clasp

Efficient Appliances for People & the Planet

MECS Study on The Repair and End of Life of Electrical Appliances in Rwanda

This research has been commissioned and funded by MECS.

AUTHORS
This report was authored by Mike Ofuya and Shalom Mulinge. We would also like to thank Ruth Kimani, Monica Wambui and Michael Maina for their guidance throughout the study and review of the report.

DISCLAIMER

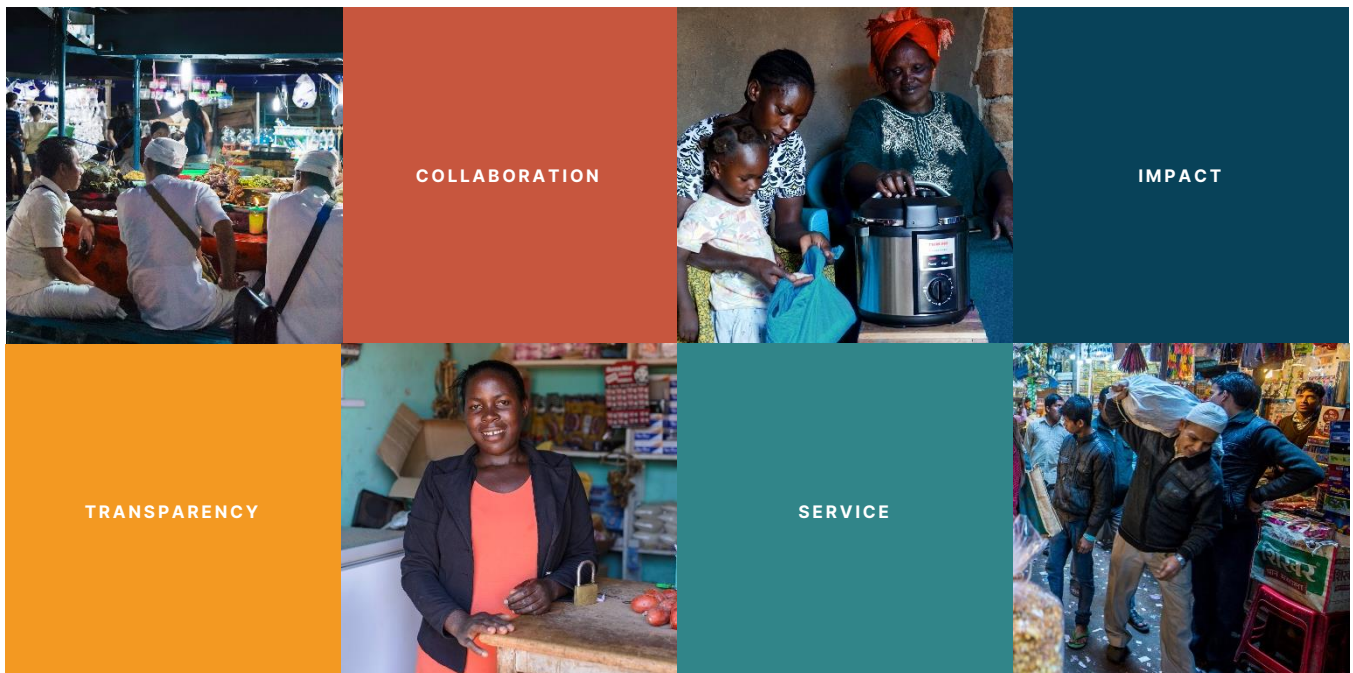**COLLABORATION**

IMPACT

TRANSPARENCY

SERVICE

Contents

Executive Summary

Appliances enhance living standards and have become indispensable to modern societies. Increased access to electricity, increased levels of disposable income, and growing urbanization are key contributors to the increasing number of appliances. Consequently, the amount of e-waste generated from these appliances is equally rising; leading to ever-growing urgency for their proper management and disposal given the potential health and environmental hazards they pose.

Loughborough University, through the Modern Energy Cooking Services (MECS) Programme engaged CLASP to conduct a research study on repair and end-of-life practices relating to cooking appliances in Rwanda. As the market for electrical cooking (e-cooking) products is only just taking off in many Sub-Saharan Africa countries, the study explored the end of life of televisions which have a relatively mature market as a proxy. The first stage of the research involved a contextual study and customer behavior survey to understand current behaviors and practices relating to appliance failure and end-of-life practices. Here, inclusive elements such as gender, income levels, and disability were included to ensure that nuanced data was collated. The second stage involved an end-of-life ecosystem mapping to identify a comprehensive range of stakeholders engaged in handling materials at all stages of end-of-life pathways, to assess the capability and capacity of each, to estimate materials flow volumes handled by each, to identify barriers constraining the operations of each, and to assess the awareness and influence of prevailing policies.

CLASP applied a systematic literature review process on academic, grey literature, media, local and national policy, and social media. We researched the different aspects of e-waste management in the country including collection and disposal i.e., recycling, repair, and refurbishment, take-back, and awareness raising. Review of the selected articles revealed that lack of policy enforcement, lack of consumer awareness, lack of technical expertise and limited recycling infrastructure were the main barriers to effective e-waste management in the country. The research also found that the country has a relatively developed e-waste management ecosystem but is mainly centered in the capital city of Kigali. An e-waste collection and processing site is located near Kigali and managed by Enviroserve Rwanda Green Park. It has the capacity to collect and process over 10,000 tonnes of e-waste yearly. Nonetheless, more consumer awareness needs to be executed to increase the collection rate of e-waste at the designated collection points across the country.

Initial findings from survey of households indicate:
- Majority have access to the national grid electricity (98%) with charcoal being the primary cooking fuel (55%)
- Most common appliances are mobile phones (94%) followed by lighting appliances (90%), radios (78%) and TVs (58%). Only 3% (microwaves) and 0.1 % (electric pressure cookers) of households own electrical cooking devices.
- Male heads were responsible for decisions on appliance purchases in most households (64%).

- Most households were unwilling to purchase used appliances (64%); with quality/durability/longevity ranked as the most important factor in guiding purchase decisions.
- Repair at local shops is the most preferred option (80%) for appliances that have failed. Male heads hold the decisions on action to take when an appliance fails (62%). Cost-effectiveness is the most important factor when determining actions to take when an appliance fails (62%).
- 61% of households rely on private waste management companies for the collection and disposal of their household waste, with the rest disposing their waste using local council collection and disposal companies, recycling and burning. The male head is the primary decision maker (43%) on waste disposal
- Of those that had disposed of their televisions, 61% did so together with their general household garbage.
- Many of the respondents believed their current waste disposal behavior was environmentally friendly. Of those that acknowledged their waste disposal behavior was not environmentally friendly, 54% were unwilling to change and use more sustainable ways.

Rwanda has made considerable progress in establishing regulations to set up a robust e-waste management system. Guidelines are in operation to regulate the import and trade of second-hand appliances, and to handle the collection and disposal of e-waste. Nevertheless, the country confronts limitations in enforcing appropriate regulatory frameworks. Interviewed stakeholders had limited awareness of the policies and regulations that had a direct effect on their enterprises. Moreover, there is inadequate information accessible regarding the influence of these regulations on appliance markets and e-waste value chains. This suggests that more actions are necessary to implement and enforce these regulations effectively. Furthermore, to establish efficient and comprehensive policies and regulations for e-waste management, it is essential to comprehend the products and by extension materials that enter and exit the ecosystem. However, in Rwanda, there is limited data on material flow. Only a few out of the 44 stakeholders that were interviewed provided sufficient estimates of the quantities they handle. This is attributable to concerns around data usage as well as the possibility of regulatory scrutiny and backlash. Additionally, efforts to identify referenceable quantitative studies were unsuccessful. Overall, this can be anecdotally linked the global e-waste documentation challenge which stood at 17.4% only according to the Global E-waste Monitor, 2020

A full understanding of the end-of-life (EoL) practices for appliances will contribute to the creation of sustainable frameworks that will not only support safe and proper disposal but also contribute to the greater circularity goal of better-designed products that last for longer, are easy to repair, and contain less hazardous materials. The aim of this report is to share the learnings from this study, to inform future efforts to address growing amounts of e-waste and advance the state of practice in the sector.

The report can find use across stakeholders involved in e-waste management including recyclers, investors, sector support programs and governments, each of whom has a crucial role to play in

ensuring that e-waste is responsibly managed. Based on the common barriers identified, our recommendations, as listed below, can also provide insight to policymakers, contribute to theory, and offer opportunities for future research.

- Robust awareness campaigns not only build awareness on the importance of proper e-waste management but also notify different stakeholders of solutions available to them. Awareness campaigns can be rolled out by different stakeholders and target different groups across the value chain. For example, recyclers can carry out a collection campaign to increase collection targets and notify users about existing collection points.

- Effective implementation and enforcement of e-waste regulations. Rwanda is already ahead of the curve with several adopted regulations and policies as well as a state-of-the-art treatment facility. To reap the benefits, we recommend financing schemes and incentives targeting the private sector and consumers.

- Systemic data collection- this system should target all players along appliance value chains, upstream manufacturers and importers, to downstream collectors and recyclers.

Introduction

1. Introduction
1.1. Project background

A wide range of electrical cooking appliances are becoming increasingly accessible and affordable to (predominantly urban) populations across low- and middle-income countries (LMICs). As these markets continue to attract the attention of appliance manufacturers and distributors, the MECS programme is working pro-actively to understand the economic and environmental implications of these trends in priority countries. The growing supply of (and demand for) modern cooking appliances will lead to an increase in the volume of waste, and e-waste, as products reach their end of life. However, it is preferable that appliances are not simply produced, sold, used, and disposed of. Value can and should be generated through circular processes of reuse, repair, and recycling of both components and materials.

This study explores the end-of-life ecosystem in Rwanda, as it should be applicable to modern energy cooking devices but drawing experience and expertise from the existing systems surrounding the end-of-life (EoL) of televisions. Unlike electrical cooking appliances, televisions have a relatively mature market, making them more suitable for deriving insights into end-of-life practices. This study generates a description and understanding of the ecosystem, how it works, what happens to products at each stage of their end-of-life pathway, and the associated impacts.

1.2. Research Objective

The primary objective of this study is to assess the end-of-life ecosystem of televisions in urban and rural environments in Rwanda. This is intended to act as a proxy for e-cooking appliances given their nascent market. The research includes:

- Contextual study and customer behavior survey – to understand current behaviors and practices when an item fails, what options are perceived to be available, what drivers lie behind actual behavior, and what barriers exist to more sustainable behavior that would extract value from failed devices.
- End-of-life ecosystem mapping – to identify the comprehensive range of stakeholders engaged in handling materials at all stages of end-of-life pathways, to assess the capability and capacity of each, estimate materials flow volumes handled by each, identify barriers constraining the operations of each, and to assess the influence of prevailing policies.

2. Research methodology: study set up and area, selection (maps)
2.1. Research Study Design

Data for this study was collected through literature review, household surveys and stakeholder/key informant interviews. The literature review was executed using a systematic approach with sources drawn from academic material, grey literature, media, local and national policy, and social media. Survey instruments were designed to capture information from households and stakeholders. A local research partner, Enviroserve Rwanda, was engaged to provide contextual understanding and to assist in the data collection process. Enviroserve is the largest collector, recycler and refurbisher of e-waste in Rwanda.

2.2. Literature Review

The literature review was executed using a systematic approach with sources drawn from academic material, grey literature, media, local and national policy, and social media.

An initial desk review was conducted to understand the policy and investment environment at local and national levels, as well as any obligations or agreements at an international level (recycling, waste and e-waste management and disposal). The review included policies, strategies, reports, protocols, regulations, studies, and other related documents. The research team also conducted desk-based research into standards relating to quality, materials, and performance (efficiency) of electrical cooking products, and standards relating to recycling and/or waste disposal. The team then mapped the list of stakeholders in the e-waste management ecosystem.

2.3. Household Surveys

The household survey instrument (See Annex) was structured to collect data pertaining to respondent background information, purchase attitudes and behaviors, appliance ownership and usage, appliance failure behavior and general waste and e-waste disposal practices. Within each of these key areas, the survey instrument was devised to investigate perceived available repair and disposal options, behavioral drivers, and barriers that hamper more sustainable disposal behavior. An inclusive approach was used to formulate the survey, with questions added to gather data on gender, income levels and disability. This would provide a deeper understanding of differences in appliance end-of-life perceptions and actions across surveyed groups. Data collected using this survey was primarily qualitative. Through collaboration with the research partner, the research team identified four focus areas for the study. These areas were selected to provide both an urban and rural context. They varied on electricity access, income levels, appliance ownership and infrastructural development[1], established from data in the 2022 Rwanda housing census results. This is summarized in Table 1 below.

TABLE 1: DESCRIPTION OF SELECTED REGIONS FOR DATA COLLECTION(RWANDA CENSUS DATA)

Name	Context	Household electrification rate	% urban households with monthly income FRW 100,000 (USD 91.26) and above	%households owning a TV	% agricultural households
Kigali	Capital City	90%	74%	36%	21%
Musanze	Provinicial City	63%	54%	13%	68%
Bugesera	Rural town	61%	_	13%	67%
Muhanga	Rural town	57%	58%	12%	80%

[1] Rwanda Population and Housing Census

The locations of each of the selected regions in Rwanda is shown in Figure 1.

FIGURE 1 SELECTED REGIONS FOR DATA COLLECTION IN RWANDA
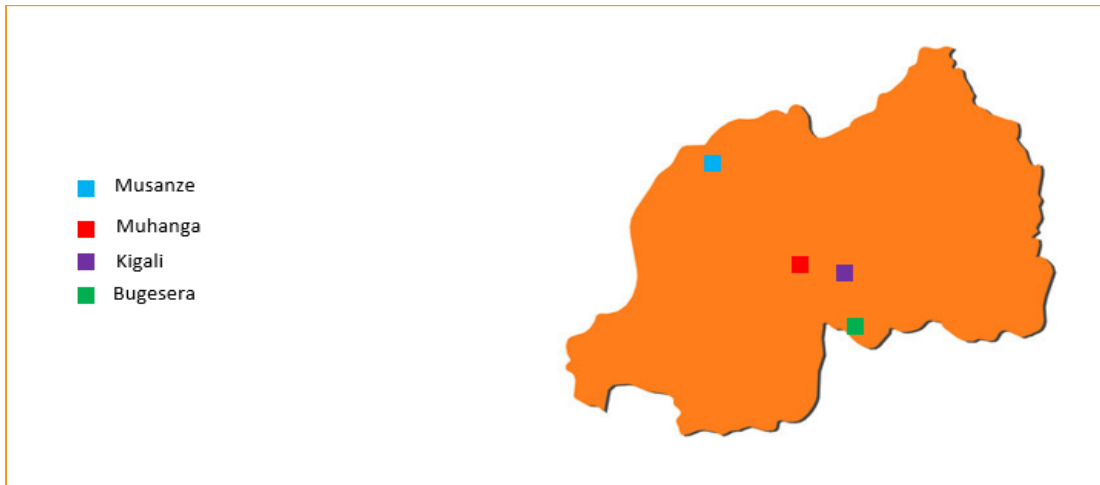
2.4. Stakeholder Survey

The stakeholder survey instrument was designed to cater for the different possible stakeholders within the e-waste management ecosystem. It was informed by findings and gaps from the literature review and research partner insights. This survey was devised to collect data on roles played by different stakeholders within the ecosystem, stakeholder behavior and attitudes, and stakeholder partnership and collaboration. It was also structured to aid in the development of a materials flow analysis by capturing data on quantities of appliances and electrical materials handled by each stakeholder. Moreover, questions relating to challenges faced by each stakeholder and barriers preventing more sustainable behavior were included. The stakeholder survey was administered in a hybrid manner, with virtual interviews carried out with government and multilateral stakeholders; and in-person interviews conducted with other players in the ecosystem.

NetMap for Stakeholder Ecosystem Mapping

The NetMap toolkit was used to map the interviewed stakeholders to help draw out and visualize the relationships, influences between the different actors and attempt to assess the strength of the connection across these two aspects. The inputs to NetMap factored observations, perceptions drawn from interactions with household and stakeholders as well as stakeholder categories. The relationships were chiefly determined and analyzed based on the roles and responsibilities of the actors in relation to the study topic. The assessment of the level of strength across relationships and influence was informed by situational analysis.

The influence rating in Net-Map methodology is a qualitative approach which is subjective, and context-dependent based on the perceptions and interpretations of the actors involved. It provides an indicative representation of the network and insights into the dynamics of influence rather than a precise calculated rating. This net-map approach is depicted in the figure below.
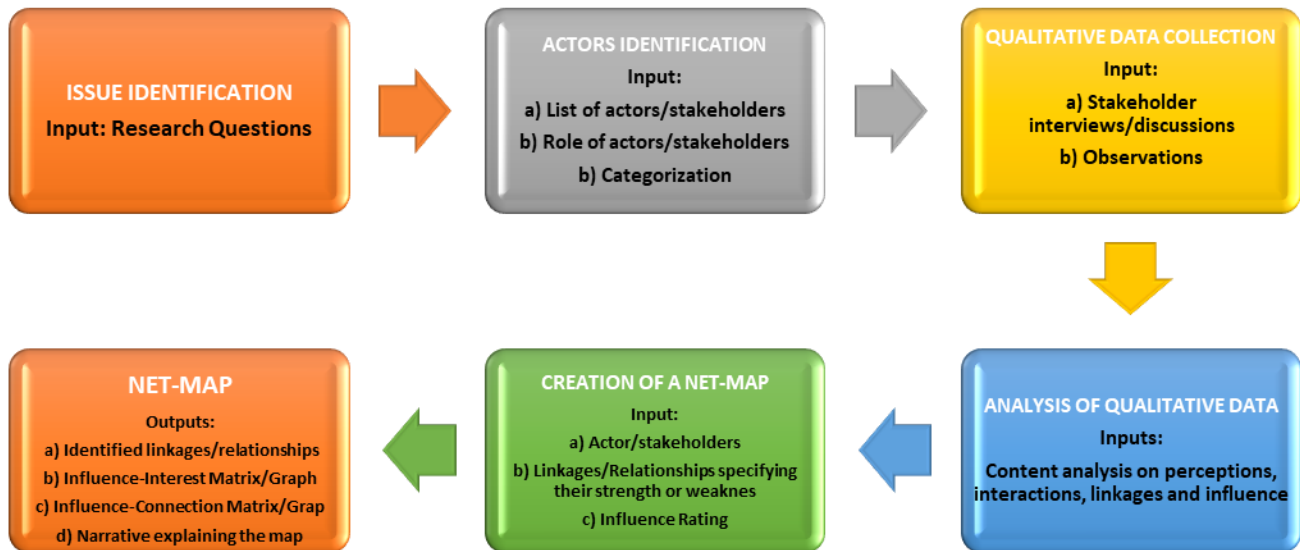
Figure 2:NET-MAP METHODOLOGY MAPPING STAKEHOLDERS INVOLVED IN PROPER APPLIANCE END-OF-LIFE AND E-WASTE DISPOSAL PRACTICES IN RWANDA. The linkages are mainly determined and analyzed based on the roles and responsibilities of the actors in relation to the research topic. Further, strengths and weaknesses of the links as well as actor goals are informed by situational analysis.

2.5. Research Sample Populations: Household Surveys

Rwanda's population is predominantly rural: 72.1% of the resident population (9,545,149 inhabitants) live in rural areas compared to 27.9% in urban areas[2]. With the understanding that household appliance ownership is higher in urban areas than in rural areas, this survey targeted a subset of these urban centers with representation from rural towns, a provincial city and Kigali, the capital city. Table 2 provides a brief overview of the number of households located in the study regions.

TABLE 2: SELECTED REGIONS FOR DATA COLLECTION (RWANDA CENSUS DATA)

Name	Context	Number of households (Rwanda census data)
Kigali	Capital City	286,664
Musanze	Provinicial City	84,756
Bugesera	Rural town	85,369
Muhanga	Rural town	75,207

[2] Rwanda Census

A simple random sampling method was utilized across the four locations to select the household survey respondents for the study. To calculate the ideal sample size, a confidence level of 95% and a margin of error of 5% were applied. The research partner screened neighborhoods in the selected regions based on electricity access to determine where to conduct data collection. Shown below is the total number of respondents interviewed at each location.

TABLE 3: HOUSEHOLD DATA COLLECTION SUMMARY

Location	Number of respondents
Bugesera	367
Kigali City	276
Muhanga	212
Musanze	266
Blank (country indicated but location not stated)	4
Total	1125

Household data referenced in this report was collected from a total number of 1125 respondents in Rwanda, from January 6th to January 12th, 2023. There was a wide degree of variability in demographics which brought forth differences in observed attitudes and behaviors towards appliance failure and end-of-life practices.

2.6. Demographic profile from Sampled Households

Most respondents were from the two rural districts (52%), followed by the provincial city (24%) and the capital city (25%). Table 4 summarizes the observed household characteristics.

TABLE 4: RESPONDENT PROFILE (DATA RELATING TO HOUSEHOLD CHARACTERISTICS N=1125)

Household Characteristics	Total
Gender	Male: 49.6% Female: 50.4%
Average age	35
Average household size	5
% Of households with person/persons living with disabilities	9.4%
Highest level of education attained by any person living in household	• Tertiary: 36.1% • Upper Secondary: 38.8% • Lower Secondary: 10.9% • Primary School: 9.7% • Never went to school: 4.0% • Don't know:0.5%

72% of the respondents indicated that their households earn below FRW 88,000 (USD 80.86) per month, followed by 18% of the respondents earning between FRW 88,001 and FRW 176,000 (USD 80.86-USD161.64). This was **replicated across all the selected regions with 71% of capital city respondents, 76% of the provincial city and 71% of the rural town respondents earning below FRW 88,000**. This means that majority of the households were earning less than the FRW 651.6 a day poverty line[3]. In 2021, Rwanda's population living under the international poverty line was 54%. This could be as a result of respondents misrepresenting their income levels. 33% of the respondents reported casual employment as their main occupation, followed by self-employment (30%) and no employment (24%).

36% of the respondents had at least one household member who had attained tertiary level education. This high proportion of people with a tertiary level education may be because of the survey being carried out primarily in urban centers and rural towns.

---

[3] Rwanda Poverty and Equity Brief

2.7. Research Sample Populations: Stakeholder Interviews

Key informant interviews were carried out with stakeholders across the waste management value chain, including retailers, collectors, repair shops, e-waste recycling companies and government institutions. These stakeholders represented the breadth of companies working in the waste management ecosystem operating in Rwanda. This range of stakeholders were targeted to give a holistic view on e-waste management and determine the stakeholders and facilities needed to maximize product value (and minimize waste and impact).

TABLE 5: STAKEHOLDER DATA COLLECTION SUMMARY

Stakeholder	Number
New Appliance retailer	11
Local repair shop	8
General waste collection/disposal	6
Appliance/appliance parts collector	5
New Appliance importer	3
Used appliance retailer	3
Recyclers	2
Materials recovery	2
Appliance Manufacturer	1
E-waste collection and disposal	1
Industrial scale refurbishment	1
Government Agency	1
Total	44

The survey team experienced challenges securing interviews with identified stakeholders. This is because most of the stakeholders were uncomfortable providing information regarding their businesses due to concerns about how the data usage and possible regulatory scrutiny and backlash. This in turn affected the target of 4 interviews per stakeholder group.

2.8. Data Quality Assurance and Analysis

CLASP carried out in-person enumerator training for Enviroserve on 5th and 6th January before formal data collection kick off. The training entailed:

- An introduction to the background of the study
- Data collection guidance; an in-depth review of the questionnaires.
- Introduction to ODK Collect tool (data capture and upload to online platform),

- Pre-testing of the survey instruments with a subset of households.

Data quality checks were carried out continuously as the data was uploaded by the research partner. Data cleaning and analysis was conducted immediately after the data collection process was finalized. Data cleaning involved checking for outliers, typos and other erroneous inputs which were either corrected or removed from the final analysis dataset.

Country
Outlook

3. Country Outlook
3.1. Electricity Access

According to Rwanda Energy Group (REG)[4], 50.9% of the Rwandan population had access to electricity through the national grid as of October 2022. Total installed on-grid energy capacity stands at 276.1MW, with households being the main energy consumers. With more than 82% (nearly 11 million) of Rwanda's population located in rural areas, more than 6 million people still lack access to electricity. The country has a target to achieve universal energy access by 2024.

The Rwandan government uses the SE4All's Multi-Tier Framework to define targets for electrification in its Rural Electrification Strategy (RES). This means Rwanda's universal access targets include off-grid solutions[5]. The Global Off-Grid Lighting Association (GOGLA) estimated that some 97,000 off-grid lighting products and 2,624 appliances (solar water pumps, refrigeration units, fans, TVs) had been sold in Rwanda between January and June 2021[6]of which TVs constituted 92% of sales.

TABLE 6: RWANDA DEMOGRAPHIC DATA (SOURCE: RWANDA ENERGY GROUP [1])

Rwanda	
Population	13,764,395
Access to electricity (% of population)	75.3%
Connected to the national grid	50.9
Off-grid connections (mainly solar)	24.4

From the household survey data, **it was established that majority of the respondents (98%) were connected to the main grid**. This was observed across all the selected geographical locations with almost all the respondents in the capital city (99%), the provincial city (98%) and the rural districts (97%), indicating that they had access to main-grid electricity. These findings contrasted with those derived from the literature review. This could be because surveyed locations were targeted based on higher levels of energy access, which was assumed to co-relate with increased possibility of ownership of electrical appliances. Table 7 below summarizes the two main energy sources for household respondents.

[4] Rwanda Energy Group
[5] Magalini, F. et al.: E-waste impacts and mitigation options in the off grid renewable energy sector (2016)
[6] GOGLA: Rwanda country brief

Indicator name	Results
Percentage of households with access to national grid electricity	98.0%
Percentage of households with access to solar power (solar home systems & rooftop solar)	0.8%

3.2. Clean Cooking Landscape and Appliance Ownership

3.2.1. Clean Cooking

Only 1% of households in Rwanda use clean fuel cookstoves.[7] The National Survey on Cooking Fuel Energy and Technologies in Households, Commercial and Public Institutions in Rwanda estimated that only 0.21% of households use electricity for cooking.[8] However, quite a number of electric cooking appliances already exist in the Rwandan market as shown below[9].

TABLE 8: COMMON ELECTRICAL APPLIANCES IN RWANDA[6]

Category	Appliances
Household	Blenders, coffee maker, deep fryer, electrical coil, electrical match igniter, electric oven, hotplates, induction stoves, kettles, microwave, rice cookers, toasters, electric pressure cookers (EPCs)
Commercial	Food mixers, ice cream maker, multicookers, panini makers (grill), popcorn maker, yoghurt makers

EPCs are nascent in the Rwandan market. Despite their relatively higher upfront cost, EPCs, particularly in East Africa, face the lowest barrier to adoption compared to other e-cooking technologies. They are highly desirable to consumers due to significant time savings and the ability to offer different types of cooking services in a single unit. Recent studies have shown that cooking with electricity is already cost-effective and the cheapest alternative in areas with low-cost grid connections (electricity tariffs below USD 0.35/kWh) and high charcoal cost (above USD 0.40/kg). By 2025, expected declines in battery costs, coupled with continued increases in biomass fuel costs, will also make electric cooking cost-effective for populations in off-and weak-grid

---

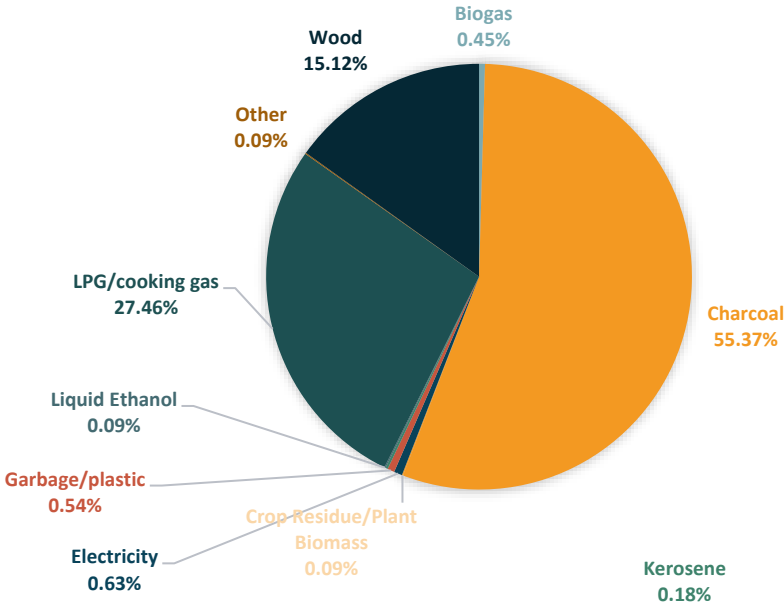[7] Development Bank of Rwanda, 2021
[8] MINIFRA & MINECOFIN, 2020
[9] The world's e-waste problem is being reckoned with in Rwanda, one gadget at a time | CNN

communities served by solar home systems and mini-grids.[10] Electric pressure cookers (EPCs) have entered the urban market– imported for local distribution - with Ewant and Nutricook being some of the locally available brands. Companies operating in the importation and distribution of EPCs include Electrocook, Neseltec Ltd, ARC Power (a private mini-grid developer looking to increase usage), and East African Power.

