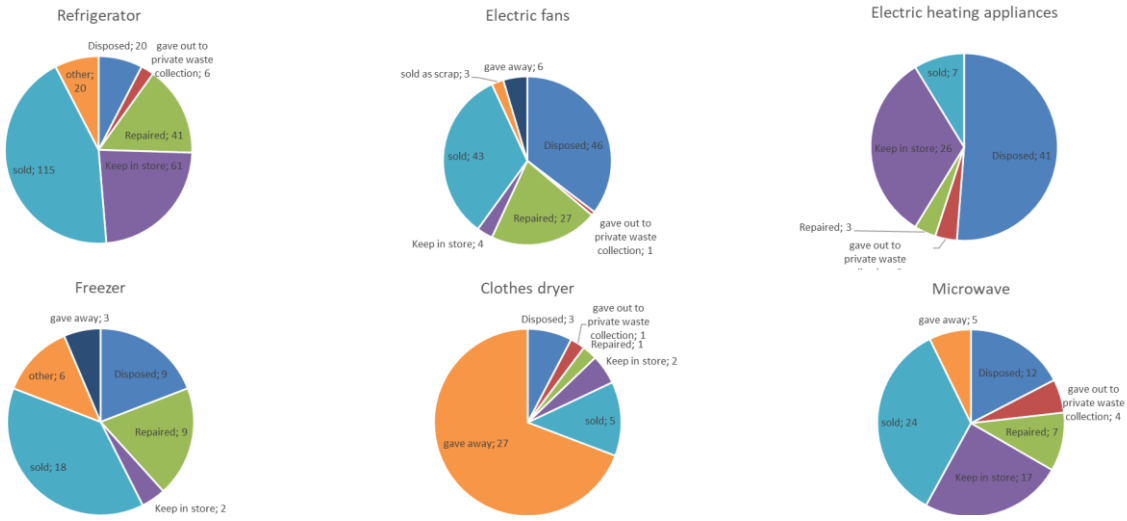

Figure 21 Different ways of 'disposal' of LHHAs

obviously used until they do not function properly and are probably of a dimension which makes disposal a popular step. Refrigerators are often kept or sold. Dryers are obviously in a decent state and are given away. These figures make it clear that dealing with LHHA not only concerns waste management but includes all Value retention processes, presented earlier.

The items mentioned as ‘threw away’, ‘disposed’, or similar expressions are presented again in Figure 21. Clearly, the relatively cheap products such as electric fans end up in dump sites or unsorted waste relatively often. Larger items are dealt with differently. The relatively long lifetime and the rather slow pace of technological development of these LHHAs are obviously the reason why many LHHAs are not seen as waste in the literal meaning of the word.

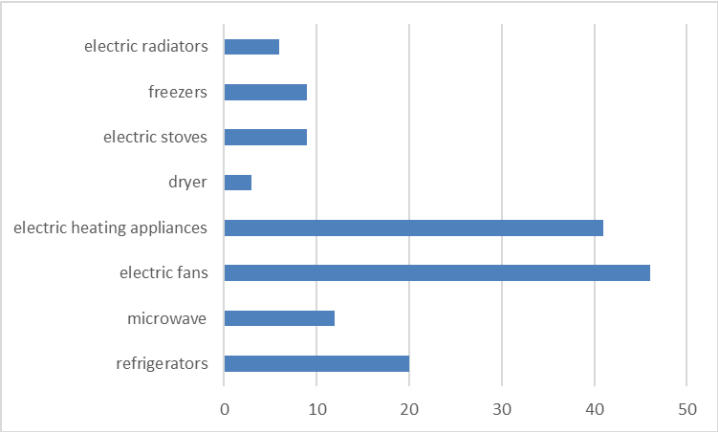

Figure 22 Waste LHHAs

5.1.3 *Appreciation of policies by households*

Though the absolute level of waste LHHAs is rather low, the respondents were asked about their opinion of the county waste management system.
The general satisfaction with that system is not very high.

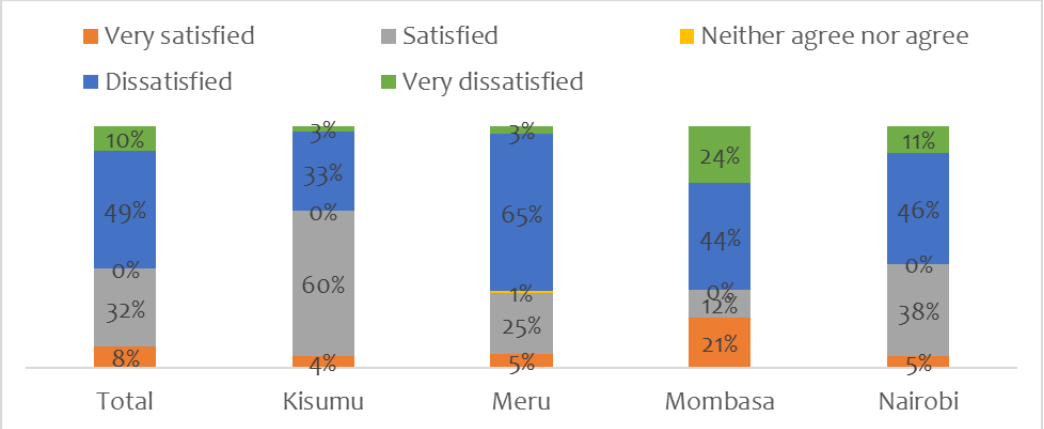

Figure 23 Level of satisfaction with waste management system

Though being rather dissatisfied, on average 37% of respondents (rather similar in all counties) stated they were willing to spend more on well-organized LHHA waste management.
In absence of effective waste management services by governments private companies step up in that space.

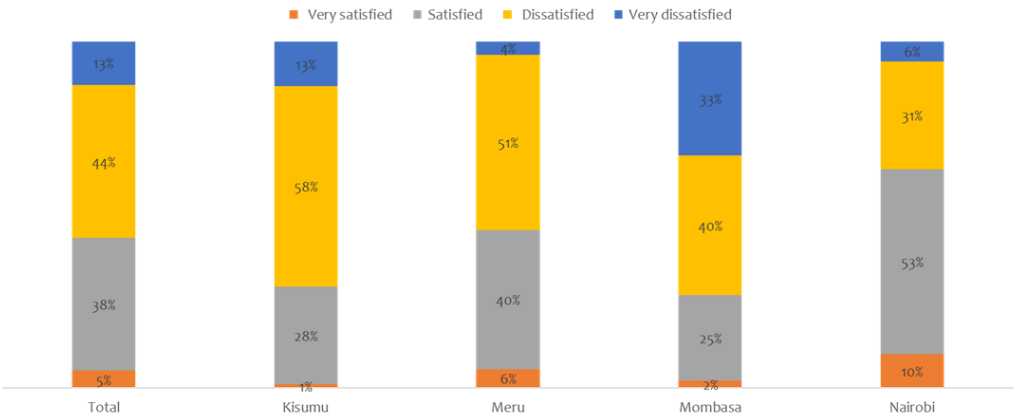

Figure 24 Level of satisfaction with private waste companies

The satisfaction level with private companies is obviously not higher than with government provided services.
The general satisfaction level with the informal waste sector is slightly higher: 50% of the population is satisfied with the services offered by this sector compared to 38% who are satisfied with the formal sector services. Probably, the flexibility of the informal sector service providers as well as the incentives they offer to households could be the leading factors to why the population is satisfied with their services.

