The electronics afterlife

Is E-waste compensation a stepping stone to a circular electronics sector?

A collaborative inquiry with CTL Foundation

June 2024

FOOTPRINTS AFRICA | CTL

Image credit: Robin Ingenthron

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About Footprints Africa

Footprints Africa's mission is to advance sustainable, scalable and inclusive approaches to the development of local African economies and prove that business can be a force for good at scale. We have developed a framework to help circular businesses measure their impact.We map what is happening. And we give direct support through tools and training to de-risk their circular journey. Our circularity work started by mapping over 500 circular case studies from across Africa, showcasing the potential and impact of circular businesses on the continent.

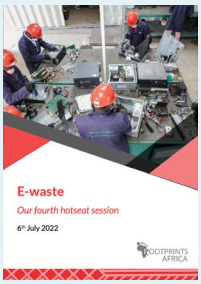
Igniting the circular transition in the electronics sector

Our desire to be practical drives us to support those who are directly applying circular principles, hence our focus on the private sector. That said, in order to accelerate the transition to circularity, all stakeholders need to align incentives to build a self-reinforcing ecosystem.

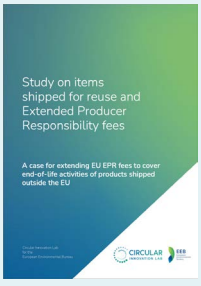
It's hard to align those incentives, so we have been creating connections across the ecosystem through cross-continent peer learning, evidence and data building, and showcasing real-life examples to drive systems change.

A snapshot of our projects to date in the electronics sector:

Impact measurement for businesses: to support companies to evidence their impact, de-risking investment and operational decisions, Footprints developed a measurement framework for African circular businesses. We have evaluated the impact of 3 electronics companies, Hinckley (Nigeria), Quadloop (Nigeria) and WEEE Centre (Kenya). From this we have developed guidance that is accessible to all businesses in these value chains.



E-waste hotseats: our peer learning series brings entrepreneurs together with technical experts and investment professionals to solve their toughest business questions. The programme brought together over 150 participants creating a non-competitive space for businesses to learn together and help move circular thinking forward.



Extended Producer Responsibility (EPR) enquiry: To inform European e-waste and EPR policy, the European Environmental Bureau commissioned Footprints Africa to present a deep dive into case studies of second-hand value chains in West Africa. This showed the real picture of electronics flows, environmental impact and power dynamics, highlighting challenges with equitable compensation for the informal sector.

Introduction

Where would we be without electronic devices?

They are becoming increasingly embedded in our lives, carried in our pockets connecting us to information, people and possibility, part of everyday items as we embrace the Internet of Things. They drive progress at ever faster rates.

But there is a dark side: the end of life. As we buy more new products, the old and obsolete are piling up. Markets are developing to respond to the opportunity, but with few solutions to the problematic consequences and harmful health and environmental impacts.

Enter: E-Waste Compensation.

Since the value of materials in old electronics is lower than the cost of recovery, this model has been developed to support the cost of safe handling of electronics.

Purpose

This report is a collaborative inquiry into the extent to which electronic waste (e-waste) compensation models are a step forward in the transition to circularity for electronics.

Taking a deep dive into the case study of e-waste compensation business Closing the Loop, we explore the value chain, benefits and disadvantages (and possible unintended consequences), and look at what can and should happen next to make a real step towards circularity.

As you will see, this inquiry throws up almost as many questions as it brings answers. This is important, however: we want to stimulate debate and promote collaboration as much as to investigate the benefits and drawbacks of e-waste compensation.

What's the circular vision?

The logical starting point should be a vision for a circular electronics sector.

Disclaimer: *This report has been produced with support from* ***CTL Foundation****, the non-profit arm of Closing the Loop.* ***The foundation nor Closing the Loop have had*** *no editorial control of the final report, but, whilst we have made every effort to remain objective in our evaluation, we acknowledge the potential conflict of interest in this dynamic.*

That's hard to define precisely, but, broadly speaking, we think its goal is to reshape habits, industries, and lifestyles to achieve a state where everything and everyone has a purpose and is valuable, where nothing is ever discarded. Material production and consumption become intentional. The term 'e-waste' itself becomes obsolete.

Our hypothesis

We are a long way from this end state. Achieving the vision will require huge shifts that cannot happen overnight but will comprise practical steps at many levels to stimulate a transition in the right direction. Each step along the road may be imperfect. And there may be divergences or contradictions.

The hypothesis we seek to investigate with this report is that **e-waste compensation is one such imperfect transition step setting the foundations to reshape African value chains along circular lines.**

Background

The nature, scale and urgency of the global e-waste crisis has already been well-documented[1]. Our focus is on tangible and creative solutions that pave the way to circularity. However, here we set out key contextual details to frame this inquiry.

When we look at the value chains for electronics - that is, everything with a plug or a battery - we see the following:

- E-waste is one of the fastest growing solid waste streams, currently at 62 million tonnes annually,[2] with the projection that it will reach 104 million tonnes by 2050. The speed at which it is being produced is outpacing growth in documented collection and recycling. *There is an information gap however: official figures are based on models and estimates, and cannot capture all activity- particularly informal recycling.*

- Africa is by far **the world's most resource-efficient continent,** producing seven times less e-waste per person than Europe, while offering ingenious examples of increasing circularity in electronics.[3] *But there is little reliable data on the efficiencies of the secondary market, where people use, re-use and repair electronics until the very end of their useful life.*

- **Consumer electronic products are generally not designed nor produced on the African continent** - although that landscape is evolving,[4] e-waste mainly originates from imported products that have reached their end of useful life.

- Despite the importation of e-waste being outlawed by international agreements,[5] **a significant amount of electronics enters the waste stream immediately** because it is simply 'dead on arrival'.[6] [7]In spite of the efficiency and creativity of African electronics markets in valorising materials, this simply adds to the e-waste management challenge. In these contexts, end-of-life solutions for electronic products are generally geared towards extracting valuable materials and discarding or burning everything else.

- Even extended producer responsibility (EPR) regimes, which we describe below, are a long way from addressing the planned obsolescence, poor design choices, inefficiencies in the value chain, and negative externalities which just aren't priced in by electronics producers. This means **EPR calculations are unlikely to capture the full costs of safe processing.**

Taking all of this into account, it's reasonable to conclude that the e-waste crisis is too big, urgent, and complex for any single solution. A set of approaches – long- and short term – need to be explored, which look at all aspects of systems change, from changing the rules of the game to redefining commercial incentives.

Mobile waste collection point Accra, Ghana. Image credit: Closing the Loop

Aggregator point in Lagos, Nigeria. Initial stage of sorting mobile phones. Image credit: Closing the Loop

E-waste compensation: The model explained

E-waste compensation responds to the need for better e-waste management in lower- and middle-income countries - West Africa specifically, in the context of this inquiry.

In simple terms, it works as follows:

- In Europe, a customer - whether a business or individual - purchases a new electronic product"
- An additional charge is added to the purchase, to cover the cost of collecting the waste that this product will one day produce
- The charge covers the cost of collecting (today) an equivalent amount of e-waste from a country that lacks safe recycling systems.

Underneath this simple transaction is a structured recovery system:

- E-waste is collected, aggregated, sorted and inspected in-country (e.g. Ghana)
- Sorted e-waste is transported to a recycling plant that meets specific environmental criteria. None exist in Africa, currently.
- Recycling plants retrieve materials from e-waste during a recycling process, feeding these materials into new life cycles to create new products.

Certification for this process exists, but is limited to three product types: phones, laptops, and tablets. However, compensators have also recycled batteries, screens, and servers. The scope is potentially much larger.

One important thing to note is that e-waste compensation does not free producers from their legal obligations under Extended Producer Responsibility (EPR) schemes in countries where their products are sold. It is a voluntary complement by participating businesses/ customers.

> "The mountains of e-waste piling up in Africa are a symbol of both a global failure and a local opportunity."
>
> **Moses Musaazi**
> *Ugandan Innovator and Social Entrepreneur*

In the absence of this model, what would happen?

In Africa, at the end of an electronic product´s life, value is extracted through material recovery. As with many material recovery sectors, e-waste collection and recycling is generally informal. Small-scale collectors go from house to house, offering cash for domestic electronic waste; from mobile phones, televisions, and fridges to air conditioning units. This is convenient for consumers. However, artisanal recycling practices often prioritise 'cherry picking' of higher value materials. Valuable materials such as aluminium and copper are recovered, while non-valuable and polluting fractions are thrown away or burned.[8]

Case study: Closing the Loop

E-waste compensation is a relatively new mechanism, with few participating organisations. As the most established in this market, Closing the Loop is a natural reference point.[9]

Established in 2014, Closing the Loop aims to promote the circular economy for electronic devices. Through their 'one for one' model, the business' goal is to create an economically viable pathway for safe recovery of e-waste, minimising human and environmental harm.

