Last mile repair
Innovation spotlight

July 2025 - updated with new learnings from GDC members pioneering last mile repair

Global Distributors Collective

Extending product lifetimes through decentralised repair services

E-waste is the world's fastest-growing domestic waste stream, fuelled by higher consumption rates of electronic appliances, the rise of low-quality appliances with short product lifetimes, and few options for repair. A record 62 million metric tonnes (Mt) of electronic waste was generated worldwide in 2022 (UN e-waste monitor), up 82% from 2010. Whilst still only representing a fraction of the total volume, e-waste from off-grid energy products, such as solar lanterns and solar home systems, is set to grow exponentially in the very parts of the world that are currently least able to process it. Efficiency for Access estimates that in 2020 more than 66 million off-grid solar products were no longer 'in use'. It is unlikely they have found their way into responsible electronic waste flows, which are non-existent or insufficient in low-income markets.

SolarAid, who have been pioneering e-waste management solutions in Zambia, found that almost 90% of out-of-warranty, non-functioning solar lanterns 'hibernate' within their customers' households. This is tragic because, after examining some of these products, SolarAid found that around 90% were repairable if customers or agents could access the right tools and spare parts. SolarAid research findings from 2022 and 2023 suggest that households are spending money purchasing new products when they could be saving money repairing their old ones, or in some cases are going without solar electricity altogether.

Benefits of last mile repair services

1. Improved **customer satisfaction and loyalty**
2. New **revenue streams** from the same product
3. Opportunity to meet **sustainability commitments**

Photo credit: Kukula Solar

Building on learnings from pioneering last mile distributors

Traditionally, LMDs offer their customers basic troubleshooting support for the products they sell. Only LMDs with their own products, such as Solar Village who have developed a battery stick sprayer that is sold to small scale farmers in Zambia, offer more advanced repair services, given their knowledge about the product and relationship with suppliers of the product's parts. However, in recent years, various LMDs such as SolarAid have experimented with different approaches to expand on their repair services; from networks of trained and certified informal repair shops to repair apps.

From early 2024 to early 2025, the GDC's Innovation Launchpad supported a cohort of last mile distributors to develop and pilot their own business models for last-mile repair services, namely Natfort Energy in Zimbabwe, Kukula Solar in Zambia and Nyalore Impact in Kenya. They received six-months of advisory support from SolarAid's team in Zambia, to make the business alterations required to add repair as an after-sales service in a way that was technically feasible and economically viable. Implementing repair solutions is not straightforward. Thus, we hope that other distributors can learn from and build on the important lessons yielded from the GDC's interactions with these pioneering companies, which are explored throughout this spotlight.

Repair as the cornerstone of a circular economy

In a circular economy, the ability to repair is essential to prolong the life of a product or give broken appliances a second life, either by repairing it for the same user, or by refurbishing and re-selling it to someone new (often at a lower price). Repairing products generally requires less energy and is often cheaper than replacing them. This is because collecting and (centrally) processing e-waste relies on relatively expensive infrastructure and logistical operations. For emerging markets, where recycling infrastructure is often inadequate, repair presents an opportunity to combat the increasing volume of e-waste while providing a desired service to customers. Repair services, especially when organised using decentralised models by last mile distributors (LMDs), can therefore offer a viable and scalable solution to extending the life of products sold and used in low-income markets.

If appliances (or component parts) are not repaired or are unrepairable, households and repair shops might dispose of them in harmful ways (USAID, 2019), unaware they contain various hazardous materials, such as lead, cadmium, mercury, and sulfuric acid. These substances can cause serious adverse health effects to humans and the environment if not responsibly handled. Other households may hold on to the broken appliances and keep them at home. This is a missed opportunity for valuable electronic components to be reused in a circular economy, putting more pressure on finite planetary resources.

Photo credit: Kukula Solar

Opportunities and challenges for last mile distributors to offer repair services

Everyone deserves the opportunity to have their appliances repaired. Repair delivers significant social, economic, and environmental impact, and, as one of the market players interacting most closely with customers and their products day-to-day, LMDs can play a key role in enabling these repair services.

Current practices

Globally, there is a resurgence of consumer interest in repairing products, as they seek to save costs by fixing what they have, rather than investing in new technologies (The Guardian, 2020). Consumers in low- and middle-income countries are no different. In fact, they have traditionally been more inclined to fix things rather than throw them away. A 2023 CLASP study found that 72% of Kenyans take their broken appliances for repair, mostly at local repair shops (90%), followed by specialised repair shops (8%), and distributors or manufacturers (6%) that offer repair services. A small-scale study of 114 people carried out by SolarAid's social enterprise SunnyMoney in Zambia, in 2020, found that 43% of the surveyed households tried to either fix their solar lights themselves or asked someone else to do so.