The Clean Cooking Results Based Financing (CC-RBF) scheme implemented by the Energy Development Corporation Ltd (EDCL) and the Development Bank of Rwanda (BRD) includes EPCs, rice cookers and induction cookers among the eligible clean cooking appliances. The scheme is co-financed by the World Bank's clean cooking fund through the Energy Access and Quality Improvement Project (EAQIP) facility.[11]

Household survey data painted a similar picture to the information drawn from literature on clean cooking in Rwanda. **Most of the surveyed households (55%) reported using charcoal as their primary energy source for cooking**. This was followed by LPG/cooking gas stoves at 27% and wood at 15%. **Only 0.6% of the respondents used electricity for cooking**. Regarding the use of electric appliances for cooking, few respondents indicated owning electric cooking appliances. 3.4% of surveyed households owned a microwave and **only about 0.1% owned an electric pressure cooker.**

FIGURE 2: PRIMARY ENERGY SOURCE/FUEL FOR COOKING (SOURCE RWANDA HOUSEHOLD SURVEYS N=1118)

Biogas 0.45%
Wood 15.12%
Other 0.09%
LPG/cooking gas 27.46%
Liquid Ethanol 0.09%
Garbage/plastic 0.54%
Electricity 0.63%
Crop Residue/Plant Biomass 0.09%
Kerosene 0.18%
Charcoal 55.37%

[10] EforA_Solar_Appliance_Technology_Brief_EPCs_July-2021.pdf (storage.googleapis.com)
[11] Development Bank of Rwanda, 2021

3.2.2. Appliance Ownership

ICT has been identified as an enabling factor for transforming Rwanda into an information society through initiatives such as e-government, e-education, e-health, e-commerce, etc. The country developed an ICT for Development (ICT4D) Plan, which recognizes the importance of ICT as a key driver for socio-economic development.[12] This growth in the ICT sector has a direct impact on the increase in uptake of electronics. Penetration of consumer electronics, such as TVs, radios, and mobile phones, in the country stands at 14.2% and is projected to reach 21.1% by 2027.[13] The quality of electricity supply also influences clean energy technologies and electrical appliance purchase, ownership, use and perceived value. Thus, with the country's aim to reach universal electricity access by 2024, one of the greatest implications will be acquisition of new appliances in households.

TVs are the most desired appliances among off-grid consumers after lighting products.[14] They are a critical driver of off-grid solar adoption in many markets and the most common motivation for existing solar home system customers with small systems to upgrade to larger systems. Global off-grid TVs sales are relatively high compared to other off-grid appliances. GOGLA affiliates sold 472,000 TVs in 2019, compared to just 8,200 refrigerators.[15]

Currently, like in most markets, appliances uptake is urban centric and gendered. Literature shows that Social Shaping of Technology (SST) and gender-related factors influence domestic appliance ownership since traditional appliances, like traditional cookstoves and charcoal irons, co-exist with modern appliances. SST points to a situation in which socio-political acceptance, community acceptance and market acceptance remain synchronized to promote appliance uptake.[16]

High ranking appliances for women are typically those that could serve as both household and productive use appliances and would likely be used in home-based businesses. The appliances with little gender deviation are those which could also be used in home-based businesses, perhaps due to the traditional view of women as home keepers and men as wage earners. According to a market survey by CLASP in 2020, rrefrigerators and sewing machines emerged as more impactful for women, while hand power tools and mills/grinders were more important to men. This shows that use and impact of appliances is gendered, as there were significant differences between the appliances ranked higher by women and those ranked higher by men in terms of their perceived impact. Electric cookstoves had a large deviation between the development impact potential rankings in 2018.[17] This means that respondents perceived that electric cooking equipment had a lower impact on their socio-economic development in 2020 than had been observed in previous surveys. This could possibly impact their interest in purchasing these appliances. However, this decline could have been due to a narrower categorization of cooking appliances and thus may not suggest a change in consumer perception.

[12] Rwanda e-waste policy, 2018
[13] Consumer Electronics - Rwanda | Statista Market Forecast
[14] https://www.clasp.ngo/wp-content/uploads/2021/01/Solar-TV-Report__-FINAL.pdf
[15] EforA_Solar-Appliance-Technology-Brief_Televisions_May-2021.pdf (storage.googleapis.com
[16] Disruptive innovation for inclusive renewable policy in sub-Saharan Africa: A social shaping of technology analysis of appliance uptake in Rwanda | Elsevier Enhanced Reader
[17] CLASP-MarketSurvey-2020-final.pdf (storage.googleapis.com)

### 3.2.3. Appliance Ownership and Usage: Findings from Household Surveys

From the household surveys, we found that **the most common appliances owned by respondents were mobile phones (94%), lighting appliances such as torches (90%), radios (78%) and TVs (58%).** Few of the respondents owned electrical appliances for cooking, **with only 0.1% of surveyed households indicating ownership of electric pressure cookers.**

TABLE 9: APPLIANCES OWNED BY HOUSEHOLDS (SOURCE: RWANDA
HOUSEHOLD SURVEY N=1120)

Appliance type	% Of households that own it
Mobile phone/charger	93.7%
Lights	89.9%
Radio	77.9%
TV	58.2%
Clothes iron	36.8%
Electric fan	36.8%
Computer/laptop	36.8%
Kettle	26.1%
Fridge	18.9%
Microwave	3.4%
Toaster	1.3%
Rice-cooker	1.2%
Toaster/sandwich maker	1.2%
Dish washer	1.2%
Coffee machine	0.8%
Printer	0.8%
Air conditioner	0.7%
Electric Oven	0.6%
Hair dryer	0.5%
Electric hot-plate cooker	0.4%
Washer/Dryer	0.4%
Air-fryer	0.1%
Electric pressure cooker	0.1%
Vacuum cleaner	0.0%

Majority of the respondents (40%) mentioned that they were not interested in purchasing any electrical cooking appliances at the time. This was persistent across both genders as most of the male (39%) and the female respondents (40%) had no plans of purchasing electrical appliances for cooking mainly based on their preference of their current cooking methods as well as barriers covered in the next sections**.**

FIGURE 3: INTERESTED IN PURCHASING ELECTRICAL COOKING APPLIANCES(RWANDA HOUSEHOLD SURVEYS N=963)
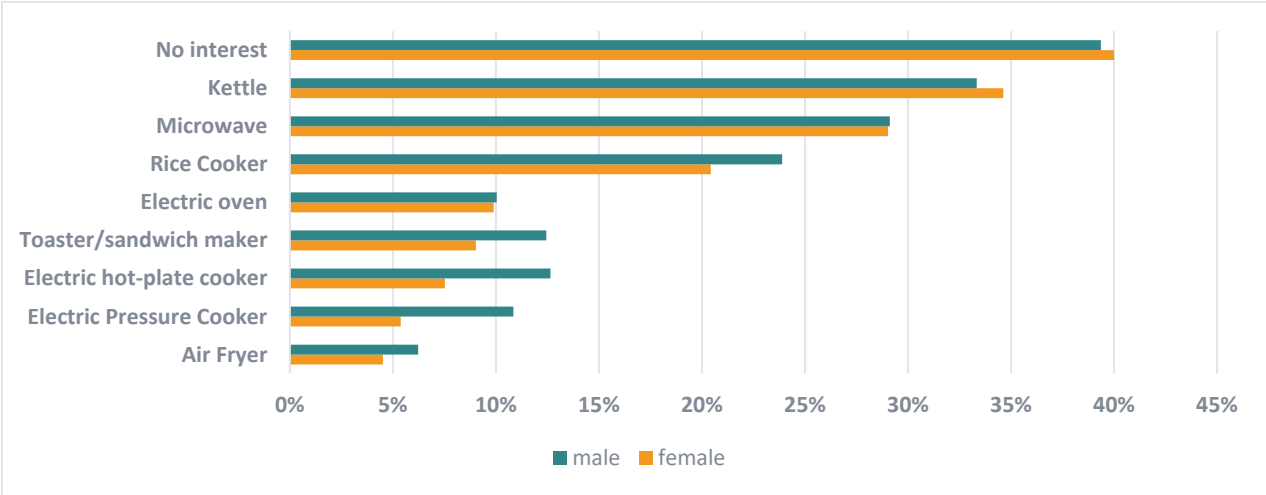

Regionally, **most of the respondents (46%) from the provincial city and those from the rural districts (41%) mentioned that they had no interest in any electrical cooking appliances**. 30% of the capital city respondents had no interest in any electrical cooking appliances.

TABLE 10: SHARE OF RESPONDENTS WHO DESIRED TO PURCHASE ELECTRICAL COOKING APPLIANCES (SOURCE: RWANDA HOUSEHOLD SURVEYS N=963)

|	Capital City	Provincial City	Rural District
No interest	30.1%	45.9%	41.3%
Microwave	37.7%	30.0%	33.9%
Kettle	33.5%	28.8%	27.0%
Rice Cooker	20.9%	23.2%	22.3%
Electric oven	10.0%	15.9%	7.0%
Electric Pressure Cooker	10.0%	9.0%	10.6%
Electric hot-plate cooker	13.8%	8.2%	10.4%
Toaster/sandwich maker	3.8%	4.7%	2.9%
Air Fryer	9.6%	4.3%	9.2%
Other	7.9%	5.2%	4.1%

For those who had no interest in purchasing any cooking appliances, **69% indicated that upfront capital costs were the largest barrier preventing them from purchasing electrical cooking appliances,** followed by concerns about appliance electricity consumption (18%) and unavailability in local stores (17%). Cost in this instance implies the initial purchasing cost even though it was not specified in the survey tool.

FIGURE 4:: BARRIERS INHIBITING PURCHASE OF ELECTRICAL COOKING APPLIANCES (SOURCE: RWANDA HOUSEHOLD SURVEYS N=376)
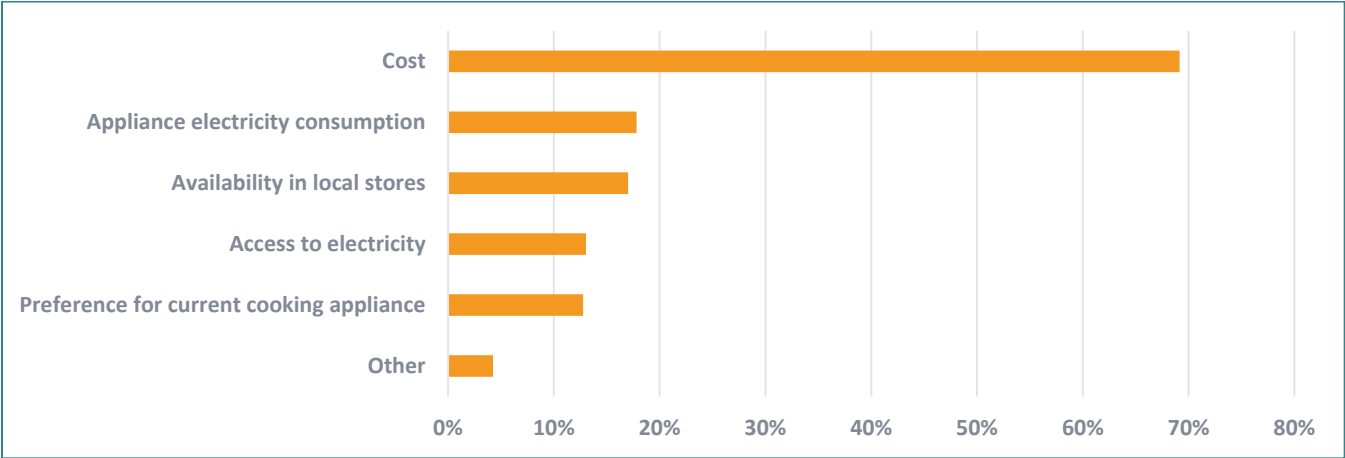
The primary purchaser of electrical appliances for surveyed households was the male head of household**. 64% of the surveyed households indicated that the male head of household oversaw purchasing of electrical appliances**, 21% indicated that it was the female head of household and 11% indicated that it was a shared responsibility between both male and female household heads. However, **it was noted that female respondents indicated that they had a much larger responsibility in purchasing appliances**. This signifies that female heads of household also play an important role in appliance purchasing decisions. Figure 5 below portrays the differences in responses across both genders.

FIGURE 5: PRIMARY PURCHASER OF APPLIANCES IN HOUSEHOLD (SOURCE RWANDA HOUSEHOLD SURVEYS N=1114)
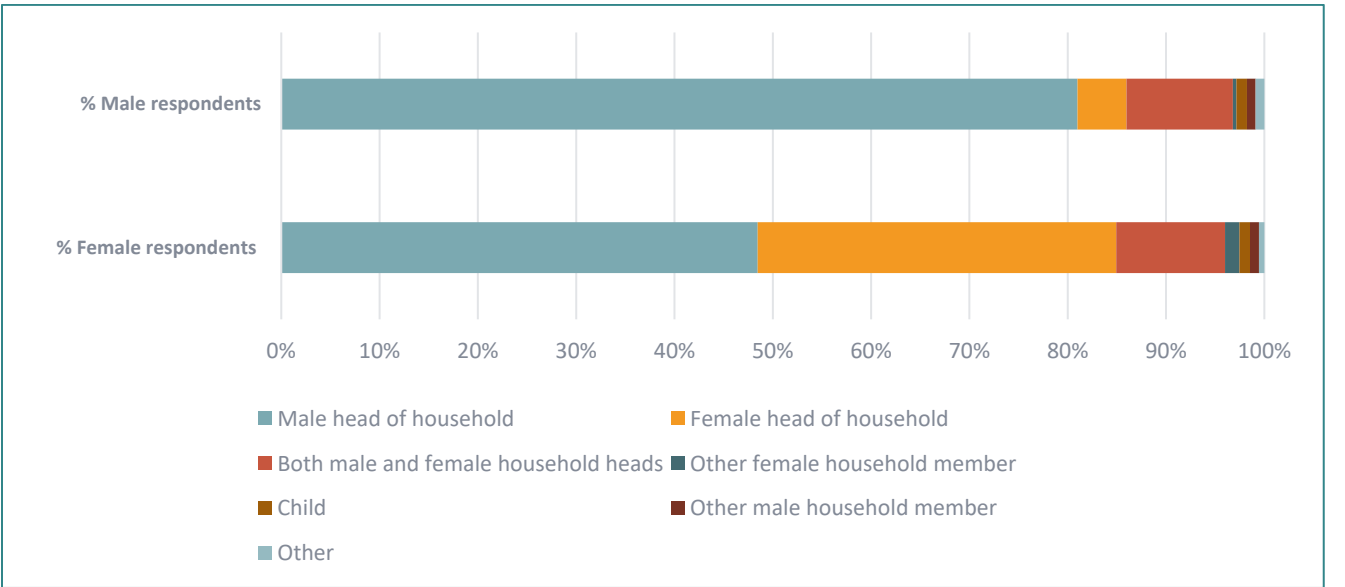
On appliance usage, **31% of the respondents who owned a TV indicated that the male head of household was the primary user,** followed by 26% of respondents who mentioned that TV usage was split equally between male and female household heads. **37% of the surveyed respondents indicated that the female household head was the primary user of cooking appliances,** followed by 31% who indicated that it was the male head of household. Curiously**, when disaggregated according to gender, majority of the male respondents (43%), indicated that they were the primary user of electrical cooking appliances**. The research partner stated that this is not the case for a typical Rwandan home. This could mean that the respondents may have misrepresented their responses.

FIGURE 6: PRIMARY USER OF TV IN HOUSEHOLD
(SOURCE: RWANDA HOUSEHOLD SURVEYS N=650)

FIGURE 7: PRIMARY USER OF COOKING APPLIANCES IN HOUSEHOLD (SOURCE: RWANDA HOUSEHOLD SURVEYS N=961)
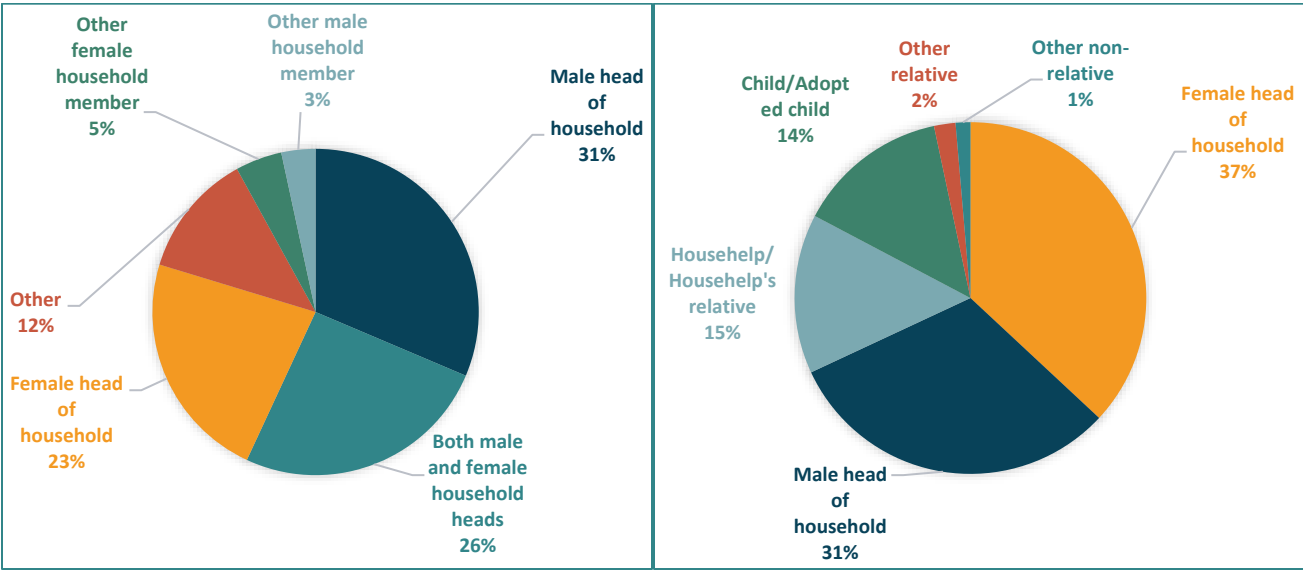
75% of the respondents did not have a preferred retailer for electrical appliances. Of those that did, **the majority (62%) indicated that manufacturer/new appliance retail stores were their preferred retail option**, followed by second-hand retail stores (32%) and online retail stores (4%).

FIGURE 8: HOUSEHOLD PREFERRED RETAILER (SOURCE: RWANDA HOUSEHOLD SURVEYS N=283)
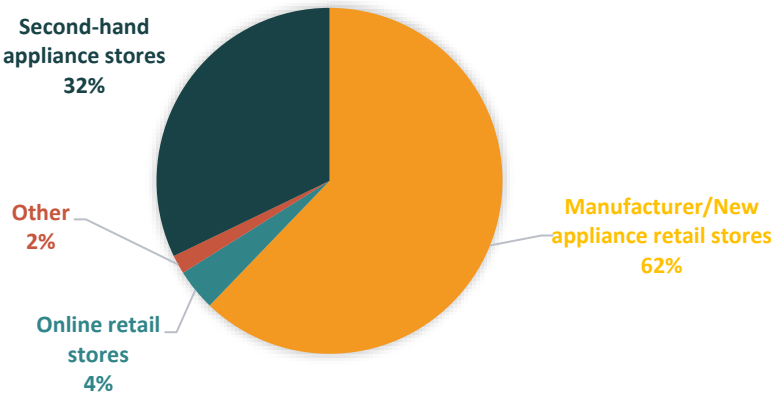
Among the factors that influence electrical appliance purchasing decisions, quality/durability/longevity was ranked as the most important factor by majority of the respondents (40%). Quality/longevity/durability was based on the appliance's features, lifespan, and its ability to withstand damage. Brand type was ranked as the second leading factor by 41% of the respondents, cost as the third (36%), size as the fourth (72%), color/style/design as the fifth (78%), and presence of warranty as the least influencing factor (83%). A study carried out in Kenya showed that consumers often associate quality products with brands [18] and could explain why these two factors were placed consecutively on the priority list by respondents. It was interesting to note that although cost was identified earlier as the leading barrier that hampers purchasing of electrical cooking appliances, it was less prioritized in comparison to quality and brand type when making general purchasing decisions. However, the number of respondents who ranked cost (36%) as the leading factor was not far off from those who selected quality/durability/longevity(40%).

FIGURE 9: HOUSEHOLD RANKING OF MOST IMPORTANT FACTORS THAT INFLUENCE PURCHASE DECISIONS 1-MOST IMPORTANT 6-LEAST IMPORTANT (SOURCE: RWANDA HOUSEHOLD SURVEYS N=1011)
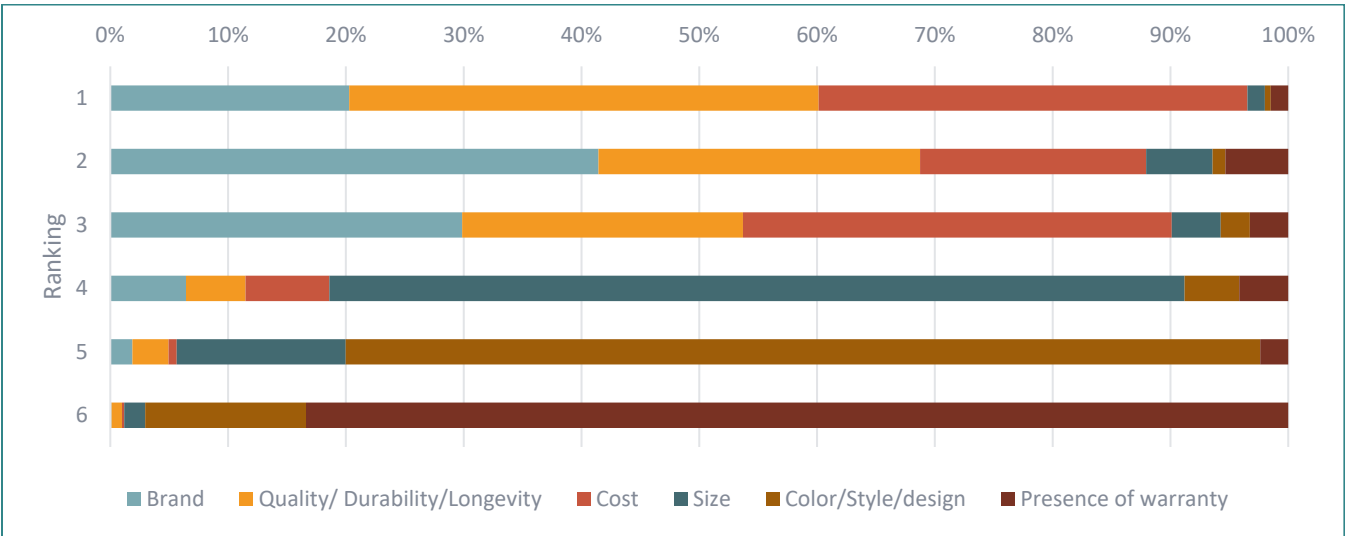
Nearly all the respondents (96%) preferred to pay for their purchased appliances using one-time cash payments rather than using payment with instalments alternatives. Most of them revealed that this was because they were unsure whether they would be able to complete payment plans and therefore did not want to become indebted to retailers. This could be based on experiences with bad debts among households and individuals- however, we did not find literature to correlate this.

Surveyed respondents mentioned that they got information concerning the appliances they wished to purchase from a variety of sources. Prior to purchasing appliances, (**40%) sought recommendations from other users for information concerning the appliances**, followed by information provided at manufacturer's/retail store (30%) and social media (29%). Studies show that consumers are more likely to trust word of mouth recommendations from close friends or family

---

[18] https://www.clasp.ngo/research/all/kenya-consumer-experience-study-insights-on-solar-appliances/

over advertisement campaigns, especially when purchasing items for the first time or when purchasing expensive items[19].

FIGURE 10: SOURCES OF APPLIANCE INFORMATION BEFORE PURCHASING (SOURCE: RWANDA HOUSEHOLD SURVEYS N=110 4)
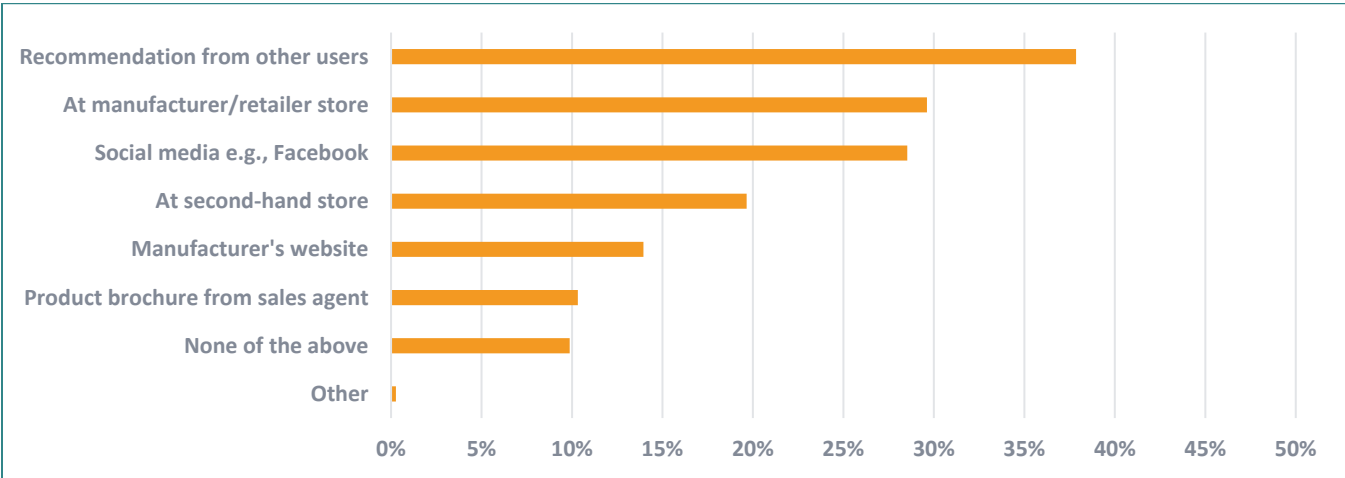
Majority of the surveyed households **(64%) had not purchased second-hand/used appliances**. This behavior was persistent across the 4 selected regions. 63% of the respondents from the capital city, 59% from the provincial district and 68% from the rural districts had not purchased second-hand/used appliances.

FIGURE 11: SHARE OF RESPONDENTS WHO HAD PURCHASED SECOND-HAND APPLIANCES (SOURCE: RWANDA HOUSEHOLD SURVEYS N=1119)
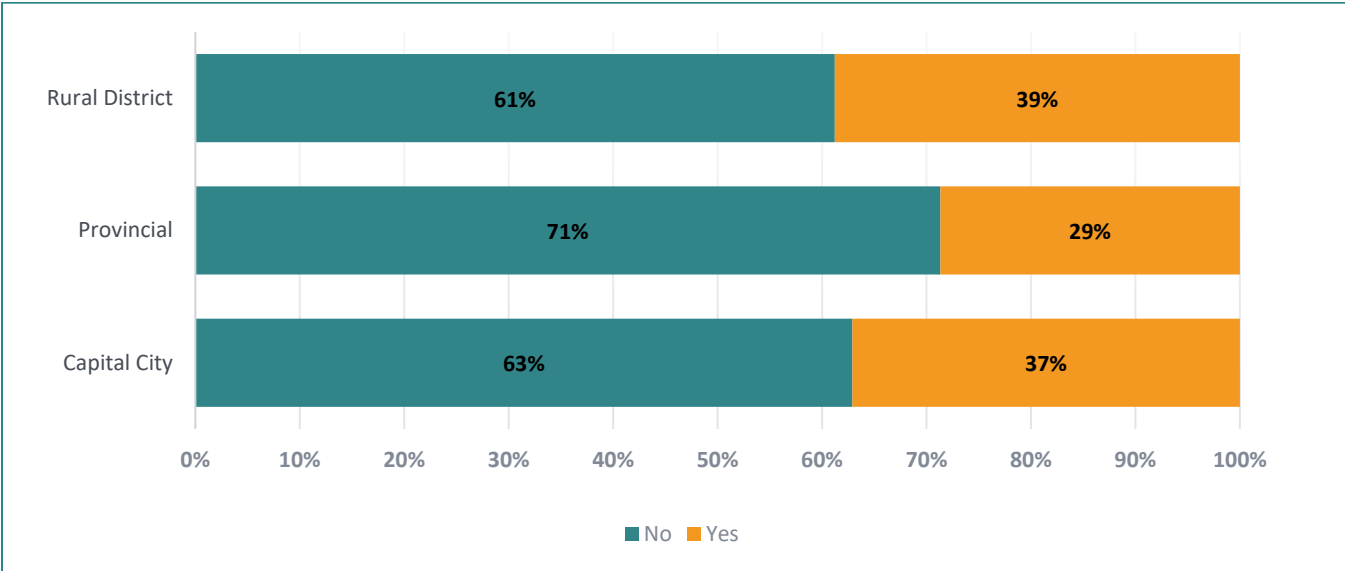
A variety of reasons were provided for not having purchased the second-hand/used appliances. The most common reason given was concerns about the quality of these used appliances (68%), followed by concerns about the product warranty (38%) and concerns about product age (24%).

