Solar E-Waste Management Innovations in Sub-Saharan Africa

Webinar

Tuesday 26 May 2020
16:00 – 17:30 (East African time)
EEP Africa and Our Approach to Environmental & Social Risks  
Fred Eklund, Portfolio Coordinator, EEP Africa

Clasp and the Global LEAP Awards Solar E-Waste Challenge  
Monica Wambui, Clean Energy Access Associate, CLASP  
Rebecca Rhodes, Project Manager, GOGLA  
Hannah Blair, Communications Associate, CLASP  
Declan Murray, Independent Consultant
Introduction to EEP Africa

Webinar on Solar E-Waste Management Innovations in Sub-Saharan Africa

26 May 2020
EEP AFRICA – QUICK FACTS

- Multi-donor, blended finance trust fund
- Current donors: Austria, Finland, NDF
- Managed by NDF and integrated with the NDF climate finance portfolio
- Early stage grant and catalytic loan financing for innovative clean energy projects
- Focus area: Southern and East Africa
EEP AFRICA PILLARS

Clean Energy Financing

Investment Facilitation & Business Development

Knowledge, Policy & Partnerships
KNOWLEDGE, POLICY AND PARTNERSHIPS
FOCUS COUNTRIES

1. Botswana
2. Burundi
3. Eswatini
4. Kenya
5. Lesotho
6. Malawi
7. Mozambique
8. Namibia
9. Rwanda
10. Seychelles
11. South Africa
12. Tanzania
13. Uganda
14. Zambia
15. Zimbabwe

Regional
TECHNOLOGIES

Clean energy and energy efficiency

Solar PV
Biogas and liquid biofuels
Cookstoves and solid biomass
Hydro and wind power
Energy efficiency
Waste-to-energy
Hybrid solutions
PORTFOLIO RESULTS since 2010

<table>
<thead>
<tr>
<th>Metric</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual savings on energy-related expenditure</td>
<td>93 million EUR</td>
</tr>
<tr>
<td>Women in leadership</td>
<td>40%</td>
</tr>
<tr>
<td>People with enhanced energy access</td>
<td>5 million</td>
</tr>
<tr>
<td>Direct job creation</td>
<td>8,750</td>
</tr>
<tr>
<td>GHG emissions reduced or avoided</td>
<td>1.4 million tCO₂e</td>
</tr>
</tbody>
</table>

1. **No Poverty**: Reduced poverty
2. **Gender Equality**: Enhanced gender equality
3. **Affordable and Clean Energy**: Affordable and clean energy
4. **Decent Work and Economic Growth**: Decent work and economic growth
5. **Climate Action**: Climate action

1. **EEA Africa**
2. **NDF Nordic Development Fund**
Environmental & Social Risk Mitigation
E&S RISK MONITORING

- Business development support to reduce, mitigate or avoid risks
- Knowledge exchange among project developers and other stakeholders on mitigation measures

Application
- Identification and assessment of E&S risk factors in proposals
- Support throughout the contracting process in developing mitigation
- Contract clauses committing project developers to address risk factors

Implementation
- Regular reporting on risk status and mitigation measures
- Continuous monitoring of project risks by the EEP team
- Site visit verification of risks and results
All projects in the EEP Africa portfolio must follow the policies and guidelines as outlined in:

- **NDF Environmental & Social Policy and Guidelines**
- **Call for Proposal Application Guidelines**
- **Administrative Manual for Project Implementation**
- **NDF Policy on Anticorruption and Integrity**
E-WASTE MANAGEMENT IN THE PORTFOLIO

REDUCE

Jaza Energy has moved from lead acid to Lithium-ion batteries, increasing battery lifetime up to 6 years and reducing the number of batteries used and replaced.

REUSE

REDAVIA is partnering with equipment suppliers in Tanzania to establish an exchange scheme for diesel-powered equipment, enabling suppliers to redeploy old equipment.

