Solar E-Waste Market Scoping Report
Executive Summary

As the off-grid solar market grows rapidly, innovative approaches to e-waste management demonstrates the sector's commitment to sustainability.

Sustainable management of solar e-waste is an emerging priority for the off-grid solar sector. Solar e-waste refers to pico-solar products (PSPs), solar home systems (SHSs), and solar-powered appliances at their end-of-life. A recent study estimates that 26.2 million solar lanterns and SHSs have already reached their end-of-life in sub-Saharan Africa and South Asia[1]. In Kenya alone, 3-4% of the 55,000 tons of total e-waste produced in 2017 was from PSPs and SHSs[2]. Recapture and recycling of off-grid solar e-waste is particularly challenging for three reasons:

1. **Collection Cost:** There is a high cost to collect products from remote areas. The cost is high for two reasons: logistics and incentives. The logistical cost of reaching dispersed users' homes and returning waste products to a centralized location is high because of distance and terrain. There is an incentive cost because users, as holders of the waste, recognize there is value in its materials and so often want to be paid to give up their products.
2. **Battery Diversity:** SHSs use a variety of battery chemistries. Lithium-based batteries dominate in pico-solar products and are increasingly found in smaller SHSs (<50W), but there is no lithium battery recycling facility in Africa. Instead, they are sent to Europe for recycling. While larger SHSs have lead-acid batteries, for which local recycling options exist and there is a positive recycling value, not all local facilities meet environmental, health, and safety standards. Improper disposal of lead acid batteries can lead to the contamination of food and water sources.
3. **Multiplier Effects:** The weight of SHSs and the presence of more copper cabling increases their positive recycling value compared to PSPs. However, the typical distribution model of bundling SHSs with other end-use appliances increases overall waste volumes, increasing in turn the collection costs outlined above. The multiplier effect is especially challenging when SHS and appliances are "locked" together by proprietary software or hardware, and therefore cannot be used independently. This means that if just one part of a system fails, its still-functional accessories and appliances may become waste too.

Despite action on behalf of some key actors, e-waste management efforts remain nascent. The USAID and UK aid-funded Global LEAP Awards Solar E-Waste Innovation Challenge will make $1.6 million available in grant funding to support innovations in e-waste management for the off-grid sector in sub-Saharan Africa. By doing so, the program will also encourage greater investment in the long-term sustainable growth of the off-grid sector.

1 Cross, Jamie, and Declan Murray. 2018. 'The Afterlives of Solar Power: Waste and Repair off the Grid in Kenya'. Energy Research & Social Science 44 (October): 100–109.
2 Magalini, Federico, Deepali Sinha-Khetriwal, and Seth Munyambu. 2017. 'Cost Benefit Analysis and Capacity Assessment for the Management of Electronic Waste (E-Waste) in the Off-Grid Renewable Energy Sector in Kenya'. DFID.

Solar E-Waste Challenge

This Market Scoping Report outlines the current state of knowledge and activities on this topic. The report informed the design of Global LEAP Awards Off-Grid Solar E-waste Innovation Challenge, particularly the categories of prizes and the criteria for judging applications. It will also act as a baseline for later program impact assessments.

Although product design (i.e. material composition, product assembly and system software[3]) plays a key role in exacerbating or alleviating the solar e-waste problem, this report focuses on the two key in-market components of the solar e-waste ecosystem:

1. Processes for product servicing and collection
2. Infrastructure for e-waste recycling

The report, based on an extensive literature review and a series of stakeholder interviews, is structured into three sections:

1. Current and historic approaches to solar e-waste management.
2. Barriers to reducing volumes and improving the management of solar e-waste.
3. Opportunities for improving solar e-waste management.

Each of these three sections includes an exemplar case study of good practice.

The report identifies several barriers the Solar E-Waste Challenge should seek to address, including

- Costs involved in the responsible management of solar e-waste. The primary costs associated with e-waste management come from securing waste from consumers, transporting it to a central location, storing it and then processing (where such facilities exist).
- Current data gaps. Data gaps on the specific quantity, location and material make-up of solar e-waste create a major challenge for downstream recycling partners. This is particularly true in non-vertically-integrated business models. There is also a lack of knowledge among solar companies around the location of recycling facilities, particular processes and their associated costs.
- Quality and trust. Ensuring the quality of product performance in repair processes and maintaining the trust of consumers, waste partners and industry peers in collaborations are further challenges when implementing effective solar e-waste management.

The report also recognizes the opportunities to improve solar e-waste management systems such as those presented by pay-as-you-go (PAYG) business models. PAYG offers opportunities to improve consumer awareness around proper product usage and disposal through company communications as well as facilitating preventive maintenance services and assisting in the tracking of waste volumes and locations.

Other opportunities include the targeted provision of relatively low-cost machinery like a cable stripper or circuit board grinder which can reduce costs in storage and transport of waste materials.

Priority Future Market Research Topics

- The challenges and opportunities for engagement with the informal sector
- Greater attention to diverse projects and business models beyond East Africa
- Consumer perspectives on solar e-waste management

3 Future phases of the Global LEAP Solar E-waste Challenge intend to look at the question of product design and battery management as vital tools to reduce volumes and improve management of solar e-waste.

The Global LEAP Solar E-Waste Challenge is a program under the Efficiency for Access Coalition and is supported by the U.S. Agency for International Development (USAID) as part of its commitment to Scaling Off-Grid Energy (SOGE) Grand Challenge for Development and Uk aid Transforming Energy Access (TEA) Programme.