Closing the Loop's model is built on the principle that it is currently not economically viable to recover materials from end-of-life electronics in a responsible way, making an additional financing mechanism necessary.

> "It is time for Africa to turn this challenge into an opportunity for sustainable development."
>
> **Nnimmo Bassey**
> *Director of the Health of Mother Earth Foundation*

The company has run projects across more than ten African countries, with a current emphasis on Ghana, Nigeria and Cameroon. At the time of writing they have processed some 5.6 million devices.

Initially focusing on mobile phones, it has added other electronic devices like laptops, tablets, computer screens, and batteries. Its clients include organisations such as Vodafone, the Dutch government, and KPMG.

To drive greater responsibility in the sector, Closing the Loop has invested in certification and support to develop industry-wide standardised principles for e-waste compensation. In Annex 2 we set out details of Closing the Loop's status as an Approved Collector under the TCO Certified Edge, e-waste compensated scheme.

Inspection by Closing the Loop team in Accra Ghana. Image credit: Closing the Loop

The E-waste compensation value chain

To explain the value chain end-to-end, we show a representative scenario where e-waste compensation does not exist, using a 2012 evaluation of Nigerian electronics and e-waste.[10] We then compare Closing the Loop's operations in Ghana for mobile phones.

Without e-waste compensation - the Nigerian comparison

The diagram below shows the journey of electronics, new and used.

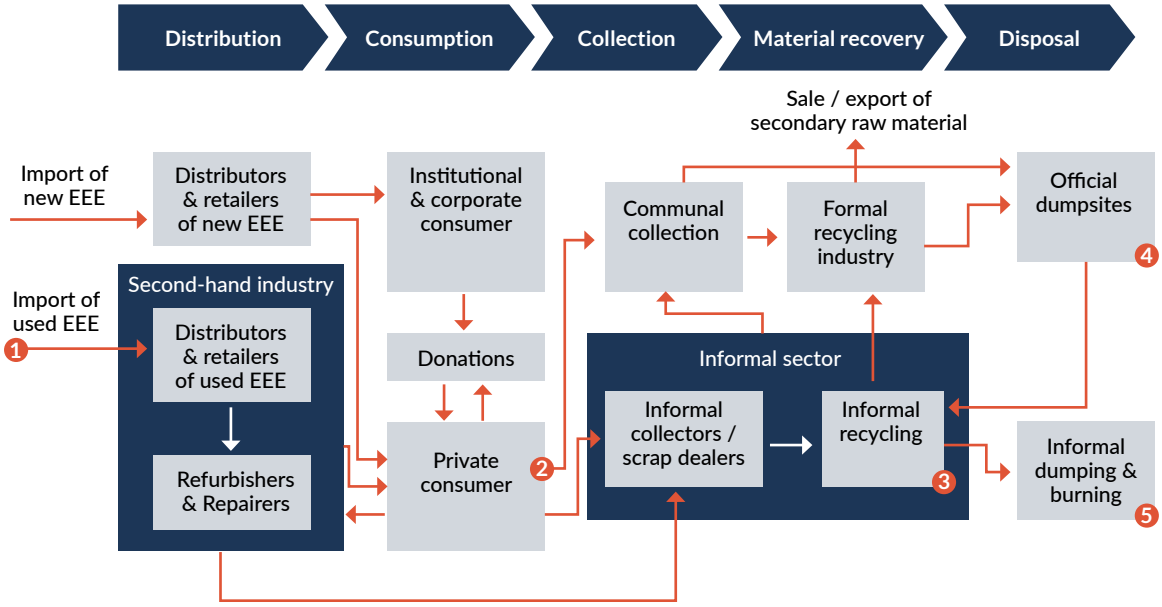


Figure 1: Electrical and electronic equipment processing in a business-as-usual scenario in Nigeria

The diagram's authors demonstrate five negative 'hotspots', numbered on the illustration:

1. Imported electronic equipment that is effectively e-waste on arrival.
2. Mixing of e-waste with household waste.
3. Unsafe informal recycling .
4. Disposal on dumpsites which cannot avoid leakage or emissions of hazardous substances.
5. Dumping and burning of post-recycling e-waste on informal dumpsites.

Hotspots 2-5 are the downsides that e-waste compensation seeks to avoid. We show the extent to which this is achieved by mapping out the process.

> Selling end-of-life phones is beneficial because it offers us [repairers] an extra income, and also prevents e-waste ending in landfills or polluting the environment. Collectors also earn a livelihood through the collection process.
>
> **Baba, Repairer, Accra**

E-waste compensation

The diagram below takes the same distribution and consumption stages as the business-as-usual model, focusing on the Collection and Material recovery stages, which is where e-waste compensation differs.

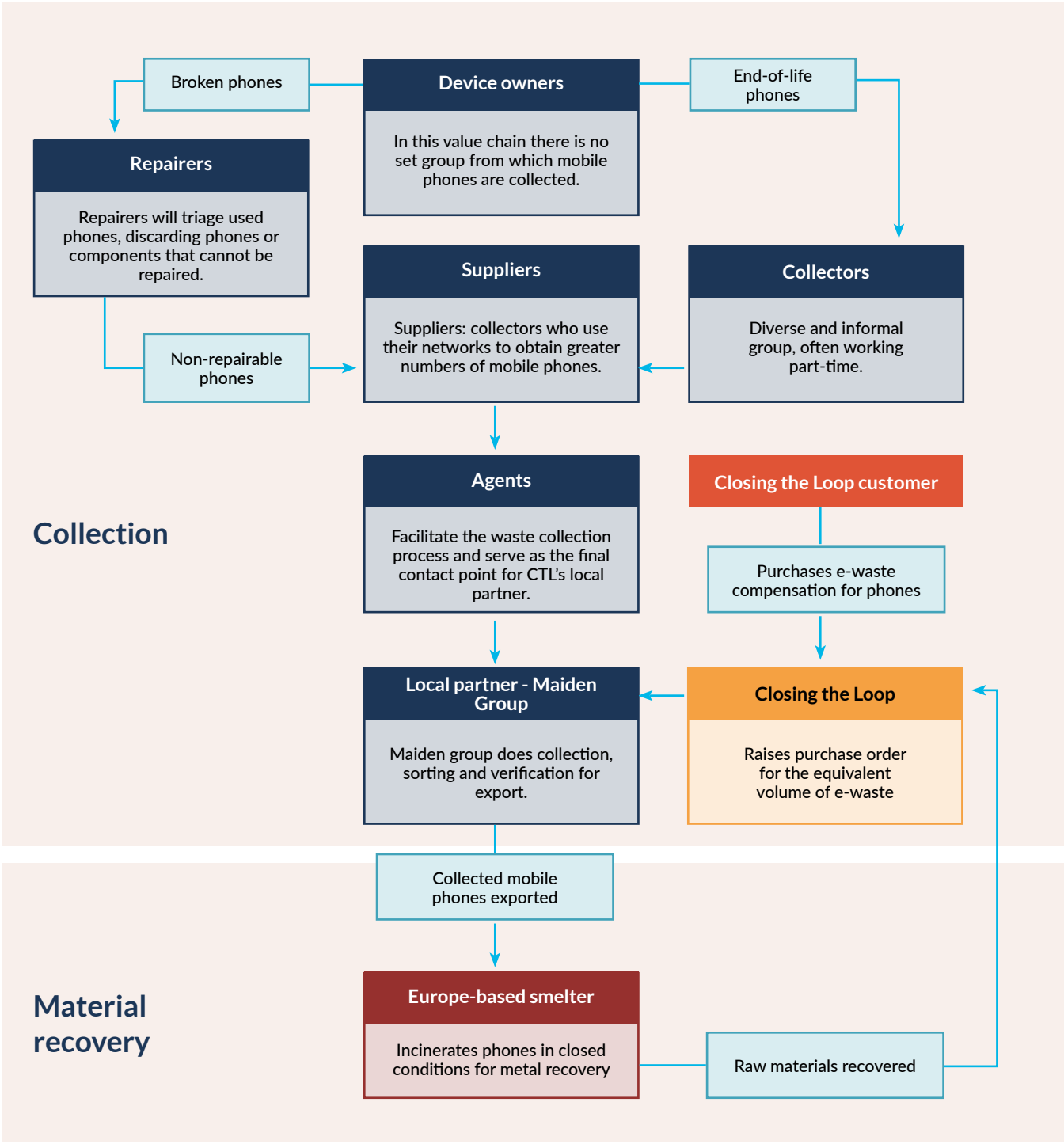


Figure 2: Mobile phone compensation in Ghana illustrated by Closing the Loop's process

In Ghana, Closing The Loop has a local partner, Maiden who manages the upstream supply chain of informal collectors and takes responsibility for sorting and shipping phones.[11]

Additional context

There are some important additional points of detail of phone recycling which our analysis uncovered and which explain this process and its trade-offs better.