The informal sector handles the majority of repair and e-waste collections (GSMA, 2020), with some repair technicians extending their work to include solar repair. Some markets, like Nigeria, have well-organised hierarchical informal e-waste ecosystems; while others, like Rwanda, are more dispersed and less organised. In Western Kenya, Solibrium Solar developed a first-of-its-kind map of the regional solar e-waste ecosystem, locating informal solar technicians. The capacity of these informal repair technicians is, however, often limited to a few repairs a day. The quality of their repairs can be compromised by a dearth of tools and components, and, to a lesser extent, the lack of skills which informal repair entrepreneurs typically gain through trial and error or by consulting their peers. SunnyMoney found that 60% of the repairs offered at local repair shops were not successful and, of those that were, few repaired products lasted longer than six months.

Photo credit: GDC

Why last mile distributors can and should play a role in improving repair and e-waste

LMDs are well positioned to influence consumer behaviour change

As trusted stakeholders, LMDs are well positioned to influence consumer behaviour change. A USAID-funded study in Uganda in 2019 found that a key predictor for more responsible e-waste disposal behaviour by rural consumers is owning a branded appliance that a trusted distributor sells. This suggests that LMDs can educate customers about the opportunities for product repair and safe disposal.

LMDs can keep costs down for themselves and their customers alike

By setting up decentralised repair solutions, LMDs can keep costs down for themselves and their customers alike. Warranty packages for solar lanterns and solar home systems range from one to five years (USAID, 2019), with additional and sometimes longer component-based warranties offered by the original manufacturer. 84% of GDC's members provide warranty packages for the products offered, this is according to the 2024 members survey data. Under warranty protection, LMDs act as repair agents for manufacturers and perform repairs and replace faulty system components at no cost, though some charge for local transport or require their customers to travel with the product to a point of sale. In cases of system failure resulting from product misuse or failure outside the warranty period, distributors will often repair the system for a fee. Basic troubleshooting and repair are already commonly practised by LMDs. If repair requires more advanced technical know-how, testing, equipment, or spare parts, products are typically returned to the manufacturer, often outside the country. This requires investment in reverse logistics, which poses a key cost and affordability constraint in the context of rural economies. It also leaves customers without a product unless a (temporary) replacement can be offered. This demands a decentralised approach in which LMDs organise local repair services. When SolarAid started to offer extended repair services to their last mile customers, they learned that many faulty products could be relatively simply and cheaply repaired by, for example, replacing the battery (in about 69% of the cases), having dirt removed at the power switch, or fixing the wiring. For Kukula Solar, battery replacements were also the most frequently performed repair activity, accounting for 52% of all repairs, followed by switch replacements at 14%.

LMDs selling PAYGo appliances understand that assets which remain in need of repair during the customer's payment period cost them money – whether in terms of lost revenue, the costs of storage or disposal. A product that is out of action represents lost income and customer dissatisfaction. If a product can be repaired locally, and quickly, all the better.

