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How are off-grid solar customers in Kenya managing their electronic waste?

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CDC lead:
Veronica Di Bella

vdibella@cdcgroup.com

Foreword from CDC

Higher levels of disposable incomes, urbanisation, and industrialisation in many developing countries is leading to increasing amounts of electrical and electronic equipment, and consequently to greater volumes of e-waste. E-waste is one of the fastest-growing forms of waste in many developing countries. Discarded equipment such as phones, laptops, fridges, sensors and televisions contain substances that pose serious environmental and public health risks, particularly if treated inadequately.

E-waste also presents several challenges to sustainable development, and to the achievement of the United Nations Sustainable Development Goals (SDGs), principally addressing SDG 12 (sustainable consumption and production), as well as the impacts that improper e-waste management can have on ecosystems (SD14 and 15) and human health (SDG3). At the same time, proper management of e-waste can also be key to achieving 'Circular Economy' principles, which can be defined as a framework for an economy which is restorative and regenerative by design, in part by designing out waste and pollution and by keeping products and materials in use.[1]

According to the Global E-Waste Monitor Report, in 2019 the world generated 53.6 million metric tonnes (Mt) of e-waste, and only 17.4 per cent was recycled through appropriate channels – even though nearly three-quarters of the world's population is subject to e-waste legislation.[2] Significant efforts are still required to ensure adequate enforcement and implementation, and to encourage more actors to develop sustainable solutions to e-waste management. In Africa, 2.9 Mt of e-waste was generated by households in 2019, of which only 0.9 per cent was reported to be collected and recycled by the formal sector. In addition, recycling activities are dominated by an ill-equipped informal sector, coupled with inefficient resource recovery and environmental pollution risks.

CDC recognises that e-waste is a major issue for people and their surrounding environment, principally due to a lack of collection, transportation and recycling facilities. Through our investments, we have considerable exposure to the off-grid solar (OGS) sector, and we are also exposed to e-waste generation through other sectors, such as the manufacturing of white goods. Yet it is important to note that e-waste from the OGS sector represents a small fraction (roughly 7 per cent) of the total e-waste produced and the cost of treatment means that it is not economically feasible to recover the associated costs from the OGS sector alone. This is why an integrated solution is necessary to tackle this problem, and this has motivated our focus in recent years on e-waste governance and management across our portfolio.

We have found that Africa in particular lacks formal governance to support e-waste management. This is aggravated by the fact that not all the producers nor local authorities are taking sufficient ownership of this issue, and although e-waste volumes continue to rise, recycling facilities are not operating at capacity due to poor collection systems.

However, there is evidence to suggest that e-waste is increasingly a national priority across various African countries. In Kenya, for example, the rapid deployment of OGS products is leading to growing discarded e-waste volumes.[3] In response, the Ministry of Environment has developed draft regulations and an e-waste strategy. Therefore, the study presented in this document focuses on consumer behaviour and e-waste in Kenya.

Mark Eckstein
Director, ESG Impact
CDC Group plc

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Foreword from M-KOPA

M-KOPA has connected over one million customers in East Africa to lighting, smartphones, and energy-efficient appliances. Responsible e-waste management is central to our sustainability efforts – with established re-collection and repair processes in place across a network of over 100 service centres and a centralised refurbishment hub.

We promote a circular economy in which our products are kept in use for as long as possible – we repair approximately 80 per cent of the e-components returned. Giving a second life to returned, yet restorable, components helps to avoid emissions along global supply chains, reduces the need for materials, increases affordability for customers and also upskills the workforce with technical skills.

Nevertheless, with a scaled, expanding customer base, there is a pressing need to develop, test and operationalise more efficient re-collection and replacement processes, especially along the 'last mile'. In Kenya, 65 per cent of products are kept in houses after they stop functioning (Chirumamilla, 2014). This is likely due to limited awareness of collection schemes, poor knowledge of safety and environmental risks, as well as the high value placed on produce at end of life.