The general knowledge of waste management policies is rather low (with Kisumu respondents the knowledge was only 7%), and where as two thirds of respondents did not see waste management being enforced only the majority (62%) of Mombasa respondents saw waste management enforcement being executed.

5.2 Survey among distributors of LHHA

5.2.1 Size and ownership of surveyed companies

In total 28 distributors and 4 repair companies of LHHAs (14 in Kisumu, 10 in Meru, 4 in Mombasa and 4 in Nairobi) were interviewed as well. Both in Mombasa, Kisumu and in Nairobi 2 companies had branche locations, and 3 in Meru.

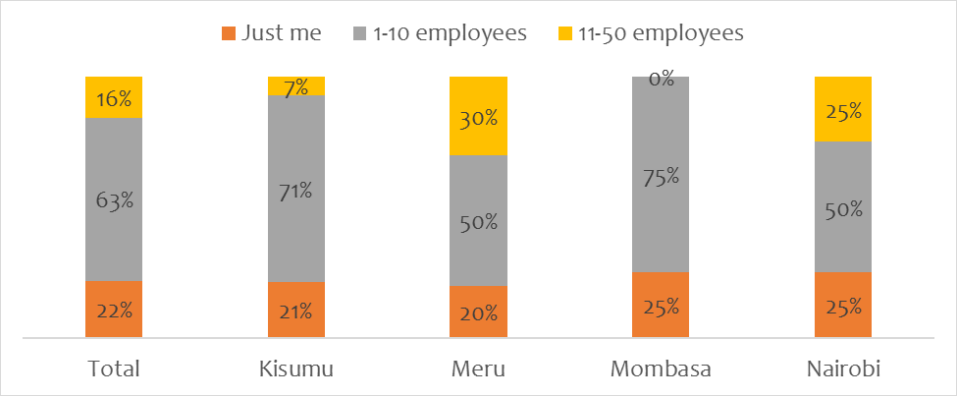

Figure 25 Size distribution of interviewed distributors

The distributors in Kisumu, Meru and Mombasa distributed most of the LHHAs that are subject of this study. The Nairobi distributors were more specialized.

The companies were very open about their turnover: the results are given in Figure 26.

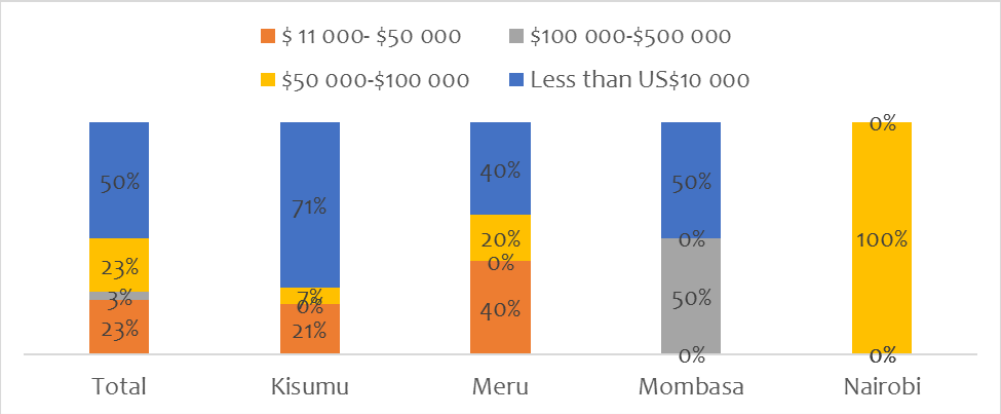

Figure 26 Turnover of survey distributors

Figure 27 shows the share of total sales of the LHHAs for these companies.

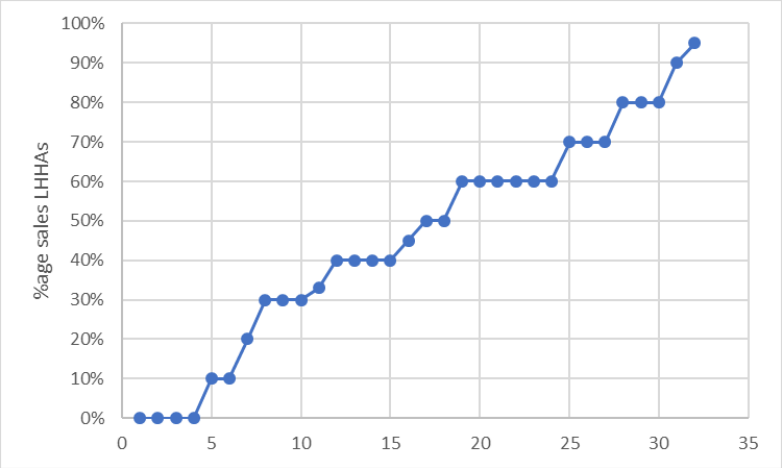

Figure 27 Share of LHHAs in total sales of interviewed companies

5.2.2 *'Circular' business models*

Though the companies are primarily established for sales of products, 20 companies are engaged in repair activities and 8 in refurbishment activities.
11 Companies claim to be involved in the recycling supply chain by a.o. handing in electronics to recyclers.
Companies who are involved in repair activities make the following statements about their involvement:

- because customers prefer a long lasting appliance
- it is part of the after sales services
- due to high demand from customers
- to give service to our customer for a bit longer time
- to enable our clients to get quality products
- to help out the consumers and create a good relationship with them
- manage our environment to be a free LHHA waste zone
- I want a clean eco system
- by making available the spare parts required for replacement
- buying used products that can be still be fixed or refurbished of LHHA

Making such observations, distributors demonstrate being active 'circular' entrepreneurs, though only a minority would call it that way.

Most companies believe their customers would be interested in purchasing refurbished LHHAs (Figure 28).

