TOWARDS A CIRCULAR ECONOMY IN UNHCR

A FOCUS ON CORE RELIEF ITEMS (SOLAR LAMPS)

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UNHCR Innovation Service

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EXECUTIVE SUMMARY

This report is produced by the University of Edinburgh and UNHCR's Innovation Service. The report aims to increase the knowledge base around circular economies in humanitarian organisations and supporting pathways to greening UNHCR, in line with the Strategic Framework for Climate Action. Based on in-depth interviews with over 40 people across UNHCR and the wider humanitarian community, this report shows how updates to technical specifications and procurement protocols for core relief items could help UNHCR meet key sustainability goals.

Solar lamps are a core relief item distributed by UNHCR in significant volumes, particularly during humanitarian emergencies. They are composed of materials that – when they reach the end of life – become part of global electrical and electronic waste (e-waste) flows. These include plastics, copper, steel, thin film or poly-silicon photovoltaic modules, and lithium ferro phosphate batteries.

The research conducted for this report revealed that in refugee camps around the world, people seek to repair or repurpose solar lamps before they enter national or regional e-waste flows. ***Repairing*** a technology to restore an original function and ***repurposing*** an object so that it can serve a new function are two essential components of a circular economy. Both repair and repurposing allow the continued circulation of materials in the economy and reduce waste flows.

This report summarises the opportunities and benefits to repair and repurposing, and demonstrations what can be done to mainstream circular economy thinking within UNHCR.

KEY FINDINGS

- **UNHCR is the world's largest institutional buyer of solar lamps** and represents one of the largest global markets for sales of all quality assured pico solar lamp products.
- Over five years between 2016 and 2020, UNHCR procured 3.41 million solar lamps at a total cost of $US 84.91 million. **In 2020, UNHCR spending on solar lamps represented one fifth (20 per cent) of its total budget for core relief items which provide safety and protection to displaced populations.**[1]
- UNHCR has enormous purchasing power in the off-grid solar industry. **In 2020 sales of solar lamps to UNHCR accounted for ~12.5% of all quality assured solar lamps sold globally**; equivalent to cash sales of quality assured solar lamps across the whole of West Africa.
- Since 2016, **UNHCR purchases of solar lamps have generated an average of 204.68 tonnes of electrical and electronic waste (e-waste) per year.** Cumulatively, between 2016 and 2020 UNHCR's procurement of solar lamps generated 1749.54 tonnes of e-waste. The total cost of collecting, transporting, sorting, treating and recycling e-waste from UNHCR purchased solar lamps since 2016 is estimated at $US 11.94 million.
- **Electrical and electronic waste from solar lamps is attracting increased scrutiny from investors, governments, and consumers.** Current initiatives aimed at reducing electrical and electronic waste are entirely focused on downstream activities (waste collection, transportation, and recycling) rather than upstream issues around eco-design and design for repairability.
- International (ISO/Verasol) quality assurance standards for off-grid solar lamps do not currently evaluate the ecological design or repairability of products, and there is currently no timetable for updating these. **UNHCR technical specifications and frame agreements for the procurement of solar lamps do address key aspects of ecological design and repairability, but they are not well**

1. In 2020 UNHCR purchased US$60.3 million worth of core relief items US$12 million of that total was spent on 578,802 solar lamps. See: https://bit.ly/3ltANhc (p.200)

enforced and should be expanded.

- **The repair and repurposing of solar lamps (alongside many other products) is a key feature of refugee economies** and sustains the operation of technologies, machines and humanitarian goods across contexts of emergency and protracted displacement.
- **Repair is a net good.** Increasing the repairability of core relief items distributed to refugees has social, economic, and environmental benefits through the supply chain and contexts of use (these include: cost savings; reduced material flows; reduced Co2 emissions; support for livelihoods as well as increased self-reliance).
- **Procurement is a lever to greening UNHCR.** Procuring solar lamps that can be repaired in the context of use is a beneficial, achievable, and desirable route to reducing electrical and electronic waste, and Co2 emissions. There is widespread support for this goal across UNHCR – in procurement teams, energy teams and field teams – but internal capacity and capabilities are barriers to change.
- **UNHCR's purchasing power means that it has the institutional capacity to drive changes across the supply chain.** Changes to procurement protocols and frame agreements in support of the right to repair and the circular economy would allow UNHCR to leverage its position as the world's largest institutional purchaser of solar lamps and drive a sector-wide transformation.
- **There is a latency in the system.** It will take between 12-36 months to update specifications and for manufacturers to respond to these new specifications.

KEY RECOMMENDATIONS

Pathways to a greener UNHCR must include support for repair economies. It is crucial for UNHCR to quickly engage with this process so the benefits of repairability can be realised as soon as possible.

Pre-Distribution: Using Procurement to Build a Circular Economy in UNHCR

1. Develop new guidelines for circular procurement and use them
2. Update, enforce and extend existing technical specifications for solar lamps
3. Consult with existing suppliers and refresh the supplier pool
4. Support the "right to repair" everywhere

Post-Distribution: Supporting Repair in Refugee and Host Communities

1. Work to remove barriers to repair in displacement settings
2. Engage with refugees and repair practitioners (technicians)
3. Provide spare parts for solar lamps to refugees
4. Support co-ordinated action across the humanitarian sector

1 UNHCR – WHERE CIRCULAR ECONOMY THINKING MEETS HUMANITARIAN ACTION

The humanitarian sector is greening. Concerns with the carbon footprint of humanitarian activities, the longevity of humanitarian technologies and the impact of material flows in humanitarian contexts are creating new pressures and priorities on humanitarian organisations to act sustainably. Against this backdrop, many UN agencies are beginning to reflect on the scope for circular economy thinking in the sourcing, transportation and distribution of products intended to meet essential humanitarian needs in crisis.