Together with CDC, M-KOPA is committed to better understanding consumer habits related to e-waste, as well as testing and scaling new methodologies that support responsible e-waste management and mitigate the serious environmental and health risks. Furthermore, we will continue to play a central role in the off-grid e-waste dialogue, as committed active committee members of the GOGLA (Global Off Grid Lighting Association) most actively discussing the off-grid e-waste policies and regulatory landscapes.

Danny Stoker
Head of Retail
M-KOPA

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For questions please contact Veronica Di Bella
vdibella@cdcgroup.com

3 Evidence on Demand and DFID - Cost Benefit Analysis and Capacity Assessment for the Management of Electronic Waste in the Off-Grid Renewable Energy Sector in Kenya (2017)

Executive summary

Energy access greatly improves quality of life, but it can also cause environmental damage in the form of e-waste. When OGS products and other consumer electronic appliances reach end of life, they are often discarded into the surrounding environment, resulting in unmanaged e-waste. These substances contain a wide range of hazardous chemicals and toxic pollutants which can lead to environmental contamination and adversely affect public health, most notably to the people who handle the waste.

The rapid development of OGS products and non-OGS electronic appliances in remote areas of Kenya raises legitimate concerns – both about e-waste production and the local capacity to manage the resulting hazardous waste, especially when appropriate waste management infrastructure is often lacking. Understanding consumer behaviour in terms of waste management in the off-grid sector is a good entry point to identify systemic improvements.

Once consumer behaviour and challenges are better understood, policymakers can create an enabling environment for responsible e-waste disposal, and companies can adapt their strategies, including through potential consumer incentives, to prevent and minimise the negative impacts of e-waste on populations and their environment.

Leveraging the existing call centre and customer data of a Kenyan OGS company, M-KOPA, Sofies undertook a survey of 500 consumers between October 2019 and January 2020. From this survey, a clearer picture emerged of the volumes of OGS and non-OGS e-waste found at consumer homes. It also highlighted the way consumers dispose of e-waste, and their interest in various incentives to return the e-waste to the seller.

The prevalence of non-OGS electronic products in consumer homes, and the high rate at which these products do not function (25 per cent of water pumps, 24 per cent of radios and 15 per cent of cathode-ray tube (CRT) televisions) is a major finding from the survey. In addition, only 38 per cent of consumers understood the need to return e-waste to the seller. The remaining consumers either kept the e-waste at home or disposed of it by burning, burying, or dumping. The final key insight of this survey is the clear consumer preference for free products as an incentive to return their e-waste. However, validation of

Understanding consumer behaviour in terms of waste management in the off-grid sector is a good entry point to identify systemic improvements.

500

This report is based on a survey of 500 consumers between October 2019 and January 2020.

this preference would require a pilot programme to discover whether the survey respondents would make this decision in a 'real world' scenario.

Overall, this study provides unique insights into the quantity of e-waste at rural households in Kenya, the way it is managed and the potential preferred incentives for consumers to bring their e-waste back to the seller. These take-aways provide a glimpse into the future of an unmaintained and unregulated market, demonstrating the need and the opportunity to increase consumer awareness of the impact of e-waste, and the importance of returning non-functioning products to the producers.

01

Introduction

Due to the range of hazardous materials contained in e-waste, poor treatment and disposal of e-waste can result in adverse health impacts for both the community and the individuals interacting with it. As OGS products, which are part of a quickly-growing sector, reach their end of life and generate e-waste, there is a growing need to ensure the release and impact of e-waste is minimised as much as possible.

At CDC, we recognised e-waste as a notable and rising waste stream within our portfolio, and one that was particularly prevalent in the OGS sector. We invested in M-KOPA, a solar energy company whose product line includes lighting solutions, fridges and mobile phones, in 2016, and together we saw an opportunity to improve the management of e-waste in Kenya. This study's primary aim is to improve the understanding of consumer behaviour regarding e-waste management. The study explores these key questions:

- Do consumers treat e-waste like regular waste?
- Do consumers know how and where to dispose of e-waste properly?
- If they do know – do they care?