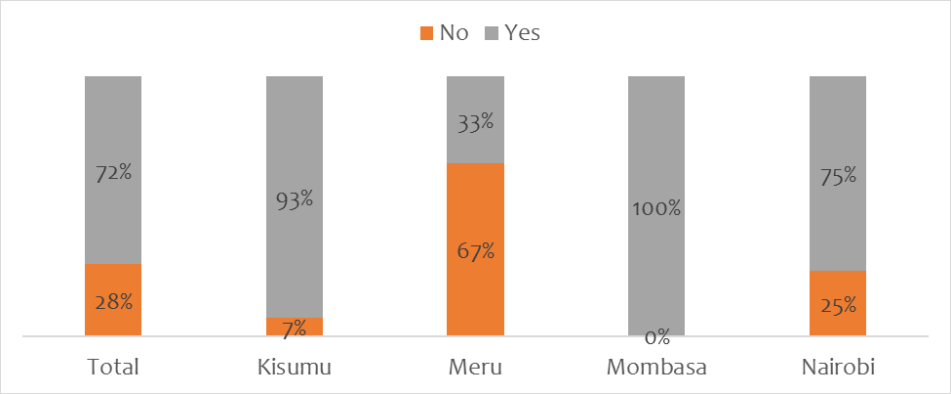

Figure 28 Supposed Customer Interest in purchasing refurbished goods

All companies refer to the price differences between new and refurbished goods as main incentive for their customers ("consumers like refurbished LHHA because they are cheap and even durable").

Distributors was also asked what they would do with LHHA if it becomes waste while still within their ownership (e.g. broken down)? Almost all companies indicated that they actively searched for solutions for either proper disposal of for creating business; the following actions were indicated:

- call (formal or informal) recyclers to take them at an agreed cost (or for free)(9)
- repair them to gain some income (5)
- send them back to manufacturers unless the business contract does not cover that (5) or send it to the service centre
- store for future action (3)
- sell to repair shops (2)
- dispose to county government collectors

Most (20) distributors acknowledged that they could collaborate with workers from the informal sector to organize end-of-life LHHA management. If asked how this collaboration could take shape, the following answers were given:

- create job opportunities for them (3)
- by forming centres to become the collecting station (3)
- to educate people on how to manage LHHA after the break down (3)
- use the size of the informal sector (much bigger than formal) to help in reaching out to customers (2)
- by selling the end of life LHHA to scrap collectors (2)
- exchanging contact and making agreements
- as 'supplier' for second hand equipment for repair
- use their customer intimacy

From these arguments a picture of a positive relation between (formal) distributors and the informal sector emerges. They are partly considered as part of the value chain both upstream (in relation to customers) and downstream (in relation to scrap recycling).
Eight respondents state that they cannot collaborate with the informal sector: the reasons mentioned are the low reliability (3) and the perceived absence of connection with either collection points or recycling centers.

5.2.3 Distributors and their opinion about policies at national and county level

Companies were asked about the responsibility that various stakeholders should bear. For the national government the following responsibilities were suggested:

- provide LHHA waste collection points (8 x)
- ensure that they have a strategic plan and policies (6 x)
- support companies dealing with LHHA waste management (3 x)
- championing for the proper channel of recycling (2 x)
- should give information and training for its citizens
- they should train on handling the LHHA
- Enabling the importation of spares to be more easier
- should ensure standardization of items

Only half of the companies stated that the government already executed these responsibilities.

Some distributors experienced that county governments don't deal specifically with LHHA waste management but only with other waste and that they may be more active in ensuring that appliances are collected properly and taken to the right people.
Nine distributors (from Meru and Kisumu) acknowledged that county governments already took their responsibility with respect to setting up proper disposal, collection, creating awareness and policies.

The companies were also asked to identify the main barriers they experienced that negatively affect collection of end-of-life LHHA and the proper processing.

Table 5 Main barriers in the eyes of distributors

Policy/legislation	**Technological**	**Capacity development and awareness**	**Business model**
implementation of policy (4)	difficult to understand the new technology	properly trained personnel	Inadequate supply chain
Lack of policies (3)	frequency in the exchange of new products in the market (4)	Awareness with customers (2)	business should comply with government regulation on LHHA waste management
lack of government support	Absence of good technology to manage e-waste	informing people on good disposal practices (2)	the current models do not accommodate collection and processing LHHA
	some parts may not be available in the market while doing repairs	Instruct people on good practices	

5.3 Survey among repair sector

5.3.1 Size of surveyed repair companies

In total 48 repair companies were interviewed evenly distributed over the 4 counties.

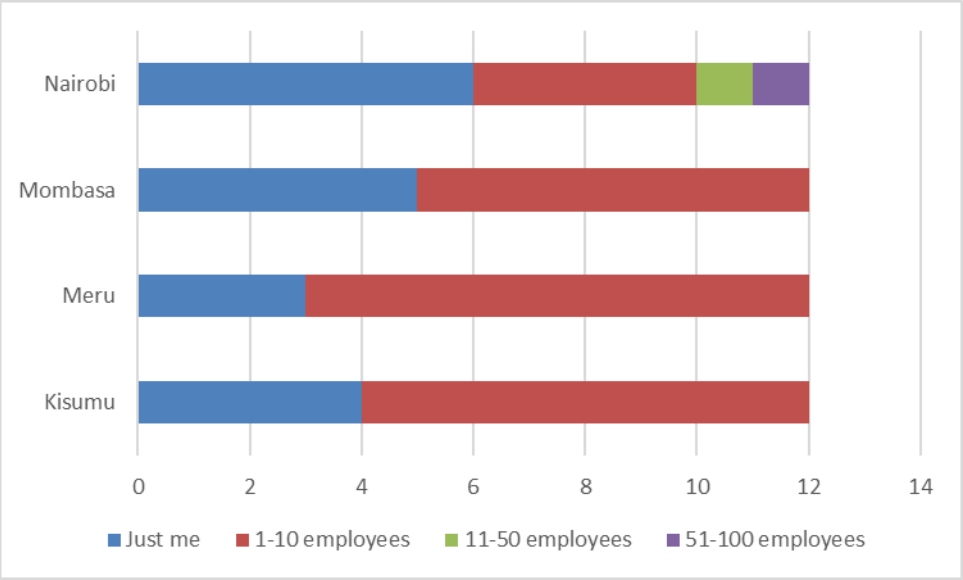

Figure 29 Repair companies in the survey

These businesses are fully or partly dependent on income from repairs. A minority (average 20%) indicated that their repair activities did not concern LHHA but electronic devices. Others were involved in e.g. television, radio and computer repair.