RECYCLE

Zonful is establishing a recycling facility in Zimbabwe. A feasibility study is being initiated that will assess the value chain and volume of batteries that could be recycled.
EEP Africa Call for Proposals

Clean Energy Powering Green Growth
CLEAN ENERGY POWERING GREEN GROWTH

Clean Energy for Productive Use

Increased economic activity & job creation

Clean Energy in Circular Economy

THEME OF 2020 CALL
OVERVIEW OF THE CALL

- **357** total applications submitted by 10 March 2020
- **14** countries of implementation
- **41** countries of applicants; **79%** registered in region
- **39%** women-led companies or social enterprises
- **€345,000** average grant request (30% co-financing required)

Types of projects:
- **57%** pilot/demonstration stage; **23%** scale-up
- **43%** solar PV; **13%** waste-to-energy; and **6%** energy efficiency
- **50%** stand-alone systems; **27%** mini-grids
New Innovative Approaches

- Energy as a service to agro-processing
- Business models that include the ability for customers to trade energy or earn credits based on use (implemented through block chain technology)
- Electric vehicles with batteries charged using energy from mini-grids; 3 wheelers, electric fishing boats and e-motorcycles with milk freezer boxes for the dairy sector
- Dynamic business models that are scalable based on demand (smart mini-grids and scalable SHS)
- The call attracted some “game changing” pilot projects such as battery revitalization, microgrid SHS, demand side management through internet of things approaches.
Solar E-Waste Management Innovations

EEP Africa Portfolio

Global LEAP Awards Solar E-Waste Challenge Team
26 May 2020
• **Growing market:** In 2018, an estimated 180 million OGS products were sold globally. **2.23 million solar products** sold in East, West & Central Africa in the second half of 2018 (GOGLA).

• **Product lifespan:** expected to be **3 years** for PSPs and **5 years** for SHSs.

• **E-waste quantities:** An estimated **10,000 metric tonnes** will be produced in 2020.

• **Poor data:** Lack of data, especially on non-quality verified products, make estimates unreliable.
Background

• Sustainable management of solar e-waste is an **emerging priority** for the off-grid sector.

• Recapture & recycling of off-grid solar e-waste is particularly challenging for three reasons
  - Collection
  - Battery Diversity
  - Multiplier Effects

• Efforts remain nascent across sub-Saharan Africa.

Photo source: WeTu Kenya
The Challenges

- **Distribution, maintenance & repair**
  - Replace- lack of spare parts
  - Repair- informal sector
  - Affiliate and non-affiliate products
  - Location of customers

- **Recycling Capacity & Volumes**
  - Insufficient public infrastructure
  - Volumes for profitability

- **Product Design**
  - Multiplier effects

- **Legislation**
  - Most bills still remain in draft and governments lack support for implementation
The Global LEAP Solar E-Waste Challenge

Supporting innovative approaches to solar e-waste management across sub-Saharan Africa.

• **$2.2 million** made available to support the creation and implementation of innovative sustainable e-waste management solutions

• 1\textsuperscript{st} Round
  - Solutions for takeback, repair and recycling

• 2\textsuperscript{nd} Round
  - R&D focused on improved product design and battery technology
Solar E-Waste Challenge Summary

Round 1

- **8 winners across 5 countries**: Nigeria, Kenya, Uganda, Rwanda & Zambia
  - 3 recyclers and 5 SHS companies

Round 2

- **4 winners across four countries**: Kenya, Tanzania, Benin & Burkina Faso
Take-back and collection is an integral part of a company’s e-waste management strategy to deal with end-of-life (EoL) products. Supplementary to normal reverse logistics for in-warranty products.

There are several advantages to leveraging the consumer relationship beyond the warranty period:

- Meeting EPR legislation
- Risk mitigation - reduces health hazards and environmental pollution
- Avoids circulation of EoL products with dubious quality repairs
- Improves brand perception and customer retention
Lack of consumer awareness about the hazards of e-waste and recommended means of disposal is a barrier to recovery of e-waste.