The secondary objective of the study is to understand how consumers would respond to potential incentives for takeback schemes of OGS products in Kenya.

The survey and this report are part of a broader programme funded by CDC Plus, CDC Group's technical assistance and support facility, investigating different levels of the electronic product value chain including repair operations, consumer management behaviour and cost of collection and treatment of e-waste.

This study's primary aim is to improve the understanding of consumer behaviour regarding e-waste management.

02

Survey methodology

Sofies, an international sustainability project management and consulting firm, conducted a consumer survey between October 2019 and January 2020, leveraging the existing call centre and customer information at M-KOPA. Through this, a comprehensive list of 500 M-KOPA customers were asked a series of questions about their e-waste management practices and habits.

The key aims of the survey were to:

- Obtain data about the type and volume of OGS e-waste at the consumer's home.
- Obtain data about type and volume of other non-OGS e-waste at the consumer's home.
- Gain insight into the ways in which consumers dispose of their e-waste.
- Understand the customer's interest in various incentive options.

In order to survey a broad mix of consumers, the targeted customer list consisted of a cross-section of different age groups, genders, geographic locations and customer performance (as classified by M-KOPA).

The criteria for the consumer selection process were that the customers surveyed had to have been M-KOPA's clients for more than 24 months, in order to ensure that any questions regarding incentive attractiveness were relevant. Among the customers that met this criterion a random selection was conducted.

The survey was structured in three parts: customer information, e-waste and incentives.

2.1 Consumer information

A host of information on the customer was collected in the survey, including payment status, age, gender, length of time as a customer, and distance from the closest shop.

2.2 E-waste information

There is limited data on how much e-waste consumers keep in their households in rural areas of Kenya, so this survey was a valuable opportunity to complete primary research on the volume of e-waste and length of time products have been non-functional in the home. The latter point is important because it could indicate the prevalence of damaged or broken electronic products due to lack of service and maintenance contracts. Both OGS and other electrical and electronic equipment (EEE) products were captured in the survey. By asking consumers how many of each product they owned, and of these, how many were not functioning properly, a clear understanding of e-waste rates could be established.

In addition, customers answered multiple choice questions on how they handle their e-waste upon failure to understand whether they dispose it, return it or keep it; and if they dispose it, how they do so. On top of identifying the rate of e-waste generation, this would allow conclusions to be drawn on how much e-waste is retained, disposed of improperly, and disposed of properly.

2.3 Incentive enthusiasm

Understanding the scale of the issue was just the first step. Understanding what measures might incentivise customers to return electronic products at the end of their life is essential to developing a functioning e-waste management system.

Determining the best customer incentive options was the greatest challenge for the survey due to the difficulty in providing quantitative questions to the respondents. First, the respondents were presented with five options – which were developed and agreed jointly with M-KOPA -- and asked to rate the incentives between 1 and 5 based on their preferences. The options included:

- discounts on products;
- free credit on their solar home system;
- free products, limited to small items like torches;
- telco and TV vouchers; and
- community group incentives.

Finally, a free text field was provided to allow recommendations outside of the provided options which respondents might be interested in.

Understanding what measures might incentivise customers to return electronic products at the end of their life is essential to developing a functioning e-waste management system.

03

3 Survey results

3.1 Distance between customers and shops

A key piece of the information collected during the survey was the perceived distance to the nearest shop, which would likely influence the customer's ability and enthusiasm to return e-waste once incentivised. Figure 1 presents the average distance from the shops of customers living in the counties selected for the study.

As can be seen from Figure 1, customers in certain regions, such as Marsabit, live at least on average 25 km from the nearest shop. Other areas, such as Isiolo, have a high number of customers that live at a distance of about 1 km from shops.