> Repair and repurposing – key features of any circular economy – are an essential part of life in all humanitarian settlements.

One area where circular economy thinking meets humanitarian action is in the management of waste from plastics, metals, and electronics in humanitarian settlements for refugees[2] and internally displaced people. Repair and repurposing – key features of any circular economy - are an essential part of life in all humanitarian settlements; and sustain everyday access to systems for communication, energy, shelter, mobility, and hygiene.

To date, humanitarian agencies have been primarily focused on managing waste at the end of product lifecycles and use. However, focusing on these downstream waste streams neglects considerable opportunities for addressing waste upstream. Addressing waste upstream involves shifting attention towards procurement practices, the design and manufacturing of humanitarian goods, and the opportunities to support and promote localised repair economies. We illustrate this through a case study of the solar lamps that UNHCR procures as a core relief item for distribution in humanitarian emergencies and contexts of protracted displacement.

This report draws on over 40 interviews with key actors and stakeholders in the humanitarian sector across 14 countries and 10 different organisations. These organisations include humanitarian organisations, refugees, refugee-led community-based organisations, product manufacturers, and institutes, bodies or organisations relating to the United Nations. These interviews sought to gain new knowledge and understanding of repair and repurposing activities, and the structures and issues that surround them. The interviews were semi-structured in their approach, using a topic guide to aid in consistency whilst allowing for flexibility to explore new themes. All interviewees will remain anonymous in this report.

We have also used published and unpublished data from humanitarian agencies, including UNHCR. All data was gathered or accessed between September 2020 and August 2021. The report includes detailed diagrams that to illustrate the complex material flows, human interactions, and procurement processes which emerge from, and engage with these activities. The report includes two Appendices. Appendix One details anecdotal evidence for the repair and repurposing of technologies and technical systems across refugee camps, globally. Appendix Two provides four case studies of current funded programmes, projects and businesses around repair and repurposing in the humanitarian sector.

2. Note on use of the word 'refugee': In the context of this report, the term 'refugee' is used to refer both to legally defined refugees and internally displaced people. The term refugee camp is used to refer to legally constituted settlements for displaced people where UNHCR has an operational mandate.

2

UNHCR SOLAR LAMP PROCUREMENT & E-WASTE DATA

The solar lamp has become a key part of UNHCR's response to crises and is the only electronic item in the list of core relief items.[3] This chapter presents UNHCR procurement figures and electronic waste flows derived from publicly available data (including market reports and UNGM statistics). This data demonstrates the relative size and scale of UNHCR's purchases of solar lamps compared to the rest of the global market, and the extent of annual e-waste flows.

PROCUREMENT

UNHCR is the world's largest institutional buyer of solar lamps that meet international consumer standards for quality assurance. Over five years between 2016 and 2020, UNHCR procured 3.41 million solar lamps at a total cost of $US 84.91 million. By 2020 spending on solar lamps represented one fifth (20 per cent) of the total budget for core relief items by UNHCR.[4]

These figures make UNHCR one of the world's largest markets for solar lamps.[5] Sales of solar lamps to UNHCR in 2020 accounted for 12.5% of all solar lamps sold globally by companies affiliated with the Global Off-grid Lighting Association (the world's largest membership-based trade body).[6] Between 2016 and 2020, UNHCR purchased an average of 680,000 solar lamps per year (see table 1). Sales of solar lamps to UNHCR in 2020 were equivalent to (if not greater than) the total cash sales of solar lamps across the whole of West Africa.[7]

A volunteer technician from the refugee community works to repair a broken solar lamp. Image credit: CTEN

3. Cross, J., 2018. Solar basics. Limn# 9. https://limn. it/articles/solar-basics; Cross, J., 2020. Capturing crisis: Solar power and humanitarian energy markets in Africa. The Cambridge Journal of Anthropology, 38(2), pp.105-124.
4. In 2020 UNHCR purchased US$60.3 million worth of core relief items US$12 million of that total was spent on 578,802 solar lamps. See: UNHCR's Global Report 2020 (p.200) https://bit.ly/3ItANhc
5. There is limited data available for the size of the entire global solar lamp market. However, GOGLA, the global industry association for off-grid lighting, collates sales figures from companies affiliated with themselves, IFC Lighting Global, or Efficiency for Access Coalition. Only 107 out of 237 eligible companies participated in the 2020 market report and Schneider was not one of them. Purchases from Schneider account for roughly 10% of UNHCR's total solar lamp purchases between 2016 and 2020. GOGLA reporting includes data from approximately 90% of the solar lamps procured by UNHCR must have passed these quality standards, GOGLA's collated global sales figures can be directly compared against UNHCR procurement figures.
6. GOGLA affiliated companies sold 4.27 million solar lamps in 2020 (1.98 million in H1; and 2.29 million in H2). UNHCR purchased of 578,802 lamps in the same period all from GOGLA affiliated companies, equivalent to 13% of all sales.
7. See: www.gogla.org/sites/default/files/resource_docs/global_off_grid_solar_market_report_h22019.pdf (p.21)

These sales figures mean that UNHCR has enormous purchasing power in the off-grid solar industry and a valuable opportunity to lead future developments in sustainability in the sector. UNHCR has the institutional capacity to drive changes across the supply chain. Changes to procurement protocols and frame agreements in support of the right to repair and the circular economy would allow UNHCR to leverage its position as the world's largest institutional purchaser of solar lamps and drive a sector-wide transformation.