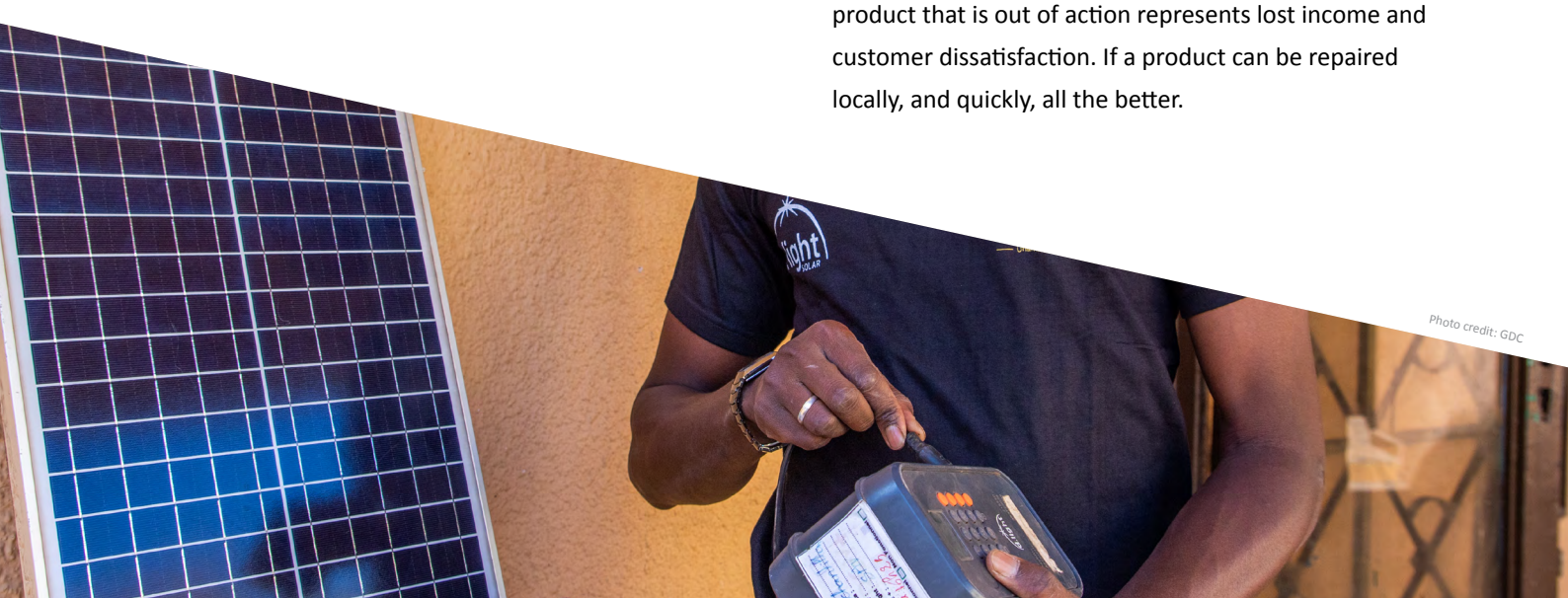


Photo credit: GDC

Offering repair services can open new doors for LMDs

Embracing repair operations presents LMDs with an opportunity to enhance customer value and extend their relationships with customers through increased touchpoints, such as repair shops. These increased interactions can be leveraged to reacquaint the customer with the company's brand; introduce the customer to - and provide demonstrations of - new products on offer; and, ultimately, up-sell customers additional products and services. This model therefore not only enables customers to access more support for in-warranty products requiring repair or replacement, it also offers a further revenue stream for LMDs through the sale of spare parts and repair services to customers with post-warranty products. A good example is Kukula Solar from Zambia, who managed to charge a 35% profit margin on average for the repair works they carried out for the first 280 customers during their pilot.

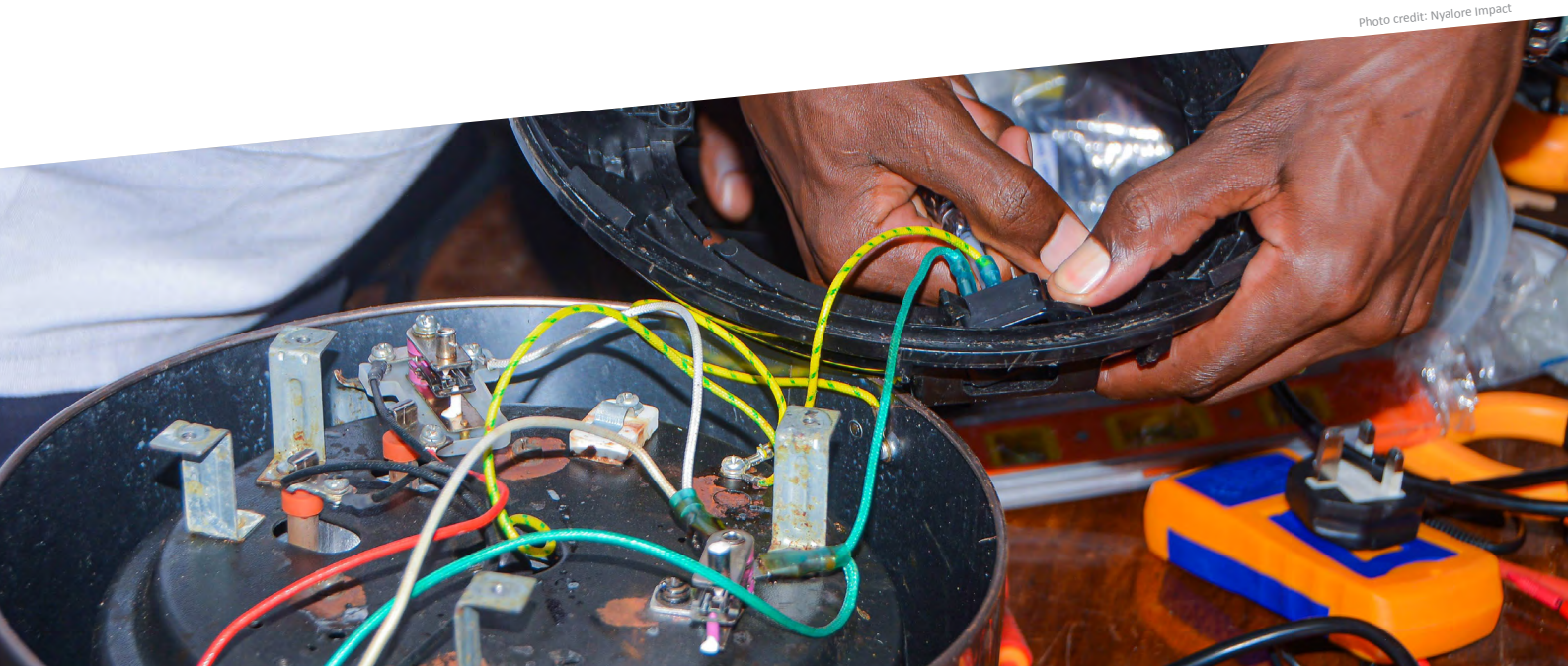
One could argue that LMDs operate business models that rely on repeat sales. And although customers may express willingness to pay for repair services, there is understandable concern that, by extending the lifetime of their products, LMDs and their sales agents will experience a loss in income. This is certainly a significant issue in a saturated market. The potential global off grid solar market, however, is far from saturated, with 733 million people still lacking direct electricity access, and another group of comparable size having unreliable grid access (Lighting Global, 2022).