This wide range in terms of distance between customers and shops may have an impact on the uptake of any incentive schemes, which are likely to be more attractive for customers living in the vicinity of a shop.

25km

Customers in certain regions live on average at least 25 km from the nearest shop.

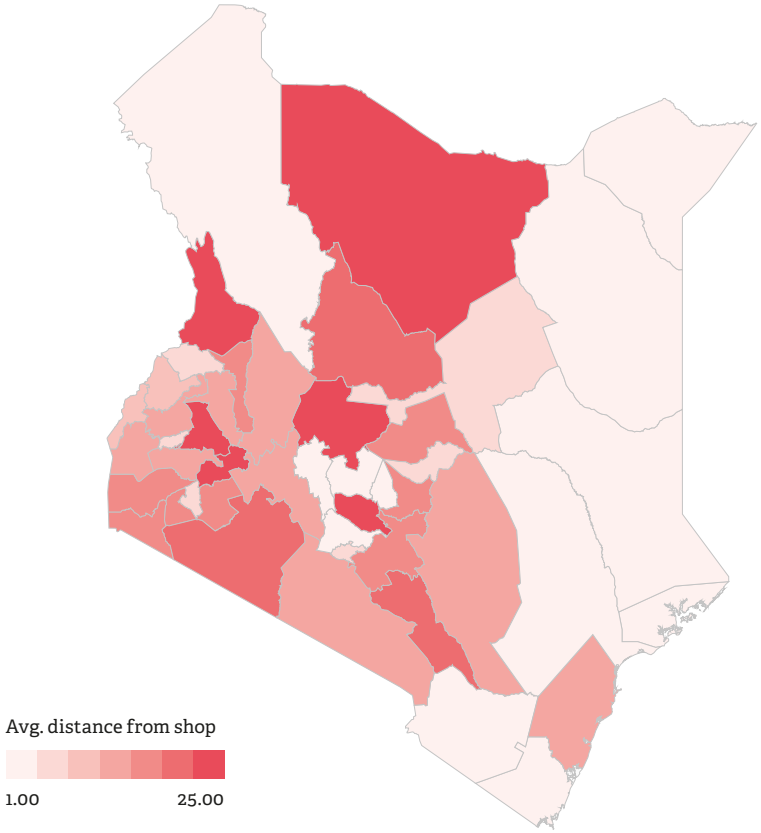

Figure 1: Average distance (km) customers live from closest solar energy provider shop

3.2 Household products

The data on EEE possession aligned with general expectations, according to Sofies' in-house expertise. Almost 90 per cent of consumers stated that they had a mobile phone in their possession and this number aligned with recorded mobile phone penetration countrywide (over 95 per cent)[4]. Radios were also popular (24 per cent), probably given they are usually the cheapest electronic entertainment device.

In addition, 25 per cent of respondents stated that they owned flat screen TVs, versus 5 per cent of respondents owning fridges and 7 per cent laptops, as shown in Figure 2. To some extent, this mirrors the product portfolio offered by M-KOPA, but it also speaks to a broader trend of household consumption habits and corresponding e-waste volumes – larger and more complex appliances are becoming ubiquitous in rural settings, which is likely to lead to greater issues with bulk waste disposal at end of life in the near future.