Table 1: UNHCR Solar Lamp Procurement Figures 2016-2020

Year	GOGLA Affiliated Solar Lamps Sales (millions)[1]			UNHCR Purchased[2]	UNHCR Purchases as a Proportion of GOGLA sales (%)	Cost to UNHCR (millions USD)
	H1	H2	H3			
2020	1.98	2.29	4.27	578802	13.6	23,106,088
2019	2.83	2.81	5.64	604380	10.7	23,638,520
2018	2.7	2.79	5.49	662771	12.1	13,994,124
2017	2.74	2.97	5.71	791380	13.9	12,318,184
2016	3.3	3.07	6.37	773555	12.1	11,855,173
				Total Purchased:	Average (%):	Total Cost (USD):
				3,410,888	12.5	84,912,091

1. These figures are taken from GOGLA's Off-Grid Solar Market Reports available at: https://www.gogla.org/global-off-grid-solar-market-report
2. Procurement data provided by UNHCR colleagues and taken from the United Nations Global Marketplace. Procurement data is only available from 2016-2020. These figures include solar lamps with and without mobile chargers, and where the term 'solar lanterns' was used for some products in 2016.

SOLAR WASTE

Solar powered technologies have attracted increased scrutiny from international organisations for their contributions to electronic and electrical waste flows in resource poor countries.[8] Our calculations suggest that UNHCR solar lamps generate considerable electronic and electrical waste when they reach the end of their working life.[9]

Since 2016, UNHCR purchases of solar lamps have generated an average of 204.68 tonnes of electrical and electronic waste (e-waste) per year. Cumulatively, between 2016 and 2020 UNHCR's procurement of solar lamps generated 1749.54 tonnes of e-waste. The total cost of collecting, transporting, sorting, treating, and recycling e-waste from UNHCR purchased solar lamps since 2016 is estimated at $US 11.94 million (see table 2).

In this report, we argue that the procurement of more repairable solar lamps will extend the useful lives of these products and the materials from which they are made, thus reducing e-waste and the associated costs.

These figures use a standard formula for calculating waste from pico-solar products used

8. Spear, R. Cross, J, Tait, J. and Goyal, R (2020). *Pathways to Repair in the Off Grid Solar Industry*. Efficiency for Access.
9. This represents the first systematic or independent attempt to calculate or project UNHCR e-waste flows based on a standard industry formula. To date, there is little data on e-waste in the humanitarian sector more generally.

by the Global Off Grid Solar Association (GOGLA), the industry's largest membership-based trade organisation: E-waste = Product Sales or Units x Weight x Lifespan.[10]

Lifespan is based on GOGLA's standardized impact metrics for estimating product lifespan. This is the warranty period (1 year for quality assured solar products) multiplied by 1.5 years. Although GOGLA considers this a conservative estimate.

Weight assumes an average unit weight of 0.2kgs for a single, solar powered light source without an external power outlet or mobile phone charging capability < 100 lumens.

Cost estimates are based on assumption that an entry level solar lantern has a negative recycling value (that is a cost) of $USD 1.36/unit and $USD 6825/tonne at the End of Life (EoL). Note that humanitarian e-waste flows are likely to have different costs than e-waste flows from cash sales in off-grid energy markets. Humanitarian e-waste flows may have lower costs of collection, due to the centralised nature of logistics within camp settings. Due to their geographical locations, humanitarian e-waste flows are likely to have greater costs of transportation from sites of use to centralised sites of recycling and sorting within countries and regionally, if and when they exist.

Cumulative e-waste flows are calculated on the assumption that there have been no attempts to date to collect, transport, treat or recycle solar lamp units at the end of their life. As the procurement data only goes back to 2016 the true figures may be higher.

Table 2: E-Waste from UNHCR Solar Lamps 2016-2020z

Year	UNHCR Solar Lamps (Units Purchased)	Annual E-Waste (Kgs)	Annual E-Waste (Tonnes)	Annual Cost of E-Waste Collection & Treatment (USD)	Cumulative E-Waste (Kgs)	Cumulative E-Waste (Tonnes)	Cumulative Costs of E-Waste Collection & Treatment (USD)
2021	TBC	173640.6	173.64	1,185,093.00	3,005,726.60	1749.54	11,940,610.50
2020	578802	181314	181.13	1,236,212.25	2,409,020.00	1533.59	10,466,751.75
2019	604380	198831.3	198.83	1,357,014.75	1,763,766.30	1051.52	7,176,624.00
2018	662771	237414	237.74	1,622,575.50	1,010,969.00	797.29	5,441,504.25
2017	791380	232066.5	232.06	1,583,809.50	232066.5	232.06	1,583,809.50

10. See: https://bit.ly/2Z6UAvg (p12; 16)

3 UNHCR SOLAR LAMP SUPPLY CHAINS

In this chapter we describe the supply chain for solar lamps procured by UNHCR in detail. The diagram on the next page maps this supply chain. It covers initial supplier selection; the manufacturing, transportation, and storage of solar lamps; the journeys they take within refugee camps; the methods to request stock; and the interactions with host communities and with other solar lamps, not procured by UNHCR.