- **For phones, recycling quantities are based on weight and count.** This is important to note since when it comes to determining how much to recycle, there are three potential ways to calculate: on a one-for-one basis, by equivalence in the device, or by the device's pollution potential. [12]Closing the Loop uses a two-stage weight and count verification system with an error margin to create more accurate phone processing. That means a greater than 1:1 ratio, accounting for potential weight and count fluctuations.
- **Our interviews indicate that over time, the value of the material that can be recovered from phones is diminishing.** This goes somewhat against recent reporting on the value that urban mining can bring. It suggests that recycling will always need an element of subsidy, whether that is in the form of e-waste compensation, EPR schemes or measures such as Ghana's eco-levy, described below.
- **Phone handsets are typically exported from Ghana intact, but with the battery having been separated.** An estimated 97% of phones that they receive do not have batteries. Our interviews indicate this is because phone and battery failure rarely coincide. When batteries are recovered, they are separated from phones, sorted and stored in barrels of sand for safety until a sufficient volume is reached.
- **Rather than being dismantled, the entire phone handset is shredded and used in the smelting process.** Screens and plastic casing are used as thermal reagents (fuel) in the smelting process. The smelting process produces a slag that is used in the bitumen industry, and a metal ingot that is then processed at the recycling plant to extract the various metals. This downgrading of non-metal materials through burning was surprising as it is decidedly less 'circular', but our interviews indicate it is a trade-off between cost and feasibility.
- **The most important minerals that are recovered from phones are copper, gold, nickel and silver.** Gold and silver are either used in manufacturing new devices or sold to a Netherlands based sustainable jewellery business (NoWa).
- **Getting the price right is a critical consideration.** The prices that an e-waste compensator pays have to be low enough for their clients who purchase compensation, and high enough to provide a viable alternative to the informal market. They also have to be 'scrap' prices so that they process end of life products, avoiding possible rebound effects such as diverting new phones to smelting before their use is exhausted.

As we indicate, phones are the simplest products that are processed by Closing the Loop. Screens, for example, are more complex, and include toxic substances such as mercury, as well as more elements that can be valorised, for example in cement production.

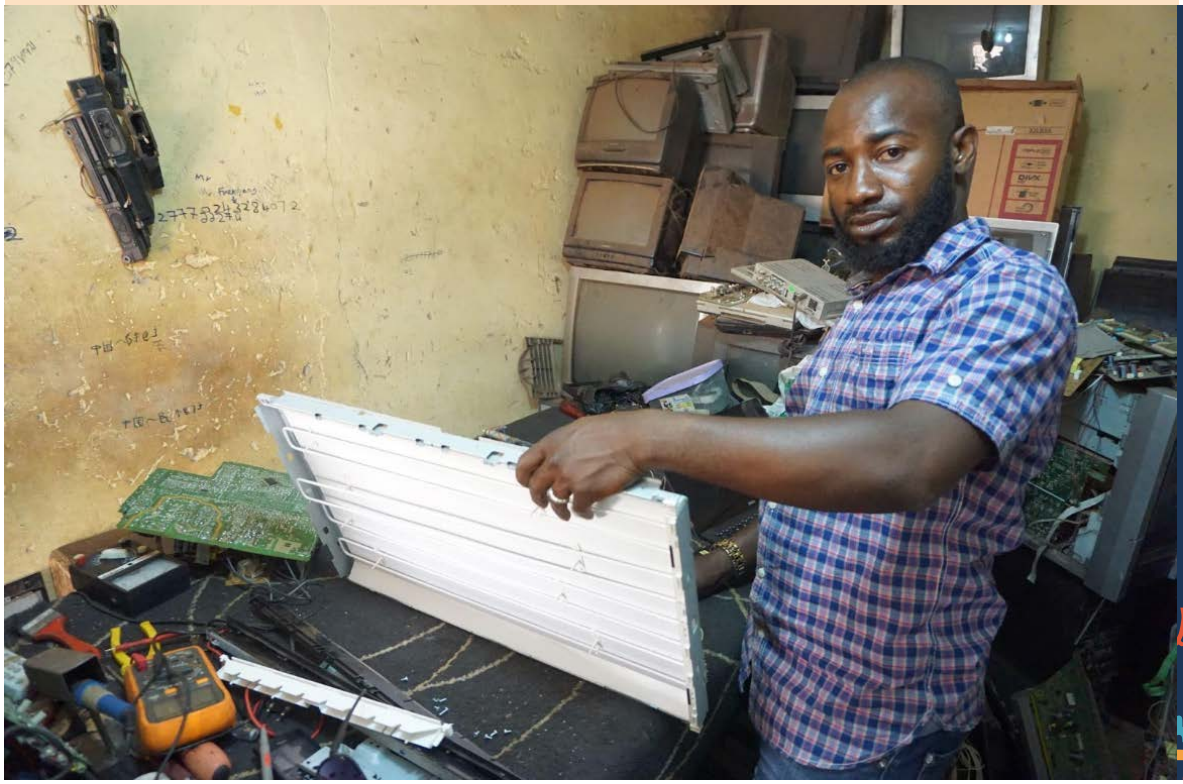
Collection yard for mobile phones in Agbogbloshie. Image credit: Footprints Africa

Coordinating the upstream value chain: Maiden Group and Closing the Loop's local suppliers in Ghana

Maiden Group was founded in 2013 and began partnering with Closing the Loop in 2015.

As with Closing the Loop's other partnering organisations in Africa, Maiden is the link with the upstream informal sector in the e-waste processing chain. Maiden works directly with around five agents, who must be registered under an agreement with Maiden. Each has multiple suppliers who, in turn, engage with four collectors, of which two are repairers and two general collectors. Maiden focuses on aggregating, counting and quality control of phones, with their agents facilitating the collection process.

On a monthly basis, Maiden gathers between 80,000 to 140,000 phones for Closing the Loop. This covers a wide range of brands and models, both smartphones and feature phones. From our interviews, Bani, Itel and Tecno are the most popular current brands; common older brands and models include Blackberry, Apple iPhone, and Samsung.



Television screens are repurposed into signage displays in Accra Ghana. Image credit: Robin Ingenthron

Comparison: e-waste compensation vs business-as-usual processing

E-waste compensation claims a range of benefits compared to typical handling of end-of-life electronics in emerging economies:

- Avoiding unsafe recycling and adverse impacts on human and environmental health
- Providing predictable economic incentives, stability and better conditions to the stakeholders in the value chain
- Preventing disposal on dump sites which cannot avoid leakage or emissions of hazardous substances
- Preventing dumping and burning of post-recycling waste
- Providing, through metal recovery, a more efficient, lower emission alternative to mining of virgin materials.

To what extent do these hold true? In the table below, we outline the environmental, social and economic effects of the two scenarios.[13]

For the purposes of this comparison 'business-as-usual' means:

- Informal collection and aggregation of end-of-life products without a formal registered partner
- Artisanal processing of products to extract more valuable material for domestic re-use or export
- Non-registered or illegal export of end-of-life electronics products or their constituent valuable materials.

Material recovery from phones. Image credit: Closing the Loop

Key

High positive impact | Medium positive impact | Low positive impact | Negative impact

Impact category		Business as usual scenario	E-waste compensation
ENVIRONMENT			
Greenhouse gas emissions	Direct		
	Indirect		
Soil contamination			
Water contamination	Processing		
	Transportation		
Human health	Workers		
	Community		
Resource recovery			
Biodiversity			
Energy efficiency			
SOCIAL			
Workplace and worker conditions			
Child labour			
Employment			
ECONOMIC			
Business formalisation			
Tax revenue			
Value chain development			
Investment attraction			

See Annex 3 for elaborated version

This table is indicative rather than exhaustive. A more rigorous analysis would take us beyond the scope of this report, particularly given the lack of data on informal activities. But it gives an illustration of the shortcomings of the business-as-usual approach, the advantages of e-waste compensation, and the disadvantages or areas for improvement.

There are many areas for further investigation, for example how African businesses can capitalise on the know-how that they are building up through participating in e-waste compensation that will be essential in building localised e-waste processing.