Communication is a central pillar of take-back schemes:

• Messaging should be **clear and concise**

• Focus on **positive messaging** rather than detailing hazards

• Utilise touch points throughout the customer journey
  - Difficult for cash-based sales with one-time transaction
  - PAYGo companies have many more opportunities to connect

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**Awareness Campaigns**

- SMS and radio messaging to reach last-mile communities
- Integration of e-waste messaging with marketing materials
- Clear disposal information on product packaging and at installation
- Collaboration with national campaigns or waste-management facilities
Incentives required to motivate customers to give up EoL solar products and **overcome barriers such as attachment and perceived value**.

Take-back schemes being piloted have considered the **perceived value of products** in the informal sector, and the **cost of transport** to collection centres.

Discounts on replacement products encourage **customer retention** and maximise the **positive impacts of solar energy**.

**Types of incentivisation:**
- Discount on new solar product or appliance
- Mobile airtime
- Merchandise
- Agri-inputs
Take-back and Collection: External Partnerships

- Third party services:
  - E-waste management facilities with collection services in urban or peri-urban hubs
  - Community-based collection points such as schools and filling stations
  - Often mixed-waste collections - sufficient volumes to reach economy of scale

Enviroserve, Rwanda

- Community Collection points in every district
- Partnerships with OGS companies in Rwanda:
  - Collections
  - Communication with customers

Photo Source Enviroserve, Rwanda
Take-back and Collection: External Partnerships

- Informal sector
  - Many consumers will first seek to repair or repurpose a broken electronic product, and will go to the local informal sector
  - Large footprint and community network for OGS companies to tap into to increase take-back and collection volumes
  - Requires incentivisation; financial, training, certification, franchising etc.

Informal Repair & Refuse Sector:
- Subsistence waste collectors / pickers
- Repairers ("Fundi") - non-registered workshops or individuals
- Recyclers, typically extracting precious metals through poor, unsafe practices

Photo source: Fenix
**Take-back and Collection: Grantee Initiatives**

**Take-Back:**
- d.light
- Fenix
- Sunny Money
- Solibrium
- WeTu

- Mix of own and other products
- IP issues
- Value of incentive

**Collection:**
- Enviroserve
- WEEE Centre
- Hinckley

- Working in partnership with OGS companies
- Consumer Awareness
- Repair vs. Refurbishment
- Despite Lighting Global & GOGGLA requirements for products warranty, **maintenance & repair is limited**
  - Replace rather than repair protocols
  - Limited to urban areas
  - Variability in processes
  - Balance between initial sales & after-sales services
  - Informal repair sector
- Repair/refurbishment are context & product specific
  - PSP vs. SHS lifespan
  - High cost of replacement parts & low revenues
Repair & Refurbishment: Opportunities

Opportunities:

- After-sales services increase customer trust in off-grid solar products
- Secondary solar market for solar products
- Further research to better understand product lifespans
- Partnership to outsource repairs
Repair and Refurbishment: Grantee Initiatives

**Sunny Money**
- Repair manual & step-by-step videos
- Web app to demonstrate most common repairs
- Online marketplace for refurbished components
- Battery replacement

**WEEE Centre**
- Upskilling the informal sector through trainings on repair

**Solibrium**
- Take-back/buy-back system for faulty or broken products
- Repair and refurbish these products for resale
- Refurbish components for resale to informal sector
Recycling: Overview

Areas
1. Regulation
2. Economics
3. Capacity

Examples
1. Hinckley Recycling
2. WEEE Centre
3. Enviroserv
Recycling: Regulation