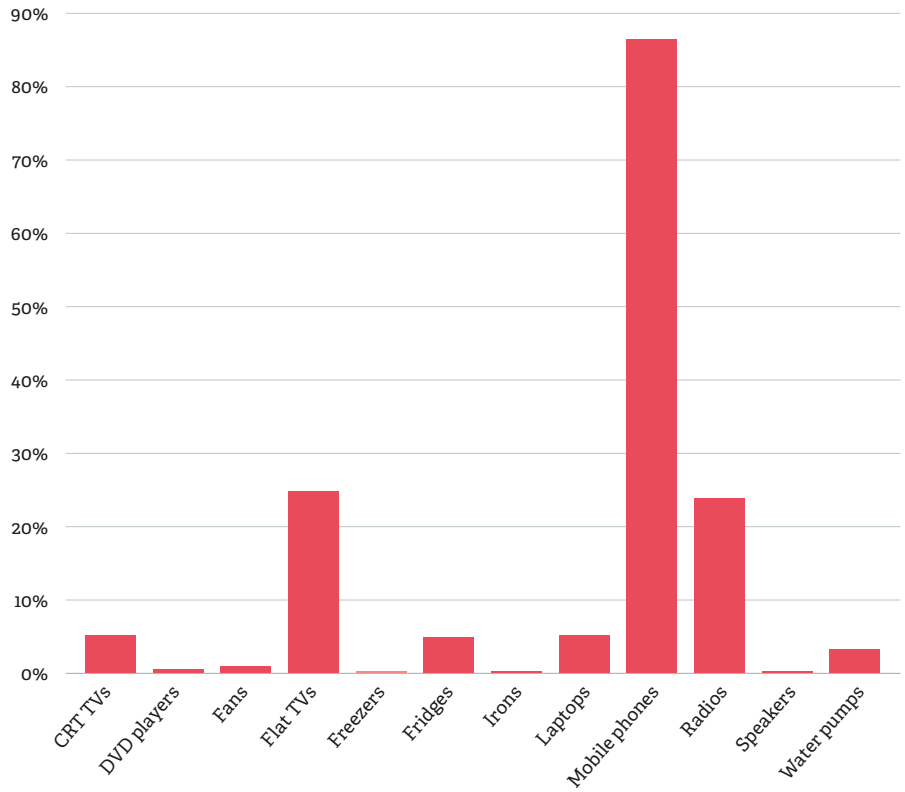

Figure 2: Percentage of customers with certain EEE products at home

90%

Almost 90 per cent of customers stated that they had a mobile phone.

4 Communications Authority of Kenya: First quarter sector statistics report for the financial year 2018/2019

3.3 Household waste

Tracking the quantity of e-waste in rural households is a task that is rarely conducted by OGS companies, probably due to limited resources and the fact that the sector has existed for a relatively short period of time. Therefore, the opportunity to speak directly to customers about the products they have at home is valuable. Of the products that customers had at home, a high percentage were non-functioning, especially water pumps (25 per cent), radios (24 per cent) and CRT TVs (15 per cent) as shown by Figure 3. This could be a demonstration of how a lack of service and maintenance contracts for such items can result in a prevalence of damaged or broken electronic products littering the market.

Despite a high percentage of non-functioning items, broken mobile phones were very low at less than 1 per cent as indicated in Figure 3. This is most likely due to the perceived importance of maintaining a working phone as well as the fact that an informal repair system has established itself thanks to high demand, creating a low-cost maintenance ecosystem.

Using highly approximated weights for each product, the quantity of e-waste per person as indicated by this survey leads to a total of around 0.5 kg per customer, lower than the average production in East Africa (0.8 kg per capita) but significant considering that the survey was conducted in rural areas.

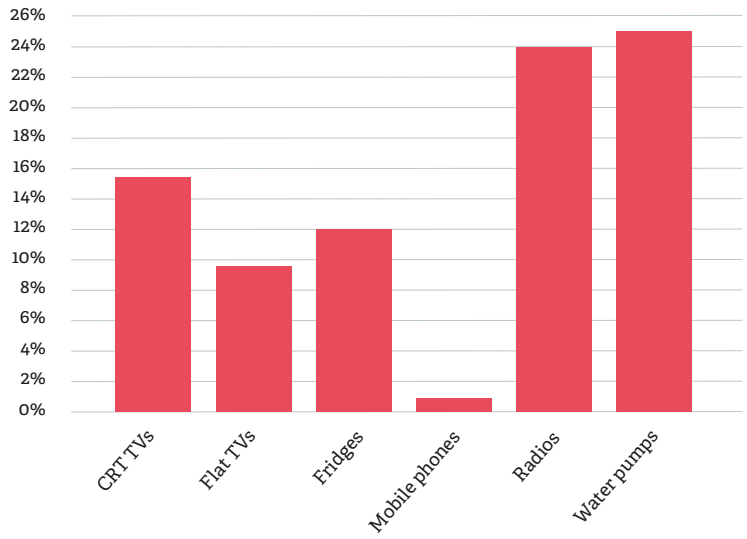

Figure 3: Percentage of EEE products that are not functioning

OGS companies rarely track e-waste in rural households, probably due to limited resources and the fact that the sector is still relatively new.