‘Yam’ phones: How e-waste compensation can help stem a seemingly unstoppable tide

Yam phones are basic, non-smartphones. Comparatively cheap (GH¢80 to GH¢300 or approximately US$4-23), they are imported from Brazil, China, India, Indonesia, Japan, and South Korea[14] and often replaced rather than repaired, sometimes in a matter of months. They are not subject to any kind of EPR or regulatory regime which extends to African contexts.

E-waste compensation recycles everything rather than cherry-picking high value materials. A significant portion of the collected phones in the Closing the Loop process - roughly 80% - consists of non-smartphones (or ‘T9’ phones), helping process the huge volume of these low-value products, the import of which shows no signs of slowing down.

Image from a collection centre in Lagos, Nigeria, showing an array of ‘non smartphone’ handsets.
Image credit: Closing the Loop

Transitioning to circularity

Whilst defining a vision for circular electronics is out of scope, there are core principles that we know would be involved. Below we explore to what extent the e-waste compensation model should help or hinder in the adoption of these principles.

Circular Strategy	Help/ Hinder/ Neutral	Explanation
Circular Product Design		
Modular & Repairable	Neutral	Data on end-of-life could feed into design
Durable Materials	Neutral	
Reusable components	Hinder	If components are not harvested before recycling
Recyclable Components	Help	
Avoid virgin raw materials	Help	Material recovery
Circular Supply Chains		
Closed Loops	Help	A step but needs more actors. Magnitude depends on ambition of each company
Decentralised value addition	Help	Aggregating volumes & strengthening local value chains BUT requires commitment to investment in local infrastructure
Repair/ Refurbish/ Remanufacture		
Product as a Service	Neutral	No impact
Materials as a Service	Help	Possibility to rethink ownership of materials recovered
Ownership models		
Extend product lifetime	Neutral	Supports sorting but could be a disincentive to repair if financial incentives are misaligned
Recycle		
Achieve Zero Waste	Help	Reduce e-waste to landfill & dump
Zero pollution	Help	Mitigate environment & health risks
Collaboration		
Standards & Policy	Help	Contribute to standards & transparency
Supporting the ecosystem	Help	Developing local value chain

From this analysis, e-waste compensation plays a stronger role later in the value chain towards the end of life. It has interesting potential to inform product and business model design and localised closed loops but this will not happen without a concerted effort in this direction.

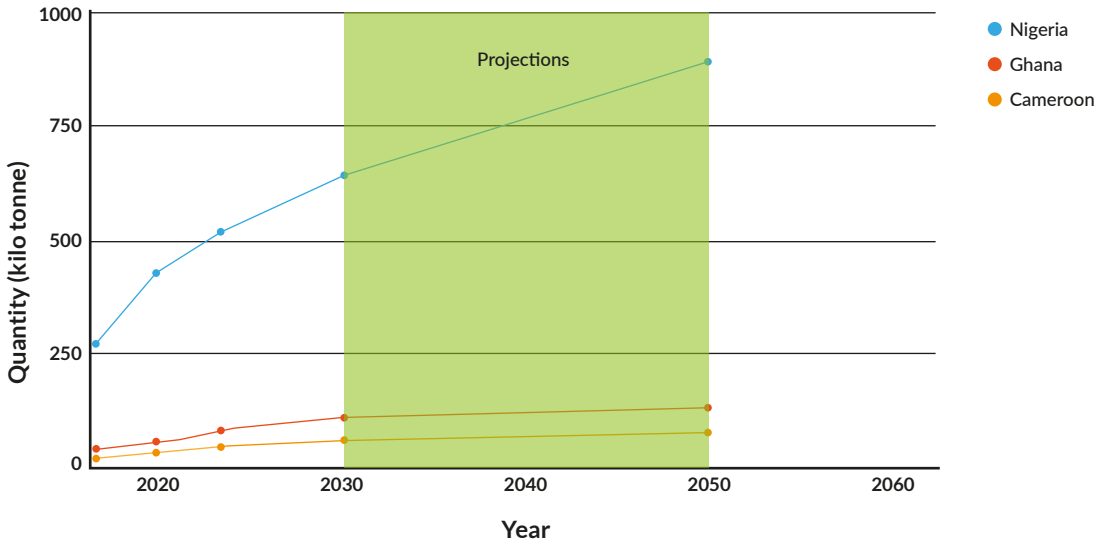
The future for e-waste compensation

In the absence of any major reimagining of global value chains, e-waste is set to grow, year-on-year, by staggering amounts. With investment into infrastructure and value chains, this could provide a potential strategic source of raw materials that Africa needs. How could e-waste compensation address this?

Steady upward trends for global e-waste

We are seeing population growth, urbanisation, consumerism, renewables and increasing integration of electronics into smarter everyday items. Africa can look forward to more accessible electronics, at lower cost, with less durability. Unchecked, this will drive the continent down the path of the global economy which, year on year, is becoming less circular.

Figure 3: e-waste generation: past trends and future projections[15]



These are projections rather than predictions, and the data depends on many assumptions.

- The amount of recycling on the continent. This itself can be influenced by the development of e-waste compensation if it reaches its stated aim of building African recycling capacity.
- Fluctuations in types of e-waste, or the introduction of new categories of e-waste. That will include, for example, solar panels or electric vehicle batteries as uptake increases, and after they come offline.[16]
- The possible increased uptake of circular business models which slow down the growth of e-waste streams.

These uncertainties aside, the projections are staggering. Logically that means there is a role for solutions such as e-waste compensation for the foreseeable future.

Returning to our question: does e-waste compensation, which focuses more on the end of life, pave the way for more circular models? We know they are being discussed but what is holding them back from being implemented?

The strategic importance of raw materials for Africa

It is important to look at e-waste compensation in the context of the challenge that African countries have in securing critical minerals.

If e-waste compensation scales it could be a significant part of the solution. The raw materials that e-waste compensation extracts - cobalt, copper, lithium, and nickel - are integral to the worldwide transition to energy that is electric rather than fossil-fuel derived. This translates into intensifying critical mineral demand over the next 20 years. The International Energy Agency, for example, estimates that mineral demand from clean energy technologies will quadruple by 2040.

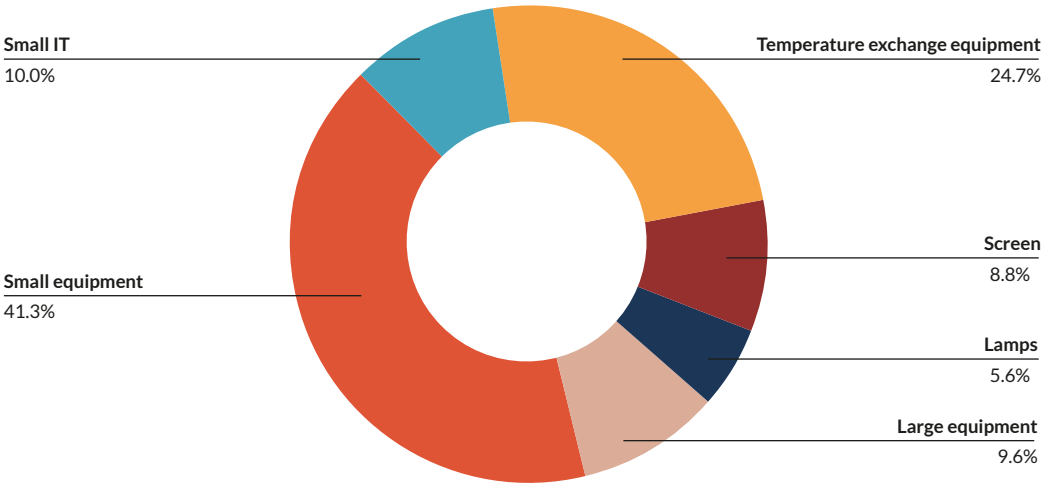
The argument for metal recovery remains true even if the per-product recovery of minerals is lower than generally assumed. Their supply in African countries needs to be guaranteed. And there is potential to use e-waste recycling - potentially financed in the short term - as a new source of export revenue to players such as the European Union that are looking to diversify their own supply chains.

Future directions for e-waste compensation

Given these strategic implications, could and should e-waste compensation expand to other categories to increase its impact? Current e-waste compensation models focus on just a possible fifth of the total e-waste that is being generated (see below). And although its model is well-established, e-waste compensation can only tackle a fraction of that volume at the industry's current level of investment.

To illustrate: the following figure gives a breakdown of categories of e-waste, again using UN data as a guide. They comprise the volumes that are generated for Cameroon, Ghana and Nigeria.[17]

Figure 4: e-waste generated per category



This raises the question of how the model might be expanded to other sectors for greater impact, commercial return and reduction of environmental harm. In turn that would mean working out a model for equipment that has a lower value to weight ratio than consumer electronics, in some instances. Our interviews indicate that this is possible.