Uneven spread and ambiguous status of solar
  e.g. Hinckley Recycling

<table>
<thead>
<tr>
<th>Country</th>
<th>E-Waste legislation</th>
<th>Availability of recycling infrastructure</th>
<th>Off-Grid Products specifically in scope</th>
<th>Batteries in scope</th>
<th>Main EEE in scope (connected SHS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUR</td>
<td>First Draft</td>
<td>Fair / Poor</td>
<td>No</td>
<td>No</td>
<td>TV, Radio, Fans, water pumps</td>
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<tr>
<td>KEN</td>
<td>Draft, pending final approval</td>
<td>Fair / Good</td>
<td>Potentially</td>
<td>Yes</td>
<td>TV, Radio, Fans, water pumps</td>
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<td>TAN</td>
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<td>Fair / Poor</td>
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<td>N.A.</td>
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<td>RWA</td>
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<td>Fair / Good</td>
<td>Under discussion (to be in)</td>
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<td>TV, Radio, Fans, water pumps</td>
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<tr>
<td>UGA</td>
<td>No Draft</td>
<td>Poor</td>
<td>No</td>
<td>No</td>
<td>TV, Radio, Fans, water pump</td>
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<tr>
<td>GHA</td>
<td>Published, not enforced</td>
<td>Fair / Good</td>
<td>Yes / Partially</td>
<td>Yes</td>
<td>TV, Radio, Fans, water pumps</td>
</tr>
<tr>
<td>IND</td>
<td>Published, not enforced for off-grid solar</td>
<td>Fair / Good</td>
<td>Not in scope</td>
<td>Separate Batteries legislation for LABs</td>
<td>TV, Refrigerator, AC</td>
</tr>
</tbody>
</table>

SOURCE: GOGLA / Sofies, 2017, updated August 2019
Recycling: Economics

It’s costly and recyclers need volumes

e.g. WEEE Centre

Table 6 Material composition\textsuperscript{18} for representative products and average prices for fractions.

<table>
<thead>
<tr>
<th>Material</th>
<th>PC1</th>
<th>PC2</th>
<th>PC4</th>
<th>Market destination</th>
<th>Average price (incl. transport) €/t</th>
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</thead>
<tbody>
<tr>
<td>Average weight (g)</td>
<td>150</td>
<td>906</td>
<td>2,450</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel</td>
<td>20</td>
<td>160</td>
<td></td>
<td>Local</td>
<td>140</td>
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<tr>
<td>Copper</td>
<td></td>
<td>418.6</td>
<td></td>
<td>Local</td>
<td>2.649</td>
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<tr>
<td>Aluminium</td>
<td></td>
<td></td>
<td></td>
<td>Local</td>
<td>615</td>
</tr>
<tr>
<td>Plastics</td>
<td></td>
<td></td>
<td></td>
<td>Local</td>
<td>129</td>
</tr>
<tr>
<td>Pb Batteries</td>
<td></td>
<td></td>
<td></td>
<td>Overseas</td>
<td>363</td>
</tr>
<tr>
<td>LIP Batteries</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>Overseas</td>
<td>-3.250</td>
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<tr>
<td>PV modules</td>
<td>411</td>
<td>1,180</td>
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<td>Overseas</td>
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<tr>
<td>CFL (Hg)</td>
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<td>30</td>
<td>107</td>
<td>Overseas</td>
<td>-675</td>
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<tr>
<td>LED</td>
<td></td>
<td></td>
<td></td>
<td>Overseas</td>
<td>80</td>
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<tr>
<td>Mixed Plastics (incl. BFR)</td>
<td>205</td>
<td>551.4</td>
<td></td>
<td>Overseas</td>
<td>23</td>
</tr>
<tr>
<td>Printed Wiring Boards (PWB)</td>
<td>93</td>
<td></td>
<td></td>
<td>Overseas</td>
<td>500</td>
</tr>
</tbody>
</table>

SOURCE: DFID, 2017
Recycling: Capacity

Absence of controlled facilities on continent so vast majority of processing is carried out by artisans, individually or in groups

e.g. Enviroserv Rwanda
Recycling: Conclusion

- Better to pre-empt legislation
- Expensive
- There is potential to create jobs & economic value in-country
Distinguishing Characteristics

- Battery Diversity: Lead acid & Li-Ion-handled different across their usage life and end of life.
- Weak Link: shortest life span (2-6 yrs). Attributable to poor usage and unoptimised design.
- Pose a negative health & environmental impact.