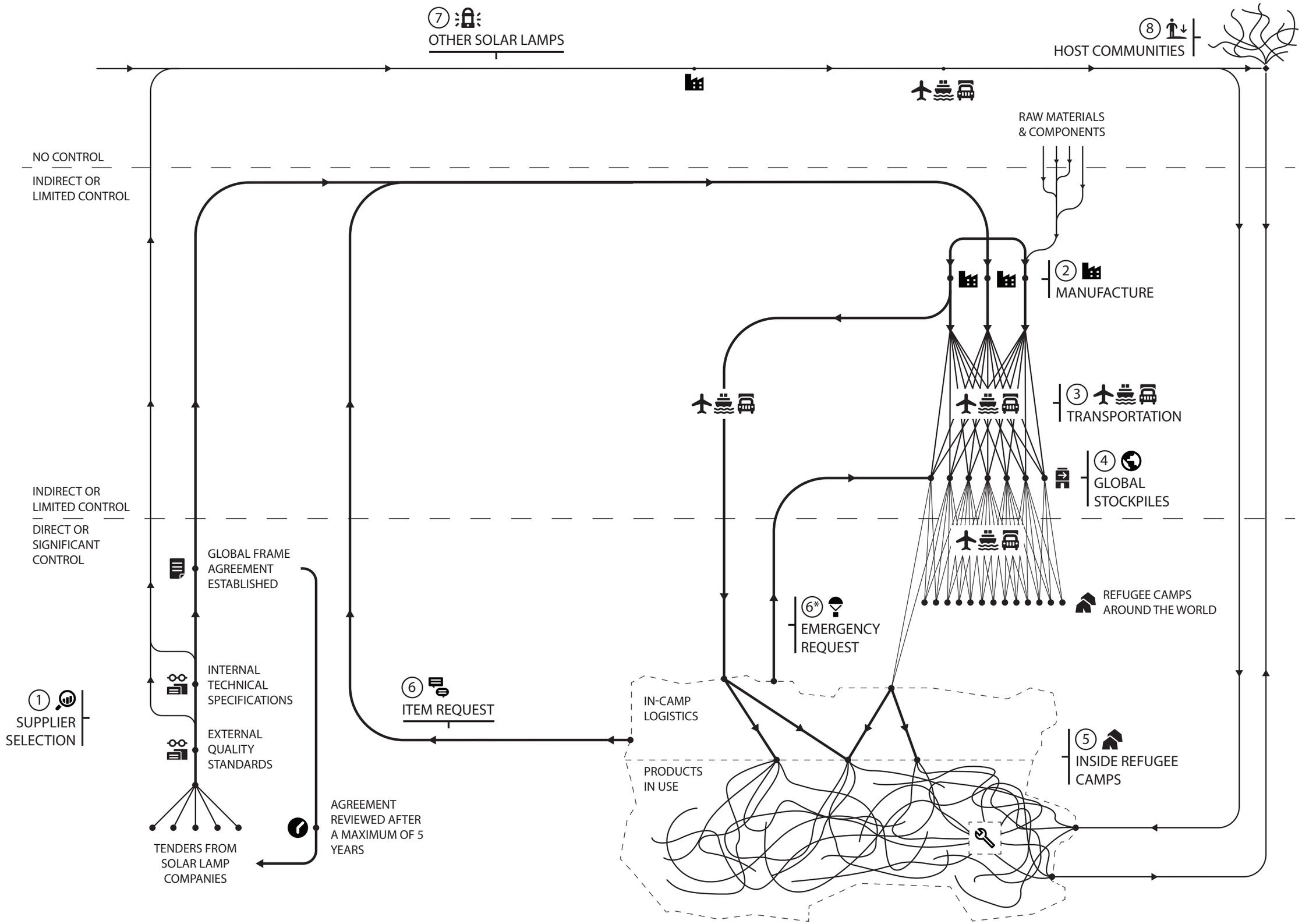
The diagram has been created as a tool to help situate the act of repair in refugee camps within the broader context of international humanitarian logistics. It also aims to help colleagues understand and visualise the relationships between the various processes. It shows how changes to these processes can achieve cross-cutting economic, social, and environmental benefits- changes such as elevating the importance of repairability in the procurement of solar lamps.
The processes within the diagram are divided into layers based on UNHCR's level of control over them: the bottom layer representing areas of 'direct control', then progressing through 'indirect or limited control' in the middle layer, to 'no control' at the top of the diagram.

The diagram is, naturally, a simplified version of an incredibly complex series of overlapping organisations, teams, and processes. It was not designed to disregard this complexity, but serve as a high-level introduction to it and the relationships within.

Each process is numbered. They are described and examined on the pages following the diagram.

SOLAR LAMP SUPPLY CHAIN

PROCUREMENT | MANUFACTURE | DISTRIBUTION | USE



1 SUPPLIER SELECTION

Suppliers of solar lamps are selected via an open tender process. A 'request for proposal' is advertised online, though some suppliers may be directly invited to submit tenders. Suppliers submit one or more of their existing products, which are then evaluated and filtered by UNHCR using technical and financial specifications. For solar lamps, technical evaluation uses both external and internal specifications. Products must have a certification from Verasol[11], which assesses against international quality standards, and then be assessed against UNHCR's own technical specifications for solar lamps.

UNHCR has developed technical specifications for portable solar-powered lights[12] - both with and without mobile charging capabilities. These are largely based on the Verasol Quality Standards, as a global benchmark. UNHCR's specifications list general specifications for both variants, each variant then has a list of technical specifications. These technical specifications are broken down into three elements:

- Information the supplier must provide, including test reports, compliance documents and technical information regarding the light, battery, and photovoltaic panel (solar panel) in the product.
- Minimum criteria that must be met by the submitted products. Including information relating to the product's performance and warranty.
- Additional functionalities which will be taken into account, including robustness, charging indicators, and the product's dimensions.