---

[19] https://fairing.co/blog/measuring-word-of-mouth
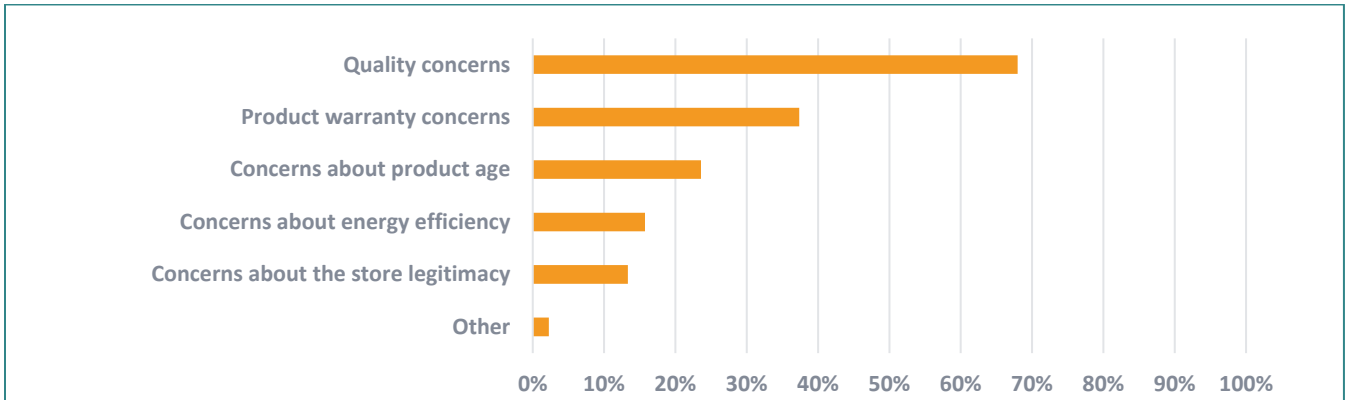
Of the respondents who had purchased second-hand appliances, **80% ranked cost as the leading factor that influenced them to purchase used appliances as used appliances would be relatively cheaper than new ones**. 58% ranked ease of accessibility to second-hand stores as the second leading factor, 60% ranked peer reco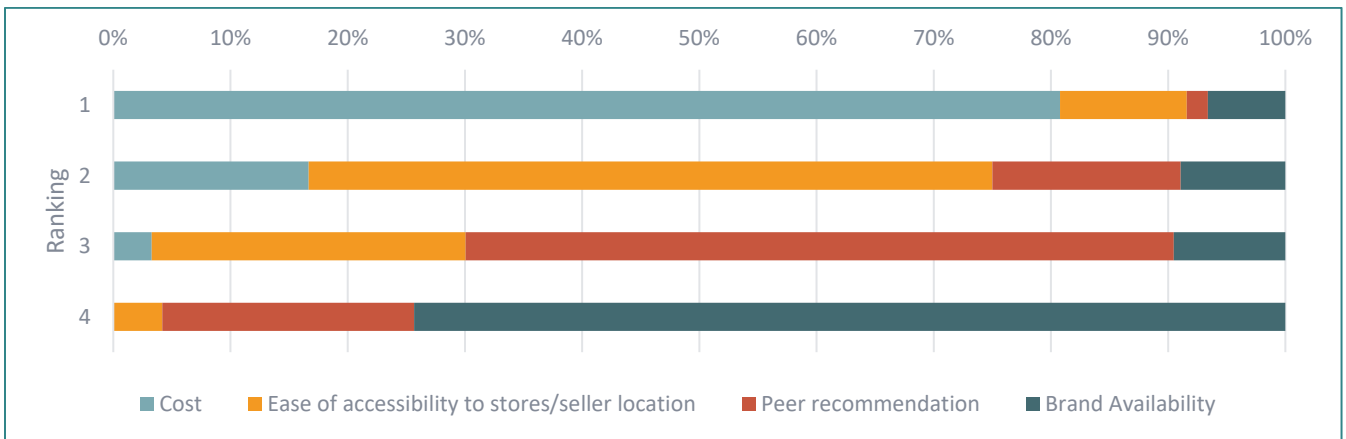mmendations as the third leading factor and 74% ranked brand availability as the factor with least influence on used appliance purchasing decisions.

FIGURE 13: RANKING OF FACTORS THAT INFLUENCE HOUSEHOLDS TO PURCHASE USED APPLIANCES 1-MOST IMPORTANT 4-LEAST IMPORTANT (SOURCE: RWANDA HOUSEHOLD SURVEYS N=336)

When asked about the performance of second hand/used TVs, **58% of the respondents said that they were good as new**, 32% said that they performed moderately and 10% said that they performed poorly. This indicates that the majority of the respondents who purchased used TVs had a positive experience using them. Additional research is necessary to understand user experiences with other appliances, for example cooking equipment which can be considered more personal compared to TV for instance. This research would enable a comparison of user perceptions regarding the performance of various appliances when purchased used.

Concerning product warranties, **most of the respondents mentioned that they received product warranties when purchasing appliances**. 61% of the respondents mentioned that their used appliances came with a consumer facing warranty, while 58% of respondents who purchased new

appliances received a warranty during purchase. It is important to note that a much smaller sample size answered the question concerning product warranties for used appliances.
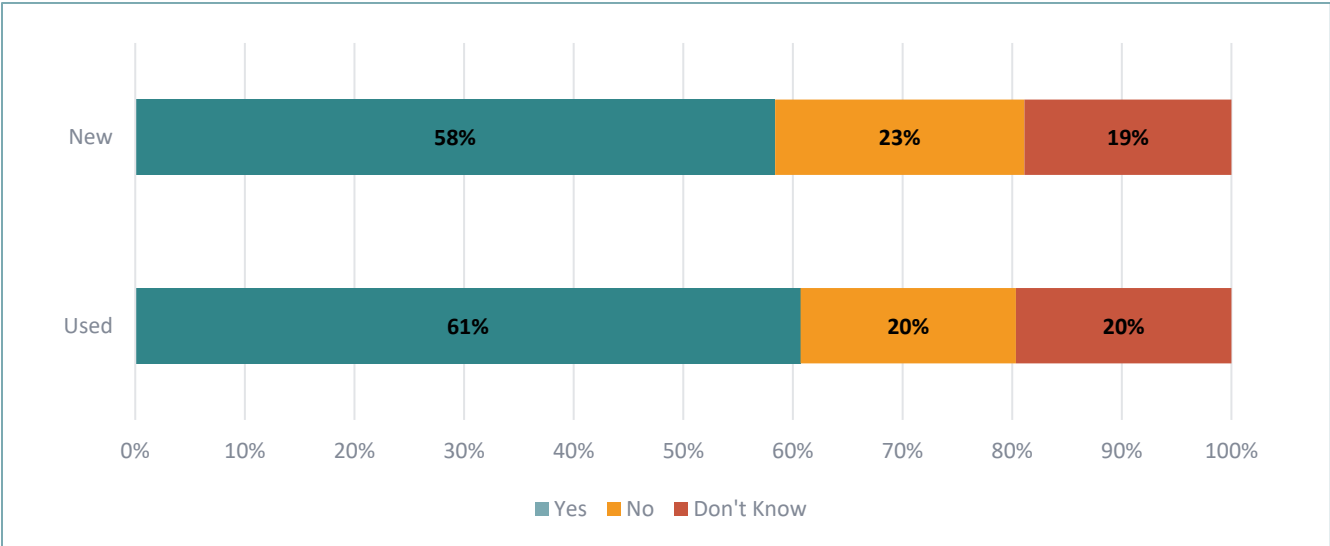
When asked if they had been informed about the product warranties prior to purchase, **54% of capital city respondents indicated that their retailers had informed them**. Provincial city and rural district respondents were less likely to have been informed by their retailers about product warranties prior to purchase.
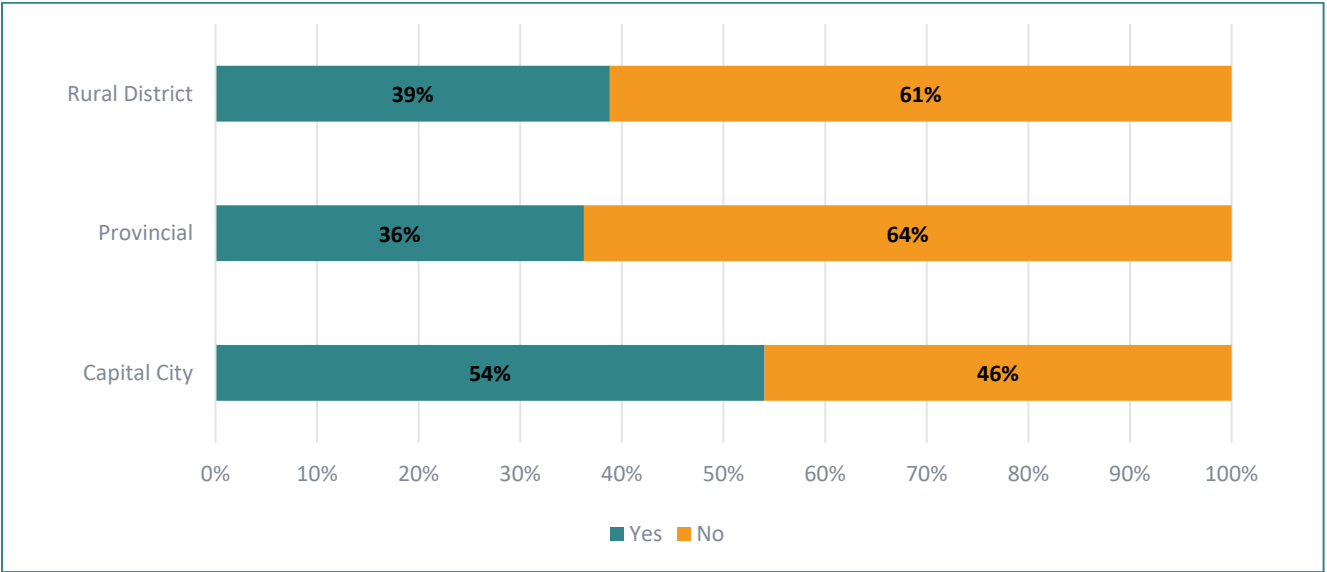
77% of the respondents who stated that the appliances purchased came with a product warranty had not claimed the warranty at the time of the survey. For respondents with malfunctioning TVs,

only **17% had made attempts to claim a warranty from their dealer**. This indicates that although warranties are present, very few consumers actually make use of them. This could be due to the observations made earlier where more respondents indicated that their retailers had not informed them about the warranties during purchase. Nonetheless, **79% (n=29) of the respondents** who had made attempts to claim product warranties **noted that these warranties were honored by the retailers**.

3.3. Circularity and e-waste landscape

The municipal authorities are responsible for the management of general waste and citizens are only required to pay for collection and disposal services[20]. The municipal authorities here refer to the municipal council of the city of Kigali for Kigali city and the districts for the other 4 provinces[21]. Solid waste contractors collect waste from different places and discard it in designated landfills without any distinct segregation of e-waste. Kigali uses a public-private partnership, with exclusive franchises in 35 sectors being tendered every three years; households pay an affordable fee depending on their ability to pay with the poorest category getting free services.[22] A fee collection rate of 95% is achieved. The National Sanitation Policy - approved by cabinet in December 2016 - provides guiding principles for all aspects of waste management and recognizes the uniqueness of e-wastes which require a specific policy governing their management.

82.6% of total e-waste flows globally are undocumented. Less than 20% of e-waste is collected from homes and institutions globally, according to the 2020 Global e-waste Monitor, a report by the Global E-waste Statistics Partnership.[23] In Africa, less than 1% of e-waste is documented to be collected and recycled properly[24]. Rwanda generates about 7,000 tonnes of e-waste annually[25] . Domestic e-waste is generated from discarded mobile phones, computers, radios, and light bulbs, as well as larger appliances like televisions, refrigerators, washing machines, air conditioners, fans, and cookers.

There have been small scale efforts from entrepreneurs in Rwanda, and large-scale efforts from the government to control e-waste pollution. Once electric devices are spoilt or come to their end-of-life, some repair shops within the country refurbish them and sell them anew. Some of the e-waste like broken down computers and printers from government offices would be refurbished in the Tumba College of Technology.

The handling of appliances at point of failure or at End of Life (EoL) greatly varies in Rwanda and depends on multiple factors including the reputation of the merchant, the availability of product warranties, and the quality of the product. Consumers typically determine the end-of-life channel for their used electronics – whether this is a government-registered drop-off point, informal waste

---

[20] National E-Waste Management Policy for Rwanda
[21] Solid Waste Management in Rwanda: Status and Challenges
[22] Benchmarking performance of solid waste management and recycling systems in East Africa: Comparing Kigali Rwanda with other major cities - Telesphore Kabera, David C Wilson, Honorine Nishimwe, 2019 (sagepub.com)
[23] Ramping up e-waste awareness in Rwanda - ITU Hub
[24] Global e-waste Monitor (2020)
[25] https://www.itu.int/hub/2022/06/e-waste-awareness-in-rwanda/

collection, or storage within the home.[26] Table 11 outlines methods used for household waste disposal by Rwandan households, obtained from 2019/2020 census data. The exact type of waste the census data is referencing is not specified i.e. is it e-waste, general waste etc.

TABLE 11: WASTE MANAGEMENT FACILITIES AT NATIONAL LEVEL IN RWANDA (SOURCE: RWANDA HOUSEHOLD SURVEY 2019/2020 | NATIONAL INSTITUTE OF STATISTICS RWANDA)

Primary household waste disposal method	Rwanda Household Survey 2019/20
Compost heap on own property	46.5%
Thrown in the HH's fields/bushes	41.2%
Rubbish collection service	9.9%
Dumped in river/lakes/ditches	0.1%
Publicly managed refuse area	2.2%
Burnt	0.1%
Other ways of rubbish disposal used	0.0%

As in many emerging economies, managing not only their e-waste but also large amounts of e-waste dumped within their borders by affluent nations has been difficult for Rwanda[27]. The country did not have appropriate channels through which electronic waste (e-waste) could be sorted, recycled, or disposed of back in 2016. As a result, many of the obsolete appliances ended up piled up in storage rooms within households and government offices.

Whereas Rwanda has adopted several mandatory standards (see Standards Section) to protect their markets from counterfeit products and reduce energy consumption, many such products still find their way into the markets. Such products are mostly sold with very short warranty periods (about 6 months) and can prove to be difficult to repair for various reasons, at the top of the list is poor design. In cases where the warranty has expired, a product owner will utilize the local repair person who may lack either capacity/skills or tools and spare parts to do a quality repair job. In such cases, without alternatives, the owner resorts to storing the broken appliance in the home or hands it over to the technician for 'scavenging' of parts usable in other appliances.

The main appliance EoL and e-waste channels available in the country are:

[26] Ramping up e-waste awareness in Rwanda - ITU Hub
[27] Rwanda to enforce policy on disposal of e-waste - The East African

- Take-back by distribution/manufacturing companies for recycling, replacement, repair, or disposal.

- Independent repair by consumers at local repair shops

- Disposal by consumers by burying, burning, or storing in their homes/premises.

- Collection, recycling and disposal by Enviroserve Rwanda Green Park[28]

Enviroserve Rwanda Green Park collects and recycles e-waste. They handle a wide range of e-waste including[29]:

- Small and large household appliances

- IT and telecommunications equipment

- Consumer equipment

- Solar products and lighting equipment

- Electrical and electronic construction tools

- Toys, leisure, and sports equipment

- Medical devices

- Monitoring and control instruments

- Batteries, Metals, Plastics, and more

Earlier in 2020, the Rwandan Ministry of ICT in partnership with Smart Africa Secretariat installed a smart waste management system in Kigali. These include smart bins with real-time monitoring using sensor technology to alert collectors of their filling levels. The system is coupled with closed-circuit cameras and a geographic information system (GIS) for security of waste collection facilities.

Presently, less than 20% of the e-waste generated in Rwanda is being collected[30]. Due to this, GoR recently mounted the #GreenRwanda campaign to spur e-waste returns by consumers to official collection points in Kigali and Musanze, managed by Enviroserve. The campaign aims to educate and mobilize the public, create buy-in across the public and private sectors, and raise awareness on the dangers of improper e-waste disposal on health and the environment. It is a collaboration between RURA, the International Telecommunication Union (ITU) and UNEP[31].

---

[28] Rwanda's Green Fund FONERWA invested into the establishment of an environmentally friendly e-waste collection centre and dismantling/recycling facility,
[29] Enviroserve Rwanda Green Park
[30] Rwanda: Rura, Enviroserve Rwanda Launch Competition to Boost E-Waste Collection
[31] Ramping up e-waste awareness in Rwanda - ITU Hub

3.3.1. Appliance Failure and E-waste Disposal Behaviour and Attitudes: Findings from Household Surveys

77% of surveyed households stated that all their appliances were functioning properly at the time of survey. Table 12 below contains the percentage of respondents who mentioned that they had failing/failed appliances in their household at the time of survey, for each appliance type.

TABLE 12: APPLIANCES THAT ARE CURRENLTY FAILING (SOURCE: RWANDA HOUSEHOLD SURVEYS N=227)

Appliance	% Of surveyed households with failed appliance
Mobile phone/charger	43.6%
Radio	40.1%
TV	31.3%
Lights	24.2%
Kettle	9.3%
Fridge	7.0%
Clothes iron	5.3%
Other	3.1%
Computer/laptop	3.1%
Electric pressure cooker/Electric oven/Rice Cooker	2.7%
Printer	1.8%
Microwave	1.8%
Washer/Dryer	1.3%
Toaster	1.3%
Electric hot-plate cooker	1.3%
Coffee machine	0.9%
Toaster/sandwich maker	0.9%
Hair dryer	0.9%
Electric fan	0.9%
Vacuum cleaner	0.9%
Air-fryer	0.9%
Dish washer	0.9%
Air conditioner	0.9%

Households that had a non-functional/failed TV were asked the number of times that their TV had failed since purchase. **44% indicated that it had failed once, 26% indicated twice, 12% that it had failed three times and 19% that it had failed more than three times**. The data was collected from a very small sample size of 44 respondents.

When an appliance fails, **most of the respondents (67%) mentioned that they take it for repair, followed by 21% who opt to store it in the household and 17% who replace it**. There were minor regional differences with 64% of the capital city respondents, 70% for the provincial city and 68% for the rural districts opting to take their failed appliances for repair.

FIGURE 16: HOUSEHOLD BEHAVIOR WHEN AN APPLIANCE FAILS (SOURCE: RWANDA HOUSEHOLD SURVEYS N=1106)
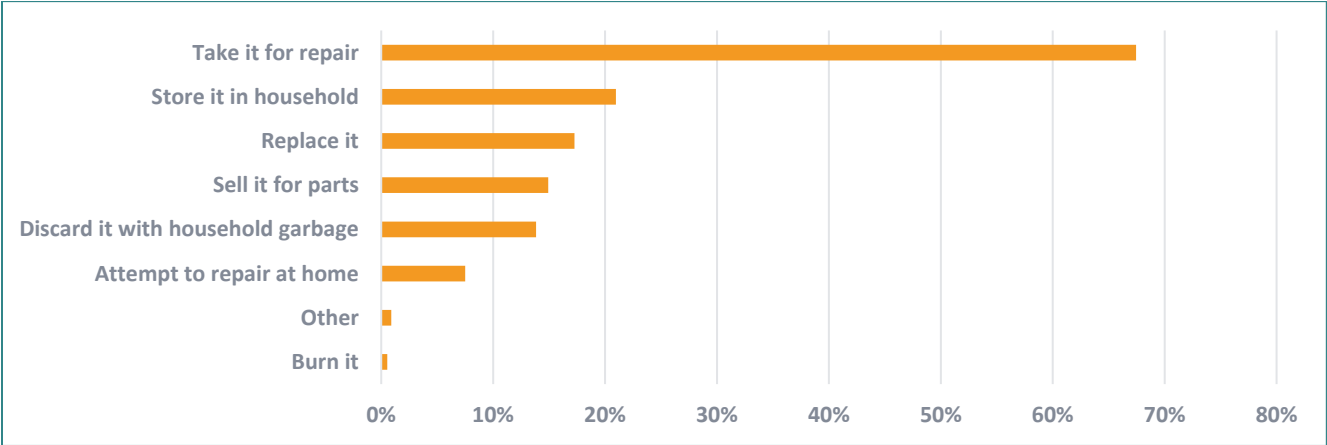
Local repair shops are the most preferred repair option for most respondents (80%), while others choose to return to the manufacturer or seek out specialized appliance repair shops. This could be due to their accessibility, as local repair shops were more common in the chosen survey locations.

FIGURE 17: PREFERRED OPTION FOR REPAIR (SOURCE: RWANDA HOUSEHOLD SURVEYS N=744)
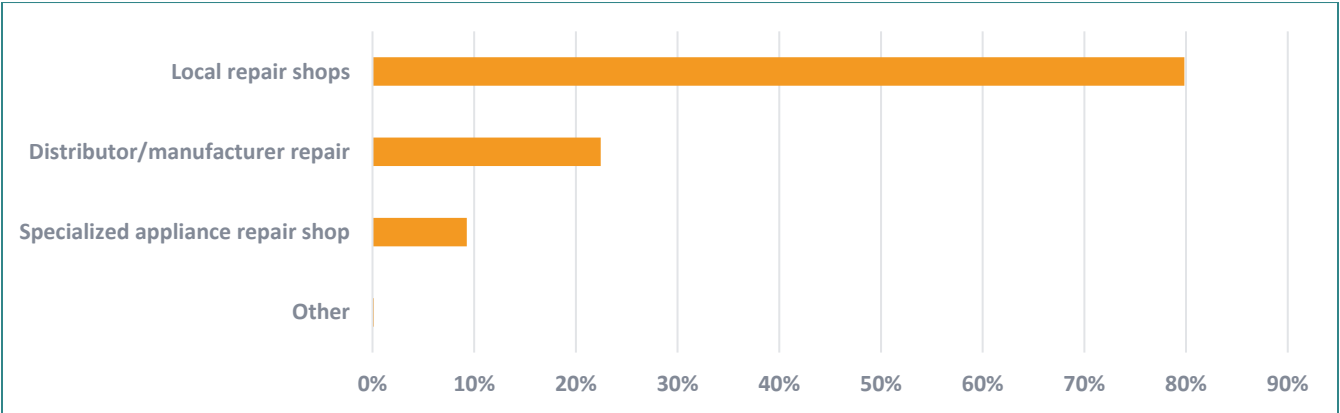
Cost of repair is the leading factor that influences choice of repair shop, as ranked by nearly 70% of those who chose to repair. 60% of the respondents ranked proximity to the household as the second leading factor, 59% ranked reputation of the repair shop as the third, 68% ranked repair shop authorization as the fourth and 93% ranked the appliance type as the least influencing factor.

FIGURE 18: RANKING OF FACTORS THAT INFLUENCE CHOICE OF REPAIR SHOP 1-MOST IMPORTANT 6-LEAST IMPORTANT (SOURCE: RWANDA HOUSEHOLD SURVEYS N=653)
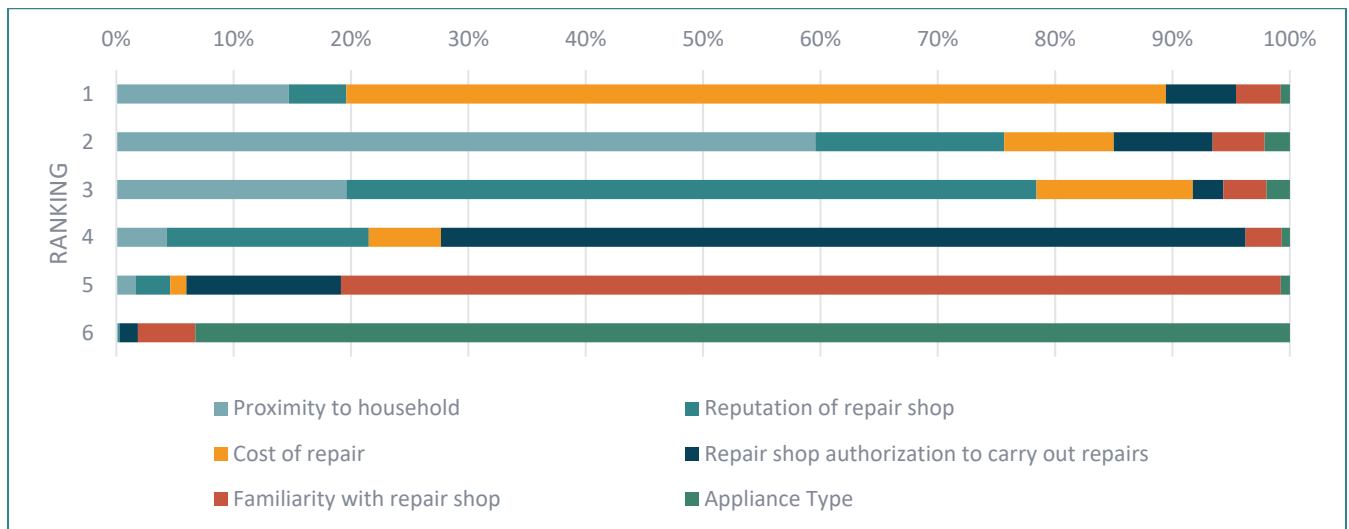
Regarding costs associated with appliance repair, **most of the respondents (34%) mentioned that they usually spend about 41%-60% of the original appliance price when seeking repairs**. A follow-up survey would be needed to further investigate the implications if the cost was higher or lower than above stated range.

FIGURE 19: COSTS ASSOCIATED WITH REPAIR IN COMPARISON TO ORIGINAL APPLIANCE PRICE (SOURCE: RWANDA HOUSEHOLD SURVEYS N=711)
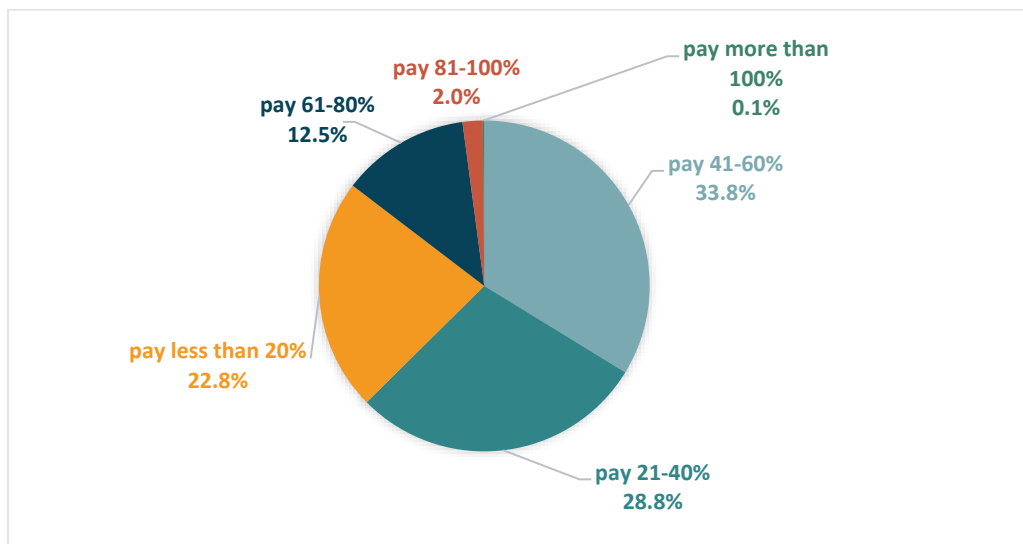
Of the respondents who opted to replace their failed appliance, **40% said that they chose to replace the appliance because it was cheaper to replace rather than repair**, followed by 38% of the respondents who mentioned that the appliance was could not be repaired and 21% who said that the product warranty covered replacement.

Overall, when asked which were the overarching factors that influenced their choice of action to take upon appliance failure, **62% of the respondents said that they factor in the cost effectiveness of the options available**. This means that they prefer to select the cheaper option when determining what to do with their failing/failed appliance. This was followed by 38% who mentioned that they lacked awareness of the appropriate appliance repair and disposal process and therefore did not factor in any of the options provided. This was observed across all the selected regions for data collection.