E-waste compensation and other circular strategies

From our interviews we have learned that Closing the Loop and other e-waste compensators believe e-waste compensation is a pragmatic solution for e-waste that can support and - in some cases - converge with the other measures that are trying to point in the direction of circular electronics. They emphasise that e-waste compensation has the advantage of bringing short-term, tangible results, formalising the networks that facilitate recycling, and - little by little - creating the business case for greater investment in recycling, or more circular solutions.

A circular economy for electronics will mean strategies that take us much further up the hierarchy of 'Rs' than e-waste recycling or e-waste compensation in its current form. In Annex 4 we set out more background detail on various options that we have identified. For the purposes of this work there are two strategies which we believe interface most strongly in the short-term with e-waste compensation: extended producer responsibility, and regulating imports.[18]

Setting the base for extended producer responsibility

The first is extended producer responsibility: shifting the 'waste' burden back to original equipment manufacturers to ensure proper recycling and waste management practices and, in principle, long-term moves towards circularity.

Currently the only example relevant to this inquiry is Nigeria's e-waste Producer Responsibility Organisation (EPRON), with which all manufactures, importers and retailers of electronics are required to be registered.

Our interviews indicate EPR's success depends on strong institutional contexts (especially enforcement) which are still developing to

Case study

What happens if lithium-ion batteries are not disposed of properly?

Hinckley RECYCLING

Name of company: Hinckley Recycling

Location: Nigeria

Sector: E-waste recycling

Year founded: 2011

Hinckley is Nigeria's first e-waste recycling facility that processes tens of thousands of tonnes of e-waste each year.

Hinckley worked with Footprints Africa to estimate the potential environmental benefits of their recycling activities, focusing on lithium-ion batteries from mobile phones, solar systems and laptops. This data is critical. It can be used to seek investment into recycling infrastructures to mitigate environmental risks, advocate for policy change and stimulate future research into health and other impacts.

The assessment uncovered that Hinckley contributed to diverting of 1,720 tonnes of Li-ion batteries from landfill each year. While significant, that is just a fraction of the quantities of heavy metals that would have otherwise ended up in Nigeria's environment per annum.

apply more 'rule-based' solutions. They also suggest that the waste compensation can be a catalyst for EPR since the latter depends on two things: the first is sufficiently large and efficient collection networks. The second is achieving competitive prices for collection and recycling that make EPR implementation viable. From the information we have received there is still quite some way to go: Closing the Loop, for example, has reduced the cost of screen recycling in Nigeria from €6 to €4 per unit, whereas EPR fees will currently only cover an estimated €0.50 of recycling costs.

Regulating imports

The second concerns regulations on imports by African countries that have as their goal to control the influx of e-waste alongside secondhand imports and build up resources for better domestic e-waste handling.

The most relevant example of this is Ghana's eco-levy, introduced in 2018, and which is applied to imported second hand electronic goods. In order to clear their goods, importers pay fees into the government's Electrical and Electronic Waste Management Fund. We understand this will be used by Ghana's Environmental Protection Agency to finance the construction of an e-waste treatment facility.

> While Closing the Loop has reduced the cost of screen recycling from EUR 6 to EUR 4, EPR fees only cover EUR 0.50 of recycling costs

We see a point of convergence here. While it may be challenging to link the efficient and informal e-waste processing market with more formal mechanisms, at the same time there is an opportunity to look at how e-waste compensators can collaborate on financing domestic e-waste facilities.

In the next section we make recommendations on how the stakeholders involved in or affected by e-waste compensation can collaborate and make concrete moves towards circularity.

Image credits: Closing the Loop

Where next for e-waste compensation?

Conclusions

We have talked in this inquiry about the benefits and disadvantages of the e-waste compensation model, and possible future pathways. From our interviews with the Closing the Loop team and partners, they are prioritising the pragmatic (i.e. what is viable now) over the perfect.

We conclude that e-waste compensation:

- **Has built up an established and transparent mechanism** that gives many benefits over the business-as-usual options for treatment of end-of-life electronics.
- Is effective at **channelling significant financing** efficiently to the contexts in which it is needed, bringing a 'last mile' advantage that other formal mechanisms such as EPR find hard to do.
- **Is lower down the circular hierarchy,** dealing in recycling and involving long-distance transport, rather than closing loops locally. There are strategies that it does not currently influence, such as ecodesign.
- **Needs to scale up if it is to have real impact and make structural change.** By 'scale' and 'impact' we mean not just processing higher volumes of e-waste - although that is vital. The structural change includes building up the efficient informal sector, and making the business case that creates investment in recycling facilities on the continent.
- **Needs - if scale is the intention - to move from a voluntary or corporate social responsibility type approach to something more institutionalised and industry-wide.** Without this, its revenue and ability to address the e-waste market will stay small in a context which needs scale, especially if attracting investment into local processing is a goal.
- **Has a challenge to influence the other end of the value chain:** understanding how it can impact design, use and manufacture in electronics' primary and secondary markets (the latter of which will remain important in West African contexts while manufacturing remains low).

We also conclude from our research and interviews that there is a need for much better understanding and collaboration between the people who are aiming, in different ways, to address the global mess that is e-waste. There is often the challenge of 'friendly fire' when talking about pathways to real sustainability. Rather than viewing this as an impasse, we believe this opens up a series of options for collective problem-solving.

Recommendations

Our vision is to reshape the development pathway for a circular electronics sector in Africa to one that:

- Champions the valuable current and potential contributions of repairers and material recovery actors who are often marginalised
- Harnesses resourceful innovations that secure access to renewables and ICT, driving resilience and self-sufficiency
- Eradicates environmental and human harm.

With these considerations, we urge actions for those involved in and around e-waste value chains, outlined below. We have begun convening stakeholders. We look forward to hearing from those wishing to participate.

African governmental institutions

- Calculate the true cost of safe processing locally and its financial viability. Create an enabling environment to promote investment into local and regional processing capabilities (clear, uniformly applied regulation, harmonised e-waste compensation principles with country-driven strategies such as EPR or eco-levies)
- Determine the impact of e-waste compensation on nationally determined contributions as a potential avenue to mobilise financing
- Champion job creation by creating clear roles and licences for informal and formal actors (collection and initial processing for informal and advanced processing for formal).

European governments and institutions

- Integrate findings from collection and recycling in Africa directly into regulation of the electronics sector, including product design, right to (and ease of) repair and end-of-life management
- Drive equity of industrial support (level the playing field) to allow more nascent recycling industries on the continent to support critical raw material supply
- In climate finance, review the impact of mandating e-waste compensation as a transition measure and extend EU-wide extended producer responsibility rules to exporting countries, giving receiving countries financial coverage for end-of-life treatments.

Electronics producers and importers

- Design products and processes for higher levels of circularity; longer lifetimes, repairability and ease of safe disassembly
- Publish clear targets and performance on circularity, zero waste to landfill throughout product lifetimes and steps in the transition
- Consider e-waste compensation as a step in the transition with support to develop global collection and safe processing that creates jobs.

E-waste compensation industry players

- Collaborate on data publication to demonstrate impact, and build investment cases for potential processing facilities located on the African continent
- Build strong, collaborative in-country value chains that provide foundations for investment into localised processing
- Support the development and enforcement of industry standards (e.g. TCO).

Africa-based e-waste processors

- Measure and report data on e-waste volumes and processing costs to inform effective policy, stimulate investment and attract support programmes.

Standards bodies (for example TCO)

- Work on the next generation for e-waste compensation certification, and turn current principles and non-binding recommendations into enforceable, reportable standards
- Include enforceable targets on higher 'Rs' in circularity to incentivise a move towards greater circularity.