3.4 Off-grid solar energy waste

As highlighted in Figure 4, radios and torches emerged as the most common e-waste product from OGS appliances followed by light bulbs, universal serial bus (USB) charging cables, and the control box itself.

Considering these components are the most commonly sold, this is not a surprise. But it does, perhaps, demonstrate the relatively short lifespan of radios and torches in comparison to light-emitting diode (LED) bulbs, highlighting the resilience of the bulbs themselves. This is partly due to the portable nature of the products, which often contain weak components (such as the antenna in the case of the radio). Nonetheless, it is something that should be monitored and considered. The short warranty periods for these components and the low cost (and therefore low value in repair) exacerbates the issue, and might lead to a stockpile of low-value e-waste in customer homes.

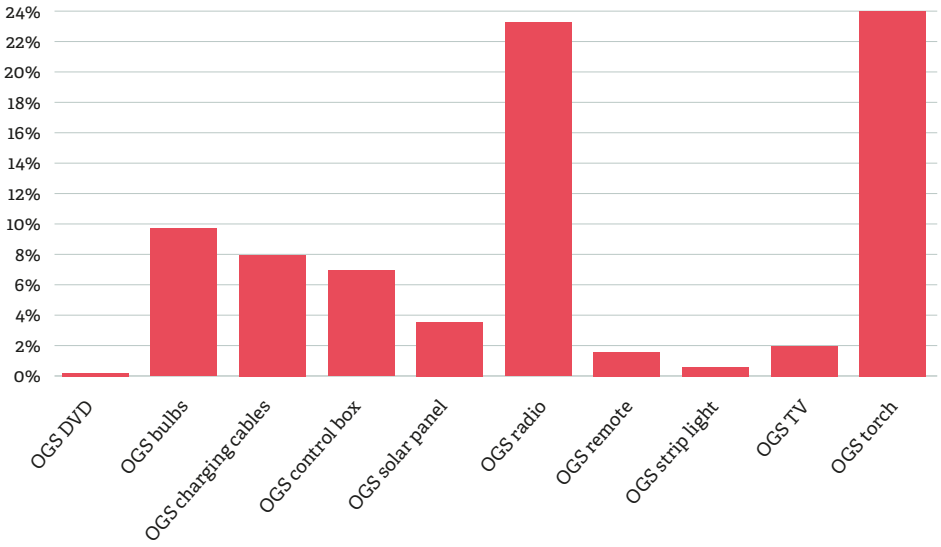

Figure 4: Percentage of customers with non-functioning OGS appliances

3.5 End-of-life handling

Understanding how rural consumers handle their e-waste products at the end of the usable life is a key input into ensuring correct management of out-of-warranty electronic products. As Figure 6 shows, 40 per cent of the M-KOPA customers surveyed stated that they would keep the e-waste at home, 38 per cent would return it to the seller and 7 per cent would dispose of the product. 'Hibernation', as the practice of keeping waste at home is called, is a worrying figure as this is not a safe practice for managing e-waste, in addition to not making the most of valuable resources. E-waste contains a wide range of hazardous materials with potential effects on the health and on the environment, including the risk of fire due to the presence of flammable components such as lithium.

A potential factor contributing to the high number of product hibernations might be linked to the social status of owning electronic products.