Figure 30 shows the estimated annual profit from repair activities.

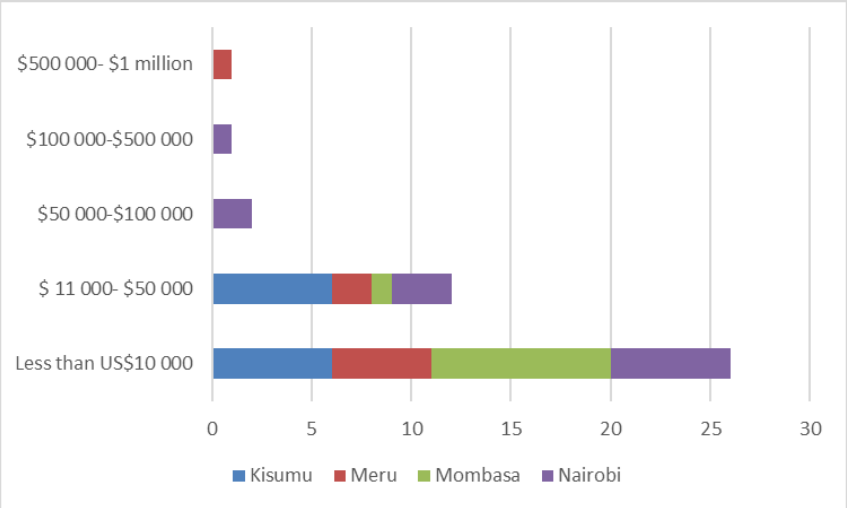

Figure 30 Annual income from repair activities

5.3.2 What gets repaired (and what not)?

The survey has retrieved which specific items were repaired and which parts of those items could and could not be repaired. This information provides valuable insights in the opportunities and hurdles to stimulate repair businesses further.

34 Repair shops were willing to disclose how the items to be repaired by them reached their premises. The majority of goods arrived at the repairer by client drop-off: for 15 repairers this was the main route with some claiming a 100% through client drop-off. Collection points were used less: 8 companies mention them as a source with a maximum of 50% of goods delivered through this route. Further, a significant percentage of LHHAs were collected at homes of clients: for 15 companies (and three even exclusively) this was a main route for obtaining goods. 11 Companies also performed repairs at the clients home (30% on average with a maximum of 90% repairs at clients premises).
This wide variety of routes through which repair items arrive at the repairer shows that there is no clear case for centrally organised collection points. The 'logistics' of repair goods will be correlated to the nature of the LHHA: large stoves, dishwashers and refrigerators will be difficult to move and will receive repair at clients' premises; smaller items like fans and small heaters will be easily brought to the repair shops.

Figure 31 shows the number of items that were repaired by 33 of these companies (7 companies lacked the competences and were more specialized in computers and television sets).

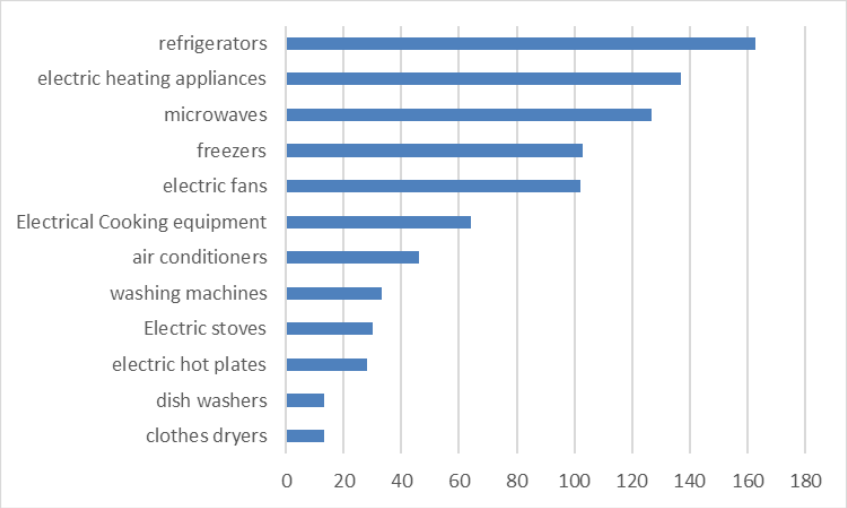

Figure 31 Number of items repaired by interviewed companies

The number of repaired items varies between less than 10 to 99 items. The survey results do not unambiguously show that these numbers correlate to revenues from repair.
Again, refrigerators show up as items that are most often repaired by these companies: not only were they by far the most purchased item (see Figure 19), but they also represent a rather costly item that makes repair a likely and desirable activity.

Respondents was also asked which components of these items could or could not be repaired. The results of this query for the 5 most popular LHHAs is given in Table 7. Remarkably, similar items show up in the columns that could, or could not be repaired. See for instance the occurrence of ‘compressor’ under the heading of ‘refrigerators’. Of course the failure status of the various components can vary widely, but the background may also lie in different levels of experience and competence, or on the availability of the right equipment or spare parts. Ideally, the repair potential should be similar among all companies, and various forms of capacity building might support that.

When components could not be repaired the general mode of action is to dispose of the items as waste or to sell to informal scrap metal pickers (see Table 6)

Action	
I just dispose them	16
dispose them at a local scrap shop	4
sold to informal pickers	19
kept for other use	6
take to another company	1
give to clients for disposal	2
send them to Nairobi for repairs	1
replace by new ones	3

Table 6 Responses to the question “What do you do with the parts you cannot repair?”

We have no insight in what items are disposed of and what are sold to pickers, but the general picture that emerges is that the commercial value of the LHHAs and their components leads to a proper route towards recycling or re-use.
In general the opinion about the cooperation with the informal waste pickers and their role in the system is very positive. Some of the following quotes were given:

- they reduces environmental pollution and help to clean up
- they collect the waste and bring to my shop to see if I can buy
- they always come to pick up waste that cannot be repaired
- they help release and create space for other appliances
- bringing the appliances to be repaired and buy the parts that cannot be repaired from me
- providing me with more spare parts and cheaper ones
- They always go and re-manufacture the parts
- they provide me with information of clients whose LHHA need repair and also bring them on their behalf