Companies must be able to manufacture a minimum of 100,000 units per year and submit an annual financial report and audit report as part of their application. Suppliers which pass these evaluations then enter a bidding process to determine prices at which they are willing to sell certain quantities of products. This process can take approximately 120 days, to allow for verification and selection in line with the established parameters.

Successful companies are offered a frame agreement with UNHCR. In general, frame agreements (sometimes called 'long term agreements') initially last 3 years, with the potential for 2 subsequent 1-year extensions for a maximum agreement length of 5 years. This may be extended in the future to a maximum of 7 years (5+1+1) to facilitate longer partnerships, improve relationships with suppliers and enable increased feedback on product development.

Frame agreements are non-exclusive and do not require UNHCR to purchase a minimum quantity of products. Several such agreements may be in place at the same time with different suppliers for products serving a similar purpose. Where frame agreements concern the international supply of products, they are referred to as 'global frame agreements'.

The majority of this selection process takes place in Europe: drafting the technical specifications for solar lamps is the responsibility of the Technical Support Section (TSS) hosted in the Division of Resiliency and Solutions, whilst teams in the Global Service Centre in Budapest are responsible for product purchasing. Some frame agreements for solar lamps have been established directly between country operations or regional offices and suppliers.

> Stories and images of a company's products being used in humanitarian contexts can be valuable PR tools to obtain investment, improve brand image, and sell more products.

The off-grid solar sector is highly competitive and continues to grow rapidly. Against this backdrop, off-grid solar companies often deploy highly persistent marketing strategies with international organisations. Staff in UNHCR procurement teams report that they receive more emails and telephone calls from solar lamp companies than the suppliers of any other core relief item, with requests for meetings and follow-up on framework agreements.

Sales to UNHCR are hugely beneficial to off-grid solar companies. A Global Frame Agreement with

11. See: https://verasol.org
12. Available to download from: https://bit.ly/3gyXhfc

UNHCR provides manufacturing and distribution companies with direct and indirect benefits. As well as providing a significant source of revenue, stories and images of a company's products being used in humanitarian contexts can be valuable PR tools to obtain investment, improve brand image, and sell more products.

② MANUFACTURE

Companies with global frame agreements will provide solar lamps for UNHCR when requested. Depending on the size of the request, these products will either be manufactured to order or delivered to UNHCR from a company's existing stock. Some suppliers keep stock in their own warehouses in anticipation of a request from UNHCR. This stock is referred to as 'Ready Stock'.

Product manufacture includes both the fabrication of propriety components as well as the assembly of final products. The materials and components used to create these products all have their own complex global supply chains, processes, and ethical and environmental implications. Solar lamps use many energy intensive processes in their creation, especially in the manufacture of the solar panels which charge them.[13] They also contain materials in their electronics which can be environmentally harmful to extract, process and dispose.[14]

Factories for solar lamps are likely to be located in East and Southeast Asia, Europe or the United States. Different components will be manufactured in different factories and may have to travel internationally before they are assembled into the final product.

③ TRANSPORTATION

Assembled and packaged solar lamps are transported around the world using a range of methods. International transportation often uses ships or planes, whereas trucks are commonly used for regional transportation. In 2020 UNHCR transported approxminately 1000 tons of emergency CRIs by air, 2100 tons by sea, and 4800 tons by road.[15]

Depending on the type of request, products may be sent to one of UNHCR's global stockpiles or more directly to the requesting operation.

Repair keeps products in circulation for longer, so a shift to procuring more repairable solar lamps will likely mean fewer lamps need to be purchased and transported by UNHCR. Instead, the focus could change to supplying spare parts to support the repair of products already in circulation, only procuring new products when needed e.g. for global stockpiles.

This shift to supplying spare parts for solar lamps may result in lower transport related emissions. Spare parts are naturally smaller than fully assembled products. The space required, for example, to transport 1000 batteries and 1000 switch assemblies (common failure points in solar lamps) would be far less than that needed to transport 1000 new solar lamps. Manufacturers and colleagues in procurement are supportive of supplying spare parts to refugee camps, but they highlight the need for further research to understand how these parts would be stored and sent to the appropriate camps: parts for specific products would need to be sent to camps where those products were in circulation. Additionally, the lithium-based batteries used in solar lamps can be volatile if mishandled. As such, appropriate safety precautions would need to be taken to ensure their safe transportation and storage.

④ GLOBAL STOCKPILES

At the time of writing, UNHCR has 7 global stockpiles located in Accra, Ghana; Amman, Jordan; Copenhagen, Denmark; Dubai, UAE; Douala, Cameroon; Nairobi, Kenya; and Panama. These stockpiles pre-position core relief items, including solar lamps, for emergency distribution to up to 600,000 people within 72 hours of a request.

13. IEEE Spectrum 2014 *Solar Energy Isn't Always as Green as You Think.* https://bit.ly/3Cpc7x1
14. Institute for Energy Research 2020 *The Environmental Impact of Lithium Batteries.* https://bit.ly/2XqkKZ8
15. UNHCR 2020 *Global Report 2020.* (pp.200) https://bit.ly/3ltANhc

Solar lamps procured by UNHCR have a minimum warranty of 2 years. This warranty assumes the products will be in use during that period. If the lamps are not used, the health of their batteries can be negatively affected. To avoid this, solar lamps are stored, whenever possible, for no longer than 6 months. UNHCR's procurement team actively try to move them to areas where they are needed before this period elapses. After this period the batteries in the lamps must be tested to ensure they are still functioning optimally. In order to test battery health, batteries must be removed. In solar lamps without an easily removable or replaceable battery, the entire unit must be disassembled.