FIGURE 20: FACTORS THAT INFLUENCE APPLIANCE FAILURE BEHAVIOR (SOURCE: RWANDA HOUSEHOLD SURVEYS N=1108)
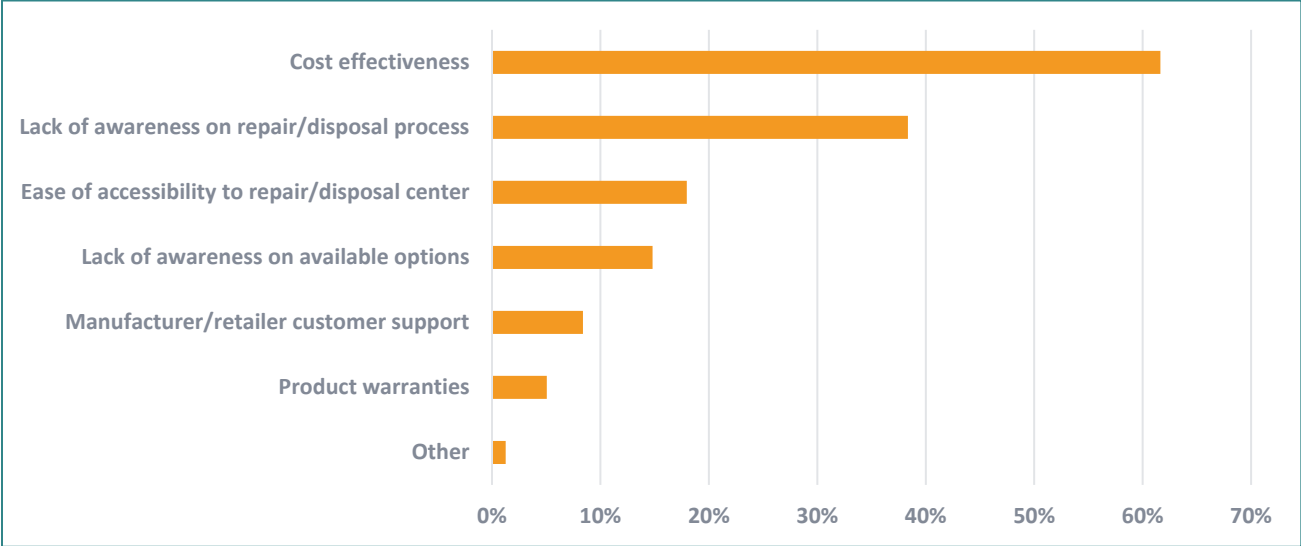
When asked which household member had the most influence on appliance failure behavior, majority of the respondents (62%) mentioned that it was the male head of household, followed by the female head of household (22%). 12% of the respondents mentioned that it was a shared responsibility between both male and female household heads. However, it was noted that female respondents were more likely to indicate that the female head of household played a bigger role in appliance failure behaviour as seen in the Table 13 below.

TABLE 13: HOUSEHOLD MEMBER IN CHARGE OF APPLIANCE FAILURE BEHAVIOUR (RWANDA HOUSEHOLD SURVEYS N=1106)

Individual in charge of appliance failure behaviour	% Female respondents	% of Male respondents
Male head of household	45.16%	79.43%
Female head of household	39.31%	5.37%
Both male and female household heads	12.61%	11.09%
Other female household member	0.91%	0.72%
Other male household member	0.91%	1.43%
Other	1.10%	1.97%

This observation was replicated when asked which household member influenced e-waste disposal behavior. **Majority of the respondents (43%) mentioned that it was the male head of household, followed by the female head of household (36%)**. 15% of the respondents mentioned that it was a shared responsibility between male and female household heads. Again, it was noted that female respondents were more likely to indicate that the female head of household played a much bigger role in waste disposal behaviour as seen in the Table 14 below.

TABLE 14: HOUSEHOLD MEMBER IN CHARGE OF WASTE DISPOSAL BEHAVIOUR (RWANDA HOUSEHOLD SURVEYS N=1106)

Individual in charge of appliance failure behaviour	%Male respondents	% Female respondents
Male head of household	57.9%	27.7%
Female head of household	20.4%	52.5%
Both male and female household heads	16.3%	14.0%
Other male household member	2.8%	1.6%
Other female household member	1.1%	3.4%
Child/Children	0.7%	0.2%
Househelp/Househelp's relative	0.5%	0%
All of them	0.2%	0.4%
Other non-relative	0%	0.2%

Private waste management companies handle waste collection and disposal for majority (61%) of interviewed households. These are independent waste management companies that are not affiliated with the government. This waste disposal behaviour was observed in both urban and rural contexts. The research partner confirmed that the Rwanda Utilities Regulatory Authority ("RURA") oversees waste collection and provides licenses to private companies across the country, allowing them to enter the waste collection market. Private waste collection companies collect the waste directly from households and then transport it to disposal sites. Other respondents indicated that they burn their household waste in their compounds or opt to recycle it. Information was not provided on how they recycle their household waste. Table 15 shows the options for general waste disposal that were available to surveyed households across the selected geographical locations.

	Capital City	Provincial City	Rural Cities
Private waste management company collection and disposal	60.6%	63.5%	88.8%
Local council collection and disposal	42.9%	31.6%	46.0%
Burning	0.8%	3.8%	6.0%
Recycling	0.8%	4.6%	7.0%
Other	1.2%	0.4%	2.6%
Total n=1089			

Majority of the respondents (84%) mentioned that they were not aware of any designated e-waste disposal options in their community. There was no observable difference in awareness across urban-rural contexts.

16% of the respondents had previously disposed of a faulty/dead TV. **Most of these respondents (61%) disposed of the TV with their household garbage**, followed by 18% of the respondents who took their dead TVs to e-waste disposal centers.

FIGURE 21: DISPOSAL METHOD USED FOR TVS (SOURCE: RWANDA HOUSEHOLD SURVEYS N=177)
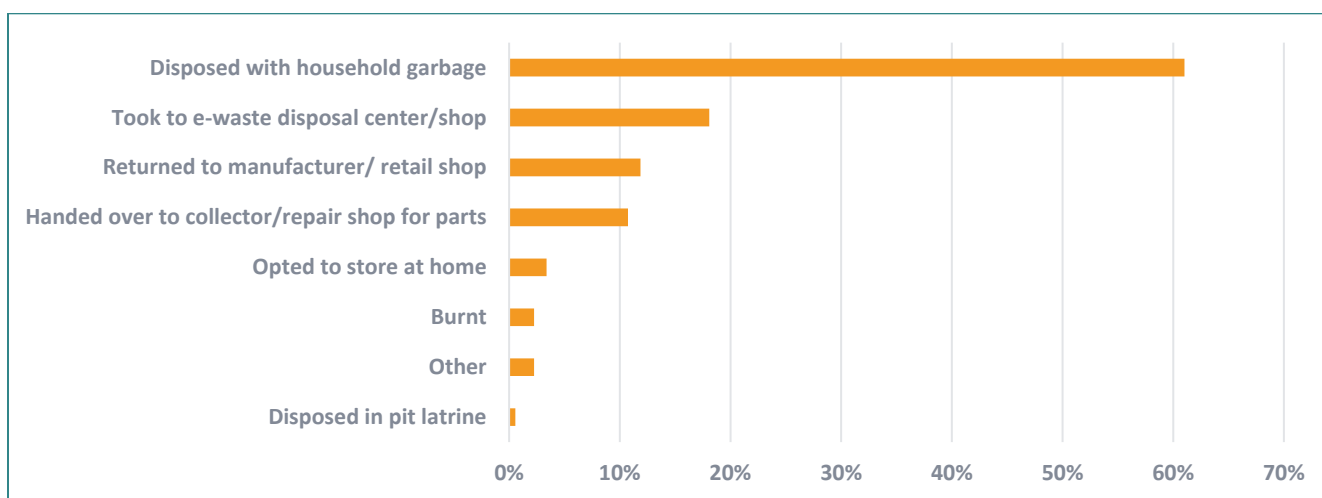
When asked if they had disposed of any other electrical appliances excluding TVs, most of the respondents (67%) mentioned that they had never disposed of any. The assumption here is that these appliances are likely still held in the households -this can be verified in follow up surveys. **61% said that they had not disposed of any electrical appliance because all their appliances were still functioning, followed by 32% of the respondents who said that they lacked awareness on proper disposal methods.**
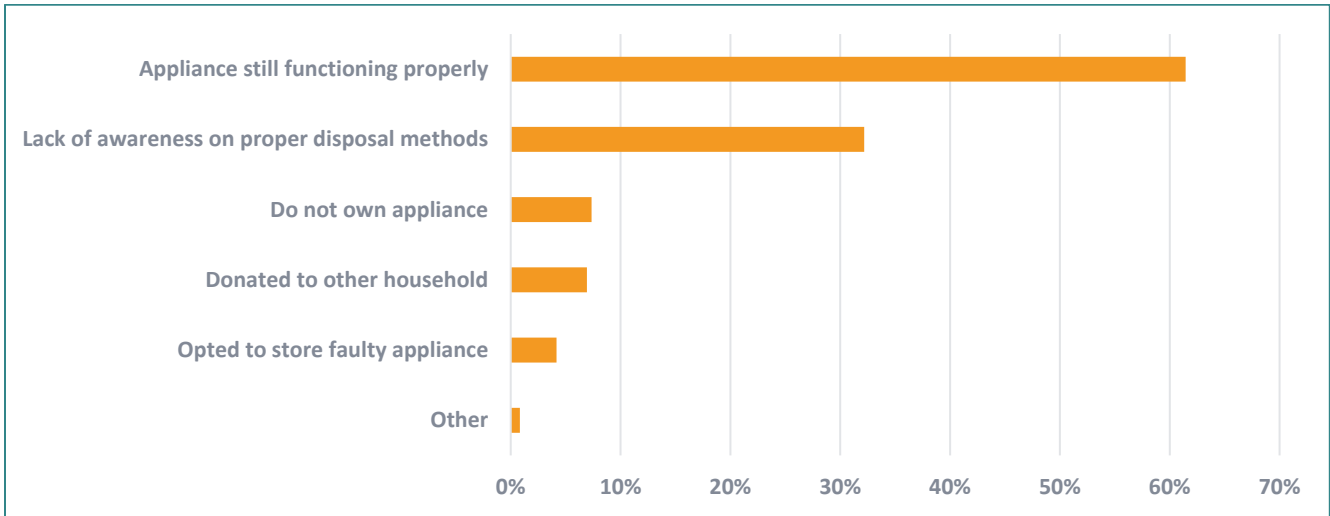
Regarding the disposal of other appliances, **most of the respondents (75%) who had disposed of other electrical appliances** mentioned that they had **disposed of them with their household garbage.**

FIGURE 23: DISPOSAL METHOD USED FOR OTHER ELECTRICAL APPLIANCES EXCLUDING TVS (SOURCE: RWANDA HOUSEHOLD SURVEYS N=360)
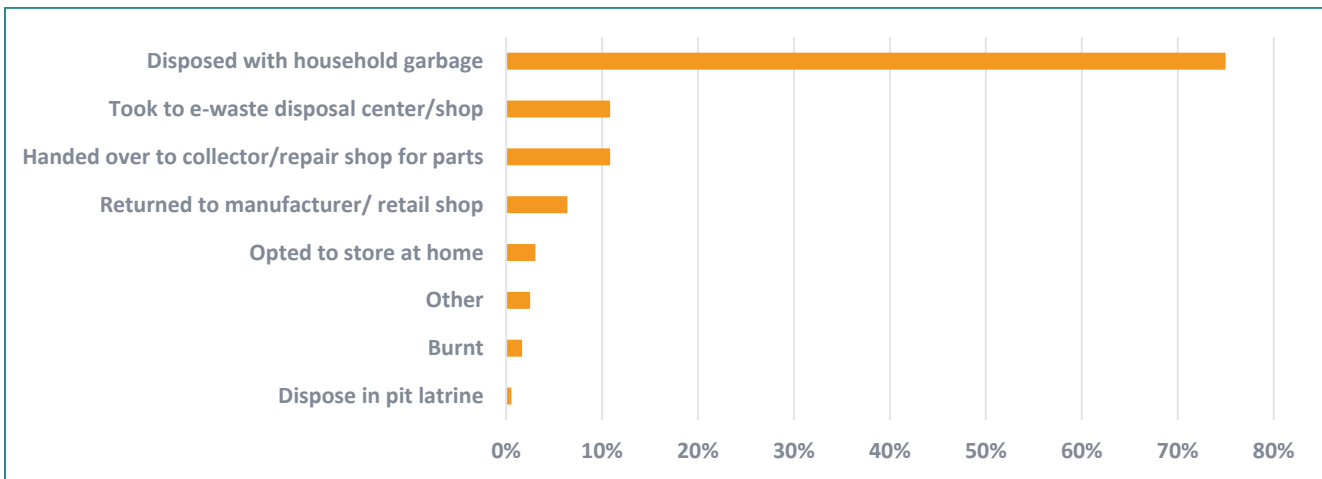
Regarding attitudes towards their reported e-waste disposal behavior that can be seen in the figure above, **most of the respondents (72%) mentioned that they believed that their behavior was environmentally friendly**. This was noted for respondents across all the educational levels as shown in Table 16 below.

Educational level	Behaviour is environmentally friendly	Behaviour is not environmentally friendly
Tertiary, College/University/Technical Vocational Training	68.2%	31.8%
Upper Secondary	74.0%	26.0%
Lower Secondary	74.2%	25.8%
Primary School	73.6%	26.4%
Never went to school	84.1%	15.9%
Don't know	83.3%	16.7%

In addition, **54% of the respondents who acknowledged that their current behavior was not environmentally friendly indicated that they were unwilling to use more sustainable means of disposal. "**Willingness" was used to explore the sense of respondents' likelihood to alter to new behavior from the usual way of doing things **.** Given that the majority of the households disposed of their e-waste with their household garbage, this feedback can be indicative of possible lack of awareness on the dangers of improper e-waste disposal to the individual and community.

FIGURE 24: BELIEF THAT CURRENT DISPOSAL BEHAVIOR IS ENVIRONMENTALLY FRIENDLY
(SOURCE: RWANDA HOUSEHOLD SURVEYS N=1111)
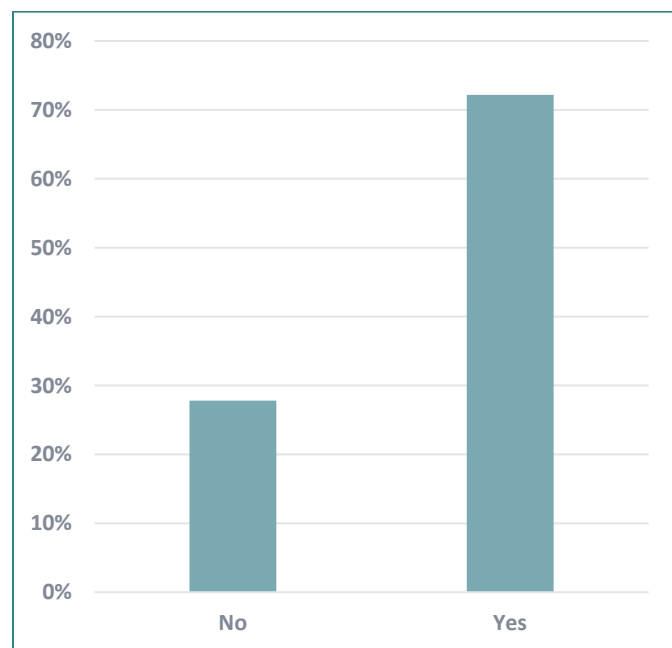
FIGURE 25: WILLINGNESS TO USE MORE SUSTAINABLE BEHAVIOUR
(SOURCE: RWANDA HOUSEHOLD SURVEYS N=308)
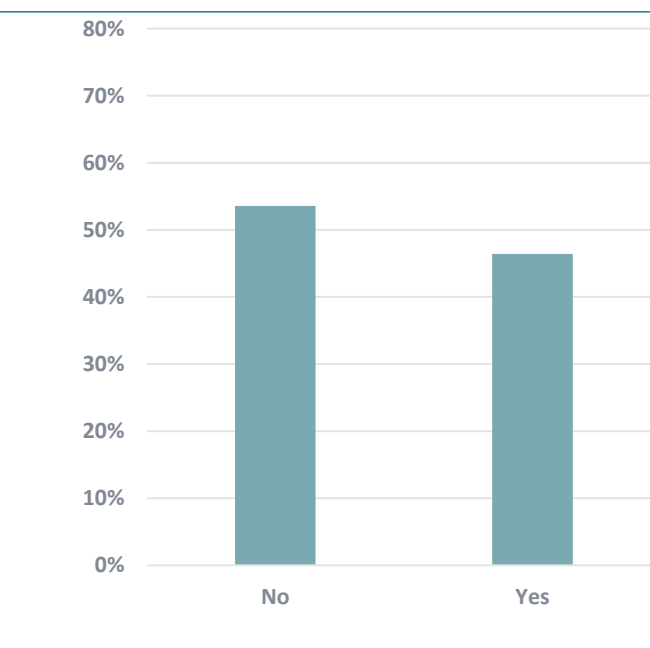
When asked about the barriers hindering more sustainable behavior, **majority of the respondents (88%) mentioned a lack of information on available options**. Additionally, **65% of the respondents**

stated that increased awareness of the environmental impact of improper e-waste disposal would encourage them to seek more sustainable means.

FIGURE 26: BARRIERS HINDERING SUSTAINABLE
E-WASTE DISPOSAL
(SOURCE: RWANDA HOUSEHOLD SURVEYS N=309)
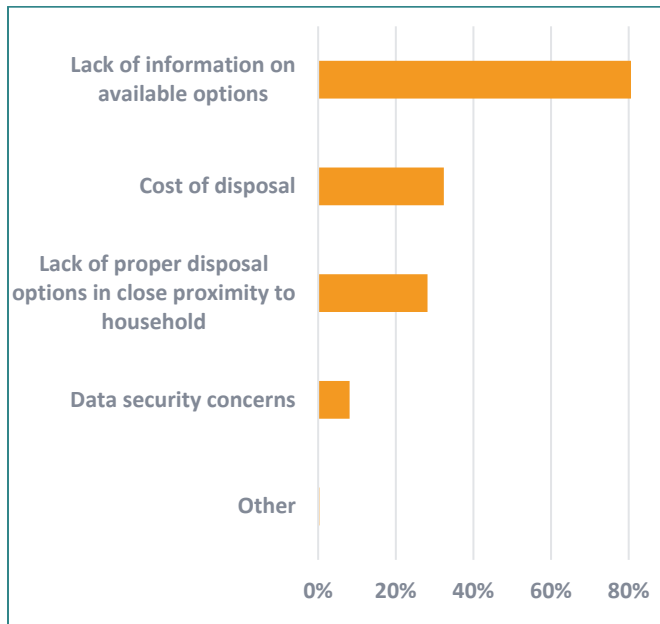
FIGURE 27: FACTORS THAT WOULD PROMOTE MORE
SUSTAINABLE BEHAVIOUR
(SOURCE: RWANDA HOUSEHOLD SURVEYS N=307)
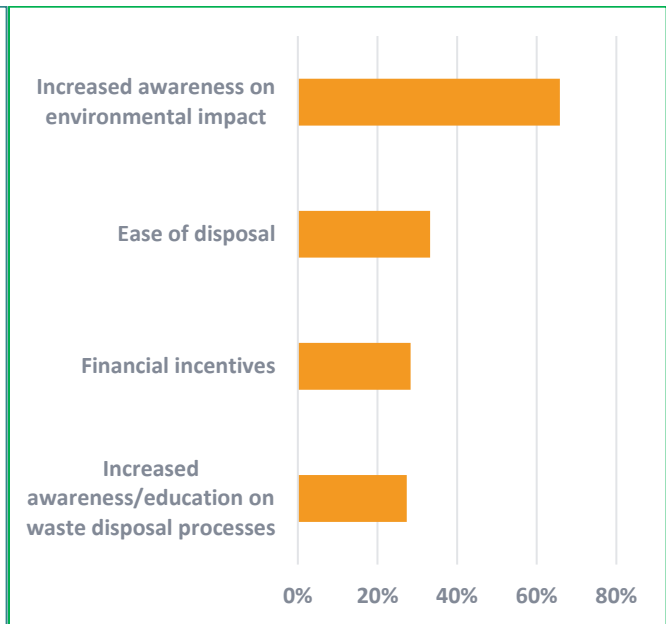
Regarding the influence of local leaders on appliance repair and disposal behavior, **88% of the respondents said that local leaders had no influence on their current behavior**. 76% of the respondents whose behavior had been influenced by local leaders, noted that their leaders had done this by creating awareness on appliance waste disposal options. 32% of these respondents mentioned that their local leaders had increased appliance waste disposal options in their communities

3.4. Quality Standards and Labelling

The Rwanda Standards Bureau (RSB) is the government institution charged with the implementation of standards, testing, product certification, accreditation, labelling, marking, and technical regulations. RSB has developed and published several standards for various electrical and electronic products and a dedicated standard on e-waste management. These standards prescribe handling, collection, transportation, and storage of various categories of e-waste.[32]

Rwanda not only develops domestic standards but also accepts international standards. Being a member of the EAC Standards Technical Management Committee, approved EAC measures are generally incorporated into the Rwandan regulatory system within six months and are published in the National Gazette like other domestic laws and regulations.[33] Rwanda is also a member of other international standardization organizations and accepts their standards. These include:

- ISO: International Organization for Standardization
- IEC: International Electro-technical Commission
- IEEE: Institute of Electrical and Electronics Engineers
- ASTM: American Society for Testing and Materials
- ITU: International Telecommunication Union
- AOAC: Association of Analytical Communities
- ARSO: African Organization for Standardization
- AFSEC: The African Electro-Technical Standardization Commission
- WTO: World Trade Organization

A list of the standards catalogued by the Rwanda Standards Bureau can be found in Table 17 below[34].

[32] PAOP Rwanda Market Assessment (usaid.gov)
[33] Rwanda – Standards for Trade
[34] https://portal.rsb.gov.rw/webstore.php

Standard Code	Function
RS 290: 2016	Specifies the requirements and test methods for solid biomass cookstoves. The standard is applicable to cookstoves used primarily for domestic and small-scale institutional cooking or water heating excluding stoves used primarily for space heating
RS ISO/TR 21276: 2018	Purpose of this standard is to establish a precise vocabulary for cookstove technology and testing
RS ISO 19867-1: 2018	Standard test sequence for emissions and performance, safety and durability of clean cookstoves and clean cooking solutions
RS 349: 2018	Covers the requirements and methods of test for the domestic portable plastic biogas used for biogas energy production in home cooking and lighting
RS 276-1:2021	Establishes the handling, collection, transportation and storage of electrical and electronic waste
RS 276-2: 2021	Specifies the treatment and disposal of electrical and electronic waste
RS 181: 2019	Prescribes the recommended procedure for the handling, collection, transportation and disposal of domestic, commercial and industrial solid waste to ensure safety of operatives, passers-by, animals and the environment.
RS 437-1	Articulates minimum energy performance requirements for household and street lighting electric lamps for operation from supply voltages up to 300 V. They include directional and non-directional lamps of all shapes and finishes; using incandescent, halogen, compact fluorescent, light emitting diode (LED), and other light source technologies other than high-intensity discharge lamps.
RS IEEE 1680: 2009	Each standard in the IEEE 1680 family of standards addresses criteria for a specific electronic product or group of products in at least the following eight categories of environmental performance: reduction or elimination of environmentally sensitive materials, materials selection, design for end of life, life cycle extension, energy conservation, end-of-life management, corporate performance, and packaging
RS EAS 1064-1: 2022	Covers the energy efficiency and functional performance requirements, sampling and test methods for general service lamps and tubular lamps
RS EAS 1064-2: 2022	Minimum energy performance standard for luminaires namely indoor ambient luminaires and outdoor / streetlight luminaires
RS 213: 2022	This standard specifies test methods for the mechanical qualification of domestic solar water heaters
RS ISO 5149-4	Specifies requirements for safety and environmental aspects in relation to operation, maintenance and repair of refrigerating systems and the recovery, reuse and disposal of all types of refrigerants, refrigerant oil, heat transfer fluid, refrigerating system and part thereof
RS ISO 16358-1: 2013	Specifies the testing and calculating methods for seasonal performance factor of equipment for Air-cooled air conditioners and air-to-air heat pumps. This standard focuses on the cooling seasonal performance factor.
RS ISO 16358-2: 2013	Specifies the testing and calculating methods for seasonal performance factor of equipment for Air-cooled air conditioners and air-to-air heat pumps. This standard focuses on the heating seasonal performance factor.
RS ISO 16358-3: 2013	Specifies the testing and calculating methods for seasonal performance factor of equipment for air-cooled air conditioners and air-to-air heat pumps. This standard focuses on the annual performance factor.

The Rwanda Cooling Initiative's Green On-Wage (R-COOL GO) financing mechanism[35] was launched in January 2022 to ensure environmentally friendly refrigerators and air conditioners are widely available and reasonably priced in Rwanda. R-COOL GO was launched by the Rwanda Ministry of Environment through the Rwanda Environment Management Authority (REMA). New cooling equipment comply with stringent performance standards established by the Ministry of Environment through REMA, in coordination with the Basel Agency for Sustainable Energy (BASE) and the United for Efficiency (U4E) team of the United Nations Environment Program (UNEP). A rebate coupon is provided as an incentive for customers to donate old, functional cooling equipment for safe recycling. The coupon can be used to get a 15% discount on a subsequent purchase from the vendor.

3.5. Policy and legal framework

In Rwanda, the waste management structure consists of national level policymaking institutions, and a mix of national and local level implementation agencies alongside regulatory bodies.[36] Kigali has a more relatively developed e-waste management eco-system than other parts of the country. City of Kigali launched the new Master Plan 2050 which specifies areas meant for essential infrastructure and recycling activities.[37] Rwanda Green Growth and Climate Resilience Strategy implemented resource-efficient design in the Special Economic Zone (SEZ) in Kigali for energy efficient lighting, energy and water metering, wastewater recycling and recycling of other waste products.[38] The SEZ was designated and developed to accommodate different types of industries including; heavy and light manufacturing industries, large-scale industrial plants, industries requiring excellent national/international communication network, industries requiring close links with other firms, pharmacy and plastics companies, warehousing, tourism and service industry and telecommunications among other services[39]. Rwanda's continued efforts include the ambitious adoption of legislative bans on the manufacture, importation, use and sale of polyethylene bags in 2008.[40]

The e-waste policy and regulatory environment in Rwanda is quite advanced, with the country being one of just 13 nations in Africa with national legislation governing e-waste control. The majority of the 13 African nations that had established e-waste rules and regulations as of 2019 have implemented Extended Producer Responsibility (EPR) programs in some way. EPR, which makes the manufacturers of electronic devices liable for the take-back, recycling, and final disposal of the electronics, is being increasingly incorporated into e-waste regulations across the continent. Such regulations are meant to encourage manufacturers to create recyclable goods and, by providing reverse logistics, to assist move the ecosystem in the direction of a circular economy [41]. Presently, majority of these countries have commenced drafting of EPR regulations, including their compliance and monitoring schemes, and this requires defining value chain actors. Côte d'Ivoire, Cameroon,

---

[35] A New Opportunity for Rwandans to Affordably Purchase Appliances that can Reduce Electricity Bills and Impacts on the Environment - United for Efficiency (united4efficiency.org)
[36] Waste Management in Kigali City | Karenzo M . Evariste - Academia.edu
[37] Kigali City Masterplan 2050 | Department of Economic and Social Affairs (un.org)
[38] Rwanda Green Growth and Climate Resilience: National strategy for climate change and low carbon development | Green Growth Knowledge Partnership
[39] Kigali Special Economic Zone
[40] Plastic Waste Management in Rwanda: An Ex-post Policy Analysis (worldbank.org)
[41] From Problem to Profit: Rewiring the E-Waste Value Chain in Africa - NextBillion

Ghana, Madagascar, Nigeria, Rwanda and South Africa emphasize that 'producers' include importers, distributors and manufacturers of electronics[42]. This makes it efficient to identify who must register with the associated EPR scheme. Rwanda is currently in the process of developing EPR implementation guidelines[43]. A stakeholders consultation workshop was carried out in July 2022 to facilitate a coordinated plan across government, with input from the electronics industry, to implement EPR guidelines.

Rwanda is a signatory to several agreements and conventions on environmental management including support for the provisions of Agenda 21, the Rio Declaration of 1992 on Environment and Development, a party to the Basel and Bamako Conventions on control of transboundary movements of hazardous materials and their disposal.[44] These provide overarching guidelines for e-waste management. The country has a National E-waste Management Policy that provides detailed guidance and policy direction on the appropriate legal and regulatory instruments for e-waste management. Additionally, Rwanda launched its National Circular Economy Action Plan which details high level ambitions as well as meaning and potential of circular economy efforts. E-waste is one of the focus areas in the Action Plan.