Next Steps

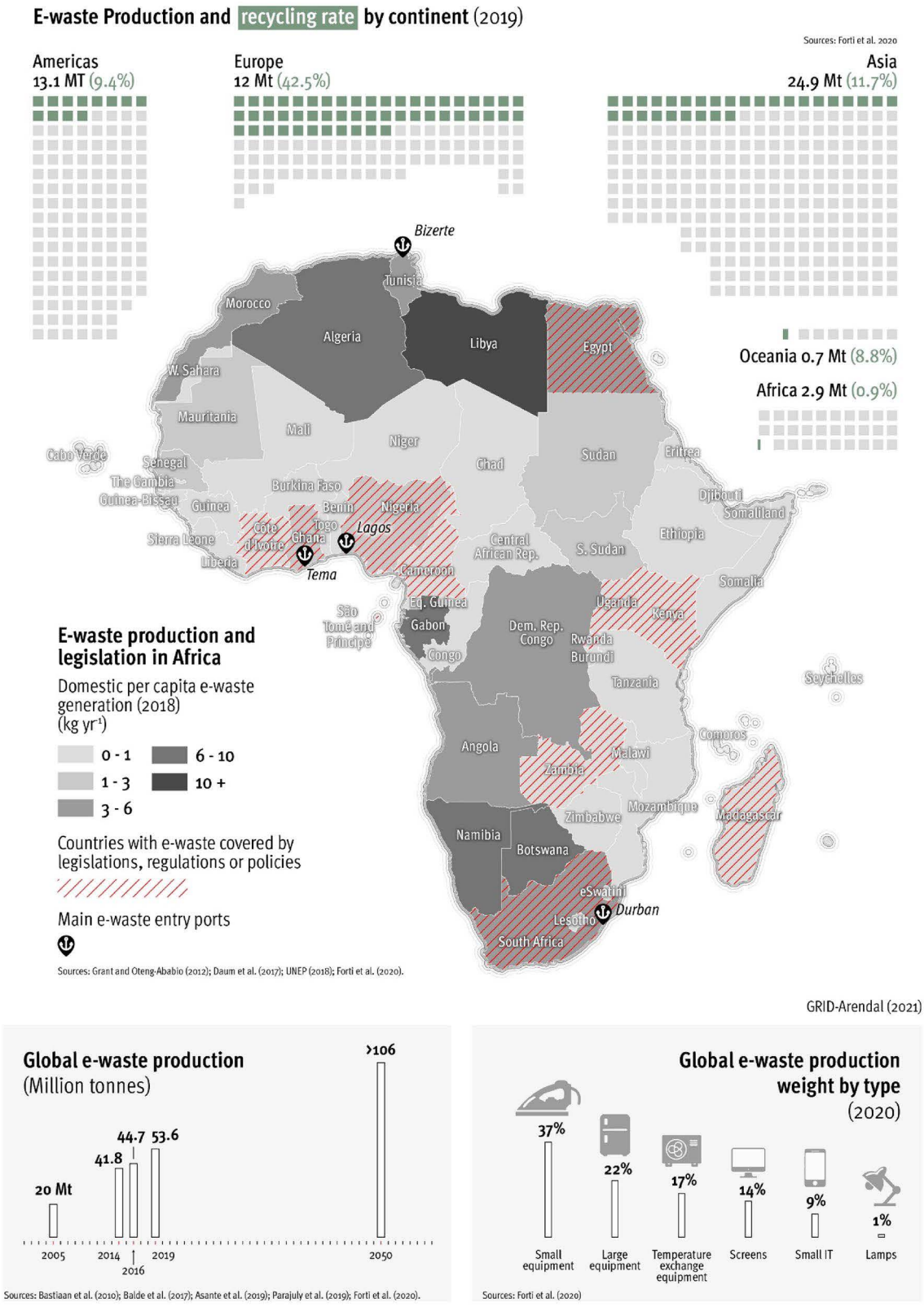
At Footprints Africa, we will continue to leverage our unique position supporting the private sector to embrace circularity and drive an inclusive transition. We are seeking collaborators and supporters in the following proposed activities that we believe will build technical expertise, de-risk investment and foment greater cohesion amongst stakeholders:

- A pan-African, multi-year, sector-focused circular programme for companies in the electronics sector
- Comprehensive mapping of circular activity in electronics across Africa
- Cost and impact analyses of existing and potential business models for different markets
- Pilot and prototype programmes to develop and refine creative innovations
- Training to upskill informal actors and private sector employees, focused on higher value circularity (safe repair, refurbishment and innovation)
- Multistakeholder convenings and dialogues to shape direction of development of the sector, that champions African priorities.

Image credits: Closing the Loop

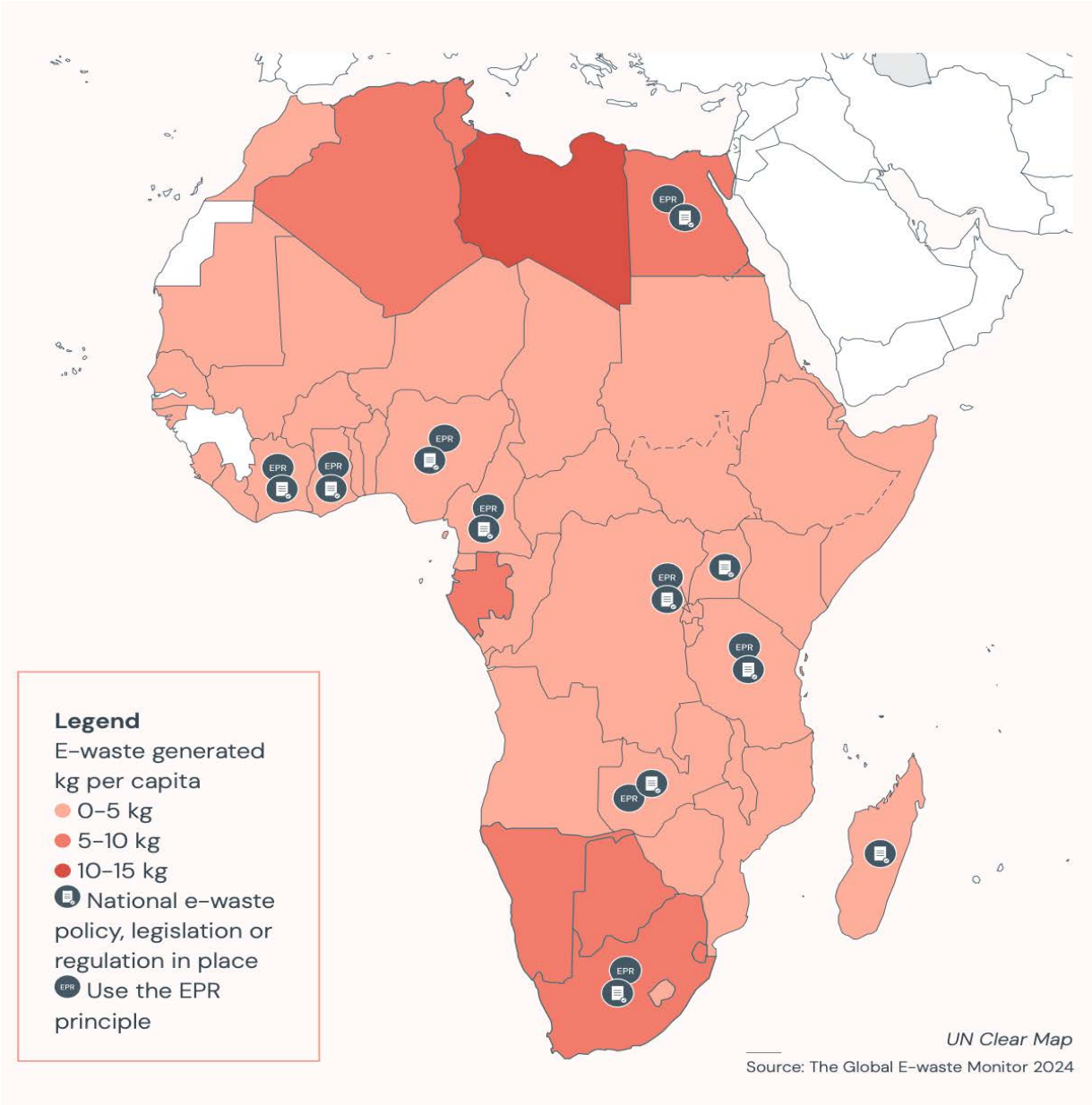
Annex 1: Key statistics on e-waste in Africa

Figure 1: Comparing Africa's e-waste to the rest of the world



Source: e-waste it wisely: lessons from Africa, by Thomas Maes and Fiona Preston-Whyte[19]

Figure 2: Africa's e-waste generation and recycling patterns



Source: The Global e-waste Monitor 2024 – Quantities, flows, and the circular economy potential, United Nations Institute for Training and Research

Annex 2: Standards and principles for e-waste compensation

Closing The Loop is a certified collector for TCO Certified Edge, e-waste Compensated, a certification programme designed to combat e-waste which covers phones, tablets and laptops. This certification is integrated into their corporate governance principles, a code of conduct that they are required to communicate to their suppliers, covering, among other things:

- ILO's eight core conventions
- The United Nations Convention on the Rights of the Child
- Local and national labour and health and safety laws
- Maximum 60-hour working week, including overtime
- Standards for responsible recycling.

It should be noted that the certification has both a binding component and a set of non-binding recommendations which are more aspirational. The second includes elements such as prioritisation of the informal sector.