Table 7 Overview of components that could or could not be repaired

Refrigerator components, that ..				**Electric heating appliances Components, that..**				**Microwaves Components, that..**				**Freezers Components, that…**				**Electric fans Components, that**			
can be repaired		**cannot be repaired**		**can be repaired**		**cannot be repaired**		**can be repaired**		**cannot be repaired**		**can be repaired**		**cannot be repaired**		**can be repaired**		**cannot be repaired**	
all parts	2			all parts	3			all parts	3			all parts	2			all parts	4		
Compressor	5	compressor	9	heating element	2	heating element		magnetor	4	magnetor	3	evaporator coil	3	evaporators	2	the motor	4	motor	2
freon gas	3	gas parts	2	coils	2			cavity magnation		transformer	6	door		door inner		blades	2	blades	1
condensor	3	condensor		thermostat				door		timer	2	compressor		compressor	4	plugs	3	worn out bodies	
body		body	4	furnace		furnace		timer		surface panels		basket		expansion valve		winding		coil	2
door		feeler bulb		short wiring		short wiring		plates and cables		automatic buttons		hinge		diffuser		capacitors		switches	2
freezers		defrost system						electrical plates				cooler		interior		base			
electrical parts	2	interior						motor and coil				scale		old worn out body		fuses			
thermostat								metal plates											
filter								starters											
coil								fuse											
compressor fan								buttons/plates											
cooler								wave guide											
								heater											
								interface											

Many reasons were given why the items indicated in *Table 7* could not be repaired. Among the most often mentioned reasons are:

- lack of skills or technological capabilities (16 x)
- lack of spare parts (11 x)
- Discontinued production (2 x)
- too costly spare parts (5 x)
- lack of machines and technology (4 x)
- items are beyond repair, or not functional anymore (8 x)

As was suggested before in this section, the repairers themselves acknowledge a lack of adequate skills, technology and parts as the main reasons for not being able to repair LHHAs. Education, training and sharing information, technology and spare parts may support the repair sector. It are exactly these points that are brought forward by the repairers themselves. Besides that some repairers call for the manufacturers to take on more responsibility (“manufactures producing products with spare parts and spare parts should be available and easy to access”, “manufactures to produce repairable parts”).

6 Identification of current and future gaps

SIB-Kenya held a 2 hours roundtable meeting on the circularity of Large Household Appliances in July 2021, in which the project stakeholders had the opportunity to raise the main issues regarding the current situation regarding LHHAs waste management in Kenya. The factors raised during this meeting are a relevant starting point for the identification of current barriers. Also, a gap analysis was held in November 2021 in which both TNO and SIB-Kenya team members discussed the current and future gaps in the whole value chain of LHHAs in Kenya. The identified aspects were classified in three main groups: institutional/value chain, market and other.

The main outcomes of both events are summarized in Table 8.

Table 8 Summary of GAP analysis for current and future LHHAs management in Kenya

Category	**Issue**	**Comments/ Suggestions for further developments**
Institutional/ value chain	Inadequate Regulatory framework on e-waste	- EPR policy regarding e-waste is currently under development, it should include LHHAs
	No institutional arrangements at different levels to collect and treat LHHA waste	- E-waste collection infrastructure should be established all over the country, such as formal service to collect large equipment from households and presence of collection points for smaller appliances.
	No formal capacity building / knowledge sharing on how to refurbish/treat LHHA	-Central database for exchange of knowledge and spare parts amongst the repair shops could motivate stronger collaboration. -Workshops and formal training for informal workers regarding equipment inspection and refurbishment could improve the safety of these activities. These initiatives could be held in partnership with recycling companies and/or manufactures
	No formal interaction between sellers, recycling companies and repair shops	-Create awareness on the benefits of having the repair shops connected to recycling activities (e.g.: knowledge sharing, access to repair parts) -Manufacturers could provide guidelines for refurbishment activities and make access to spare parts easier
	Inadequate data on e-waste (generation rates, treatment rates and methods)	-A centralized data system where such information is collected, analyzed, and stored with ease access should be built
	There is the illegal and undocumented entry of e-waste into the country.	-E-waste collection infrastructure should be established all over the country coupled with awareness creation on available mechanisms and collection centers for E-waste.
Market	Lack of standard specifications for refurbished LHHA – lack of trust from the customer side	-Access to manuals/guidelines from manufacturers could help the repair shops to build trust - Creation of standards codes/guidelines for repair of LHHAs, in which when a certain appliance is refurbished following a specific guideline, it can be certificated and properly sold in the resold in the market

Category	Issue	Comments/ Suggestions for further developments
	Recycling costs vs recovered material value	-Single recycling facility that concentrates the steps that are done manually -Integrate the current infrastructure from the WEEE Centre to support the LHHA recycling activities -Plastic waste with no flame retardant can be sold back to manufacturers – recovery of high purity PP from washing machines can be done in other countries -Low volumes of collected waste increase costs for recycling facilities, therefore, the collection of e-waste should be centralized or streamlined to ensure that e-waste management enterprises can access large volumes of e-waste. -Informal waste pickers are an integral part of enhancing e-waste management, and they should be incorporated into the e-waste value chain.
	Current low volumes of LHHAs in certain regions can make the business case difficult	-Recycling facility can have formal connection to refurbishment shops to receive the appliances that no longer can be re-use/refurbished -This can be supported by creating a guideline on LHHA inspection to check whether the equipment can be re-used or should go to recycling.
Other	Households do not have a motivation to give their used appliance to recycling or refurbishment shops	Incentives could be provided via • a take-back system in which someone delivering e-waste should be awarded 5% of the value of the product, or • consumers are given a discount when buying a new appliance if they return the old one
	There is low awareness amongst consumers on what to do with LHHA waste.	-There should be awareness creation initiatives to sensitize consumers on different aspects of e-waste management, including available collection points and improper e-waste management. Efforts in communication channels are relevant for this implementation. -Involve the manufactures and importers in this activity (information on how to handle properly the material could come when the appliance is distributed).

7 Key results and a way forward

The economic development of Kenya will undoubtedly lead to an increase in the 'consumption' of electric and electronic equipment (EEE) (among which fall the large household appliances LHHA) and consequently also to a rise in WEEE, waste from EEE. But the absolute level of LHHAs in society and therefore also the absolute level of discarded or otherwise end-of-life LHHAs is still rather low. The high value that LHHAs represent for consumers has resulted in an active repair sector and (partly) connected informal sector, that fulfills an appreciated function in dealing with goods and materials that are beyond repair.

Without being actively aware, households, distributors and (almost by definition) repairers already demonstrate circular behavior. Households stick to their equipment, invest in repair activities and either give away or sell equipment that is no longer in need. Distributors play an active role in refurbishing equipment that can be re-sold to the public. It are precisely these activities in combination with the economic circumstances in Kenya that lead to a rather 'circular' behavior of societal stakeholders. One of the challenges will be to maintain such behavior once economic conditions improve.