The Development Bank of Rwanda (BRD), in collaboration with Enviroserve Green Park developed a framework as a guideline on the approach for collection, transportation, storage and disposal of spent batteries extracted from solar home systems[45] The proposed framework for handling and management of e-waste generated from solar home systems (SHS) starts with supply of the SHS to the recipient/customer. When the supplied system experiences defects or needs a battery replacement, the recipient informs the supplier who should then collect all generated e-waste – including the spent battery – back to the solar company and transported carefully to their collection center or nearby Enviroserve Rwanda Green Park (ERGP) collection site, if any is available. Temporarily disposed e-waste at the companies' warehouse should then be transported to the ERGP collection center at District level to organize transportation to the recycling plant in Bugesera District. Enviroserve notes that this system is working effectively as old or broken batteries sent in by the solar companies are tested, recharged, repacked and returned to the market for second life. Enviroserve, in partnership with Aceleron equip the second-life batteries with a remote sensing device that tracks its performance and enables preventive maintenance contributing to the extension of the battery lifespan. Service fees for the collection and recycling are paid by the solar company as per their service agreement with ERGP. Failure to comply with this agreement can lead to disbursement cancelation or termination of contract between the Development Bank of Rwanda – Rwanda Environment Fund (BRD-REF) and the approved solar companies.[46] No SHS supplier/company is allowed to perform dismantling and recycling of components unless it holds an authorization issued by relevant authorities in Rwanda. As part of the monitoring process, random visits are done by REF Environmental and Social Safeguard specialists at various solar companies'

---

[42] Policy practices for e-waste management: Examples from African counties
[43] WEEE policy support for Rwanda
[44] RW-04_National_E_waste_Policy_2018_Revision.pdf (eaco.int)
[45] RWANDA RENEWABLE ENERGY FUND
[46] REF_ECOP_Manual.pdf (brd.rw)

warehouses/collection centers to assess compliance to the e-waste management guidelines and procedures.

Listed below are legal frameworks and regulations implemented in Rwanda that have a direct impact on stakeholders in the e-waste value chain.

- The Rwanda Standards Bureau (RSB) in collaboration with the Ministry of ICT established the Ministerial Order No: 1 of 25/10/2011 aimed to restrict and regulate importation of used computers and electronic parts.[47]

- The Organic Law of 2005 was revised in 2018. One of the main reasons for revision was to include provisions related to e-waste. The resultant Environment Law (2018), officially Law N°48/2018 of 13/08/2018 on Environment, includes Article 20 on e-waste management. The law recognizes e-waste as hazardous and toxic and must be collected, treated and changed in a manner that does not degrade the environment so as to prevent, eliminate or reduce adverse effects on human health, natural resources and environment. It also limits the collection, transportation, trading, importation, dismantling and recycling of e-waste to those who are authorized by a competent authority[48].

  Regulations

- In 2022, The Rwanda Inspectorate, Competition and Consumer Authority (RICA) put into force regulations that would require any person who intends to carry out trade of **used** electrical or electronic equipment to apply for a license from the authority[49]

- Rwanda Utilities Regulatory Authority (RURA) issued Regulation n⁰002 of 26/04/2018 that governs e-waste management on Rwanda regarding safe disposal and recycling of EoL electrical and electronic equipment. It reiterates that any person carrying out activities related to e-waste collection, transportation, retailing, importation, dismantling, recycling, refurbishment, shall hold an appropriate license issued by RURA.[50] Any individual that fails to comply to the regulation is required to pay a fine.

- Starting July 2022, a regulation banning import of e-waste, including cathode ray tubes (CRTs), came into effect in the East African Community. This also stipulates that electronic gadget vendors operating in the region are responsible for handling the waste generated by their products.[51] The specific responsibilities are not defined in the regulation. This regulation amplifies how regional blocs can embolden the resolve to tackle electronic waste by collectively putting in place practical measures. These include, strengthening border checks at a time when cross border trade is more open, while individually bridging policy gaps[52].

Table 18 outlines these regulations, who they impact and how they impact these stakeholders.

---

[47] National e-waste management policy, 2016
[48] Best Practices and Challenges in implementation of E-waste Policy and Regulatory Framework in Rwanda
[49] Dealers in used electrical equipment urged to comply with regulations
[50] Proper E-waste Management in Rwanda – ALU Global Focus
[51] RWANDA: Kigali sensitize on the sustainable management of electronic waste | Afrik 21
[52] https://www.fairplanet.org/editors-pick/the-menace-of-electronic-waste-in-africa/

Regulation	Description	Stakeholders Impacted
Rwanda Standards Bureau (RSB) Ministerial Order No: 1 of 25/10/2011	Regulates the importation of used computers into the country	■ Importers ■ Wholesalers ■ Retailers
RICA appliance trading regulation	Used appliance retailers required to apply for licenses	■ Retailers ■ Wholesalers ■ Importers
RICA appliance manufacturing regulation (still in draft phase)	Producers of electronic and electrical equipment must register their products with RICA	■ Manufacturers/Producers ■ Importers ■ Assemblers
	Any person carrying out activities related to e-waste collection, transportation, retailing, importation, dismantling, recycling, refurbishment, must hold an appropriate license issued by RURA.	■ Importers ■ Wholesalers ■ Retailers ■ Consumers ■ Appliance/appliance parts collectors ■ Refurbishers ■ Recyclers ■ Materials recovery companies ■ Waste collection and disposal companies (both general waste and e-waste)

There is no information available on the impacts of these regulations. This could largely be due to a lack of practical guidance to clearly distribute roles and responsibilities throughout the e-waste management chain[53]. As a result, e-waste stakeholders are unaware of their responsibilities. This was witnessed during stakeholder interviews, as many of the businesses that were approached had no awareness of the regulations that impacted them, and those that did could not describe their effects.

Nonetheless, the research partner noted that the Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA) conducts inspections to enforce the regulations on

---

[53] 1.   ACE-TAF, Best Practices and Challenges in implementation of E-Waste Policy and Regulatory Framework in Rwanda, 2021

importation and trading of used electronic appliances. There is low enforcement of the RURA e-waste management regulation. Traders still conduct illegal appliance auctions and e-waste is collected by informal sector players without licenses.

3.6. Challenges and barriers to the e-waste ecosystem

Common challenges facing the management and recycling of solid waste in Rwanda include a lack of segregation at source, of institutional capacity and of available & reliable waste data.[54] Specific to e-wastes, a lack of awareness, knowledge, and technical capacity among the citizens to handle e-waste has resulted in poor e-waste management with individuals and institutions storing large amounts of e-waste without any proper segregation. This was ascertained by the household survey findings, as most of the respondents indicated that they not only had failed appliances in their houses but also lacked awareness of more sustainable means for e-waste disposal. Owing to this lack of information, surveyed households were also more likely to dispose of their e-waste together with their household garbage. This was observed in the household survey data as mentioned in the findings section.

Solid waste contractors collect waste indiscriminately from different places and dump them at allocated landfills without any segregation of e-waste. In some cases, valuable components are recovered, and non-valuable component are left mixed with other waste[55].Here, solid waste collectors, sort the waste, extracting valuable materials such as metals and then send the rest of the waste to landfill sites. Infrastructure to collect e-waste is still a major challenge and the reason why e-waste ends up disposed through open dumping, burning and landfilling. The insufficient enforcement of a legal framework, due to a lack of practical guidance in the form of a ministerial order to clearly distribute roles and responsibilities throughout the e-waste management chain, has made it challenging to enforce regulations. This, coupled with the inadequate financial capacity of collection companies are other major challenges hindering effective and regular e-waste collection.

The main challenges specific to the recapture & recycling of off-grid solar e-waste include[56]:

■ High collection costs from remote areas due to logistical costs and incentives in the form of compensation to give up the products

■ Battery diversity and the accompanying lack of infrastructure to recycle lithium-based batteries which must be shipped out of Rwanda for recycling. Lead-acid batteries can be recycled locally by Enviroserve

■ Multiplier effects because of product bundling and inter-dependent software and /or hardware components of a system. The typical distribution model of bundling SHSs with other end-use appliances increases overall waste volumes, therefore increasing collection costs. The multiplier effect is especially challenging when SHS and appliances are "locked" together by

---

[54] Benchmarking performance of solid waste management and recycling systems in East Africa: Comparing Kigali Rwanda with other major cities - Telesphore Kabera, David C Wilson, Honorine Nishimwe, 2019 (sagepub.com)
[55] Renewable Energy Fund Project
[56] https://www.clas. .ngo/wp-content/uploads/2021/01/Solar-E-Waste-Market-Scoping-Report.pdf

proprietary software or hardware and cannot be used independently. If just one part of a system fails, its still-functional accessories and appliances may become waste too.

Listed below are some of the challenges mentioned by stakeholders during interviews carried out for this study.

- A lack of adequate manufacturer/wholesaler support. This makes it difficult for retailers in need of product guidance and take-back options to properly handle non-functioning appliances. It also makes it challenging for repairers and recyclers to repair appliances for which they have little knowledge of their parts, systems and operation.

- Poor working conditions affect repairers, collectors and recyclers as they do not have the protective gear and tools required to protect them from hazardous materials. Some of them also have very small business sites which makes it difficult to manage the materials they receive.

- A lack of training on how to fix certain appliances was also highlighted by some of the stakeholders. This calls for better collaboration with manufacturers.

- A shortage of tools or equipment needed to fix appliances. This is especially challenging for repairers who fix computers and laptops which require software that is difficult to access

- The absence of clear appliance testing mechanisms makes it difficult for retailers to confirm that appliances in their stock are functioning properly. Additionally, repairers and recyclers are unable to confirm whether the appliances they work on are fully fixed.

- A shortage of appliances to salvage parts from is experienced by recyclers and repairers. This indicates a lack of proper channels for product and component recovery to actors in the ecosystem that can reuse or repurpose them.

- Waste disposal companies mentioned transportation issues. This could be attributed to high costs incurred when setting up proper transportation systems to collect waste from households that they serve. It is also expensive to maintain the trucks used to collect and transport the waste to disposal sites.

Stakeholder
Ecosystem

4. Stakeholder Ecosystem

At present, solid waste management for households in Rwanda is managed in hierarchy, linearly. Although overall waste generated is collected and disposed of in landfills, there is little formal recycling of inorganic waste and reprocessing of organic waste. Since 2012, waste collection services have been assumed by the private sector and are overseen by the Rwanda Utilities Regulatory Authority[57]. Despite an increase in waste collection, Kigali is short of its targets with a desire to properly dispose of 60% of waste collected by 2020 and 80% by 2030.[58] Some of the solid waste collection companies active in Kigali, as of 2019 included AGRUNI, COPED, Ubumwe Cleaning Company, Inzira Nziza, COCEN, Isuku Kinyinya, Indatwa, Baheza, and Real Protectors.

Tumba College of Technology was the only institution in Rwanda that would refurbish broken computers and printers in 2016. Their efforts saved money from the government that would have been used to buy new devices like computers for use in school. Broken down devices were refurbished and later sent to various secondary schools within the country.[59] Between 2012 and 2016, Tumba College successfully refurbished 600 computers. Presently, the repair facility at the institution is no longer functional.

Enviroserve Rwanda is the leading formal recycler in Rwanda and is involved in the collection and proper disposal of e-waste, with over 16 e-waste collection points installed across Rwanda. They engage directly with the informal sector through capacity-building sessions and carry out the refurbishment of computers for schools. Enviroserve also collaborates closely with the Government of Rwanda and participates in the development of policies for e-waste. The Enviroserve Rwanda Green Park (ERGP) recycling plant has a capacity to process up to 10,000 metric tons of e-waste per year. Inside their facilities, Enviroserve boasts state-of-the art electronic waste recycling machinery and a "laboratory" for solar product repair and refurbishment. It collects e-waste dropped off at collection points and then separates materials that can be refurbished and recycled, while others are disposed of in an eco-friendly manner. By 2021, the recycling factory had provided more than 600 people access to formal training and employment opportunities, enhancing their quality of life. Their managing director stated in 2021 that if the outdated electronic equipment had not been recycled, it would have released 2,000 tons of carbon into the atmosphere[60]. The facility is currently operating at 30% of its installed capacity due to low public awareness and motivation to take back e-waste for recycling. This was observed in household surveys as the majority were unaware of e-waste collection and disposal services available to them.

Wastezon is a technology company established in August 2018 and based in the Rwandan capital Kigali. The company utilizes software systems for tracking and management of e-wastes, such as a smartphone app that connects consumers who are stuck with used goods like TVs and mobile phones with recycling firms.[61] Recyclers can offer to acquire the waste when consumers register

---

[57] Infrastructure Case Study: Agruni
[58] National Sanitation Implementation Strategy of 2016
[59] Rwanda to enforce policy on disposal of e-waste - The East African
[60] The rising e-waste crisis is being reckoned with in Rwanda, one gadget at a time
[61] Rwanda's Trash Warrior Tackles E-Waste With Blockchain | OZY

their used devices with a preferred price, establishing a direct connection between households and recyclers. In Rwanda, the company has benefitted over 1,800 households, 150 "e-scrappers," or individuals, and at least three recycling plants. It has also facilitated the recycling of over 580 tonnes of e-waste through its app[62]. Rwanda's cooling green-on-wage financing mechanism (R-COOL GO I)[63] initiative has involved efforts by financial institutions like the Bank of Kigali (BK), Guarantee Trust Bank (GT Bank), and vendors like: Hotpoint Rwanda, Akagera Business Group Africa (ABG), Alien Technologies and Denmar Ltd. Key government and private organizations involved in e-waste management in Rwanda are detailed in Table 19 below[64].

TABLE 19: GOVERNMENT AND PRIVATE ORGANIZATIONS INVOLVED IN E-WASTE MANAGEMENT

| Institution	Role
Ministry in charge of ICT	Lead the development and implementation of e-waste policy and regulations
Ministry in charge of Trade and Industry	Ensure the development of sustainable e-waste management implementation models and incentives to attract investments in e-waste control
Ministry in charge of Health	Develop policies that govern health and safety standards relating to e-waste management
Ministry in charge of Education	Lead the development of e-waste management curricula to grow the required skills at local and national level of the workforce for proper e-waste management and recycling
Ministry in charge of State Assets	Develop a procedure for information clean up before decommissioning government electronic assets owing to the sensitivity of information stored
Authority in charge of environmental protection	Spearhead mainstreaming of e-waste into existing environmental policies, strategies and regulatory instruments, and monitor implementation of e-waste management programs
ICT Regulatory Authority	Enforce e-waste management policies through issuance of regulations, technical guidelines and licensing regime for entities involved in e-waste management
Authority in charge of standards (RSB)	Notify World Trade Organization (WTO) member states of established EEE standards, policies & regulations affecting quality of imports into the country, develop e-waste management standards, develop mechanism for audit & monitor compliance to standards
Authority in charge of Imports Inspection (RICA)	Enforce compliance of all imported electric and electronic equipment at point of entry using set standards
Authority in charge of customs and revenues (RICA)	Maintain statistical records of both EEE manufactured in Rwanda and imports
Private Sector	Operationalize e-waste management policy and strategic plan through planning and establishment of collection, transportation, and treatment & recycling facilities

[62] Africa ClimAccelerator Start-Up Spotlight: Wastezon
[63] Launch of Rwanda Cooling Initiative's Green On-Wage (R-COOL GO) financing mechanism
[64] fonerwa.org/ksp/sites/default/files/National E-Waste Management Policy for Rwanda.pdf

A draft preliminary stakeholder map (Figure 28) was generated, deriving information from literature and early insights from the research partner. It shows the key players within the ecosystem and depicts the potential flow of appliances and e-waste from one stakeholder to another.

FIGURE 28: PRELIMINARY STAKEHOLDER MAP
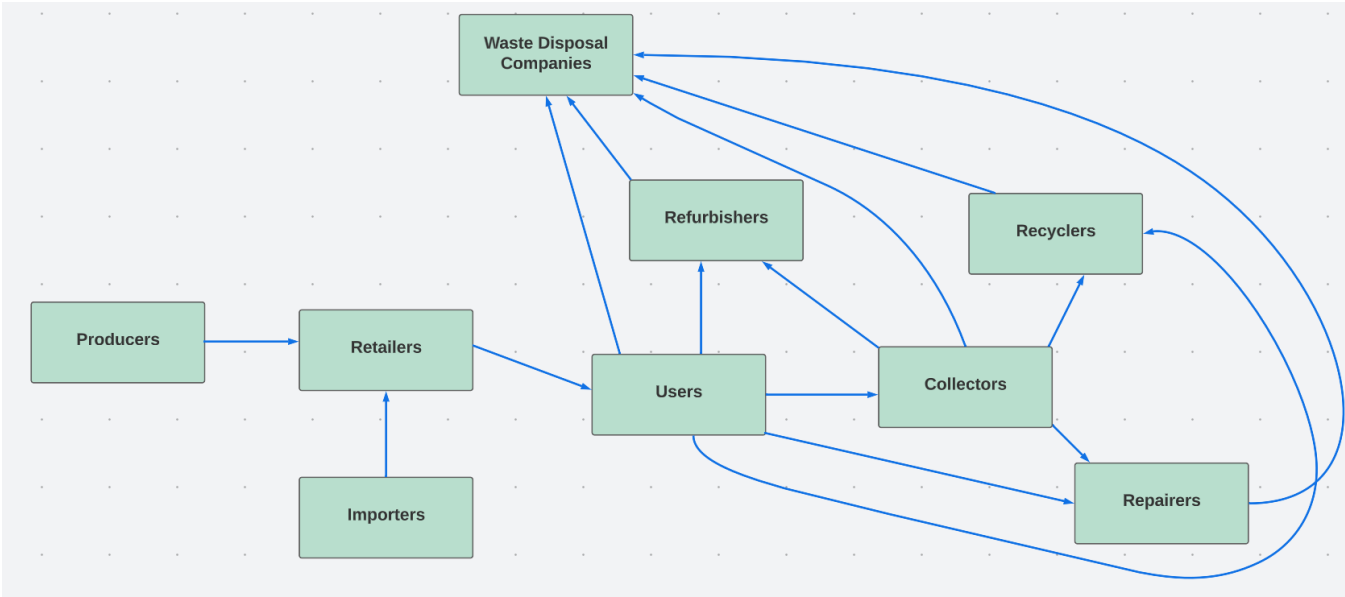
Utilizing this information, the team in collaboration with the research partner, contacted stakeholders in Rwanda. Table 20 below summarizes the stakeholder groups from whom data was derived.

TABLE 20: INTERVIEWED STAKEHOLDER GROUPS

Stakeholder group	Number
Appliance retailers	11
Local repair shop	8
Collectors	6
Waste disposal	6
Importers	3
Recyclers	2
Manufacturer	1
Industrial scale refurbishment	1
Government Agency	1

Information obtained from the interviews provided an understanding of the roles played by these stakeholders, their interactions, and the appliances/materials they handle.

4.1. Findings from Stakeholder Interviews
4.1.1. Government Agency

Government agencies formulate and enforce policies and regulations for the industry. One government agency, the Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA, was interviewed for this study. Their primary role in the ecosystem is to regulate, enforce and provide licenses for the trade of appliances in the country. They stated that they provide licenses, safety gear and awareness to players in the e-waste value chain. Moreover, they indicated that they are moderately aware of the level of e-waste management in the country and track appliance importation and e-waste disposal data in Kigali and Musanze.

Regarding e-waste targets they are hoping to attain, RICA mentioned that they would like to reach a 70% e-waste awareness level countrywide. Currently, this lack of awareness has contributed to little co-operation from the Rwandan population on proper e-waste disposal. To curb this challenge, they believe that more awareness and strengthening of the existing enforcement capacity is needed.

4.1.2. Importers

A total number of three new appliance importers, all located in Kigali, were interviewed for this study. These businesses buy foreign appliances from distributors and manufacturers abroad and then introduce them into the local market by selling them to **new appliance retailers and wholesalers**. They typically source their appliances from **Korea, Egypt, China, India, and Dubai.** All the importers interviewed mentioned that they **do not import** used appliances.

When asked if they collaborate/work with other businesses in the appliances market or e-waste ecosystem, they stated that they engage with **other new appliance importers, new appliance retailers and appliance manufacturers.** They also indicated that they stock a wide variety of appliances including TVs, radios, microwaves, kettles, electric hot-plate cookers, electric pressure cookers, electric fans, lighting appliances and washers/dryers. Of the three importers, two indicated that they imported a diverse range of appliance brands. These brand types **included Samsung, LG Von/Hotpoint, Panasonic, Maier, and Philips**. Once imported, the importers test the appliances to ensure that they are in working condition. They do this by plugging them into power sockets to confirm that they are functional and by having service center technicians ascertain that their performance matches expectations listed in the product manuals. Appliances that are not working are sent back to foreign manufacturers.

The importers were unwilling to provide quantitative information concerning the number of appliances they import and sell. Some of the concerns were around data usage and regulatory scrutiny. Nonetheless, one of the businesses indicated that they had noticed a change in the number of TVs sold during the 2019-2021 period. The number of TVs sold increased from 1144 in 2019 to 1192 in 2020. This number, however, decreased by 32% in 2021 to 806 appliances. This

decrease could be attributed stringent control measures put in place to prevent the spread of the COVID-19 virus, which led to a reduction in household purchasing power[65].

Only one of the respondents had appliances that they were unable to sell each year. They attempt to sell these appliances to other retailers or return them to foreign appliance wholesalers/manufacturers.

Two of the respondents were aware of appliances standards and labelling and indicated that they were very important to their businesses. This is because their customers often inquire about appliance standards and labelling when making purchases.

When asked if they had received any support from manufacturers, all the businesses indicated that manufacturers and distributors had supported them by providing demonstrations on appliance usage, offering delivery options and warranties. Additionally, all the importers mentioned that they were currently not facing any challenges. A small sample size was interviewed and thus cannot be used to establish that importers in Rwanda do not face any barriers. Since Rwanda is a landlocked country, with transportation costs for imports and exports among the highest in the world[66], it is likely that this may pose a challenge for appliance importers.

4.1.3. Appliance Manufacturers

Appliance manufacturers typically produce and assemble electrical products which are then sold to consumers by local wholesale and retail stores. They could also include foreign appliance manufacturing companies that have set up manufacturing plants in the country. The team engaged with **one appliance manufacturer** located in Gasabo District, Kigali. This was a smaller-scale manufacturing business that had 16 staff and had only been in business for about a year. The business manager was interviewed. He indicated that he was aware that disposed electrical appliances pose environmental risks and that some parts of electrical appliances can be profitably recycled. However, they do not include environmental impact in their product design.

This business only manufactures TVs and radios. They were unwilling to provide information on the average number of appliances manufactured and sold each year. They did, however, mention that they have their own wholesale shop where they sell appliances to consumers. Moreover, they also sell their manufactured products to other wholesale stores. Materials sourced for assembling into the finished product are imported from China.

It was noted that appliance standards and labelling and product warranties were very important to this business as customers (wholesalers) often ask about them when purchasing the appliances. The business manager mentioned that they offer product warranties that cover product replacement and repair, and this is included in the sales price. They also offer product take-back options to their customers. They, however, did not provide information on what they do with these

---

[65] Rwanda Key Message Update: Reinstated COVID-19 restrictions reducing incomes for poor urban households July 2021
[66] https://www.trade.gov/country-commercial-guides/rwanda-market-challenges

taken back appliances. Nonetheless, this is a system that can be used to set up e-waste management systems in the country, whereby customers return appliances at their end of life to manufacturers, after which they are refurbished or salvaged for parts. Lastly, this business indicated that it is not facing any challenges related to appliance manufacture, sale, or e-waste disposal. This cannot be a universal experience for other players in the appliance manufacturing industry in Rwanda, especially given that importing parts into Rwanda is very expensive as it is a landlocked country.

4.1.4. Retailers

Appliance retail stores sell new and/or used appliances to end users. These appliances are derived from **manufacturers, distributors, importers, and wholesalers**. **11 appliance retailers** were interviewed for this study. These businesses were located across the 4 selected regions for data collection in Rwanda. **All the retail stores primarily sold new appliances, with three of them also selling used appliances to customers**. Additionally, the retail stores interviewed had an average number of about 2 staff members actively working there.

Businesses were asked to classify their businesses as large-scale retail stores, medium-scale retail stores and small-scale retail stores based on their sales volumes and sales prices. **Here, 44% (n=4) identified themselves as small-scale retailers, 44% (n=4) as medium scale retailers and 11% (n=1) identified themselves as a large-scale retailer**. This can be seen in the figure below.

FIGURE 29: TYPES OF RETAIL STORES INTERVIEWED (RWANDA RETAIL STAKEHOLDER INTERVIEWS N=11)
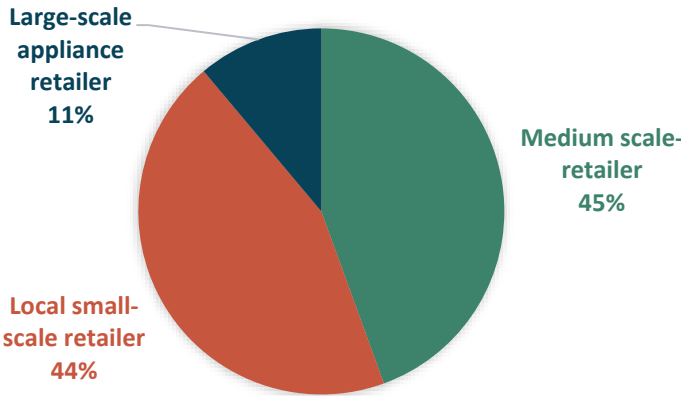
7 of these retail stores indicated that they function within the formal sector, **to mean that they are legally registered and licensed to carry out their business**, while the remaining stores stored function within the informal sector. When asked which other businesses they typically interact with, the retailers mentioned:

- other appliance retail stores (n=8)
- local repair shops (n=6)

- new and used appliance importers (n=5)
- general waste collection and disposal (n=5)
- appliance/ appliance parts wholesalers (n=2)
- appliance/ appliance parts collectors (n=2)
- e-waste collection and disposal (n=2)
- appliance manufacturers (n=1)

When asked where they source their appliances, majority of the retailers (n=7) mentioned that they get them from wholesalers, followed by local manufactures (n=3), auctions/auctioneers (n=1) and importation (n=1). The business that indicated that they import their appliances sources them from Uganda. Appliances sold by these businesses included TVs, radios, lighting appliances, electric clothes ironing appliances, blenders, kettles and computers/laptops. **Most of the retailers (n=8) primarily sold TVs and radios.** Of the retail stores that also sold used appliances, 2 out of 3 only sold computers and laptops. None of the retailers sold electric ovens, electric hot-plate cookers or electric pressure cookers. A variety of appliance brands are sold by these retailers. Table 21 below has the different types of appliance brands sold by these retailers.

TABLE 21: APPLIANCE BRANDS SOLD BY RETAILERS (RWANDA STAKEHOLDER INTERVIEWS N=10

Brand Type	Number of interviewed businesses that stock brand
Samsung	7
LG	6
Hisense	4
Stone	4
Sony	3
Panasonic	2
King	2
Skyworth	2
HP	2
Dell	2
Lenovo	2
Philips	1
Apple	1

Majority of the retailers were unwilling to provide quantitave data. Only four respondents provided data pertaining to the average number of appliances sourced to sell, those sold, and those that they

are unable to sell per year. Cumulative numbers for the appliances handled by the interviewed respondents are shown in Table 22.

	Cumulative number of appliance units
Appliances sourced to sell each year	690
Appliances sold to consumers annually	411
Appliances unsold each year	512

The large difference observed between the number of appliances sold each year vs those that remain unsold could possibly be due to inaccurate reporting by respondents on the quantities that they handle each year. It could also have been caused by the relatively small sample size.

The businesses that sell computers and laptops take the appliances that they are unable to sell due to malfunctions or faultiness to e-waste disposal centers (Enviroserve Rwanda Green Park). The other business that had appliances it was unable to sell each year mentioned that it sends them back to the wholesaler.

Retailers (81%) ranked cost as the leading factor that their customers consider when making purchasing decisions. This was followed by quality/durability/longevity as the second leading factor and appliance energy consumption. This differed from observations obtained from household interviews where quality/durability and longevity were ranked higher than cost. It should be noted that the retailer sample size was quite small and thus it is possible that the findings would have matched the household survey data if a larger sample size was obtained. Figure 30 below illustrates how the retailers ranked factors that influence consumer purchasing decisions.

FIGURE 30: RETAILERS RANKING OF FACTORS THAT INFLUENCE CONSUMER APPLIANCE PURCHASING DECISIONS (RWANDA STAKEHOLDER INTERVIEWS N=11)
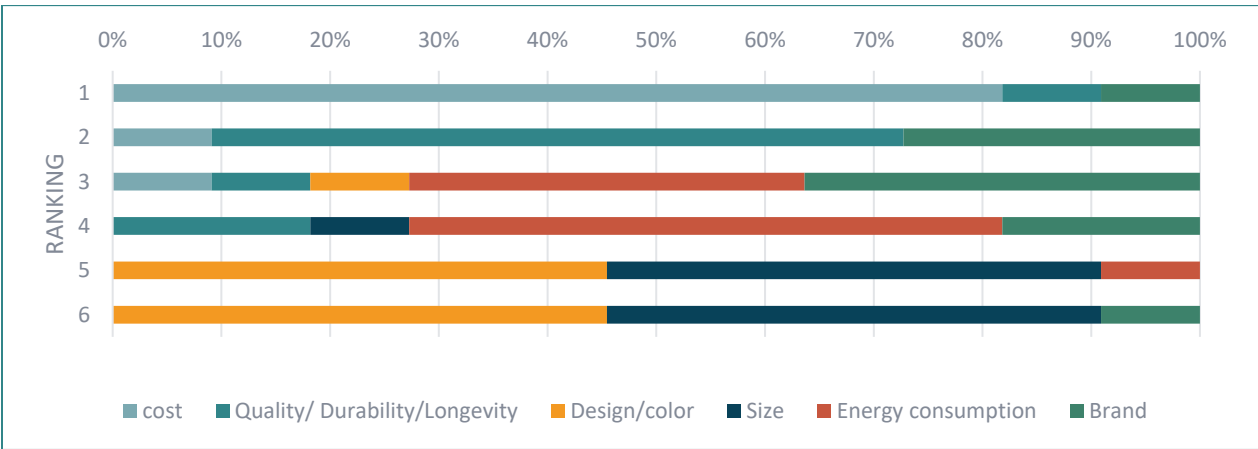
Majority of the interviewed retailers (n=9) offered both one-time cash payments and payment with instalments plans to their customers. All these retailers mentioned that one-time cash payments were preferred by their customers which matched results highlighted in the household survey findings section.