Closing the Loop is a member of the PREVENT Waste Alliance, the purpose of which is to minimise waste, eliminate pollutants and maximise the reuse of resources in the economy worldwide.

Closing the Loop was also a member of the IRBC Responsible Gold Agreement until the end of the project in 2022.

In 2022, under the PREVENT Waste Alliance's project "e-waste compensation as an international financing mechanism" (ECoN), a group of stakeholders developed and defined 11 general principles of effective e-waste compensation. These principles, although in the early stages of formalisation, cover a range of topics from compensation ratios to additionality and transparency. A key feature of these principles is the determination of the amount of waste to be compensated, which can be calculated on an equivalency basis (like for like), by combined weight or number, or by the pollution potential of the item being recycled.

Closing the Loop with partners Maiden Environmental Services in Accra,Ghana. Image credit: Closing the Loop

An electronic device repairer's desk in Accra, Ghana. Image credit: Footprints Africa

Annex 3: Impact of e-waste compensation

Key

High positive impact | Medium positive impact | Low positive impact | Negative impact

Impact category		Business as usual scenario	E-waste compensation
ENVIRONMENT			
Greenhouse gas emissions	Direct	Emissions from shipping, efficient fuel use and uncontrolled activities	Emissions from shipping
	Indirect	Avoided emissions from the recovered metals	Less emissions due to higher metal recovery rate and positive net balance of energy consumption
Soil contamination resulting from the process		Contamination from heavy metals like copper and bromine via improper incineration and disposal practices	Lower soil contamination due to controlled and efficient recycling practices
Water contamination - (ground and / or surface water)	Processing	Open burning and acid leaching of PCBs contaminates water bodies with toxic substances	Emissions are captured and treated, leading to a lower amount of emissions into water bodies
	Transportation	Contribution to pollution through illegal exports via shipping	Contribution to pollution through shipping
Human health - exposure to damaging substances	Workers	Provision of personal protective equipment usually rare	Personal protective equipment provided to workers in the supply chain
	Community	Direct air emissions not measured nor limited	Air pollutants captured and treated
Resource recovery - extent to which material is kept in circulation at its highest possible value		Only materials with high market value are recovered	Most valuable materials recovered, although, for example, plastics downcycled into bituminous material
Biodiversity - the extent to which biodiversity is promoted and/or loss prevented		Unprocessed or waste materials dumped illegally or sent to overcapacity landfill	Avoided ecosystem impacts through avoiding leakage

Key

High positive impact | Medium positive impact | Low positive impact | Negative impact

Impact category	Business as usual scenario	E-waste compensation
Energy efficiency	Involves incineration which requires significant energy consumption and manual dismantling leading to low recovery rates	Utilises modern recycling techniques with higher standards such as smelters at recovery stage
SOCIAL		
Workplace and worker conditions - working hours, health and safety equipment	Unregulated worker conditions	Improved working conditions through provision of PPE
Child labour - protection from exploitation, protection of education and development	Potential risk of child labour	TCO approval status prohibits use of child labour
Employment - Creation of good quality employment opportunities	Inconsistent income streams for workers, keeping economic opportunity lower	E-waste compensation creates competitive pay rates for collection and more predictability in demand. At the same time, we should note that when smelting takes place in Europe it reduces employment opportunity potential in West Africa
ECONOMIC		
Business formalisation - incentivisation of formalisation of businesses in the value chain	Few incentives for formalisation, particularly at illegal export stage	Encourages business formalisation at aggregation stage
Tax revenue - The extent to which the model adds to the national tax base	Tax compliance not ensured in the informal sector	Improved tax compliance at formal stages of the value chain
Value chain development - lowering of transaction costs in the value chain, for example through economies of scale.	Low cost informal value chain, but lack of structure	Estimated greater predictability of demand. For example, in Nigeria, recycling costs for screens have been lowered from €6 to €4 through Closing the Loop's economies of scale
Investment attraction - the extent to which investment (outside of processing fees) in businesses and processes is generated	Limited investment and potential for scaling e-waste collection	Potential to attract investment if operating at a sufficient scale. TCO certification, for example, includes recommendations on increasing investment in the informal sector

Annex 4: Other e-waste compensation players

In Europe there are two other organisations working in e-waste compensation in African contexts: Minimise and ARGO360. Below we summarise their business models.

Name	Where based	Business model
Minimise	Germany	Minimise operates as a platform, aggregating the work of a network of e-waste collectors in seven countries, including in Africa. Closing the Loop operates as one of their collecting organisations. They enable the collection, transport and recycling of exactly the amount of e-waste that is generated by the organisation that wishes to contribute. Along this process, they collect data and turn it into e-waste credits. Minimise's value chain partners work on a broader range of electronics than Closing the Loop, including heavy appliances and air conditioners.
ARGO360	Netherlands	ARGO360 is an IT asset disposition service provider specialised in data removal and electronics recycling. Its services include an e-waste compensation model that is materially similar to Closing the Loop's. It also reports to its clients on: • Urban mining results, • Toxicity avoided, • Hours worked (social return on investment), and • CO_2 savings. Like Closing the Loop, ARGO360 is TCO certified.

Annex 5: Detail on other e-waste treatment options and circularity strategies

Extended producer responsibility solutions

EPR requires that producers – such as manufacturers, importers or distributors – take responsibility for the end-of-life management of electronics sold on the market. It focuses on two principles:

First, the shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer and away from the public sector or consumers; and

Second, the provision of incentives to producers to take into account environmental considerations when designing their products.

EPR can encompass:

- Collection fee for products,
- Minimum content of recycled materials,
- Responsible sourcing of raw materials,
- Product passports,
- Performance and durability requirements.

By extending producer responsibility to encompass the entire product lifecycle, from conception and design to material selection, production, and ultimately post-consumption management, EPR encourages better choices. Similarly, EPR levers that require manufacturers to provide product information to consumers, such as products' composition, hazards, practices of refurbishment, and life span, can shift consumer behaviours to assume circular responsibilities.

Extended producer responsibility schemes in West Africa

Nigeria case study

Nigeria's Extended Producer Responsibility Organisation for e-waste (EPRON) is a non profit organisation set up by electrical and electronic producers in Nigeria in 2018 to promote a collaborative approach to managing electronic waste. Comprising producers, importers, distributors, and recyclers of electrical and electronic equipment (EEE), EPRON takes responsibility for collecting and recycling e-waste generated by its members. Functioning under the framework, EPRON fulfils several key roles: setting collection and recycling targets, enforcing registration and reporting requirements, and levying penalties for non-compliance. Financed by member contributions based on EEE weight and type, EPRON uses the collected funds to cover e-waste management costs, including collection, transport, recycling, disposal, and operational expenses

Levies on imported electronics

An environmental charge applied to specific products or activities. These charges aim to promote responsible waste management and encourage sustainable practices. For example, an eco-levy is imposed on imported electronic and electrical items, with the collected funds supporting the proper handling and disposal of e-waste. The levy incentivises responsible behaviour and generates resources for environmental protection efforts.

Solutions for levies on imported electronics

Ghana case study

Ghana's Hazardous and Electronic Waste Control and Management Act (Act 917), implemented in 2018, addresses e-waste challenges through a multi-pronged approach.

The Ghana Revenue Authority, specifically its Customs Division, spearheads the collection of an e-waste eco-levy on the import of new, used, and end-of-life electrical and electronic equipment. This levy supplements Ghana's e-waste fund and aims to finance sustainable solutions, promote producer responsibility, and ensure the long-term sustainability of the

e-waste management system. Act 917 allocates a portion of the collected funds to support trade associations, and future plans

Regulation of electronics importers

The regulation of electronics importers specifically addresses the management and disposal of e-waste. They work by establishing rules and guidelines for the import of electronic goods. This approach acknowledges the potential dangers of e-waste and seeks to ensure responsible handling throughout the product life cycle, from import to ultimate disposal.

Nigeria case study

In 2011, restrictions were placed on importing WEEE, often non-functional and containing hazardous materials. Additionally, a complete ban was placed on cathode ray tube devices, known for their high lead and mercury content and their difficulty to recycle.

Component standardisation

Common standards for electronic components like connectors or batteries. This can reduce manufacturing costs, increase compatibility between components from different manufacturers, and facilitate repairs and upgrades by making it easier to find compatible replacements. In turn these measures should have a slowing impact on the production of e-waste, and facilitation of recycling,

European Union case study

The European Telecommunications Standards Institute mandates for USB-C charging on all new phones sold in the EU from 2024. This regulation aims to reduce e-waste by eliminating the need for a variety of charger types and fostering interoperability between different phone brands.