Though value retention processes (VRPs) are actively pursued, all stakeholders acknowledge the fact that national and county government should play a more active role in implementing and enforcing regulations and mechanisms that increase circularity of EEE by, for example, investing in skills for repair, providing incentives for value retention processes, establishing modern infrastructure that encourage segregation of waste for better management of e-waste and enacting specific laws for e-waste management which is lacking at the moment. The implementation of an EPR on LHHAs (with as a consequence the financial potential that may result) in 2022 may become an important driver for such changes. Such funds may be used for the much desired capacity building and for additional incentives for consumers to deal with worn out products more consciously.

The repair sector (and the connected informal waste sector) plays a crucial role in the circular infrastructure. The scale of the enterprises is generally small which hampers investments in equipment and knowledge building. From a business point of view, it will be advantageous to either increase volumes or (with the same goal) stimulate more intense cooperation between players in the value chain. This not only calls for collaboration among all stakeholders from the informal sector to the formal sector, but also for cooperation between and among counties, especially now that waste management is a responsibility at county level.

Kenya is still grappling with e-waste data gathering and processing. In the era of data revolution where data is considered as the most critical currency for development, stakeholders might be convinced to work together more closely to consolidate data. Increased transparency with respect to available spare parts, available capacities and repair and test equipment may lead to an interesting cooperation and business model for the sector.

Over the last few years, there has been an improvement in adoption and scale of sustainable e-waste treatment option including recycling, refurbishment,

remanufacturing and re-sale. Rudimentary techniques of managing e-waste are still widely used including manual disassembly of WEEE without concern of the hazardous chemicals, heating printed circuits boards (PCBs) to recover solder and chips, melting and extruding flame-retardant plastics and burning plastics to isolate metals. With respect to LHHAs especially cooling devices require special attention: international regulations that also Kenya has adopted, require specific technologies to deal with cooling agents (freon) in a way that does not harm the environment. The investments required for such end-of-life treatment will also benefit from an increased scale of the operations.

A Implementation plan

Activities		Lead	Deliverables		2021-2022											
					1	2	3	4	5	6	7	8	9	10	11	12
#	Description		Output expected (draft and finals)	Delivery date	May	Jun	Jul	Aug	Sept	Okt	Nov	Dec	Jan	Feb	Mar	Apr
1	**Output 1: Development of implementation planning and communication documents**															
1.1	**Prepare a detailed work plan for all activities, deliveries, outputs, deadlines and responsible persons/organizations and itemized budget to implement the Response Plan. The detailed work plan and budget must be based directly on this Response Plan**	TNO														
1.1.1	Review the CTCN work plan template	TNO		20-4-2021												
1.1.2	Complete the work plan template based on the Response Plan	TNO	Detailed work plan	20-4-2021												
1.2	**Based on the indicators listed in the Closure & Data Collection Report (Activity 1.4) , prepare a monitoring and evaluation plan with specific, measurable, achievable, relevant, and time-bound indicators used to monitor and evaluate the timeliness and appropriateness of the implementation**	TNO														
1.2.1	Review the CTCN monitoring and evaluation plan template, define impact indicators	TNO		10-5-2021												
1.2.2	Complete the monitoring and evaluation template based on the workplan	TNO	Monitoring & evaluation plan	15-5-2021												
1.3	**Prepare two-page CTCN impact description formulated in the beginning of the technical assistance and to be updated/revised once the technical assistance is fully delivered**	SIB-K														
1.3.1	Review the CTCN impact description template	SIB-K		15-5-2021												
1.3.2	Complete the CTCN impact description template	SIB-K	CTCN impact description	20-5-2021												
1.3.3	Update the CTCN impact description template once the technical assistance is fully delivered	SIB-K	Updated CTCN impact description	14-4-2022												
1.4	**Complete a closure and data collection report at the end of the technical assistance**	TNO														
1.4.1	Review the closure and data collection report template	TNO		10-5-2021												

Activities		Lead	Deliverables		2021-2022											
					1	2	3	4	5	6	7	8	9	10	11	12
#	Description		Output expected (draft and finals)	Delivery date	May	Jun	Jul	Aug	Sept	Okt	Nov	Dec	Jan	Feb	Mar	Apr
1.4.2	Complete the closure and data collection template based on the output reports of the study	TNO	A closure and data collection report	15-4-2022												
2	**Output 2: Status quo analysis of the management of large household appliance waste in Kenya**															
2,1*	**Kick-off meeting for the presentation of technical assistance with the different stakeholders**	TNO														
2.1.1	Identification of important stakeholders and introductory KO meeting	TNO		22-4-2021												
2.1.2	Meeting report & List of Participants of the kick-off meeting	TNO	Meeting report & List of Participants	26-4-2021												
2.2.*	**Analysis of the current activities and infrastructure for the management of large household appliance waste**	SIB-K	Evaluation report	1-8-2021												
2.2.1	Analysis by (primary and secondary) data collection with stakeholders of the current activities and infrastructure for the waste management of LHHA	SIB-K		1-8-2021												
2.2.2	Interviews with key stakeholders	SIB-K		1-7-2021												
2.3	**Characterization, quantification and forecasting of large household appliance waste by secondary data collection and complemented by primary data research**	TNO	Report	1-9-2021												
	Validation of types of LHHA															
	Define sources of LHHA waste															
	Collect data on sources, quantities and treatment															
	Establish yearly forecasts on waste quantities															
2.4	**Identification of current and future gaps along the waste value chain of large household appliances in Kenya**	SIB-K	Report													
3	**Identification and definition of activities for an improved waste management infrastructure for large household appliances**															
3.1*	**Identification and evaluation of international best practices in terms of processes and infrastructure for the management of large household appliance waste**	TNO	Report presenting the identified international best practices for LHHA	1-11-2021												
3.2	**Development of recommendations for an improved waste management infrastructure for large household appliances**	TNO	Report on recommendations on waste management infrastructure for LHHA in Kenya	1-11-2021												