55% (n=6) of the interviewed businesses said that their products were of a very high quality. This was followed by 36% (n=4) indicating that they had high quality products and 9% (n=1) having moderate quality products. Due to the small sample size, it was difficult to note any observable differences in perception between the formal sector businesses and the informal sector businesses. The figure below highlights retailer perception of their product quality.

FIGURE 31: RETAILER PERCEPTION OF PRODUCT QUALITY (RWANDA RETAILER INTERVIEWS N=11)
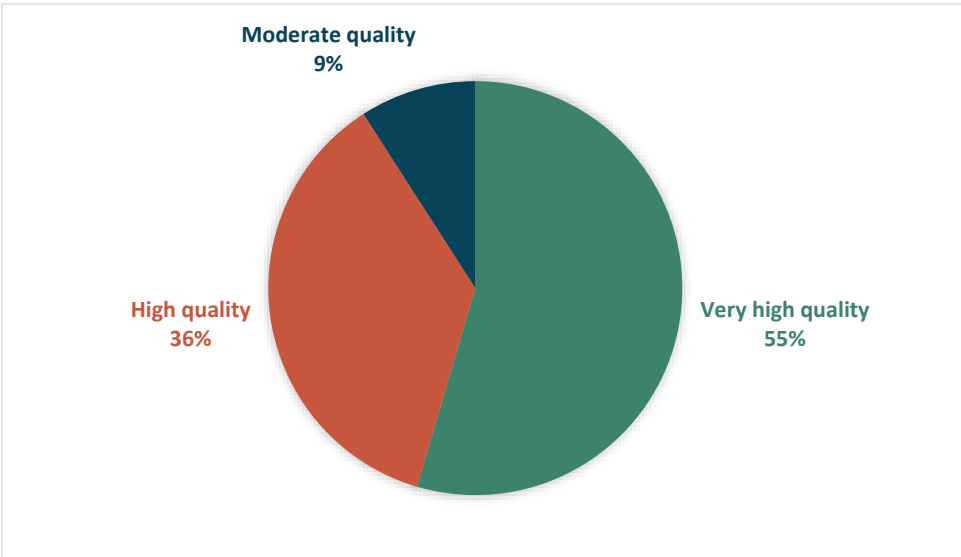
10 out of 11 of the businesses offered product warranties to their customers. These warranties typically covered product repair and replacement. 50% (n=5) of these businesses indicated that their warranties were included in the sales price while the other half did not provide information on how they make warranties available to consumers. **6 out of 10 of** these retailers stated that their customers make use of these product warranties. In addition, two retailers indicated that they receive an estimated 1 to 3 warranty claims each year.

91% (n=10) of the retailers offer customer support after purchase. This support includes product delivery, appliance replacement and appliance repair services. Most of the retailers (n=6) received wholesaler support which included financing/payment plan options, product delivery, product repair and take-back upon end of life. This can be utilized to set up sound e-waste management channels whereby consumers return non-functioning appliances to retailers who then send them back to wholesalers and manufacturers where they can be salvaged for parts or sent to e-waste recycling and refurbishment centers.

8 of the 11 retailers were aware of appliance standards and labelling, considered them important to their businesses, and informed their customers about them during sale.

Table 23 below summarizes the challenges highlighted by retailers. These included a shortage of customers, which could indicate low household purchasing power; lack of adequate manufacturer/wholesaler support and poor working conditions.

TABLE 23: CHALLENGES FACED BY RETAILERS IN RWANDA (RWANDA HOUSHOLD SURVEYS N=7)

Challenge	Number of businesses that indicated that this is a challenge they face
Shortage of customers	5
Lack of adequate manufacturer/wholesaler support	4
Poor working conditions	2
Lack of training on how to fix certain appliances	1
Inadequate facility size	1
Shortage of appliances for sale	1
Lack of repair/processing tools and technologies	1
Lack of appliance testing mechanisms	1

4.1.5. Repairers

Appliance repair shops restore broken/damaged appliances to working condition. The 8 repair shops that were interviewed were rural small-scale businesses that handle appliance repair for residents living near the shops. Two of the interviewees stated that they also carry out materials recovery where they salvage usable components from appliances for re-use. Table 24 highlights the stakeholders that the local repair shops collaborate/work with.

Stakeholder group	Number of repair shops that mentioned that they collaborate with this stakeholder
Other local repair shop	6
General waste collection/disposal	4
New Appliance retailers	3
Used appliance retailer	3
Recyclers	1
E-waste collection and disposal	1
Materials recovery	1

5 out of 8 of the interviewed repair shops are formal sector businesses while the remaining three are informal sector businesses. 75% (n=6) of the interviewees were aware that discarded electronic appliances pose environmental risks and that they can be profitably recycled. This demonstrates an awareness among repairers of the value of e-waste. Appliances repaired included TVs, radios, fridges, mobile phones, lighting appliances, kettles, electric ovens, electric hot-plate cookers, rice-cookers, hairdryers, blenders computers/laptops, electric fans, electric clothes ironing appliances and space heaters. TVs, radios, clothes ironing appliances, kettles and mobile phones were among the most popular appliances brought in for repair by customers. Table 25 below outlines these findings.

TABLE 25: MOST COMMON APPLIANCES BROUGHT INTO SHOPS FOR REPAIR (RWANDA REPAIRERS INTERVIEWS N=8)

Appliance	Number of repair shops that mentioned that this was a very common appliance
TV	7
Radio	7
Kettle	6
Mobile phone/charger	6
Clothes iron	5
Computer/laptop	4

Repairers provided quantitative data pertaining to appliances/materials handled. This was summarized to establish cumulative appliance and materials flow to and from repairers. This cumulative data can be found in Table 26.

Yearly amounts	Cumulative quantities
Number of appliances repaired	10,312 units
Number of irreparable appliances	73 units
Amount of materials used in the repair process	960 kgs
Amount of waste derived during the repair process	353 kgs

This was collected from a small sample size within the provincial city and rural districts and is thus not indicative of the actual cumulative amounts handled by repairers in Rwanda.

Repairers stated that screen damage, audio issues, wiring/cables failure and lighting damage were common issues that their customers brought in to be addressed. The interviewees were aware of the potential causes of these failures but did not provide further information regarding them.

The appliances in Table 27 below were listed as difficult to repair by respondents.

TABLE 27: DIFFICULT APPLIANCES TO REPAIR (N=8)

Appliance	Number of repair shops that indicated that it was difficult to repair
Space Heater	3
Vacuum cleaner	3
Dish waster	3
Computer/laptop	3
Electric pressure cooker	3
Blender	2
Coffee Machine	2
Air-fryer	2
Printer	2
Electric oven	2
Electric hot-plate cooker	2
Rice cooker	2
Fridge	2
TV	2

Respondents (50%, n=6) ranked the cost of parts as the biggest inhibiting factor that hampered the repair of above-listed appliances. This was followed by the unavailability of parts in the market (50%) as the second hampering factor and lack of knowledge/awareness on how to repair these appliances as the third.
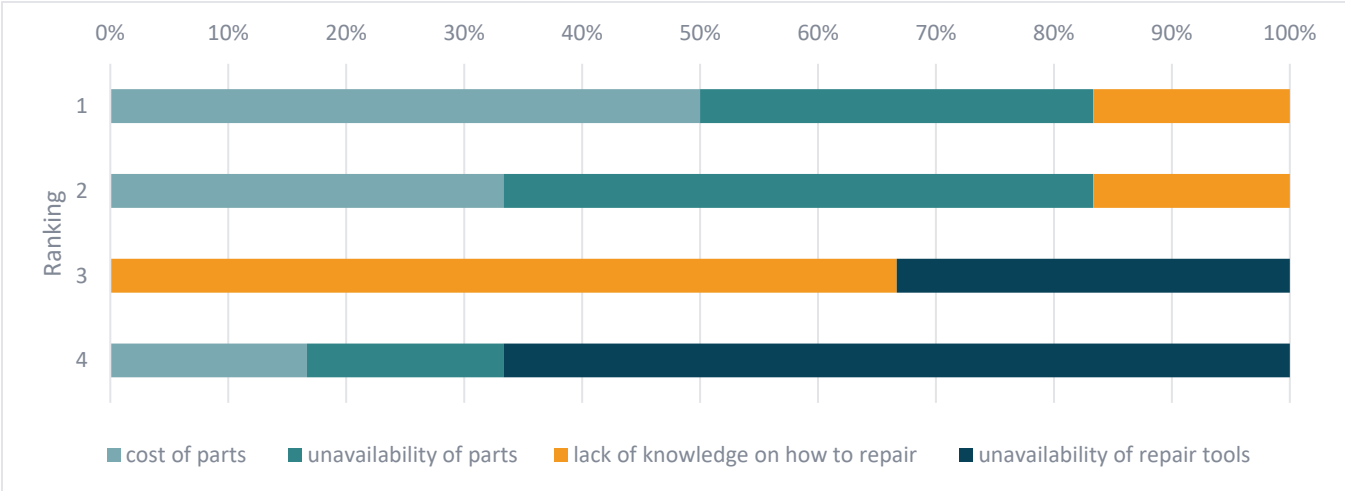
Common tools used to process the faulty appliances include screw drivers, pliers wire cutters multimeters, soldering irons, and wrench sets. When asked if there were any tools that were often difficult to access either due to their cost or unavailability in the local market, some of the respondents listed computer software or programming tools that would be needed to repair faulty computers.

The local repair shops stated that **they generally store appliances that they are unable to repair and then salvage them for parts**. Two of the interviewed businesses indicated that they return these appliances to customers**.**

7 of the 8 interviewed repair shops derived waste during their appliance repair process**. 57% of these respondents disposed of this waste with their garbage**. This would then be sent to landfills by garbage collectors. The figure below outlines repair shop waste disposal behaviour.
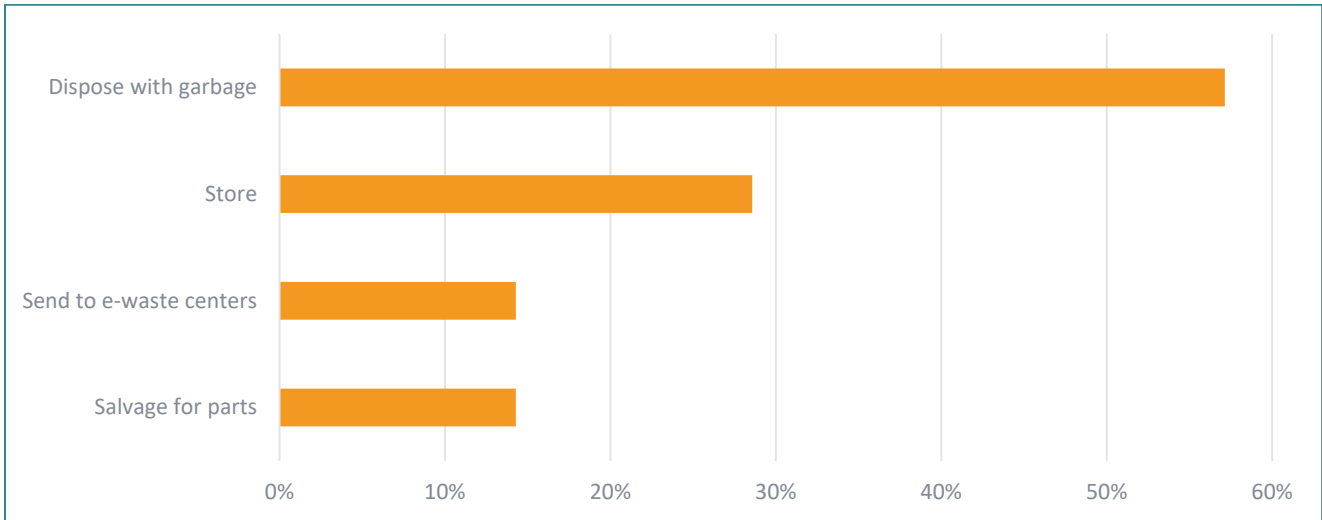
Two of the interviewed businesses said that it costs them an average of about FRW 70,000 (USD 64) per year to source parts for repair**.** When asked **where they sourced the parts they use for repair**, 83**% (n=5) mentioned appliance retailers ,** 33% (n=2) appliance manufacturers and 17% (n=1) other repairers.

5 out of 8 of the respondents charge their customers less than 20% of the original appliance price for repair. When this was further disaggregated based on formal /informal sectors, results shown in Table 28 below were obtained. This could possibly indicate that informal sector repairers are cheaper for customers.

TABLE 28: AMOUNT CUSTOMERS CHARGED FOR REPAIR (RWANDA REPAIRERS SURVERY N=8)

Amount as a percentage of original appliance price	Number of formal sector repairers	Number of informal sector repairers
Less than 20%	2	3
21-40%	1	
41-60%	1	
61-80%	1	

When asked why their customers choose to repair rather than to replace their appliances, **most of the repairers (7 out of 8) indicated that it was much cheaper for their customers to repair the appliances than to replace**. Figure 34 below summarizes the reasons provided by repairers as to why their customers repair rather than replace.
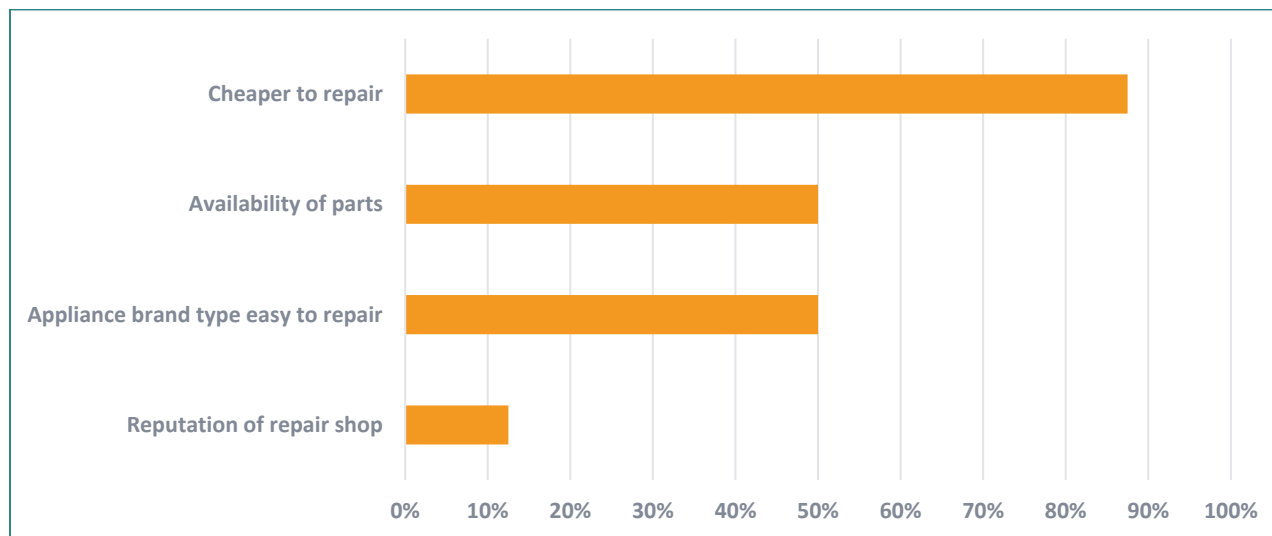
Lastly, repairers were asked to list the challenges they commonly face and majority of them cited a lack of training and availability of appropriate tools and technologies to repair certain appliances. Table 29 below outlines these challenges and the number of respondents who mentioned them.

TABLE 29: CHALLENGES FACED BY REPAIRERS (RWANDA REPAIRERS SURVERY N=8)

Challenge	Number of formal sector repairers	Number of informal sector repairers
Lack of training on how to fix certain appliances	4	3
Lack of tools and technologies	4	2
Poor working conditions	3	1
Inadequate facility size	2	1
Shortage of customers	2	3
Inadequate supply of parts	2	
Lack of manufacturer support	2	1
Lack of proper waste disposal mechanisms & facilities	1	
Lack of appliance testing mechanisms	1	1
Shortage of appliances for use in salvaging parts	1	2
Consumer appliance quality concerns	1	
Total number of respondents	**5**	**3**

4.1.6. Recyclers

For this study, recyclers are defined as informal or formal businesses that dismantle appliances for their parts which are later used for repair or manufacture. They are considered to function on a smaller scale than the industrial refurbishers. **Two recyclers were interviewed by data collectors in Muhanga.** One of the interviewed recyclers was primarily a local repair shop that also carried out materials recovery and recycling. This specific recycler worked in the informal sector while the other was a formal sector recycler. **They both mentioned that they only interact/work with general waste collection and disposal companies**. In addition, they each had only one staff member. This illustrates that they are smaller-scale recycling facilities.

Appliances recycled by these businesses included TVs, radios, mobile phones, lighting appliances, microwaves, kettles, computers/laptops, clothes ironing appliances, printers, hairdryers, and blenders.

One of the recycling businesses provided the following quantitative information.
- Recycles an average number of 467 appliances annually.
- Produces 100 kgs of e-waste yearly.

When asked if they utilize used items during appliance processing, one of the recyclers mentioned that they make use of cathode ray tubes and LCD panels. These used items are utilized because they are cheaper to access than newer alternatives.

Both businesses indicated that they utilize recycled parts to repair or refurbish items and then sell them to households. These included cathode ray tubes and LCD panels. Tools that they use to process the appliances include screw drivers, pliers, wire cutters, multimeters, soldering irons, and wrench sets.

Waste derived through the recycling process is stored by the recyclers and then salvaged for parts. Waste that cannot be salvaged is disposed with the garbage and eventually sent to landfills by general waste collection and disposal companies.

Challenges listed by both the recyclers included:
- Lack of appliance testing mechanisms
- Lack of tools and technologies for appliance recycling
- Shortage of appliances to salvage parts from
- Lack of appliance manufacturer support
- Customer complaints
- Lack of support from local governments
- Lack of support from manufacturers/retailers
- Lack of measures to handle faulty appliances

- Poor working conditions
- Shortage of customers
- Lack of training on how to fix certain appliances

4.1.7. Refurbishers

These are large-scale companies or organizations that dismantle appliances for their parts and then use these parts to restore products to a state that can re-enter the market. Through refurbishment, a product's functionality can also be improved. **The refurbisher interviewed for this study was the research partner, Enviroserve Rwanda Green Park.** They are a formal sector industrial scale refurbisher. Enviroserve Rwanda Green Park works with the following other businesses in the e-waste ecosystem:

- Used appliance wholesalers and retailers
- General waste collection/disposal companies
- E-waste collection and disposal companies
- Government agencies

They mainly refurbish TVs, mobile phones, computers, and laptops. The interviewed refurbisher noted that they **refurbish an average number 7,043 appliances each year**. These appliances are sourced from public and private institutions nationwide. They also collect a variety of appliances and parts from households for refurbishment. Once the refurbishment process is complete, the products are sold to used appliance wholesalers.

During the refurbishment process, the following recycled materials are used:

- Circuit boards
- Batteries

Enviroserve stated that these recycled materials are used because they are more easily accessible to them than newer versions. This is because they have access to a lot of appliances that they can salvage for parts. They also make use of the following tools: screw drivers, pliers, multimeters, wire cutters and soldering irons.

The refurbisher indicated that they are not facing any challenges. In addition, they are aware of the RICA regulation on used appliance trading and the RURA e-waste regulation. These regulations have had a positive impact on their business. They stated that compliance with these regulations results in proper e-waste collection, transportation, refurbishment, and disposal in an environmentally friendly manner. This is positive and aligns with their environmental protection goals.

4.1.8. Appliance/Appliance parts collectors

These are large or small-scale businesses that collect faulty or non-functioning appliances and their parts. **Six collectors were interviewed for this study**. Based on early insights from research partners and the literature review, we expected that these businesses would then sell these parts to households, repairers, recyclers and refurbishers. However, we found that they sold them to appliance manufacturers, repair shops, and scrappers. This could be because all the collectors interviewed were licensed waste disposal companies.

All the interviewed collectors were private and formal sector businesses. Only two of the businesses stated that they collaborate with other stakeholders in the ecosystem. The stakeholders that they collaborate with include:
- New appliance importers
- New and used appliance retailers
- Industrial scale refurbishment companies
- Local repair shops
- General waste collection/disposal
- Recyclers
- Government agencies
- Appliance manufacturers

All these collectors were aware of the potential hazards posed by e-waste and agreed that e-waste could be profitably recycled. Items commonly collected by these businesses included **cathode ray tubes, LCD panels, aluminum, circuit boards, copper, brass, batteries, iron, and lead**. Collectors interviewed gathered parts from a variety of appliances such as TVs, fridges, mobile phones, lighting appliances, microwaves, kettles, rice cookers, electric ovens, electric hot-plate cookers, electric pressure cookers, toasters/sandwich makers, computers/laptops, air conditioners, electric fans, clothes ironing appliances, vacuum cleaners, printers, hairdryers blenders and space heaters. These appliances and materials were sourced from:
- Households (n=6)
- Repair shops (n=3)
- Retailers (n=2)
- Garbage bins (n=2)
- E-Waste disposal centers (n=1)
- Landfills (n=1)

They provided quantitative data on the number of appliances and materials collected each year. This is summarized in Table 30 below.

Yearly amounts	Cumulative quantities
Number of appliances collected	12,060 units
Number of materials collected	233,687 units

5 out of 6 of the collectors mentioned that they had materials that they were unable to sell after collection. They stated that these unsold materials would be sent to the landfill. However, they did not quantify the number of appliances/materials that they are unable to sell yearly. Only one of the interviewed collectors repaired and refurbished some of the collected appliances using tools such as screw drivers, pliers, wire cutters, multimeters, soldering irons, and wrench sets.

Just one collector noted that their business was experiencing challenges. This collector indicated that poor working conditions were affecting their business. In addition, one collector mentioned that they were aware of the RURA used appliance trading regulation and that it had no effect on their business.

4.1.9. Waste collection and disposal companies

These are the private waste collection and disposal companies that collect waste from households, private organizations and public institutions and then dispose of it at landfills. **6 waste disposal companies were interviewed.** Of these companies, one of them mentioned that they also handled e-waste collection and disposal. Two of the interviewed waste disposal companies stated that they collaborate with other stakeholders in the appliance market and e-waste ecosystem. The businesses they collaborate with include:

- New and used appliance retailers
- Industrial scale refurbishment companies
- Local repair shops
- Other general waste collection/disposal companies
- Recyclers
- Government agencies
- Appliance manufacturers
- New appliance importers

5 out of 6 of these companies had handled electrical appliances during collection and disposal. The appliances included TVs, fridges, mobile phones, lighting appliances, microwaves, kettles, rice

cookers, electric ovens, electric hot-plate cookers, electric pressure cookers, toasters/sandwich makers, computers/laptops, air conditioners, electric fans, clothes ironing appliances, vacuum cleaners, printers, hairdryers blenders and space heaters. They indicated that they **handled an average number of 11,266 appliances annually**. Two of the interviewed companies mentioned that the e-waste encountered was increasing annually while one company noted that it was decreasing. They were all located in Kigali city. Given the small sample size, we cannot conclude from these results that the e-waste amount is decreasing or increasing. **The e-waste encountered is then sent by these collection and disposal companies to landfills or recyclers for processing**. Collected residual waste, which was defined as general household waste collected by waste collection and disposal companies is highlighted in Table 31 below.

TABLE 31: RESIDUAL WASTE COLLECTED BY WASTE COLLECTION AND DISPOSAL COMPANIES(RWANDA WASTE DISPOSAL STAKEHOLDER SURVEYS N=6)

Residual waste	Number of companies that encounter it at their site
Plastic	6
Styrofoam	6
Paper	6
Detergents/cleaners	5
Kitchen waste	5
Cardboard	5
Glass	5
Rubber	5
Metal waste	5
Piping	4
Textile/leather	1
Pharmaceutical waste	1

The cumulative amount of residual waste handled by these companies was 2,400 tonnes.
Residual waste collected was sent to landfills, buried, or sent to recyclers. **Majority of the companies (3 out of 5) stated that they did not believe that their e-waste disposal method (dumping at landfills) was environmentally friendly**. On the other hand, **4 out of 6 of the companies stated that their residual waste disposal method (dumping at landfills, recycling, and burying) was environmentally friendly**.

Challenges mentioned by these companies included:
- Inadequate facility size

- Shortage of waste collection customers
- Poor working conditions
- Customer complaints
- Transportation issues of general waste
- Difficulties in general waste collection due to prices

Only two interviewed companies had knowledge of the RURA e-waste regulation. One mentioned that it had positively impacted their business and the other that it had no effect.

4.2. Stakeholder ecosystem mapping using Net-Map Tool

A Stakeholder Mapping (SHM) exercise to identify the key stakeholders pertinent in the support of proper appliance end-of-life and e-waste disposal practices in Rwanda was carried out using the net-map methodology. Net-map analysis aids in the understanding, visualization and discussions centered in situations where diverse actors influence outcomes. It not only assisted in the identification of stakeholders currently involved in the e-waste ecosystem, but also in the definition of their roles and responsibilities relative to each other. The created network influence maps explained the diverse linkages, varied goals, and different levels of influence among the various stakeholders. These linkages were drawn from literature review and interview findings.

Further, the net-maps fostered an analysis of the material-flow of e-waste amongst the stakeholders, further detailing how they inter-relate in this regard. Determining the goals, linkages, and level of influence informed which links to strengthen and which stakeholders to leverage. Net map images, narratives and influence-interest matrices for the focus areas were generated as below.

The linkages between stakeholders were categorized based on:

- **Appliance flows**: There exists a flow of appliances between these stakeholders
- **Repair & servicing**: Stakeholders are involved in repairing or processing appliances for other players in the ecosystem.
- **Materials Handling**: Stakeholders primarily handle materials. For example, this is demonstrated by the flow of materials to and from collectors and materials recovery companies.
- **E-waste disposal**: Stakeholders encounter e-waste at disposal sites.
- **Standards and regulations**: Stakeholders enforce regulations on other players in the ecosystem.

These links were used to define the 122 observed relationships amongst actors. Out of the 122 relationships, 13 represented weak links, 84 were normal/default and the remaining 25 were strong. The figures below illustrate results derived from the net-mapping analysis.

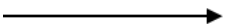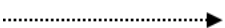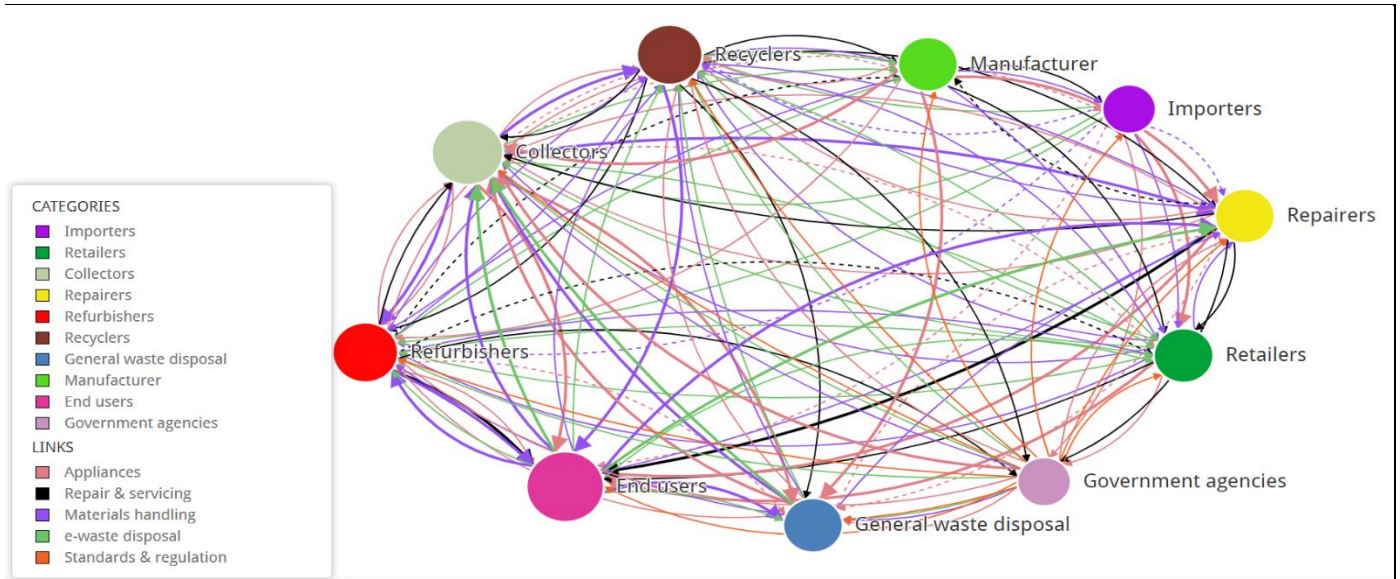FIGURE 35: KEY FOR ILLUSTRAYION OF LINKAGES

Illustration of Linkage	Interpretation
→	Strong link
→	Default/Normal Link
·····▸	Weak Link

N.B. The size of the stakeholder is proportional to their influence, i.e., the bigger the size the greater the influence.