The Global LEAP Awards team visiting Enviroserve Rwanda’s research partner CMU Africa in their solar battery test lab (Kigali, November 2019)
Informal Sector Engagement

- Batteries (esp. lead acid), have high scrap value & are often scavenged for sale or reuse
- Informal players have vast last mile presence and access to the end-consumer

Second Battery Life

- 70% usable capacity at EoL
- What are the requirements, challenges and applications?

Battery Management Systems (BMSs)

- Customized BMS will capture salient parameters and offer more precise measures of the State Of Health.
Battery Technology: Grantee Initiatives

Hinckley
- Informal sector engagement to collect batteries.
- In partnership with CMU plan to build out refurbished Li-Ion battery packs and pilot possible usages such as UPS

Fenix
- Utilize last mile presence to collect e-waste.
- Reach out to their customers in both the rural (agents) and urban peri-urban areas (service centers)
- Collaborate with the scrap collectors/pilot incentives & identify most optimal
Battery Technology: Grantee Initiatives

Acceleron
- Patented refurbished battery packs that are easy to take apart & optimized BMS
- Build out the entire supply chain: battery sourcing & refurbished battery sales.

Lagazel
- Testing refurbished batteries on several applications to be fitted into existing manufacturing lines.
- Adapting of innovative BMS to optimize cell operation in battery pack & effectively ensure service continuity.

M-KOPA Labs
- Build smart algorithms into BMS that to reduce failure and degradation.

Solaris Offgrid
- Ease the replacement of batteries & avoid purchase of new SHS kits.
- Integrate a BMS to allow for the use of different capacity battery packs.
Resources

- Solar E-Waste Market Scoping Report
- Sustainable Solar E-Waste & Battery Technology Report
- Global LEAP Awards Solar E-Waste Project Spotlights
- Global LEAP Awards Additional Resources
Resources: E-Waste Toolkit

https://www.gogla.org/e-waste

Introduction to Recycling
Module 1 is a high-level technical understanding of how each component is recycled and where to begin with identifying recycling partners. Learn more.

Design for Reduction of E-Waste
Module 2 will focus on waste reduction strategies within the off-grid solar sector, looking at circular design principles and how they can be applied. Learn more.

Financials of Solar E-Waste
Module 3 will look at the financials of solar e-waste by breaking down its supply chain, identifying where the costs lie and who is responsible for them. Learn more.

Policy and Regulation
Module 4 of the E-waste toolkit aims to provide a high level introduction to e-waste legislation, existing typologies and their financing mechanisms. Learn more.

E-waste and the Consumer
Module 5 focuses on the consumer experience, awareness and disposal behaviors upon product end-of-life. Learn more.

Take-back and Collection
Module 6 of the toolkit focuses on take-back and collection channels, challenges and incentive. Learn more.

The GOGLA e-waste toolkit is being funded by Swedfund. The design and content of the Toolkit is being developed in association with the GOGLA E-waste Working Group.

Photo credits: Jeffrey M. Wachtel for GOGLA, various from Unsplash
Opportunities

• Improved products
  – Interoperability
  – Minimum e-waste footprint
• Consumer awareness campaigns
• Collaboration within the off-grid sector
• Extended Producer Responsibility programs
• Government and stakeholder engagement for policy and regulations
Solar E-Waste Management Innovations

Photo Source: WeTu
Thank you!

Learn more at:
https://eepafrica.org/
https://www.ndf.fi/

Learn more at:
https://clasp.ngo/
https://globalleapawards.org/