Design for disassembly or recycling ('ecodesign')

This encourages the design of electronics with minimal environmental impact throughout their lifecycle. This can involve promoting energy-efficient products, encouraging the use of recycled materials, and requiring designs that facilitate disassembly for easier recycling and component reuse.

European Union case study

EU energy labelling requirements: From June 20, 2025, new phones and tablets sold in the EU will need to be tougher, lasting longer and easier to fix. This means improved resistance to drops, water, and dust, and batteries that last at least 800 charges. Additionally, manufacturers must provide spare parts for seven years and software updates for at least five years, making repairs more accessible and extending devices' lifespan.

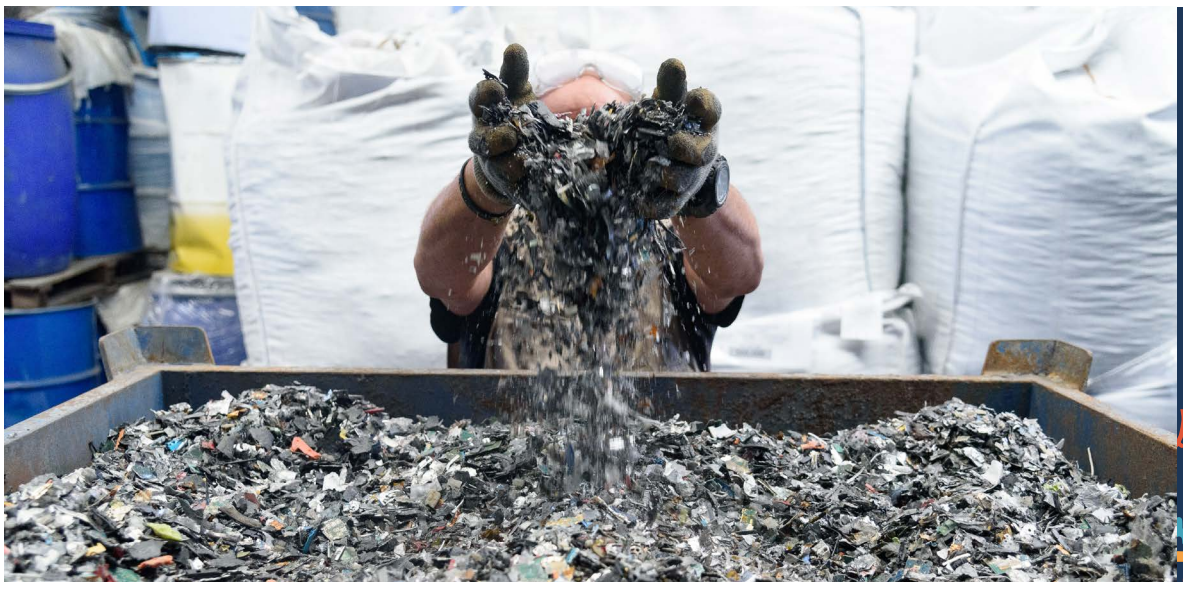


Image credit: Closing the Loop

Case study

Creative prolonging of the life of 'e-waste': Quadloop, Nigeria

Name of company: QuadLoop

Location: Nigeria

Sector: Electronic Waste Recycling into solar lanterns

Year founded: 2017

Quadloop is a Nigerian social enterprise that builds affordable solar lanterns and home systems produced according to circular principles. Their flagship product, the Idunnu solar lantern is made from 70% recycled waste material sourced from partners such as Hinckley Recycling and Closing the Loop.

Demand for Idunnu's projects is driven by energy poverty and access to reliable energy, particularly in rural areas. QuadLoop tackles these interconnected issues by repurposing post-consumer and post-industrial waste materials, focusing on e-waste components like lithium-ion batteries and end-of-life screens. This diverts waste from landfills and reduces reliance on virgin resources. The repurposed materials are then used to develop innovative solar-powered products. Having built this product range they are also exploring the possibility of pay as you go options and product take back schemes.

Footprints Africa's measurement programme allowed QuadLoop to quantify the environmental benefits of their solar lanterns. They found that the use of recycled materials reduces the lamp's CO_2 footprint by a quarter, and switching from kerosene lamps to Idunnu lanterns results in an estimated annual saving of 290 kg of CO_2 emissions.

As well as demonstrating the benefits of the current approach, this work allowed Quadloop to explore the feasibility of using secondary solar panels as a component of the Idunnu, reducing its footprint even further. QuadLoop could switch to electricity from renewable energy sources such as solar, biomass or wind, which could reduce the business' carbon emissions by more than 40%.

Endnotes

1 See Annex 1 of this report for infographics on e-waste flows in Africa.

2 For a concrete illustration of what this looks like: that is greater than the weight of the Great Wall of China, Earth's heaviest artificial object.

3 Consider examples of new products being made from old parts, such as Electro Recycling Ghana, which manufactures 'made-in-Ghana' TVs from obsolete computer monitors.

4 One example is Rwanda--based Mara Group, which launched the continent's first smartphone in 2020.

5 The 1992 Basel Convention came into existence to prevent the trade of hazardous waste, and electronic waste in particular. But the convention's existence has not significantly stemmed the trade. There is still much to do to enforce appropriate export labelling, better distinguishing between products exported for reuse and waste, and ensuring a suitable end-of-life management.

6 See Footprints Africa's electronics case study published in 2023 by the European Environmental Bureau, Items shipped for reuse and Extended Producer Responsibility fees: two case studies for used electronics and used cars, available at: https://eeb.org/library/items-shipped-for-reuse-and-extended-producer-responsibility-fees-two-case-studies-for-used-electronics-and-used-cars/

7 See UN Environment Programme: 'Nigeria turns the tide on electronic waste' 19 June 2019, available at: https://www.unep.org/news-and-stories/press-release/nigeria-turns-tide-electronic-waste

8 Some of the more harmful elements in electronic artefacts are plastics containing brominated flame retardants, or mercury.

9 In Annex 3 we also describe, for completeness, the business models of the two other e-waste compensation players active between Europe and Africa.

10 E-Waste Country Assessment Nigeria, Olakitan Ogungbuyi, Innocent Chidi Nnorom, Oladele Osibanjo, and Mathias Schluep, 2012, available at: https://www.researchgate.net/publication/280738333_E-waste_country_assessment_Nigeria

11 In Nigeria, Closing the Loop's partners are Verde Impacto and Hinckley Recycling.

12 For more information see the PREVENT Waste Alliance's 2022 report Principles and comparison criteria for e-waste compensation, available at https://prevent-waste.net/wp-content/uploads/2023/05/ECoN_Principles_and_comparison_final.pdf

13 This assessment is based on our literature review, including: a quick-scan Life Cycle Assessment (LCA) commissioned by Closing the Loop in 2022, and a 2020 comparative life cycle assessment of the informal and formal recycling procedures of mobile phones. See 'A comparative life cycle assessment of the informal and formal recycling procedures of mobile phones: A case study of Ghana and Closing the Loop', 2020 Master's thesis by Kean Yong at the Vrije Universiteit Amsterdam available at https://www.closingtheloop.eu/sites/default/files/2020-10/CTL%20-%20Final%20thesis.pdf. These information sources were triangulated through stakeholder interviews.

14 Our research and interviews indicate the dominant brands in the Ghanaian market include iTel, Nokia, Vivo, and X-tigi.

15 We based this data on e-waste generated per capita for each country and future population projection for the milestone dates. Source data: International Telecommunication Union statistics and United Nations Institute for Training and Research, 2024, available at: https://globalewaste.org/map/.

16 A recent McKinsey report predicts, for example, that the electrification of two-wheeled vehicles will progress rapidly across the continent, with electric two-wheeler sales projected to reach 50-70% percent of all sales on the continent by 2040. Another example comes from off-grid solar, where in Africa the industry generated an estimated 12,000 tonnes of waste generated in 2020 - a 545% increase from 2016. As solar energy penetration increases rapidly in Africa, so will the volumes of obsolete (and sometimes hard to recycle) equipment in years to come

17 Source data: International Telecommunication Union statistics and United Nations Institute for Training and Research, 2024, available at: https://globalewaste.org/map/.

18 For example, it is more difficult to talk about upstream-facing solutions - for example modifying the design of electronics - are less relevant in contexts where the market is largely a secondary one.

19 Available at: https://link.springer.com/article/10.1007/s42452-022-04962-9

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Berry	Repairer		Circle, Accra, Ghana
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See www.footprintsafrica.co for more information on the programmes Footprints Africa runs to support businesses to develop purpose-driven cultures and so empower their employees to improve their social and environmental impact.

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