LMDs taking action can prepare the wider sector

LMDs taking action can prepare the wider sector for longer-term, positive change. By promoting repair and safe e-waste handling, LMDs help prepare the sector for future regulatory initiatives, such as the Extended Producer Responsibility (EPR) schemes that are already being implemented in countries like Kenya. The EPR schemes make manufacturers and importers of electronic appliances responsible for cleaning up "their" e-waste. A transition to circular practices, with local repair as the cornerstone, also mitigates the potential risk to LMD brand names, as governments, donors and investors, become increasingly concerned about the growing stream of toxic e-waste components in the sector.

Through its repair hubs, Nyalore Impact in Kenya managed to become a leader in the repair of clean cookstoves. This has enabled them to establish a relationship with their clean cookstoves manufacturer Tefal, which could lead to an official partnership that allows Nyalore to offer warranty repair services for all Tefal cookstoves distributors across the country.

Photo credit: Nyalore Impact



Managing efficient repair operations can be challenging

Efficiency for Access examines issues that may restrict a company's ability or willingness to support repair. Besides companies' general resistance to change their business models, Efficiency for Access cites other key reasons for this resistance as safety and security concerns with the prospect of opening up products, as well as inadequate legislative support. However, two additional, specific barriers stand out that apply to LMDs: the cost and the complexity involved.

The associated financial costs of changing business and product strategies to include repair services can be substantial; often proving to be beyond the scope of viability for even well-established, let alone new, LMDs. In addition, if LMDs have to pay manufacturers to import spare parts and the minimum order quantities required by manufacturers exceed what they need, this can make repair uneconomical (also, considering imported spare parts may also attract import or VAT duties). Access to appropriate and high-quality spare parts is a crucial barrier to repairability. This challenge is exacerbated by many manufacturers using non-universal parts and their updated models frequently introducing new components, making it hard for LMDs to keep up with updates. Meanwhile, irregular and dispersed demand for spare parts can make the supply chain logistics challenging. Another issue flagged by Efficiency for Access is non-repairable product designs. Manufacturers, including those making products with PAYGo technology, traditionally opt for closed proprietary hardware ecosystems. While such a "black-box" design strategy protects their IP and ensures products are not tampered with, it limits the products' repairability. To combat this, and incentivise more positive strides, the Global LEAP Awards has provided recognition and grant funding to firms that improve the repairability of solar components. One example is Aceleron in Kenya and Rwanda, which builds recyclable and easily repairable battery packs from waste cells collected from the off-grid solar sector (not that the UK company ceased to trade in 2023 but their Kenyan entity continues to trade, as of June 2025).

Photo credit: Kukula Solar

Trailblazer story

SolarAid (Zambia)

"We're ready for a repair revolution to help keep solar lights switched on for longer."

About the organisation

Founded as an international charity in 2006, SolarAid has been combating poverty and climate change through its social enterprise SunnyMoney. After selling over two million solar products across rural Eastern and Southern Africa, it saw the obligation to formally tackle the challenge of broken solar products its customers were facing and reporting.

Accomplishments so far

Through their interactions with customers, SolarAid discovered that 89% of non-functioning solar products were 'hibernating' in the household. SolarAid has thus been testing different strategies designed to extend the lifespan of small solar products and build local repair capacity, to benefit customers and reduce e-waste. SolarAid open sources its work so that learnings, knowledge and models can benefit and be adopted by the wider off-grid solar sector.

SolarAid was one of the winners of the 2019 Global LEAP Awards' Solar E-Waste Challenge. This provided pilot funding for SolarAid to conduct solar repair experiments across Zambia, including working with local repair technicians to build capacity to repair solar lights, as well as developing a repair mobile app to facilitate the diagnosis and repair of solar lights by technicians in rural areas. The app can be freely downloaded at the Google Play store. For those without smartphones, SolarAid prepared a repair manual that can be printed.