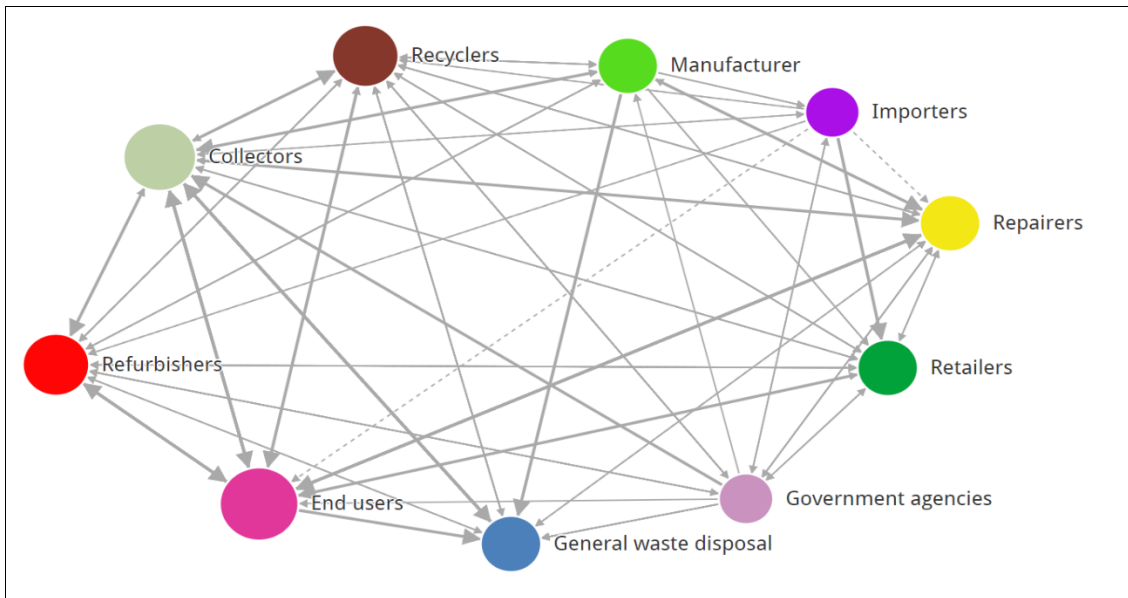A simplified version of this map merging all the links between stakeholders is shown below.

FIGURE 36B: NET-MAP ILLUSTRATING STAKEHOLDERS SUPPORTING PROPER APPLIANCE EOL & E-WASTE DISPOSAL PRACTICES.

From the net-map exercise, end users and appliance/appliance parts collectors are considered highly influential[67] in the support for proper appliance EoL and disposal practices in Rwanda and

---

[67] A rating of between 8 - 10

strongly support the same. During the stakeholder engagements, collectors were identified as the stakeholder category handling the greatest quantities of appliances and appliance parts/materials in a year. Repairers and recyclers are other stakeholder categories with high influence and strong support for proper e-waste disposal. With a moderate influence of 6-7, product manufacturers, importers, retailers, refurbishers, general waste disposal companies and government agencies generally support proper e-waste disposal.

As earlier explained in the methodology section, NetMap provides a visual representation of the network and insights into the dynamics of influence rather than a precisely calculated rating. This is attributed to its qualitative approach which is subjective and context-dependent solely based on the perceptions and interpretations of the actors involved. Therefore, for this study the influence rating was determined as follows:

Influence Rating	Influence Description	Justification
1-3	Low	The actors in this category: i) **Minimal Interactions:** Have limited direct interactions with other stakeholders as well as infrequent and/or insignificant connections and engagement with other actors. ii) **Limited Capacity:** Have a lower level of capacity or expertise in comparison to actors with high influence and their contributions to the decision-making process may be limited or unvalued. iii) **Minimal Leverage:** Have little leverage or ability to influence decisions or bring about significant change and their influence is often marginal or negligible.
4-7	Medium	The actors in this category have: i) **Indirect Interactions:** They may not directly interact with all stakeholders, but they have connections with some key actors with indirect influence mediated through other actors. ii) **Moderate Capacity:** They possess a certain level of relevant capacity and expertise and while their capacity may not be as significant as those with high influence, they contribute valuable insights and knowledge to the decision-making process. iii) **Partial Leverage:** Actors have the ability to influence decisions and outcomes to some extent but might face certain limitations. Their leverage is specific to certain rather than having a broad-ranging influence.
8-10	High	The actors in this category have: i) **Direct Engagement**: Actively engage and directly interact with other stakeholders avoiding passive participation. ii) **Substantial Capacity**: Demonstrate a significant expertise, resources and capabilities for decision making process making their contributions highly valued. iii) **Leverage and Impact**: Have the capacity to leverage their influence on decisions and drive change within the stakeholder network

4.2.1. Influence – interest matrix

The image below depicts an influence-interest matrix which further informed the analysis to better understand the significance of each actor in supporting proper appliance EoL and e-waste disposal practices.
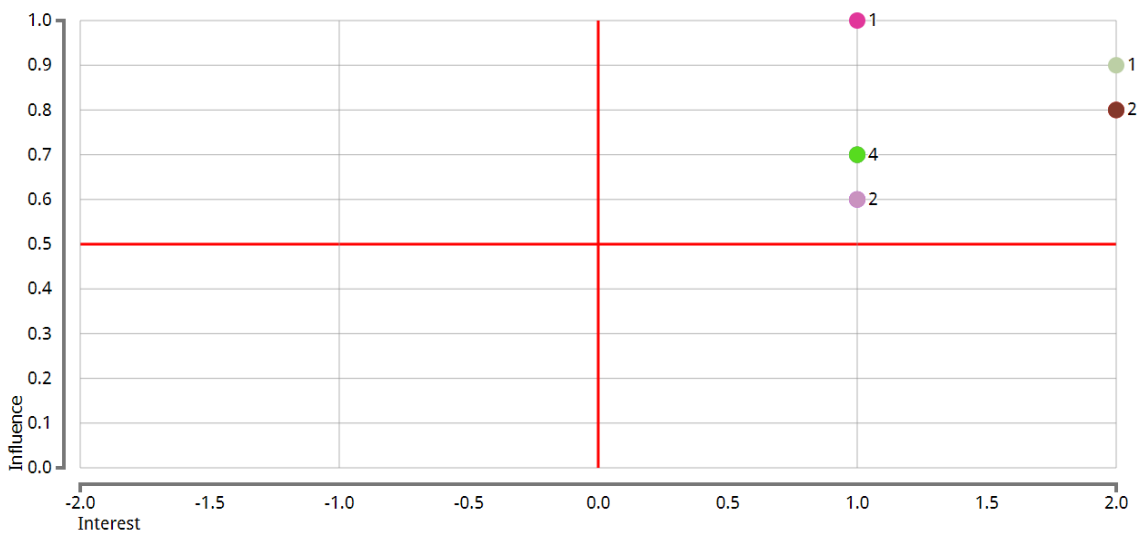
Key:
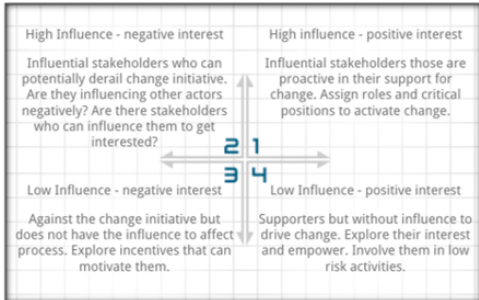
- Horizontal axis (from left to right): **Strongly Against (-2); Against (-1); Neutral (0); Strongly Support (+2); and Support (+1)**
- Vertical axis: Top - **Greatest influence** and Bottom- **Least influence**
- Dots - **Number of actors**

FIGURE 37: INFLUENCE-INTEREST MATRIX FOR THE SUPPORT OF PROPER E-WASTE DISPOSAL

It is interesting to see that the stakeholders all fall within the first quadrant; with high influence and positive interest. Stakeholders engaged in collecting, refurbishing, and recycling have the most interest as well as influence on the e-waste disposal practices. End users of appliances on the other hand have very high influence and moderate interest in proper e-waste disposal practices.

4.2.2. Influence – connections matrix

matrix: influence-connections

Repairers, recyclers, and collectors have by far the most connections (31) and high influence (8) to supporting proper e-waste disposal in Rwanda. Importers on the other hand have few connections (14) and moderate influence (6).

4.2.3. Linkages/connections

Appliances

FIGURE 39: NET-MAP SHOWING APPLIANCES LINKAGE FOR THE SUPPORT OF PROPER E-WASTE DISPOSAL
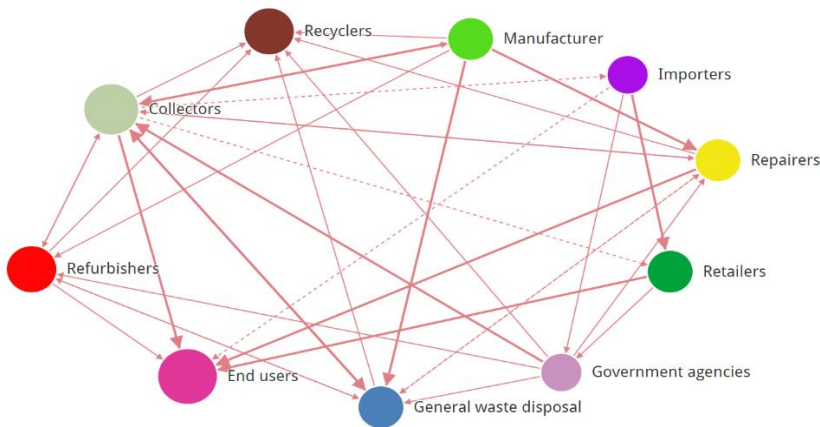
From the situational analysis conducted, there exists various stakeholders who provide appliances to other stakeholders in the ecosystem. Typically, appliances move from manufacturers to importers to retailers to end users (households and commercial consumers) to repairers and collectors. From here they could move on to recyclers, materials recovery, general waste disposal companies,

refurbishers, and back to manufacturers. These stakeholders have normal/default links between them.

Repair & Servicing
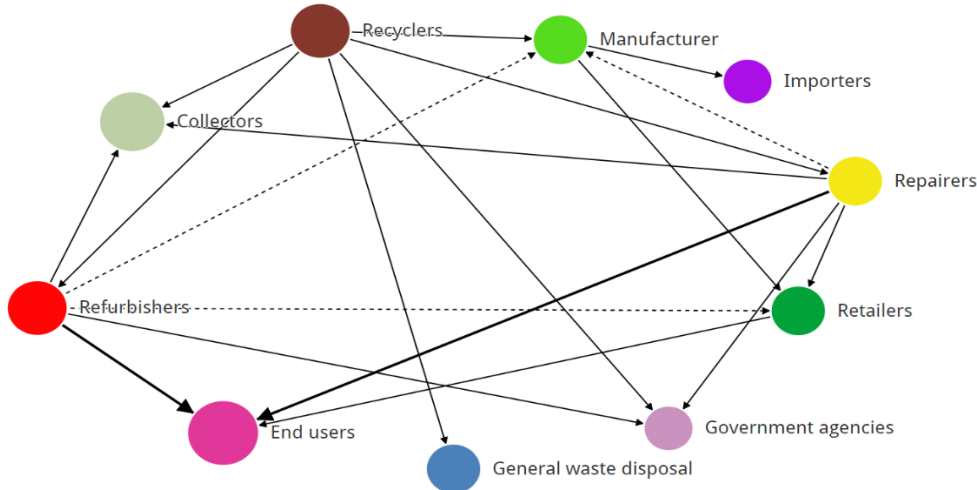
Repair and servicing for EEEs is mainly done by repairers and refurbishers hence strong linkages with end users. On the other hand, the weak linkage between manufacturers and retailers indicates that they are not actively involved in the provision of repair and servicing for appliances. There is an opportunity to explore how strengthening this linkage can lead to an improved e-waste management ecosystem.

Materials Handling

As depicted in the below net-map, EEEs and related materials/wastes typically move across many of the stakeholders, with retailers, collectors, repairers, recyclers and refurbishers handling the largest quantities hence the strong linkages between them. Most material goes through multiple stakeholders along the value chain before finally being disposed of or recycled and returned to manufacturers for re-processing.
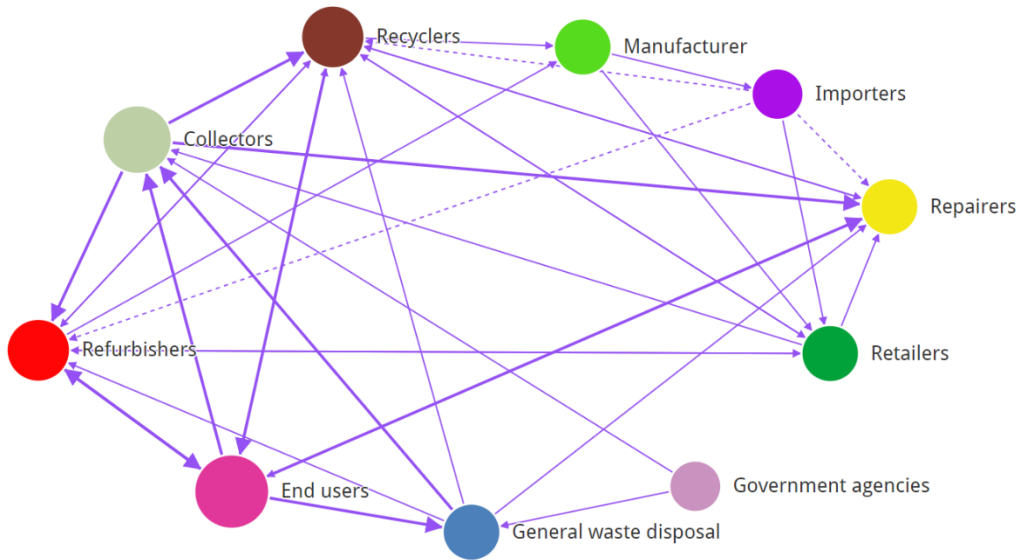
E-waste disposal

Stakeholder survey findings indicated that collectors and repairers handle the bulk of e-waste disposals in Rwanda as shown by the strong linkages in the below net-map. Recyclers, retailers, refurbishers and general waste disposal companies have normal links indicating significant quantities of e-waste flowing through their organizations.

FIGURE 42: NET-MAP SHOWCASING E-WASTE DISPOSAL LINKAGE FOR THE SUPPORT OF PROPER E-WASTE DISPOSAL
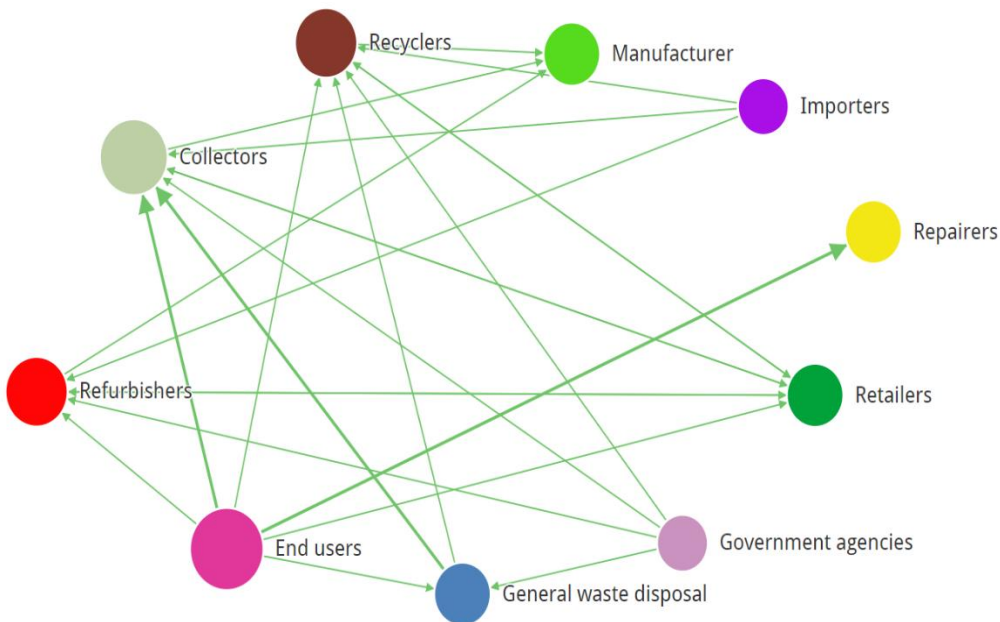
Standards & regulations

The primary role of government agencies is to provide sector oversight, policy guidance and enforcement of standards and regulations for all the stakeholders in the sector. This explains the default links between them, and other stakeholders as depicted in figure 43 below. However

FIGURE 43: NET-MAP SHOWING THE STANDARDS AND REGULATION LINKAGE FOR THE SUPPORT OF PROPER E-WASTE DISPOSAL
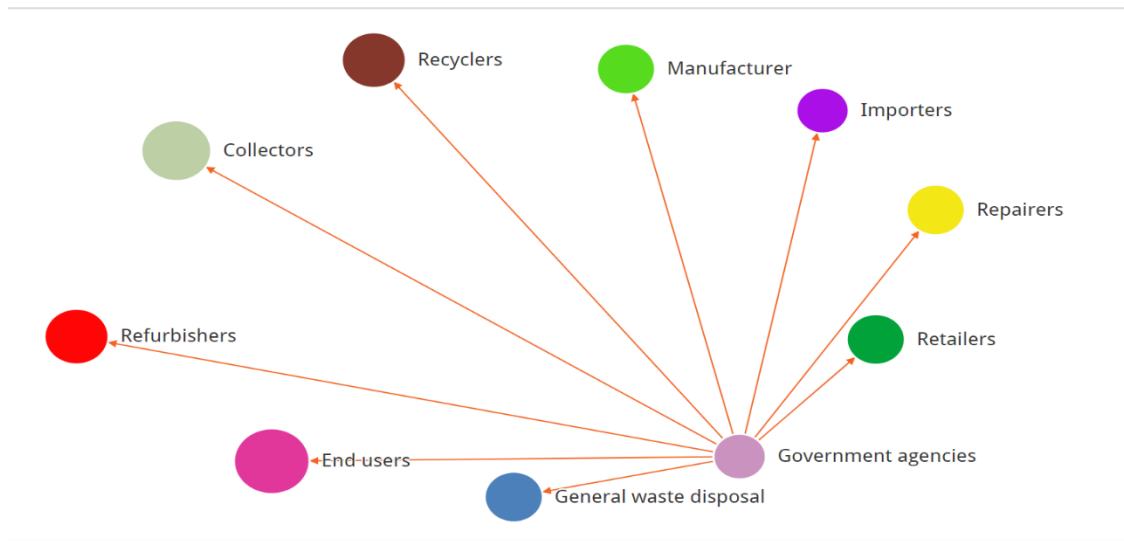
4.3. Materials Flow Analysis

A materials flow analysis was generated using data obtained from the stakeholder interviews. As mentioned in the stakeholder interviews findings section, majority were unwilling to provide quantitative data. This made it challenging to attain reliable estimates of appliances, materials and waste flows. The table below depicts annual summaries for cumulative quantitative data for each stakeholder

TABLE 32: ANNUAL QUANTITIES HANDLED BY STAKEHOLDERS (RWANDA STAKEHOLDER INTERVIEWS)

	Retailers	Repairers	Recyclers	Refurbisher	Collectors	Waste Disposal
Appliances sourced to sell (units)	690					
Appliances sold/collected/refurbished/repaired (units)	411	10,312	467	7,043	12,060	
Materials collected (units)					233,687	
Materials used in processing (kgs)		960				
Unsold appliances (units)	512	73	3			
Appliance /material waste (units)						11,266
Appliance /material waste (kg)		353	100			
Residual waste (kg)						2,400,000

Figure 44 below illustrates these flow volumes within the stakeholder ecosystem.

Key
- Appliance production and sale
- Materials and waste handling
- Waste disposal
- End users/consumers
- Appliance/materials flow
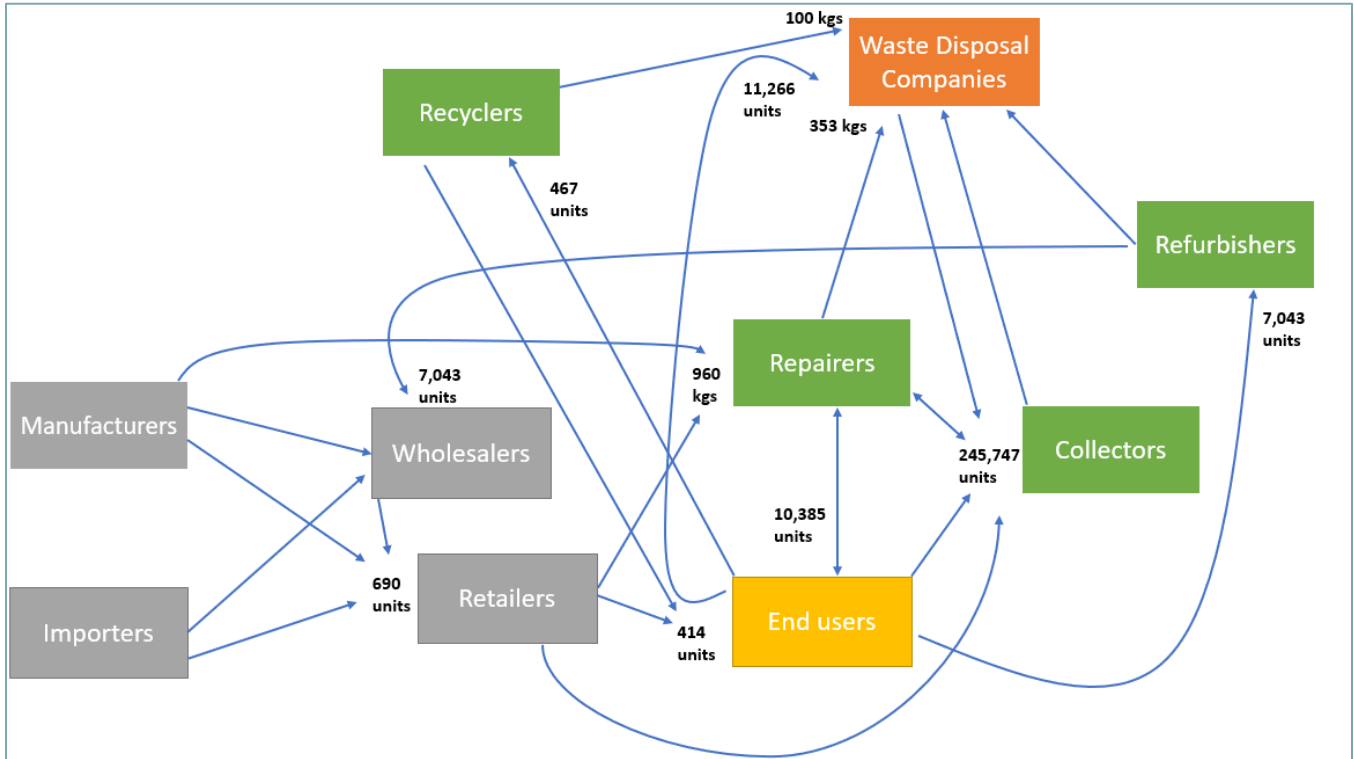
This is further summarized in Figure 45.

FIGURE 45: MATERIALS FLOW
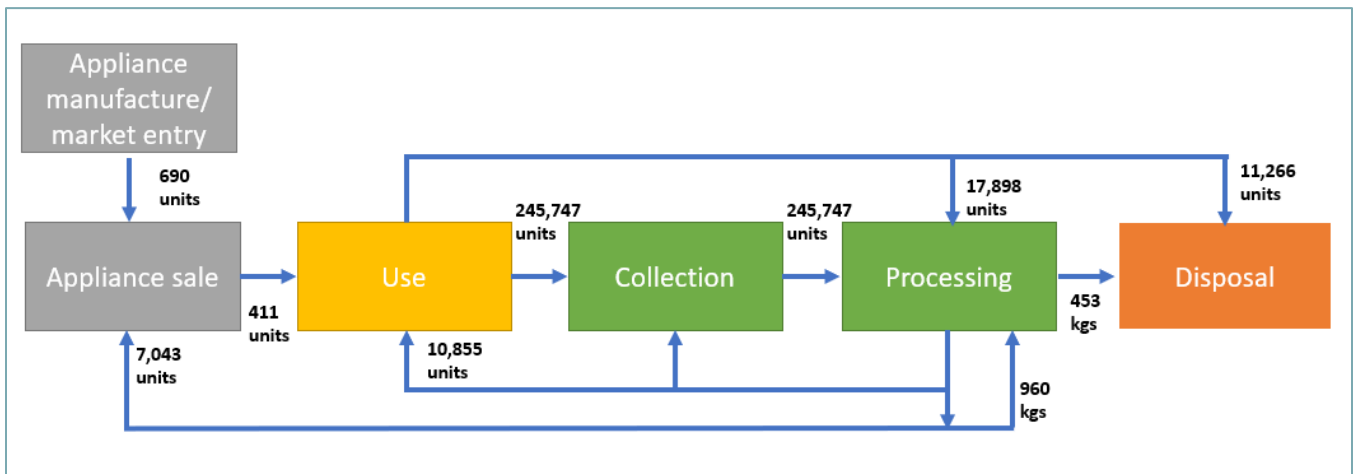
End users in figure 44 refer to households, public and private institutions that purchase appliances for use. Manufacturers and importers did not provide adequate data on appliance/materials flow to retailers. Thus, the values obtained cannot be used to infer the quantities of appliances entering the market in Rwanda. Additionally, flow volumes to end users captured from the retail shops data are quite small. This is likely due to the small retail shops' sample size used for the study. It is therefore not an accurate estimate of appliance flow volumes to consumers in Rwanda.

5. Conclusions and Recommendations

The demand for electrical and electronic appliances has significantly increased in Rwanda due to economic growth and modernization. With Rwanda currently generating an estimated 7,000 tonnes of e-waste annually, a lack of proper channels for e-waste collection and disposal poses numerous threats to peoples' health, the environment and the country's economy.

Only 1% of households in Rwanda use clean cookstoves, and only about 0.21% use electricity for cooking. The primary obstacles hindering the adoption of e-cooking appliances in Rwanda are high upfront costs and consumer perception that such appliances consume a large amount of electricity. To overcome these challenges, strategies such as end-user financing and clean cooking awareness campaigns could be employed. Increased efforts to transition to clean cooking should be paired with proper e-waste handling practices to prevent the exacerbation of the rising e-waste crisis.

Through the establishment of a public-private partnership between the Government of Rwanda and Enviroserve, an e-waste collection system and recycling infrastructure has been developed in the country. This facility has the installed capacity to collect and recycle up to 10,000 tonnes of e-waste annually. However, due to limited public awareness of sustainable mechanisms for disposal of EEE at their end of life, the facility is only operating at 30% of its capacity. Most of the waste handled by the site is collected from institutions in the country, with less than 10% collected from households.

Rwanda has taken many significant steps in adopting and developing regulations to create a sound e-waste management system in the country. They have regulations in place to manage the importation and sale of used appliances, and the collection and disposal of e-waste. However, it faces shortfalls in the enforcement of proper regulatory frameworks. Interviewed stakeholders had little knowledge of the policies and regulations that directly affected their businesses. There is also little information available on the impacts of these regulations on appliance markets and e-waste value chains. This indicates that more needs to be done to effectively implement and enforce these regulations.

Recommendations

Awareness raising and education

Consumer/ end user focused; as per findings from the study, nearly half of the respondents confirmed that their current e-waste management activities are sustainable. This is an opportunity to carry out robust awareness campaigns to sensitize end users on the importance of proper disposal, the role they play, as well as inform them on solutions available to them either from private sector or government. This would contribute to improved protection of the environment and increase e-waste collection rates. Increased e-waste quantities will contribute to maximum utilization of the existing treatment facilities (Enviroserve reported that they only use 30% of their operational capacity).

Manufacturers, wholesalers and retailers should carry out **awareness raising at points of sale**. This would include education on product warranties as well as other existing initiatives such as takeback

on failed products and financial incentives. From the study, despite being informed about product warranties, majority of the consumers did not claim them when their products failed.

Gendered awareness raising: All awareness raising activities should be gender lensed to reach women who are not only users of these appliances, but also purchasers/buyers.

The government also has the responsibility of disseminating information on existing regulations as well as other government-led interventions.