Activities		Lead	Deliverables		2021-2022											
					1	2	3	4	5	6	7	8	9	10	11	12
#	Description		Output expected (draft and finals)	Delivery date	May	Jun	Jul	Aug	Sept	Okt	Nov	Dec	Jan	Feb	Mar	Apr
4	**Output 4: Identification of opportunities for a circular waste management infrastructure for large household appliances**															
4.1	**Identification and analysis of best practices for circularity of large household appliances**	TNO		1-1-2022												
4.2*	**Market analysis for the adoption of identified best practices for circularity of large household appliances**	SIB-K		1-1-2022												
4.3*	**Stakeholder meeting on identified circularity opportunities**	SIB-K	Presentation & meeting on identified best practices	1-1-2022												
5	**Output 5: Development of an action plan and conceptualization of a pilot project for an improved and circular waste management infrastructure for LHHA**															
5.1*	**Development of an action plan for an improved waste management infrastructure for large household appliances**	TNO	Roadmap for the prioritized waste stream	1-4-2022												
5.1.1	Description and roll-out plan of identified activities	SIB-K		1-2-2022												
5.1.2	Timeline for the activities			1-2-2022												
5.1.3	Stakeholders to be involved			1-2-2022												
5.1.4	Action plan report including budget plan and financing mechanisms			1-2-2022												
5.2	**Concept for a pilot project to increase circularity of large household appliances**	SIB-K	Business plan	28-2-2022												
5.2.1	Define economic activities and/or production process			1-2-2022												
5,2.2	Identify stakeholders and existing productive and technological structures in order to create partnerships			1-2-2022												
5.2.3	Identify local public and private bodies that are already developing or are interested in developing the pilot project			1-2-2022												
5.2.4	Estimate costs (Capex and Opex)			1-3-2022												
5.2.5	Analyse of economic, environmental, social and regulatory benefits			1-3-2022												
5.2.6	Estimate the contribution to the identified gaps under Activity 2.4			1-3-2022												
5.2.7	Establish performance indicators to track and measure progress and compliance of the pilot project			1-3-2022												
5.3*	**Establishment of communication material**	SIB-K	Material for communication and the final presentation of the results to the NDE, the	1-4-2022												

Activities		Lead	Deliverables		2021-2022											
					1	2	3	4	5	6	7	8	9	10	11	12
#	Description		Output expected (draft and finals)	Delivery date	May	Jun	Jul	Aug	Sept	Okt	Nov	Dec	Jan	Feb	Mar	Apr
			project proponent and other participating stakeholders													
5.4*	**Presentation of the final results**	TNO	Meeting report & list of participants	15-4-2022												
					May	Jun	Jul	Aug	Sept	Okt	Nov	Dec	Jan	Feb	Mar	Apr

B Ethical considerations

The project sought ethical approval from all relevant authorities and stakeholders to conduct data research. They included permission to consult married women, youths staying with parents, at household level and relevant government departments and waste enterprises. The purpose of the study was explained including procedure for data collection and handling. Information confidentiality were explained and adhered to. No person was allowed to access raw data except the project team members. All the findings and presentations were shared with CTCN/ NDE.

a. The informant's approval: The most important principal concerns the informant's approval, which implied that the informant had to volunteer to become involved in the research process, and had the right to be informed about the aim of the study. In addition, the informant had the right to interrupt their involvement in the research process. This contributed to ensuring that the informants have control over their own participation in the research process. Therefore, a written consent was issued to the participant prior the interview, to read and sign where necessary. The researcher fully explained the details of the information in the consent form in the preferred language by the participant.
b. Confidentiality: The principle of confidentiality aims to secure that the information given by the informants is kept confidential. The researcher was therefore, preserve an informant's anonymity if the informant so requests. In addition, the information obtained was not shared with unauthorized persons and when it is no longer necessary to keep it, the information was disposed- off in accordance with TNO information disposal principles. Computer equipment used was used to keep security software up to date to protect against malware, viruses and hackers.
c. Consequences: The third ethical principle involves the consequences the research can have for the informants. Those who took part in the research process were not exposed to physical or social embarrassment. It was therefore important that the researcher does not ask the informant's questions that are too probing or lead to problems for them after the research. The interviews were therefore, arranged in a manner that preserves the informant's integrity and dignity, where the researcher takes the informant's evaluations, motives and self-respect into consideration (Touitou et al., 2004).
d. Accountability – the team demonstrated accountability and transparency in regularly disclosing with stakeholder's progress in implementing the research, where necessary.
e. COVID19 compliance – the study took into account and observed all COVID-19 restrictions so that the respondents and the public are not put in danger. Therefore, where face to face contact was employed, face masks were worn correctly; hands were washed and sanitized regularly and social distancing measures was employed. Where a respondent or company was not comfortable with attending face to face meetings, virtual meetings were arranged. No unnecessary risks were taken.

f. Inclusion – the study ensured inclusion of all necessary respondents and put additional measures where necessary to ensure this inclusion happens. Inclusion of women and men was ensured and times and/or meeting places or modalities adapted to ensure that both sexes participate in the research study. Inclusion also meant availing both face to face meetings and virtual meetings for respondents and offering respondents a choice based on their preference.
g. Child protection – where necessary and if contact had to be made with minors, for example, in cases where minors are engaged in waste management practices, due care to protect the minors' identity, or other issues in line with Child Protection issues were followed. No photographs were taken without express and written consent of the minor's parent or guardian. Interviews, if necessary, were done in the presence of the minor's parent or guardian. No gifts were given to encourage giving of information and participation in this study was entirely on free will.

C Consulted stakeholders

Stakeholder group	Key stakeholders	Interest	Influence
National Government	• Ministry of Environment and Forestry (MoEF)	High	High
Government departments and agencies in the environment sector	• National Environmental Management Agency (NEMA)	High	High
Households	• 966 households	Mid	High
County Governments	• Nairobi Metropolitan Services (NMS)	High	High
	• Mombasa County	High	High
	• Kisumu County	High	High
	• Meru County	High	High
Companies- Producers and Distributors/sale	• Ramtoms, • Bose, • Hisense, • BRHUM, • Hotpoint, • ARMCO, • SHARP, • BEKO, • MIKA. • Orient, • SAMSUNG, PHILIPS	Mid	Low
Companies (Companies dealing in e-waste recycling)	• WEE Centre, • Sintmund, • Niko Green, • T3, • Close the Gap,	High	High
Repair shops (formal and informal)	• 48 repair shops	Mid	Mid
Civil Society Organizations (NGOs, CSOs, CBOs)	• 18 Civil Society Organizations, among which E-waste Initiativ • e Kenya (E-wik), • Niko Green, • Komb Green, • WWF	High	Mid
TOTAL			

a)

QUESTIONNAIRE

Development of an action plan to improve the circularity of Large Household Appliances (LHHA) in Kenya.

INTRODUCTION

The Ministry of Environment and Forestry and Kenya Industrial Research Development Institute, the National Designated Entity of Kenya, in partnership with the Dutch Research Institute TNO and Sustainable Inclusive Business (SIB-K) with funding from the Climate Technology Centre & Network (CTCN), are conducting an assessment to develop an action plan to improve the circularity of large household appliances in Kenya. For this study, we value your input as important.