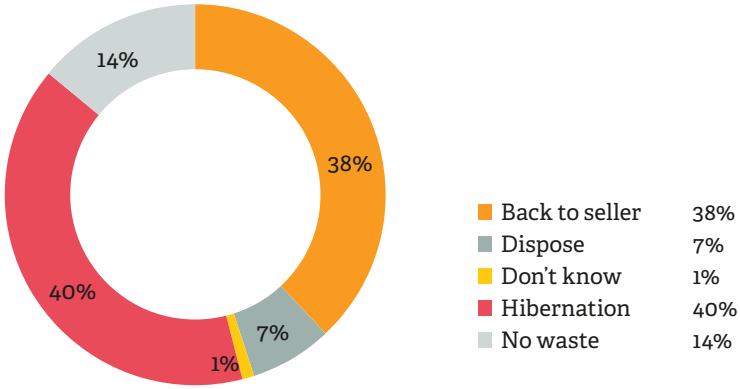

Figure 5: What consumers do with electronic products at the end of life

The 7 per cent of respondents who said they would dispose of the product were further questioned to understand how they would go about it (Figure 6). Almost 40 per cent of respondents said they would burn the product, while another 40 per cent declared that they would resort to either dumping it or burying it locally.

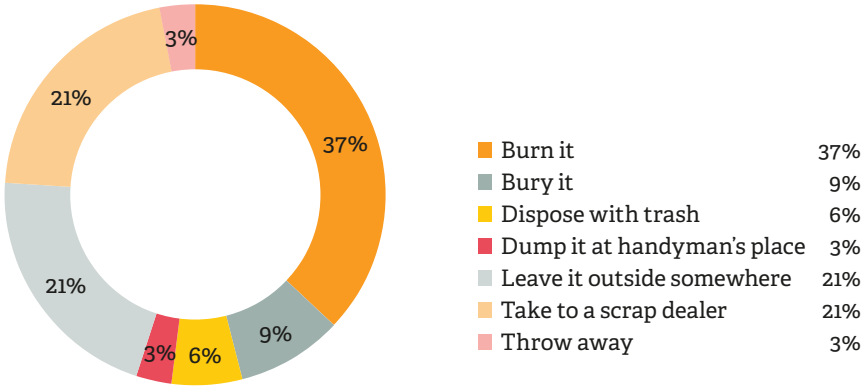

Figure 6: How consumers would dispose of EEE products

Additionally, we can assume that the high percentage of consumers who would keep the product at home may eventually dispose it, following the discard pattern outlined above. Whether consumers burn, bury, dump, leave outside or keep at home e-waste, all these options have significant environmental and health impact.

"My children play with the discarded items left in the home"
Survey respondent

3.6 Incentives

Figure 7 presents the results of preferences among customers for different types of incentives.

An interesting response was the lack of appeal in the community group incentives, presumably reflecting the lack of direct personal benefit gained from this incentive. Longer-standing customers in particular were not interested in group incentive programmes, possibly because they would expect a direct benefit following a long-term commitment.

The response to free credit for their solar home system was of limited interest to customers. This is most likely due to relatively smaller benefits compared with the other options provided. Additionally, any consumers with products out of warranty would be less likely to have any remaining credit to pay off on their system.

Despite an almost direct cash payment, 'telco and TV vouchers' was one of the least attractive options for incentives. As per solar home systems, this might be linked to the indirect and not immediate nature of this incentive.

The customers clearly showed a preference for free products, despite having limited this to small products. It is unclear whether presenting this option meant that customers were encouraged to weight-down the other potential incentives.