Most recently, with funding from GIZ, on behalf of the Federal Ministry for Economic Cooperation and Development, SolarAid implemented the Solar Saver: second-generation lights project in 2022 and 2023. The project had the objective of extending the life of small solar lights through better maintenance and repair for low-income Zambians. This was realised via experimenting with interventions that address many of the issues of solar repair and waste.

Photo credit: SolarAid/Jamiel Banda

Learnings

SolarAid found out that 91% of their customers' broken solar lanterns were repairable. They initiated the successful repair of 1,000 products of 21 different models. This was predominantly through equipping repair shops and sales agents, who had limited prior knowledge of repair, with the tools they needed to undertake effective and safe product repairs. This helped to build customers' trust and loyalty towards the SunnyMoney brand. 85% of participating customers said they would consider repair services again, as compared to a baseline of 43%. SolarAid's pilot results, learnings and recommendations can be found in their white paper (2023).

Understanding that localised repair is possible and effective, SolarAid is currently in the design stage for the scale-up of its repair project, to develop the Off-Grid Solar Repair Lab. The Lab brings together sector actors to address the challenges of ramping up repair in the sector; including developing replicable last-mile models, tools, repair standards, and frameworks, and supporting an enabling environment for repair. Leading off-grid sector organisations like GOGLA and CLASP, as part of SolarAid's Lab, will support the delivery of research and capacity-building action to ensure repair can turn from a burden to an opportunity.

Visit website

Photo credit: SolarAid

Trailblazer story

NATFORT ENERGY (Zimbabwe)

"Many customers expressed satisfaction with our repair services and a willingness to recommend them to others, suggesting strong community support and potential for last-mile repair to be scaled. "

About the company

Natfort Energy is a distributor of solar energy services based in Harare, Zimbabwe. Founded in 2014, the company manages solar engineering projects for commercial and residential sectors. In 2018, the company started serving rural off-grid communities through low-cost solar energy products sold on a PAYGo basis.

What have they accomplished so far?

As a participant of the GDC Innovation Launchpad in 2024, Natfort Energy embarked on piloting repair as a service to their rural customers. To facilitate the pilot, two staff members underwent specialised training on last-mile repair services offered by SolarAid in Zambia. This immersive experience provided them with critical insights into the technical and business capacities required to roll out repair as a service for their customers.

The company added repair functionalities to their mobile CRM app, which lets sales agents register products in need of repair, as well as facilitating technicians on problem diagnosis and giving them access to the company's standardised product repair procedures. This digital platform streamlined customer requests and technician workflows, making their repair services more accessible and transparent. As part of the pilot, the company trained 25 technicians, of whom 16 were women. As of March 2025, the company had offered 320 repairs. Overall, 72% of our customers were pleased with their repair services with only a few customers (8%) returning to report either the recurrence of the same fault or the development of a new issue with the same product.

Photo credit: Natfort Energy

Learnings

Natfort Energy noted the need to partner with a vocational training center to address foundational technical gaps for the technicians. This partnership ensures that inexperienced young technicians receive a solid foundational understanding of solar energy, electronics, and electrical systems, complementing their practical skills with essential theoretical knowledge.

The repair pricing model of Natfort Energy intended to balance affordability with long-term profitability. The average repair cost was $12 (excluding transport), with a gross profit margin of 25%. This model, while effective for market penetration, resulted in thin net profit margins, particularly in rural areas with high transportation and logistical costs, indicating a need for "patient capital" for LMDs looking to roll out repair as a service. To achieve financial sustainability, dynamic pricing models should take into consideration customer profiles and regional differences. In addition, there is a need for bundling of value-added services or tiered service levels to improve perceived value and margins.

Like Kukula Solar and Nyalore Impact, who also participated in the GDC Innovation Launchpad, Natfort Energy will proceed with their repair services beyond the pilot, and intends to expand their last-mile repair services to include productive-use-of-energy (PUE) systems like solar refrigerators. This reinforces their commitment to enhancing customer satisfaction, loyalty, and energy access while unlocking new revenue streams for the company.

Visit website

Photo credit: Natfort Energy

GETTING STARTED

Exploring the opportunity for your last mile distribution company to offer repair services

Good repair services bring faulty products to a condition where they can fulfil their intended use again. For LMDs to expand their repair operations beyond basic troubleshooting, the following success factors should be considered.

Can I offer repair services?

☑ Are customers willing to pay for repairs (outside the warranty policy)?