The circular economy is an economic system aimed at ensuring efficient use of resources, maintaining the value of products and materials for as long as possible, thereby minimizing waste. A first step in moving towards a circular economy is to improve current waste management, reducing the amount of landfill, incineration and dumping, and working towards recycling of waste streams. Developing a more circular waste system is ultimately aimed at reducing the negative impacts of waste on the environment and health, and improving the livelihoods of workers involved. To assess the potential for a more circular e-waste sector it is important to understand each aspect of the e-waste system as it is now and the needs and desires of the parties and people involved. The government, private sector, academia and civil society, play an important role in this as e-waste creators but potentially also contributors to a more circular system. With this questionnaire we would like to better understand your perception towards LHHA waste and the circular economy.

Thank you for participating.

HOUSEHOLD QUESTIONNAIRE

Enumerator's Name: ……..

Enumerator's contact: ……..

Date: ……

1. Respondent Number (e.g. 1,2,3): ……
2. Contact Details
   a) County:
   b) Subcounty:
   c) Ward: …
3. Number of people in the household…… Male Female ……
4. Age of the household head:
   a) < 16 years
   b) 17-25 years
   c) 26-35 years
   d) 36-50 years
   e) > 50years
5. Sex of the Household Head: Male/ Female
6. Educational qualification of the head of the Household
   a) Non
   b) Primary
   c) Secondary
   d) Certificate
   e) Diploma
   f) Undergraduate Degree
   g) Master's Degree
   h) Phd
   i) Other ……..
7. What is the average monthly household income (Ksh/Month) ……

LHHA WASTE OWNERSHIP

8. Do you have Large Household Appliances? Yes/ No ……
   a) If yes, tick where applicable and indicate the quantity

LARGE HOUSEHOLD APPLIANCES	**Tick all that applies**	**Quantity (Number of LHHA)**
Large cooling appliances		

Refrigerators		
Freezers		
Other large appliances used for refrigeration, conservation and storage of food		
Washing machines		
Clothes dryers		
Dish washing machines		
Electrical Cooking equipment		
Electric stoves		
Electric hot plates		
Microwaves,		
Other large appliances used for cooking and other processing of food		
Electric heating appliances,		
Electric radiators		
Other large appliances for heating rooms, beds, seating furniture		
Electric fans		
Air conditioner appliances		
Other fanning, exhaust ventilation and conditioning equipment		

LHHA WASTE GENERATION AND TREATMENT

9. How much Large Household Appliances Waste do you think you generated the past 5 years?

LARGE HOUSEHOLD APPLIANCE WASTE	QUANTITY	WHAT DID YOU DO WITH THE LHHA WASTE
Large cooling appliances		
Refrigerators		
Freezers		
Other large appliances used for refrigeration, conservation and storage of food		
Washing machines		
Clothes dryers		
Dish washing machines		
Electrical Cooking equipment		
Electric stoves		

	Electric hot plates		
	Microwaves,		
	Other large appliances used for cooking and other processing of food		
	Electric heating appliances,		
	Electric radiators		
	Other large appliances for heating rooms, beds, seating furniture		
	Electric fans		
	Air conditioner appliances		
	Other fanning, exhaust ventilation and conditioning equipment		
	TOTAL		

10. Do you separate your Large Household Appliances waste at household level? Yes/ No……
    a) If yes, how do you separate your LHHA waste?
11. If no, why? How do you dispose your LHHA waste?
    a) County government
    b) Private waste collection companies
    c) Informal waste pickers
    d) No collection, we dump it at illegal sites
    e) No collection, we dump it at legal dumpsites
12. Other, please specify How much are you currently spending on LHHA waste collection? (Ksh /month) ……

13. Would you be willing to spend more on LHHA waste collection if that means all waste is collected from your home on time and to the prescribed place?
    a) Strongly agree
    b) Agree
    c) Neither agree nor disagree
    d) Disagree
    e) Strongly disagree

14. What is your satisfaction level about the present LHHA waste collection system by county and why?
    a) Very satisfied
    b) Satisfied
    c) Dissatisfied
    d) Very dissatisfied

Why? What is your satisfaction level about the present LHHA waste collection system by formal companies and why?

    b) Very satisfied
    c) Satisfied
    d) Dissatisfied
    e) Very dissatisfied

Why?

15. What is your satisfaction level about the present LHHA waste collection system by informal companies and why?
    a) Very satisfied
    b) Satisfied
    c) Dissatisfied
    d) Very dissatisfied

Why?

POLICIES AND REGULATIONS

16. Which policies/ legal instruments related to E-waste management in Kenya are you aware of? And how are they implemented?
17. \In your opinion, are these policies/ regulations/plans/strategies enforced? Yes/ No …….

Elaborate: Why/Why not

CIRCULAR ECONOMY

18. Do you know about the circular economy concept? Yes/ No ……

    a) If yes how much do you know about circular economy?

☐ I am an Expert
☐ I understand the concept quite well.
☐ I know a little bit about the circular economy
☐ I am only aware that it exists but not what it entails.
☐ I didn't know, heard about it now

19. What do you see as the responsibility of the following in relation to the end-of-life waste management of LHHA

a) Academia
    i. Do they execute these responsibilities already? Yes/ No
    ii. If no why not? (what are the most important hinderances)
b) National Government
    i. Do they execute these responsibilities already? Yes/ No
    ii. If no why not? (what are the most important hinderances)
c) County Government
    i. Do they execute these responsibilities already? Yes/ No
    ii. If no why not? (what are the most important hinderances)
d) Recyclers ……
    i. Do they execute these responsibilities already? Yes/ No
    ii. If no why not? (what are the most important hinderances)
e) Manufacturers/Producers ……..
    i. Do they execute these responsibilities already? Yes/ No
    ii. If no why not? (what are the most important hinderances)
f) Distributors/Sellers……
    i. Do they execute these responsibilities already? Yes/ No
    ii. If no why not? (what are the most important hinderances)

GAPS/BARRIERS AND SOLUTIONS

20. What do you think are the gaps / barriers or challenges that affect circularity in the Large Household Appliances waste? (Please answer per theme)

    a) Policy/legislation ……
    b) Technological ……
    c) Capacity development and awareness ……
    d) Infrastructure …….
    e) Business (business model) ……..
    f) Other, explain …….

21. Which barrier (s) do you think is (are) most crucial? …….

22. What do you think should be done to enhance LHHA waste management in Kenya? (please answer per theme)

    a) Policy/legislation
    b) Technological ……..
    c) Capacity development and awareness …….
    d) Infrastructure ……..
    e) Business activities (business model) …….
    f) Other, explain ……..

23. Which solutions (s) do you think is (are) most crucial? …….