5 INSIDE REFUGEE CAMPS

Once a shipment of solar lamps has reached a specific refugee camp it will be distributed to refugees by Global Operations staff. The distribution process will vary between camps, but there may be one or two months between products arriving in camps and being first used by refugees. There may be many reasons for this delay. For example, if an insufficient number of solar lamps reach a site, field officers, local supply co-ordinators and site planners may hold back on distribution to reduce frictions between different refugee households and communities. These delays can add additional storage time, which are important to factor into the health of the battery inside each solar lamp.

> As solar lamps are used in refugee camps, they begin to breakdown and to be broken down into their various parts.

Once distributed the previously formalised, and often linear, journeys of the lamps become more organic and harder to track. Solar lamps are primarily used by refugees in housing units and tents to provide light for cooking, entertainment, and education. They are also used by businesses in camps, such as in markets, repair shops, and barbers, to stay open after dark. Interviewees described occasions, when money was scarce, where refugees directly traded lamps for food. Others described how lamps were frequently bought and sold in markets inside and outside of the camps.

As solar lamps are used in refugee camps, they begin to breakdown and to be broken down into their various parts. Lamps will lose ancillary parts such as stands, straps, or covers for electrical ports as these parts break or become detached. When a key component fails in a lamp the owner may sell it for parts, discard it, or take it to be repaired by a technician. (See Chapter Four for more detail on the repair process.)

If a lamp is not repaired it may end up in landfill or an informal dump, it may be burned along with other waste, or it may be sold for parts.

6 ITEM REQUEST (NON EMERGENCY)

When Global Operations staff want to order solar lamps for a camp, they submit a request to the procurement team in the Global Service Centre in Budapest. The procurement team will then begin the process of buying products from suppliers.

This process can be a slow, with varying lead times depending on the number of units requested, the current stock a supplier may already have in storage, and, when necessary, the time it takes to manufacture new products. Products can be considered for purchase from all solar lamp suppliers currently under a global frame agreement.

6* EMERGENCY REQUEST

In an emergency, requests for solar lamps are made directly to the global stockpiles. Teams in these locations will then ensure that products are delivered within 72 hours of the request.

Stockpiles usually hold one or two types of solar lamp at any one time. Only products in these global stockpiles will be delivered to camps as a result of an emergency request.

7 OTHER SOLAR LAMPS

Not all solar lamps circulating in refugee camps have been procured by UNHCR. Other products may be sold or distributed by different humanitarian agencies who will have their own technical specifications and supplier selection processes. These products share many of the same supply chain complexities as those procured by UNHCR, but may vary in quality. Some of these other solar lamps may be produced by companies who have submitted tenders to UNHCR but been rejected. Solar lamps are also often sold in host communities, entering refugee camps through trade at local markets (see below, section 4).

The variety of products in circulation complicates repair activities. Different products require different methods to disassemble and to diagnose faults, and will have parts which only work with a particular model or brand. Some may also be bonded shut and almost impossible to repair.

HOST COMMUNITIES

A semi permeable boundary for solar lamps exists between refugee camps and host communities. As refugees struggle with complex situations, including a lack of food or money for medecine, solar lamps become household assets that can be traded or bartered. Lamps distributed to refugees inside camps are likely to be sold in local markets, and as noted above, lamps sold in local markets may be bought by refugees.

Close engagement with a host community can be beneficial for the repair of solar lamps. Technicians within a camp will often buy parts or tools from shops in the host community (see the Community Technology Empowerment Network case study in the Appendix for more detail). Meanwhile, technicians based outside of a camp may have superior knowledge of how to repair a product, as well as better access to appropriate spare parts and tools, thus a refugee may seek out their services.

Where solar lamps cannot be repaired, they may be more likely to end up in a host community. In an example from Tanzania, an interviewee remarked that it doesn't take long for the distributed solar lamps to start breaking, and that they were difficult to repair. It was stated that many of the lamps are sold in local markets for a small amount of money and refugees instead use battery powered torches or their mobile phones as light sources. Another interviewee noted that, while not desirable, they do not mind if products are sold on, particularly if they are sold at a higher price than UNHCR paid for the item. A bigger problem, as they see it, is the selling on of products at a much-reduced price, as this represents a loss of value to refugees and UNHCR. More repairable solar lamps may retain this value, keeping products in use within camps for longer

4 REFUGEE ECONOMIES OF REPAIR AND REPURPOSING

The repair and repurposing of solar lamps (alongside many other products) is a key feature of refugee economies and sustains the operation of technologies, machines and humanitarian goods across contexts of emergency and protracted displacement.[16]

Repair and repurposing activities are a virtually undocumented part of refugee economies and material ecosystems. They rarely appear in field reports or audits, or in academic literature. Repair work often takes place informally and does not necessarily come to the attention of UNHCR staff. However, examples of repair and repurposing do circulate widely through UNHCR. Field staff, as well as other practitioners working in partner humanitarian organisations, are a repository of knowledge about repair. They frequently witness or hear about examples of repair in practice in the field and carry stories or anecdotes between field locations and offices. Our interviews with practitioners and humanitarian professionals resulted in many examples of repair and repurposing activities from refugee camps around the world (See Appendix 1).