Studies have demonstrated that consumers are willing to make exceptional efforts for their product to be repaired when it is not covered by a warranty. It is important for LMDs to validate customers' willingness to pay before they themselves incur any additional expenses relating to agent training and/or procurement of spare parts and repair equipment. A large-scale survey of 1082 households in Odisha, India, found that people travelled, on average, more than 20 kilometres in search of repair services. A study by CLASP (2023) found that 30% of respondents in Kenya were willing to pay more than 20% of the original appliance cost as a repair fee. The other 70% said they would pay less than 20%. Kukula Solar's GDC supported repair pilot affirmed that customers are willing to pay for repair, as long as the cost of repair is below 20-30% of the product's price. Beyond that they prefer to make a new purchase. Kukula Solar sells a range of products, from cheaper solar lanterns to expensive solar water pumps, and they found that most customers preferred to repair high value products due to the prohibitive cost of purchasing a new one.

Note that quality and speed of repair positively influence willingness to pay, considering that many consumers take their appliances to local informal repair shops which are cost-effective but not always quick and reliable.
LMDs like Nyalore Impact, Natfort Energy and Kukula Solar run community awareness days aimed at talking to customers, sensitising them on their repair services as well as understanding customers' willingness to pay for repair services. Such community outreach is a critical activity for any LMD that is new to repair. Kukula Solar found that cost savings is the most attractive message for their consumers; far more so than the environmental benefits. 100% of their customers, who paid between $1 and $50 for their repairs, reported cost savings as a result of having their product repaired and not replaced.

Tip

Conduct a survey among a small group of customers and gauge their interest in different repair offers and pricing models; from one-off repair fees to extended warranty periods and technical support plans, taking inspiration from e.g., AppleCare+ subscriptions. When you talk to customers, also ask them what repair facilities they already use in case you are interested in exploring partnerships with local repair technicians.

Photo credit: SolarAid/Jamiel Banda

☐ Can repair be carried out by local agents or technicians?

We can distinguish three models for local repair, which are not mutually exclusive but can be combined. These are in-house repair, third-party repair, and repair by consumers.

In-house repair

SolarAid found that their sales agents are capable of repairing solar lanterns after receiving the right technical training, tools, spare parts and documentation. Not all agents might be interested in this, but those that are will be building their skillset and adding repair as a new commercial service for "their" customers. Kukula Solar selected 20 from their existing 180 sales agents to become repair technicians. The selection criteria was based on the location of the sales agent, the performance of the sales agent, and their foundational understanding of repair. LMDs should ensure that agents performing repairs are adequately compensated for travel time and costs. Many agents already report that commissions do not take into account extra commitments like the time taken to travel to a customer's home for after-sales support.

Third party repair

LMDs can also leverage the dynamic and vast network of informal repair technicians founds in low-income countries, who are already accessible and widely used by last mile customers. These informal technicians present an opportunity to fulfil a growing demand for repair services that exceeds what distributors' agents can realistically offer. Rather than specialising in one type of product or brand, these technicians tend to be generalists; meaning it is important they attend rigorous, product-specific training and that they are certified by LMDs before customers are referred to them. LMDs may also need to provide informal technicians with the spare parts that are compatible with the LMD's products. Presumably this is what we mean by "right" spare parts?

For easy identification, these trained repairers could work directly with LMDs under the same brand; essentially setting up an affiliate technician scheme. When collaborating with informal repair technicians, LMDs should consider whether they safely dispose of broken components that have been replaced or products that cannot be repaired. In East Africa, e-waste recyclers such as Enviroserve and WEEE Centre are licensed by national authorities to collect, transport, and process unwanted electronic components. In Nigeria, Hinckley Recycling has been paving the way. LMDs will likely have to pay for their services or at least cover the costs of transporting the e-waste to their recycling facilities.

Repair by consumers

The most scalable, yet also the most challenging, model for the delivery of repair services is to empower customers to fix their own products. This includes making provisions for spare parts and offering repair guides in local languages that visually guide people through the repair process. LMDs could limit this approach to purely the diagnosis and repair of common faults with products that are fairly easy to repair. It is important that consumers are made aware that once they physically dismantle a product, many manufacturers' warranties would become void. Furthermore, safety precautions should be taken when dismantling electronic products. In the worst case, batteries can explode if screwdrivers are used with force.

Third-party repair has been the most popular model among pioneering LMDs like SolarAid, Kukula Solar, and Natfort Energy. Especially for low value products, this model offers the most cost-effective approach.

Tip

Compare different models for the delivery of repair services and consider the benefits and risks of each. Start small by focusing on the repair of one or two products, before tackling your entire portfolio.

☐ Are spare parts and repair tools easily accessible?