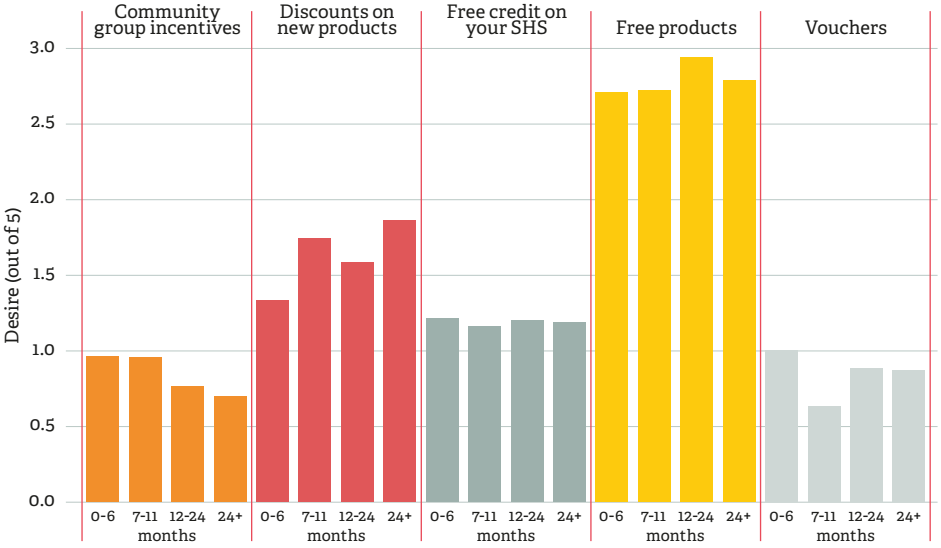

Figure 7: Enthusiasm for incentives by time as a customer

3.7 Incentive selection and next steps for the pilot programme

Based on the results from the survey, the incentives will be further tested on the ground by M-KOPA within eight of their shops which have already been identified.

Two incentive options were selected based on the results of the survey, as well as taking into account operational considerations at M-KOPA, which for instance led to eliminating the provision of free small items:

1) A discount on a new purchase of a radio or torch

2) A Telco voucher

A control group will be targeted with an awareness campaign to provide a baseline of interest and response on responsible disposal using just consumer education.

In addition to this work stream, the pilot programme includes two additional work-packages currently ongoing, which focus on collection and recycling, and decentralised repair, respectively.

04

4 Conclusion

This customer survey has provided previously unknown information on consumer e-waste management behaviour in off-grid settings, and provides insights into the potential incentives available to encourage a vibrant reverse market. This comes at an important time when millions of off-grid solar products are being deployed, demonstrating the need for a comprehensive solution to the increasing amount of e-waste being generated.

The prevalence of dysfunctional non-OGS electronic products in households was one of the most interesting results of the study. This could be linked to the fact that a high percentage of the customers surveyed live at the significant distance of 25 km from shops, as well as to the intrinsic value attributed to goods. This is even more relevant considering that the Extended Producer Responsibility legislation is on the horizon in Kenya, which will change the state of play for the off-grid solar sector.

The results also showed that the majority of respondents would not usually return e-waste to the seller. They planned to either keep the e-waste at home (hibernation) or use environmentally unfriendly solutions to dispose of e-waste, including burning, burying or discarding the products locally. This study confirms the need and importance for companies to disseminate important information on the correct handling of e-waste, and to ensure that both customers and staff are aware of the willingness and necessity of returning non-functioning products to the producers.

In terms of incentive options, this survey provides a clear view into the preference of consumers to obtain small free products in exchange for their e-waste. Two incentives will be further tested with an on-the-ground pilot programme.

More generally, this type of data serves as the first step to realising a collection system that transitions a company from a linear to a circular economy model. The OGS sector presents specific difficulties as it serves mostly rural customers, where waste collection systems are often not-existent. This also highlights the need for a joint approach across companies and across different sectors, given the limited volumes of e-waste that the OGS sector in isolation produces, which leads to challenges on the economic sustainability of setting up a collection system. Investors could play a pivotal role in catalysing efforts towards a joint approach as well as supporting companies in setting up comprehensive systems for the management of e-waste.

The rapidly expanding OGS sector demonstrates the need for a comprehensive solution to the increasing amount of e-waste being generated.

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For further information:

- **CDC Group:**
  Veronica Di Bella
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