Our interviews reveal the depth and diversity of repair and repurposing activities in refugee camps. Our informants described the various ways persons of concern repair and repurpose products; the different rationale behind these activities; the specific benefits and barriers to repair presented by contexts of displacement; and the engagement of humanitarian professionals with repair and repurposing activities. It also highlights the intersection of the COVID-19 pandemic with these activities.

The examples of repair and repurposing revealed by our systematic, stakeholder interviews show how people seek to maintain continued access to technology and an opportunity to retain and extend the value of products and materials beyond these breakages. They also emphasise the economic and environmental benefits

16. See: Cross, J. et al. 2019 *Energy and Displacement in Eight Objects: Insights from Sub-Saharan Africa* https://bit.ly/3lFJxkC

Technicians and volunteers repair laptops at CTEN in Rhino Camp, Uganda. Image credit: CTEN

to people and organisations from repair and repurposing. Limited resources mean that restoring a product is often essential to retaining access to the function it provides. A repaired radio, laptop or mobile phone continues to keep people informed and facilitates communication; a repaired solar lamp extends the useful hours of the day and keeps people safe outside after dark. Likewise, repurposing components and materials enables refugees to maximise the utility of these limited resources, whilst innovatively adapting technologies to their specific needs and contexts.

SOLAR LAMPS AND THE REFUGEE REPAIR ECONOMY

Around the world, the proliferation of broken solar lamps in contexts of displacement has given rise to specialised, informal repair economies. Self-taught, locally trained or camp trained technicians fix and repair solar lamps in situ – sourcing ancillary parts such as stands, straps, or covers for electrical ports from old or broken systems. These cultures of repair and repurposing are central to strategies of material provisioning and resilience in humanitarian settings, and their significance for livelihoods and household income demands to be enumerated in future studies. At the same time, repair work is also an important source of identify and cultural value in ways that cannot always be quantified and, as such, is deserving of recognition and respect. Just as importantly, however, repair and repurposing also represents a local solution to electronic waste flows, that keep materials and components in use or circulation.

First-hand observations highlighted many important social, environmental, and economic factors arising, and benefiting, from the activities. These factors include access to energy, lighting, communication, and transportation for refugees; reduction of waste from broken products; and opportunities for refugees to sell goods and services.

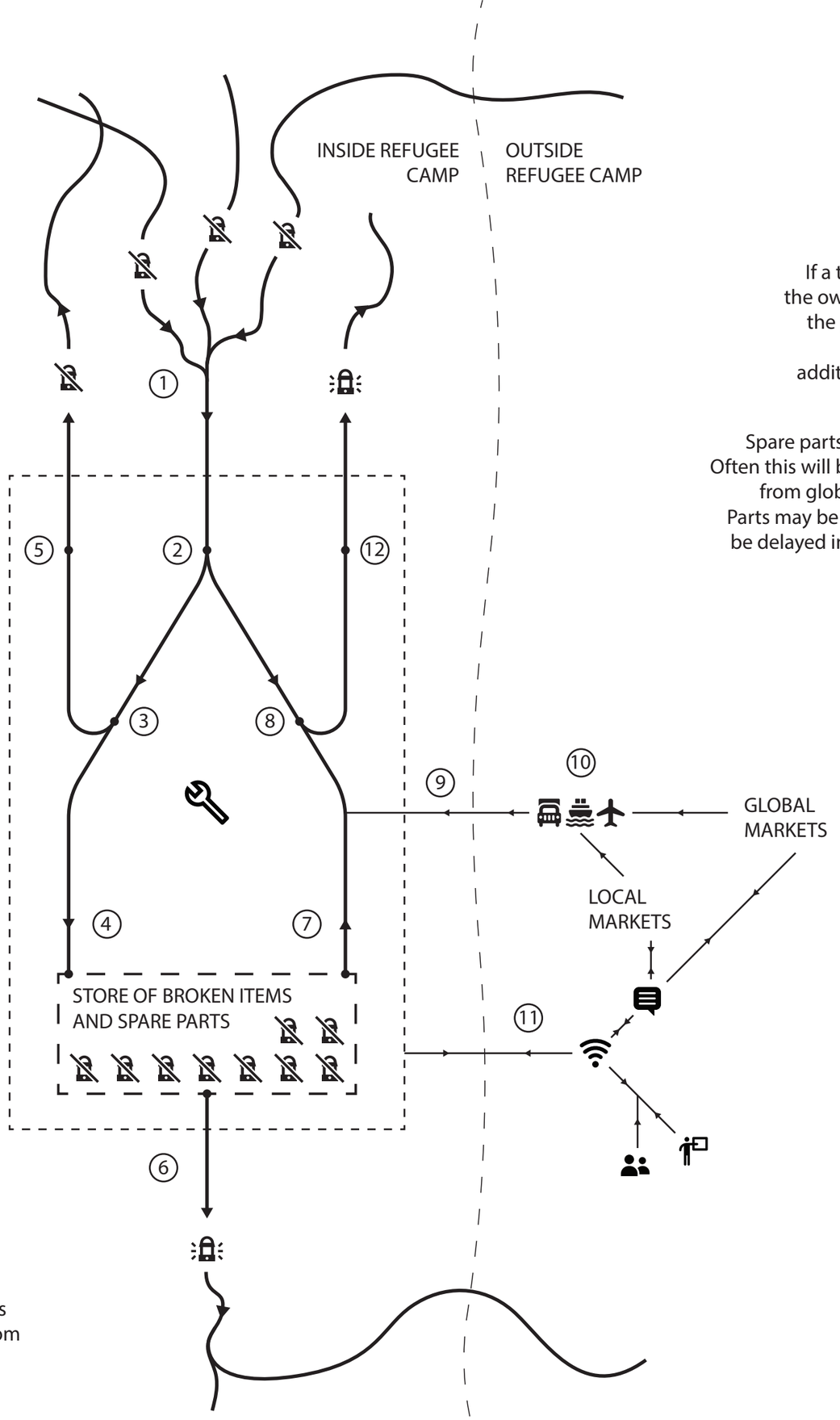
The schematic diagram on the following page (p.15) illustrates this repair process.