All LMDs that the GDC has spoken with reported that accessing spare parts is the most critical enabler to starting and scaling repair services at the last mile. Without easy access to quality-assured components, repair technicians or consumers will often use whatever is available - including salvaged parts from other products - which may compromise the quality of the repair. The availability of (generic) spare parts in a country is often limited to mainstream products only, with spare parts being procured through local hardware stores, repair shops, or specialised agencies. For example, Revivo, in Kenya, sells spare parts and accessories at wholesale prices on their webshop. Many solar appliances, however, use printed circuit boards or other custom-made parts that can only be purchased from the original manufacturer. The most reputable brands in the sector, however, present cumbersome processes for distributors to access their spare parts and their minimum order quantities are stopping LMDs from exploring this avenue. In Honduras, after LMD Soluz Honduras was not able to purchase replacement batteries from their supplier, the company started to assemble their own lithium battery packs. This means they can replace faulty batteries for customers who are willing to pay for this service, giving them a 10+ year product life. Once a reliable supply chain has been established, LMDs can start stockpiling parts that require frequent replacement based on historical repair data.

Tip

Find out whether your manufacturer or importer stocks spare parts in your country and encourage them to provide a stock of spare parts with each new delivery based on your assumed failure rate. The willingness of manufacturers to facilitate local repair should be a key factor to consider when considering adding a new product to your portfolio.

If products are not repaired, make sure to take them back from customers

When LMDs choose not to offer repair services for post-warranty products, they could still consider taking faulty products back from their customers. This is crucial to make sure e-waste is treated responsibly, valuable components can be recovered for the production of new appliances, and to strengthen customer trust in LMDs. Although still a nascent industry, many countries now have e-waste recycling facilities that handle e-waste on behalf of manufacturers.

Taking back faulty products is, however, not as easy as it sounds. Besides the challenges of reverse logistics, agents would have to firstly identify customers with broken products, and secondly convince them to let go of something to which they might be very much attached, particularly when the purchase was valuable to them (read more about take-back challenges in GOGLA's 2020 e-waste briefing note). So, what can LMDs do about this? First of all, communication with consumers is key, and cash or non-cash incentives to encourage customers to give up faulty products should be considered. SolarNow, in Uganda, found a way to make take-back efforts outside the warranty period profitable, by offering consumers vouchers which can be used to purchase a new or more superior SolarNow product. To increase the number of returns of faulty products, WeTu and d.light have explored incentivising their customers or field agents. WeTu, for example, offered their customers, who are mostly fishermen, non-cash incentives such as drinking water and fishing lantern vouchers, to return faulty products.

☐ Can the product be easily repaired?

When LMDs select new appliances to add to their product portfolio, they might not consider how easy the appliance will be to repair in the same way that they would typically consider brand reputation, product robustness, and affordability. For good repairability, system components need to be designed in a way that enables trained personnel to carry out repairs, preferably with locally available spare parts and equipment. This means that the casings of batteries and control devices must be easy to open and connections should not be glued or welded (note that, for safety reasons, some components, such as battery packs should be protected from manipulations). When Kukula Solar asked their customers to bring any broken appliances back to the company, they found that more than 20% could not be repaired because they were too difficult to open and diagnose.

Establishing lasting relationships with suppliers is important. Suppliers should not only provide LMDs with guidance documents on how to conduct the most common repair operations, but should also commit to maintaining the guidance documents and stocking relevant spare parts for the entire lifetime of their products - or at least five years after delivery. These relationships heavily depend on the willingness of suppliers to capacitate LMDs as repairers of their products.

Tip

Find out whether your manufacturer or importer stocks spare parts in your country and encourage them to provide a stock of spare parts with each new delivery based on your assumed failure rate. The willingness of manufacturers to facilitate local repair should be a key factor to consider when considering adding a new product to your portfolio.

Photo credit: Natfort Energy

Calling all governments, development partners, donors and investors!

The 'Right to Repair' movement, driven by the European Commission amongst others, advocates that products should last longer, that anyone must be able to obtain the information and spare parts they need to repair a product, and that product designs sufficiently allow for repairs to take place. This growing global movement has focused attention on the need to create appropriate legislative and regulatory foundations to develop an effective and sustainable electronics repair economy. LMDs, with the support from regulators, could persuade suppliers to develop more durable products that are designed to be repaired at the last mile, with LMDs and their repair agents providing in-warranty repairs on behalf of manufacturers.

Efficiency for Access identified seven short- and long-term pathways to enhancing repairability in the off-grid energy access sector that are focused on standards, incentives, business models, product design, reporting and awareness raising, and research. Specifically, policymakers can incentivise repair by, for example, easing restrictions on the import of (good quality) spare parts and keeping import taxes and duties low. In their white paper, SolarAid suggests more research and collaborations that will help distributors of off-grid lighting solutions identify best practices for repair across different markets and national contexts. As shown by the trailblazing work of SolarAid in conjunction with the three LMDs mentioned in this publication, donors can help last mile distributors de-risk the design and piloting of their decentralised repair approaches.