Compliance with existing regulations and augmentation

Rwanda is ahead of the curve compared to many other countries within the content. The country is a signatory to multiple relevant international and regional conventions. Additionally, Rwanda has standards which not only regulate locally manufactured products but also imported products. This is an important step towards stopping the dumping of substandard products. In addition to standards, Rwanda has other policies around e-waste, Extended Producer Responsibility (EPR) and labor regulation. Compliance, however, is a challenge and as a result, reneges the targeted benefits.

The government should increase financing through economic and market-based instruments to support compliance efforts. For example, provision of incentives to different stakeholders as per their role along the value chain.

Collaboration

As evidenced from the stakeholder mapping, the e-waste landscape/ecosystem has multiple players all variably connected with different influence and interest. Collaboration is key to ensuring that all these players contribute meaningfully to achieving sustainable e-waste management and circular economy.

Whereas some of the stakeholders identified themselves as formal sector players, majority are informal. The informal sector should be involved in decision making and the creation of different initiatives. For example, majority of the households interviewed for this study preferred to take their failed appliances to repair shops. Repair shops on the other hand highlighted limited skillset for advanced fault resolution and lack of spare parts as some of their key challenges. Their inclusion during decision making would, for example, result in initiatives that target capacity building and the creation of open spare part markets.

Systemic Data Collection Frameworks

Setting up effective and integrated e-waste management policies and regulations requires an understanding of materials flowing into and out of the ecosystem. Baseline data on materials flow in Rwanda is lacking and the small stakeholder sample size used for the study did not provide adequate estimates of quantities handled by each. This made it challenging to accurately deduce quantities flowing through the ecosystem at a national level. To ensure a precise evaluation of the e-waste flow in Rwanda, the relevant government agencies including those responsible for trade, industry and to create systemic data collection frameworks. These systems would not only track material flows but also all stakeholders along appliance value chains.

According to the International Labor Organization, it is estimated that transitioning to circular economy would provide over six million jobs. A systemic data collection framework would ensure that such impacts can be tracked and are measurable.

References

"Another Milestone Achieved -Two Million Households Have Access To Electricity." Rwanda Energy Group, July 2022.https://www.reg.rw/fileadmin/user_upload/REG_NEWSLETTER_-_ISSUE_NO_14.pdf.

Baldé, C.P., E. D'Angelo, V. Luda, O. Deubzer, and R. Kuehr. "Global Transboundary E-Waste Flows." UNITAR, n.d. https://ewastemonitor.info/wp-content/uploads/2022/06/Global-TBM_webversion_june_2_pages.pdf.

"Best Practices and Challenges in Implementation of E-Waste Policy and Regulatory Framework in Rwanda." *ACE-TAF*, March 2021. https://www.ace-taf.org/wp-content/uploads/2021/05/Best-Practices-and-Challenges-in-implementation-of-E-Waste-Policy-and-Regulatory-Framework-in-Rwanda-Stand-Alone-Solar-Sector-Perspective_-002.pdf.

Byrne, Rob, Beryl Onjala, Jacob Todd, Elsie Onsongo, Telesphore Kabera, Victoria Chengo, David Ockwell, and Joanes Atela. "Electric Cooking in Rwanda: An Actor-Network Map and Analysis of a Nascent Socio-Technical Innovation System." MECS, August 10, 2021. https://mecs.org.uk/wp-content/uploads/2021/08/Electric-cooking-in-Rwanda-an-actor-network-map-and-analysis-of-a-nascent-socio-technical-innovation-system.pdf.

CLASP. "2021 Appliance Data Trends," n.d. https://www.clasp.ngo/research/all/2021-appliance-data-trends-2/.

"Disruptive Innovation for Inclusive Renewable Policy in Sub-Saharan Africa: A Social Shaping of Technology Analysis of Appliance Uptake in Rwanda." *Renewable Energy* 168 (2021): 896–912. https://doi.org/10.1016/j.renene.2020.12.091.

"Electric Pressure Cooking: Accelerating Microgrid E-Cooking through Business & Delivery Model Innovations," July 2020. https://storage.googleapis.com/e4a-website-assets/Accelerating-Microgrid-E-Cooking-Through-Business-and-Delivery-Model-Innovations.pdf.

"Environmental Code of Practice (Used/Spent Battery Management and Disposal under the REF Project)," July 2021. https://www.brd.rw/wp-content/uploads/2022/09/REF_ECOP_Manual.pdf.

Evariste, Karenzo M. *Waste Management in Kigali City*. *Www.academia.edu*, 2020. https://www.academia.edu/50631492/Waste_Management_in_Kigali_City.

Garde, Anne, and Blessing Caine. "From Problem to Profit: Rewiring the E-Waste Value Chain in Africa - NextBillion." nextbillion.net. Accessed April 4, 2023. https://nextbillion.net/rewiring-ewaste-value-chain-africa/.

The East African. "Rwanda to Enforce Policy on Disposal of E-Waste," August 31, 2020. https://www.theeastafrican.co.ke/tea/rwanda-today/news/rwanda-to-enforce-policy-on-disposal-of-e-waste--1354116.

"Integrated Annual Report 2021 amid the Pandemic Rwanda's Economy Supporting." *Development Bank of Rwanda*, 2021. https://www.brd.rw/wp-content/uploads/2022/08/BRD_Annual_report_2021.pdf.

ITU Hub. "Ramping up E-Waste Awareness in Rwanda," June 1, 2022. https://www.itu.int/hub/2022/06/e-waste-awareness-in-rwanda/.

Kabera, Telesphore, and Honorine Nishimwe. "Systems Analysis of Municipal Solid Waste Management and Recycling System in East Africa: Benchmarking Performance in Kigali City, Rwanda." Edited by W. Cui. *E3S Web of Conferences* 80 (2019): 03004. https://doi.org/10.1051/e3sconf/20198003004.

Kabera, Telesphore, David C Wilson, and Honorine Nishimwe. "Benchmarking Performance of Solid Waste Management and Recycling Systems in East Africa: Comparing Kigali Rwanda with Other Major Cities." *Waste Management & Research* 37, no. 1_suppl (January 2019): 58–72. https://doi.org/10.1177/0734242x18819752.

Kovacevic, Michelle. "Rwanda Setting Example for Electronic Waste Recycling." Trade 4 Dev News, July 6, 2020. https://trade4devnews.enhancedif.org/en/impact-story/rwanda-setting-example-electronic-waste-recycling.

Magalini, Federico, Deepali Sinha-Khetriwal, David Rochat, Jaco Huismann, Seth Munyambu, Joseph Oliech, Innocent Chidiabsu, and Olivier Mbera. "Electronic Waste (E-Waste) Impacts and Mitigation Options in the Off-Grid Renewable Energy Sector," December 16, 2016. https://doi.org/10.12774/eod_cr.august2016.magalinifetal.

"National Strategy for Climate Change and Low Carbon Development," October 2011. https://d1bf23g64f8xve.cloudfront.net/sites/default/files/downloads/policy-database//RWANDA%29%20Green%20Growth%20and%20Climate%20Resilience%20-%20National%20Strategy%20for%20Climate%20Change%20and%20Low%20Carbon%20Development.pdf.

nextbillion.net. "Rwanda's Trash Warrior Tackles E-Waste with Blockchain - NextBillion." Accessed April 4, 2023. https://nextbillion.net/news/rwandas-trash-warrior-tackles-e-waste-with-blockchain/.

"Off-Grid Appliance Market Survey," October 2020. https://storage.googleapis.com/e4a-website-assets/CLASP-MarketSurvey-2020-final.pdf.

"Off-Grid Solar Market Assessment Rwanda." *USAID*. USAID, October 2019. https://www.usaid.gov/sites/default/files/2022-05/PAOP-Rwanda-MarketAssessment-Final_508.pdf.

"Rwanda." *GOGLA*, 2021. https://www.gogla.org/sites/default/files/resource_docs/rwanda_country_brief_0.pdf.

"Rwanda Launches Campaign to Boost E-Waste Collection and Recycling." Accessed February 18, 2023. https://www.minict.gov.rw/news-detail/rwanda-launches-campaign-to-boost-e-waste-collection-and-recycling.

Renjifo, Daniel. "The Rising E-Waste Crisis Is Being Reckoned with in Rwanda, One Gadget at a Time." CNN, February 26, 2021. https://edition.cnn.com/2021/02/26/africa/marketplace-africa-ewaste-electronics-recycle-rwanda-spc-intl/index.html.

sdgs.un.org. "Kigali City Masterplan 2050 │ Department of Economic and Social Affairs," n.d. https://sdgs.un.org/partnerships/kigali-city-masterplan-2050.

Statista. "Consumer Electronics - Rwanda │ Statista Market Forecast." Accessed April 4, 2023. https://www.statista.com/outlook/dmo/ecommerce/electronics/consumer-electronics/rwanda.

statistics.gov.rw. "Statistical Year Book 2021 │ National Institute of Statistics Rwanda," n.d. https://statistics.gov.rw/publication/1767.

"TELEVISIONS. Solar Appliance Technology Brief," May 2021. https://storage.googleapis.com/e4a-website-assets/EforA_Solar-Appliance-Technology-Brief_Televisions_May-2021.pdf.

TheGlobalEconomy.com. "Rwanda Female Labor Force Participation - Data, Chart." Accessed April 4, 2023. https://www.theglobaleconomy.com/Rwanda/Female_labor_force_participation/.

"The Global Leap Solar E-Waste Challenge Market Scoping Report," October 2019. https://storage.googleapis.com/e4a-website-assets/Solar-E-Waste-Market-Scoping-Report.pdf.

"The State of the Off-Grid Appliance Market," October 2019. https://www.clasp.ngo/wp-content/uploads/2021/01/SOGAM-Report-ExecSummary.pdf.

Trade 4 Dev News. "Rwanda Setting Example for Electronic Waste Recycling," July 6, 2020. https://trade4devnews.enhancedif.org/en/impact-story/rwanda-setting-example-electronic-waste-recycling.

Twagirayezu, Gratien, Olivier Irumva, Abias Uwimana, Jean Claude Nizeyimana, and Jean Paul Nkundabose. "Current Status of E-Waste and Future Perspective in Developing Countries: Benchmark Rwanda." *Energy and Environmental Engineering* 8, no. 1 (April 2021): 1–12. https://doi.org/10.13189/eee.2021.080101.

United For Efficiency. "A New Opportunity for Rwandans to Affordably Purchase Appliances That Can Reduce Electricity Bills and Impacts on the Environment." United for Efficiency, January 31, 2022. https://united4efficiency.org/a-new-opportunity-for-rwandans-to-affordably-purchase-appliances-that-can-reduce-electricity-bills-and-impacts-on-the-environment/.

Wansi, Benoit-Ivan. "RWANDA: Kigali Sensitize on the Sustainable Management of Electronic Waste." Afrik 21, May 13, 2022. https://www.afrik21.africa/en/rwanda-kigali-sensitize-on-the-sustainable-management-of-electronic-waste/.

www.trade.gov. "Rwanda - Standards for Trade," n.d. https://www.trade.gov/country-commercial-guides/rwanda-standards-trade.

www.statistics.gov.rw. "Fifth Population and Housing Census - 2022 | National Institute of Statistics Rwanda," n.d. https://www.statistics.gov.rw/datasource/171.

www.statistics.gov.rw. "Rwanda Household Survey 2019/2020 | National Institute of Statistics Rwanda," n.d. https://www.statistics.gov.rw/publication/rwanda-household-survey-20192020.

Xie, Jian, and J. Martin. "Plastic Waste Management in Rwanda." *Openknowledge.worldbank.org*, 2022. http://hdl.handle.net/10986/37607.

Yee, Amy. "Electronic Marvels Turn into Dangerous Trash in East Africa." *The New York Times*, May 12, 2019, sec. Climate. https://www.nytimes.com/2019/05/12/climate/electronic-marvels-turn-into-dangerous-trash-in-east-africa.html.

"2020 Buyer's Guide for Electric Pressure Cookers," 2020. https://storage.googleapis.com/e4a-website-assets/2020-Global-LEAP-EPC-Buyers-Guide.pdf.

Study on Repair and End-of-Life of Electric Cooking and Domestic Appliances - Household Survey

ENUMERATOR SECTION

Name of Enumerator

....

Country

....

County name

....

Name of District

....

SECTION A - RESPONDENT INFORMATION

A1. Name of Respondent

....

A2. Gender of the respondent?
- Male
- Female

A2i. Respondent's Phone Number

....

A3. What is the marital status of the respondent?
- Single
- Married
- Divorced/Separated
- Widowed
- Other

A4. Age of the respondent?

....

A5. What is the relationship of the respondent to the household head? (male/female)
- Head
- Spouse/Partner
- Child/Adopted Child
- Househelp/Househelp's relative
- Other relative
- Other non-relative

A6. What is the highest level of education of the respondent?
- Primary School
- Lower Secondary
- Upper Secondary
- Tertiary, College/University/ Technical Vocational Training
- Never went to school
- Other

A7. How many people live in your household including yourself?

....
A8. How many people in your household are living with disabilities?

....
A9. What is the highest level of education anyone in your household has completed?
- Primary School
- Lower Secondary
- Upper Secondary
- Tertiary, College/University/ Technical Vocational Training
- Never went to school
- Other

A10. What is your occupation?
- Casual employment
- Self-employed/Entrepreneur
- Formal/Full time employment
- No occupation
- Other

A11i. What is the average monthly income of your household?
- Below KES 30,0000/ Below FRW 88,000
- KES 30,001-40,000/FRW 88,001-176,000
- KES 40,001-50,0000/FRW 176,001-264,000
- KES 40,001-50,000/FRW 264,001-352,000
- KES 50,001-60,000/FRW 352,001-440,000
- Above KES 60,000/Above FRW 528,000

SECTION B - APPLIANCE OWNERSHIP AND USAGE

B1. How is your household powered? Do you have any of the following?
- Main grid electricity
- Mini-grid electricity
- Rooftop solar power
- Solar Home System kit
- Generator/Battery
- None
- Other

B2. What is the primary energy source/fuel used by your household for cooking?
- Kerosene
- Charcoal
- Wood
- Solar
- Animal Waste/Dung
- Crop Residue/ Plant Biomass
- Saw Dust
- Biomass Briquette
- Processed biomass (pellets)/woodchips
- Gel Ethanol
- Liquid Ethanol
- Biogas
- LPG/cooking gas

- Electricity
- Garbage/plastic
- Other

B3. What other fuels are used by your household for cooking?
- Kerosene
- Charcoal
- Wood
- Solar
- Animal Waste/Dung
- Crop Residue/ Plant Biomass
- Saw Dust
- Biomass Briquette
- Processed biomass (pellets)/woodchips
- Gel Ethanol
- Liquid Ethanol
- Biogas
- LPG/cooking gas
- Electricity
- Garbage/plastic
- Other

B4. Who is the main buyer/purchaser of electrical appliances for your household?
- Male head of household
- Female head of household
- Other male household member
- Other female household member
- Both male and female household heads
- Other

B5. Please select ALL Appliances owned by the household
- TV
- Radio
- Fridge
- Mobile phone/charger
- Lights
- Microwave
- Kettle
- Rice-cooker
- Electric oven
- Electric hot-plate cooker
- Electric pressure cooker
- Toaster
- Washer/Dryer
- Computer/laptop
- Air conditioner
- Electric fan
- Clothes iron
- Vacuum cleaner
- Dish washer
- Printer

- Air-fryer
- Coffee machine
- Hair dryer
- Toaster/sandwich maker

B6 How many ${appliance_name}'s does the respondent own?

Appliance	Number owned
TV	
Radio	
Fridge	
Mobile phone/charger	
Lights	
Microwave	
Kettle	
Rice-cooker	
Electric oven	
Electric hot-plate cooker	
Electric pressure cooker	
Toaster	
Washer/Dryer	
Computer/laptop	
Air conditioner	
Electric fan	
Clothes iron	
Vacuum cleaner	
Dish washer	
Printer	
Air-fryer	
Coffee machine	
Hair dryer	
Toaster/sandwich maker	

B7i.Who is the primary user of the TV in your household?
- Male head of household
- Female head of household
- Child/Adopted Child
- Other relative
- Other non-relative
- Househelp/Househelp's relative

B7ii. How long have you owned the TV? (In MONTHS)

....

B8. Which member of the household is the primary user of the electrical cooking appliances?
- Male head of household
- Female head of household
- Child/Adopted Child
- Other relative
- Other non-relative
- Househelp/Househelp's relative

B9. Would your household be interested in purchasing any of these electrical appliances for cooking?
- Microwave
- Kettle
- Electric oven
- Electric hot-plate cooker
- Electric Pressure Cooker
- Toaster/sandwich maker
- Rice cooker
- Air fryer
- No interest
- Other

B10. If no interest; Which of the following reasons is currently preventing the household from using electric appliances for cooking?
- Cost
- Availability in local stores
- Access to electricity
- Appliance electricity consumption
- Preference for current cooking appliance
- Other

B11. In order of priority, which of the following factors is most important to your household when purchasing an electric appliance?1-most important 7-least important.
- Brand
- Quality/Longevity/Durability
- Cost
- Size
- Color/Style/Design
- Presence of Warranty

B12. Where did you get information about these appliances before purchasing them?
- At second-hand store
- At manufacturer/retailer store
- Social media e.g Facebook
- Manufacturer's website
- Product brochure from sales agent
- Recommendation from other users
- None of the above
- Other

B13i. Does your household have a preferred retailer for the electrical appliances you buy for your home?
- Yes
- No

B13ii. If yes, which option is preferred?
- Manufacturer/ New appliance retail stores
- Second-hand appliance stores
- Online retail stores
- Other

B14. Does your household prefer to use one-time cash payments or payment plans when purchasing electric appliances?
- Cash
- Pay-as-you go system
- Other

B15i. Has your household purchased any second hand/used appliances?
- Yes
- No

B15ii. If no; Which of these reasons is preventing your household from purchasing second hand appliances?
- Quality concerns
- Product warranty concerns
- Concerns about store legitimacy
- Concerns about energy efficiency
- Concerns about product age
- Other

B15iii. If yes; Please select the electrical appliances that were purchased second-hand.
- TV
- Radio
- Fridge
- Mobile phone/charger
- Lights
- Microwave
- Kettle
- Rice-cooker
- Electric oven
- Electric hot-plate cooker
- Electric pressure cooker
- Toaster
- Washer/Dryer
- Computer/laptop
- Air conditioner
- Electric fan
- Clothes iron
- Vacuum cleaner
- Dish washer
- Printer
- Air-fryer
- Coffee machine
- Hair dryer
- Toaster/sandwich maker

B15iv. If TV selected; Were you informed how old the used appliance was/how many years of use the appliance had at the time of purchase?
- Yes
- No

B15v. If yes, how old was the appliance at the time of purchase?

....

B16. How would you rank the performance of the second-hand TV?
- Good as new
- Moderate
- Poor

B17. In order of priority, which of the following factors influenced your decision to purchase the appliances second-hand? 1-most important 4-least important
- Cost
- Ease of accessibility to stores/seller location
- Peer recommendations
- Brand availability

B18i. Were you made aware of product warranties for the appliances you purchased at the time of purchase?
- Yes
- No

B18ii. If yes; Did the electrical appliances purchased new or unused come with a product warranty?
- Yes
- No
- Don't know

B18iii. If yes; Did the electrical appliances purchased second-hand or used come with a product warranty?
- Yes
- No
- Don't know

B19. If yes for either of the above; Please select the electical appliances that came with a product warranty
- TV
- Radio
- Fridge
- Mobile phone/charger
- Lights
- Microwave
- Kettle
- Rice-cooker
- Electric oven
- Electric hot-plate cooker
- Electric pressure cooker
- Toaster
- Washer/Dryer
- Computer/laptop
- Air conditioner
- Electric fan
- Clothes iron
- Vacuum cleaner
- Dish washer
- Printer
- Air-fryer

- Coffee machine
- Hair dryer
- Toaster/sandwich maker

B20. If TV selected; Did you attempt to claim the warranty after purchase?
- Yes
- No

B21i. If yes; For how long had you owned the appliance before claiming the warranty?
....
B21ii. Was the warranty honored?
- Yes
- No

B22. If no; Which of these reasons contributed to the unsuccessful claiming of the warranty?
- Inadequate/Limited warranty
- Too confusing/difficult to understand

B23. If honored, what was covered under the warranty?
....

SECTION C - APPLIANCE FAILURE
C1i. Are all the electrical appliances in the household functioning/working properly?
- Yes
- No

C1ii. If no; Which electrical appliances are not working properly?
- TV
- Radio
- Fridge
- Mobile phone/charger
- Lights
- Microwave
- Kettle
- Rice-cooker
- Electric oven
- Electric hot-plate cooker
- Electric pressure cooker
- Toaster
- Washer/Dryer
- Computer/laptop
- Air conditioner
- Electric fan
- Clothes iron
- Vacuum cleaner
- Dish washer
- Printer
- Air-fryer
- Coffee machine
- Hair dryer
- Toaster/sandwich maker

C2i. If TV selected; How old was the TV at the time of failure from purchase time?

....

C2ii. How many times has the TV failed/broken down since purchasing it?

....

C3. What does your household do when an appliance fails?
- Attempt to repair at home
- Take it for repair
- Replace it
- Store it in household
- Discard it with household garbage
- Sell it for parts
- Burn it
- Other

C4. If attempt to repair at home selected; Did you use any of the following materials?
- Physical/online product repair manual
- Repair tool kits
- Appliance spare parts
- Other

C5i. If take it for repair selected; What options for repair do you use?
- Distributor/manufacturer repair
- Local repair shops
- Specialized appliance repair shop
- Other

C5ii. In order of priority, which of the following factors affects how you decide which repair shop to use?1-most important 6-least important
- Proximity to household
- Reputation of repair shop
- Cost of repair
- Repair shop authorization to carry out repairs
- Familiarity with repair shop
- Appliance type

C5iii. How much do you spend on average to repair appliances as a percentage of the original appliance purchase cost?
- Less than 20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%
- More than 100%

C6. If replace it selected; Which of the following factors influenced your decision to replace the appliance?
- Appliance could not be repaired
- Cheaper to replace
- Product warranty covered
- Other

C7. Which factors inform your decision to ${decision_name}

- Cost effectiveness
- Lack of awareness on repair/disposal process
- Ease of accessibility to repair/disposal center
- Manufacturer/retail customer support
- Product warranties
- Lack of awareness on available options
- Other

C8. Which member of the household is in charge of appliance failure practices/decisions?
- Male head of household
- Female head of household
- Other male household member
- Other female household member
- Both male and female household heads
- Other

C9i. Have local leaders in your community/neighborhood influenced actions taken by your household when appliances fail?
- Yes
- No

C9ii. If yes; How have they influenced the actions taken by your household?
- Created awareness on appliance waste disposal
- Increased appliance waste disposal options in community
- Other

C10i. Are you aware of any laws that regulate electric appliance repair or disposal?
- Yes
- No

C10ii. If yes; State any of these laws that you are aware of
....

SECTION D - E-WASTE DISPOSAL BEHAVIORS AND ATTITUDES
D1. Which member of the household is in charge of waste disposal?
- Male head of household
- Female head of household
- Other male household member
- Other female household member
- Both male and female household heads
- Other

D2. Which waste (GENERAL) disposal method does your household use?
- Local council collection and disposal
- Private waste management company collection and disposal
- Burning
- Recycling
- Other

D3i. Are you aware of any options for electrical and electronic appliance waste disposal in your community?
- Yes
- No

D3ii. If yes; Which options are you aware of?
- Manufacturer/retailer take-back
- E-waste collection and recycling center
- Selling to collectors for scrap material
- Other

D4i. Has your household disposed of faulty or non-operational televisions before?
- Yes
- No

D4ii. If no; Why has your household not disposed of faulty or non-operational televisions?
- TVs still functioning properly
- Donated to other household
- Lack of awareness on proper disposal methods
- Opted to store faulty TV
- Do not own TV
- Other

D4iii. If yes; Which method of disposal did you use?
- Disposed of with household garbage
- Took to e-waste disposal center/shop
- Returned to manufacturer/retail shop
- Burnt
- Handed over to collector/repair shop for parts
- Other

D4iv. For how many years had you used the TV prior to disposal?
....

D5i. Excluding TVs, has your household disposed of other faulty or non-operational devices?
- Yes
- No

D5ii. If no; Why has your household not disposed of faulty or non-operational appliances?
- Appliance still functioning properly
- Donated to other household
- Lack of awareness on proper disposal methods
- Opted to store faulty TV
- Do not own TV
- Other

D6i. If yes; Which of these electrical appliances has your household disposed of?
- TV
- Radio
- Fridge
- Mobile phone/charger
- Lights
- Microwave
- Kettle
- Rice-cooker
- Electric oven
- Electric hot-plate cooker

- Electric pressure cooker
- Toaster
- Washer/Dryer
- Computer/laptop
- Air conditioner
- Electric fan
- Clothes iron
- Vacuum cleaner
- Dish washer
- Printer
- Air-fryer
- Coffee machine
- Hair dryer
- Toaster/sandwich maker

D6ii. Which method of disposal did you use?
- Disposed of with household garbage
- Took to e-waste disposal center/shop
- Returned to manufacturer/retail shop
- Burnt
- Handed over to collector/repair shop for parts
- Other

D7. Do you believe the options used by your household for electric appliance waste disposal are environmentally friendly?
- Yes
- No

D8i. If no; Which of these barriers have prevented you from using more suitable means?
- Lack of information on available options
- Lack of proper disposal options in close proximity to household
- Cost of disposal
- Data security concerns
- Other

D8ii. Would you be willing to use more environmentally friendly means of repair and disposal of your electric appliance waste?
- Yes
- No

D8iii. Which factors would motivate you to use more environmentally friendly means?
- Financial incentives
- Environmental impact
- Ease of disposal
- Increased awareness/education on waste disposal processes
- Other

Please indicate any comments from the respondent.

Stakeholders and their responsibilities under the REF project

Stakeholder	Roles
World Bank	- Review and approve the Environmental Codes of Practice (ECOP) - As part of its supervision mission of the Project, the WB team will conduct random checks on the project's compliance to e-waste disposal and management consistent with the national regulations and WB safeguard standards.
REF E&S specialists	- Provide training on the compliance and implementation of the REF-ECOP to solar companies under REF projects - Responsible for monitoring and supervising the implementation of the ECOP by solar companies - Carry out random field visits to each solar system suppliers under REF to verify compliance with the ECOP especially the E-Waste management approach - Provide progress reports to REMA, REG, and World Bank on quarterly basis - Responsible of following up grievances and effectiveness of set Grievance Redress Committees at Umurenge and Umwalimu SACCO level
SHS providers	- Will develop and provide an E-waste management plan to BRD-REF detailing the collection, transport, storage and disposal procedure - Responsible to carry out effective after-sale services to solar beneficiaries (Replacement and repairs) - Responsible of providing training to solar beneficiaries on proper e-waste management and disposal, incident management and basic maintenance technical skills - Provide status update reports on the compliance and implementation of the REF-ECOP to BRD-REF on quarterly basis - Responsible of providing OHS training to its technicians for proper e-waste management and solar system repair - Responsible of meeting electronic system quality standard set at National level
Rwanda Utilities Regulatory Agency (RURA)	- Issuing technical guidelines for handling and disposal of E-waste - Issuing and enforcing the licensing regime for SHS dealing with collection and transportation of e-waste
Rwanda Energy Group (REG)	Responsible of registering solar system vendors' products based on set National quality guidelines

	• Assess the processes for compliance with the guidelines set out in this ECOP • Monitor the implementation of the National Electrification Plan (NEP)
Rwanda Environment Management Authority (REMA)	• Assess REF project compliance with National Environmental and pollution control regulations • Conduct checks on the solar system vendors' compliance with the ECOP.
MININFRA	• Monitor the implementation of the National Electrification Plan (NEP) by mini-grids companies, including SHS suppliers • In consultation with REMA and RURA, MININFRA will ensure that regulations for the collection and disposal of e-wastes, including lead acid batteries (LABs) are observed by solar system providers.

E-waste categories – retrieved from https://www.hrpub.org/journals/article_info.php?aid=10810

No.	Category	EEE
1	Large household appliances	Washing machines, dryers, refrigerators, air conditioners
2	Small household appliances	Vacuum cleaners, coffee machines, iron toasters, EPCs
3	IT and telecommunication equipment	Personal computers (PCs), laptops, mobile phones, fax machine, printers
4	Consumer electronics	Radio sets, video recorders, TVs, video camera, audio recorders, musical instruments
5	Lighting equipment	Fluorescent lamps, sodium lamps, metal-halide lamps
6	Electrical and electronic tools	Drills, saw machines, sewing machines, equipment for spraying, spreading & dispersing
7	Sports equipment, leisure & toys	Hand-held video game consoles, car racing sets, electric trains, coin slot machines, gym equipment
8	Medical instruments	Radiotherapy equipment, cardiology, dialysis, nuclear medicine, lab equipment for in-vitro diagnosis, analyzers and freezers
9	Surveillance and control equipment	Smoke detectors, thermostats, heating regulators
10	Automatic dispensers	Automatic dispensers for hot drinks, bottles/cans, money