Whilst manufacturers' retention of the 'black-box' approach for their PAYGo devices is understandable, there are areas where the industry could do more. This includes interoperability, access to spare parts, and understanding common causes for failure. Manufacturers of solar products and other appliances should apply circular design strategies that aim to improve the durability of products, easing maintenance and repair, and allowing for components to be recovered and recycled (TU Delft, 2014). Manufacturers can leverage product failure insights that LMDs share with them. For example, in one of their projects in Uganda, BRIGHT found that the buttons were one of the most common points of failure, which could be easily rectified by the manufacturer. GIZ suggests setting minimum requirements for the repairability and recyclability of the equipment brought onto the market (GIZ, 2022); something CLASP will be facilitating through the creation of mandatory repairability metrics to the VeraSol standards, starting with electric pressure cookers, fans and solar water pumps.

GOGLA is working with manufacturers and, in 2021, they released a white paper and a Connect Initiative through which GOGLA advocates for interoperability and standardisation in the sector, in recognition of the problems posed by closed proprietary hardware ecosystems that traditionally dominated the off-grid lighting sector. Also, GOGLA requires manufacturer members of its association to ensure that there are parts available locally for all replaceable solar home system components (USAID, 2019). Working with SolarAid, GOGLA plans to re-emphasise this policy and increase sector buy-in through their Circularity Working Group platform.

Side note: repair and the bigger picture of circular economies

Repairing products is important to help low-income consumers enjoy the benefits of their products for longer, and to minimise the number of products being thrown away or replaced; thereby reducing the volume of e-waste globally. However, we encourage stakeholders to look at the bigger picture and explore possible solutions for extended product lifetimes that go beyond just repair. Especially with the rise of non-quality verified products that tend to be of lower quality, LMDs play a role in educating consumers about the importance of purchasing high-quality and durable products that last longer. Though this may mean a higher initial purchasing cost, this upfront expense can often be balanced out (or even reduced) over the course of the product's lifetime, when less servicing requirements and fewer repairs and replacements are taken into account.

Other emerging practices include Energy-as-a Service (EaaS) models in which companies retain the ownership of the product they rent to customers. This creates a higher incentive for the distributor to offer good maintenance and repair services over a longer period of time than a standard (PAYGo) loan, as the tenure of the EaaS deal is the useful life of the product. Another practice is preventive maintenance for "smart" appliances that are equipped with sensors, such as solar irrigation pumps. This lets companies such as Futurepump offer remote troubleshooting support based on device- and component-level performance data, helping to predict a fault before the consumer experiences any disruption. Although these smart products are more expensive upfront, they have lower costs of ownership for the user.

Acknowledgements

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Market players to look out for

This is a non-exhaustive list that merely aims to get you started.

- [x] Take a look at SolarAid/SunnyMoney's and Natfort Energy's repair apps, that can be downloaded for free from the Google Play store.
- [ ] iFixit is an online repository and community that offers more than 100,000 free repair manuals, including a number of manuals for solar lanterns.
- [ ] Revivo in Kenya has an online marketplace for spare parts and offers training to (informal) repair technicians.
- [ ] The Kenya Solar Waste Collective (KSWC), that currently consists of seven companies (Azuri, BBOXX, d.light, ENGIE Energy Access, Greenlight Planet, M-KOPA, and TOTAL) and three advisors (GOGLA, KEREA and Sofies), aims to develop a common strategy around the joint take-back of solar e-waste in response to new EPR regulations in Kenya.
- [ ] E-waste recyclers such as Enviroserve and WEEE Centre in Kenya, and Hinckley Recycling in Nigeria might be interested in partnering with LMDs and manufacturers. Some offer expertise in repair training or unlock networks to access (second-hand) spare parts.
- [ ] For second-life battery refurbishing, consult Hinckley in Nigeria and SLS Energy in Rwanda.

Opportunities to pursue your last mile repair ideas

- [x] Keep an eye out for the Repairability Index that CLASP is developing with other practitioners in the sector. This can become a resource for LMDs to assess the repairability of different off-grid-appliances, starting with electric pressure cookers, fans, and solar water pumps (the tools are expected to be published by the end of 2025).
- [ ] The GOGLA E-Waste Toolkit helps off-grid solar companies and other key stakeholders address the main challenges of e-waste management, providing guidance and good practice on topics from design and manufacturing to e-waste regulation, and recycling and consumer awareness raising.
- [ ] In addition, GOGLA developed a suite of ready-made business blueprints to help off-grid solar companies implement e-waste management solutions.
- [ ] SolarAid is fundraising for a 24-month programme called the Off-Grid Solar Repair Lab which is a sector-wide initiative that will engage manufacturers, distributors, investors, and other stakeholders. Besides establishing sector standards, conducting research and advancing policy, the programme will develop replicable last-mile business models and tools that other LMDs can benefit from.

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