A second diagram (p.16) details the contextual difference between core relief items and repaired technoligies.

A final diagram (p.17) examines the movement of knowledge and expertise brought into refugee camps by UNHCR staff. It contrasts this against the movement of materials in the same camps and links into the next chapter (chapter 5) on material build-up and e-waste.

THE REPAIR PROCESS

SOLAR LAMPS AND OTHER ELECTRONIC PRODUCTS



1. In a refugee camp, a product is likely to live many lives and pass through the hands of many owners. It could have been distributed by humanitarian organisations, purchased from markets, either inside or outside of the camp, or brought into the camp as a possession by an arriving refugee. When it breaks, its current owner may bring it to a technician to be repaired.

2. The technician assesses whether the product can be repaired. The product may be left with them whilst they investigate this, and the owner's name and the product's details will be recorded. The owner may receive updates through a messaging app during the repair process, or they may have to revisit the technician.

3. Repair is not always possible: the product may be too badly damaged; the technician may not know how to repair it; they may not have access to specific or specialist tools required to disassemble the product; the cost of repair may be too high for the owner; spare parts may be too difficult, or expensive, to source. If a repair is not possible, but some of the product's components are salvageable, the technician may offer to buy the product from the owner.

4. Broken products purchased from their owner are stored by the technician. This inventory will likely also include many other parts bought in markets or salvaged over the course of the technician's career.

5. Unrepairable products, not bought by the technician, are returned to the owner. The broken product may be kept by the owner, disposed of, or sold. Repair may be attempted again in the future.

6. Over time, the technician may repair stored products using functioning parts from other products, and from their wider inventory, before selling them on.

7. Working parts from stored items can also be used to replace broken parts in items brought in for repair.

8. If a technician assesses that a product can be repaired, they will inform the owner and estimate a cost for the service. The technician then begins the process of sourcing parts and conducting the physical repair work. A repair attempt may fail due to a misdiagnosis of the fault or if additional, unforeseen repair costs make it too expensive for the owner. The owner will be consulted to decide the next course of action.

9. Spare parts are purchased from sources outside of the camp where necessary. Often this will be a local market, but some parts may need to be purchased online from global markets. The costs for these parts are included in the repair fees. Parts may be incorrect or damaged on arrival. Parts purchased from abroad may be delayed in customs and attract import taxes. These issues can greatly extend the repair time and increase the costs for the owner.

10. Often a technician will travel to local markets and source parts themselves. Uncommon parts may need to be sourced from markets up to 100km away for the camp. Journeys to local markets may also have to be carefully planned to coincide with other trips, in order to save fuel or money. This can considerably delay the repair process. When travel is not possible for the technician, a delivery agent may be hired to source and deliver the ocrrect part from the market. Part selection and delivery is often arranged via a messaging app.

11. An internet connection is used by tecnicians to communicate with suppliers and order parts; to connect with peers; and to access product specific repair training and documentation, and general electronics related education via websites such as YouTube.

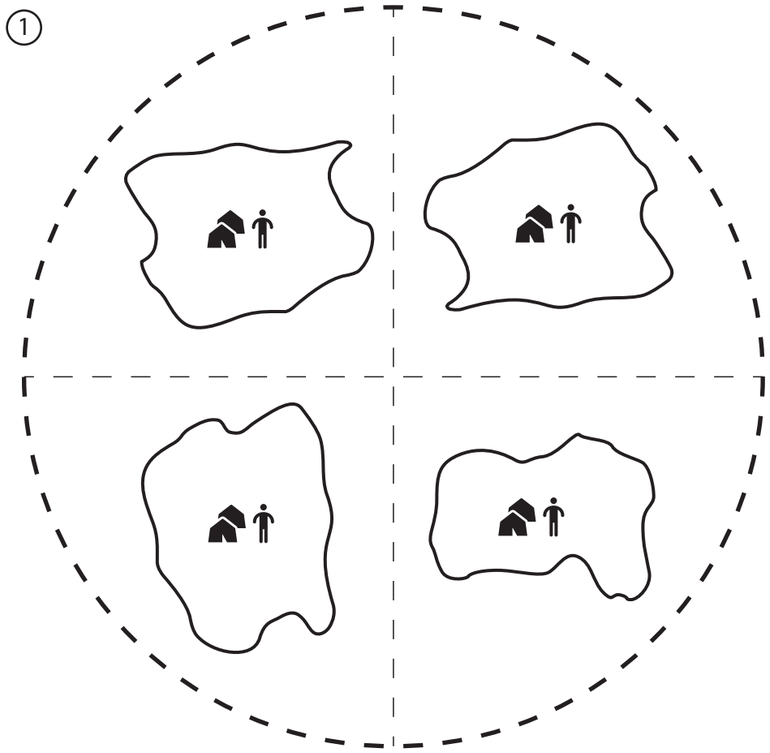
12. The repaired product is returned to its owner and a fee is charged for the service. A product may be repaired multiple times, by multiple owners, and by multiple technicians, during its lifetime.

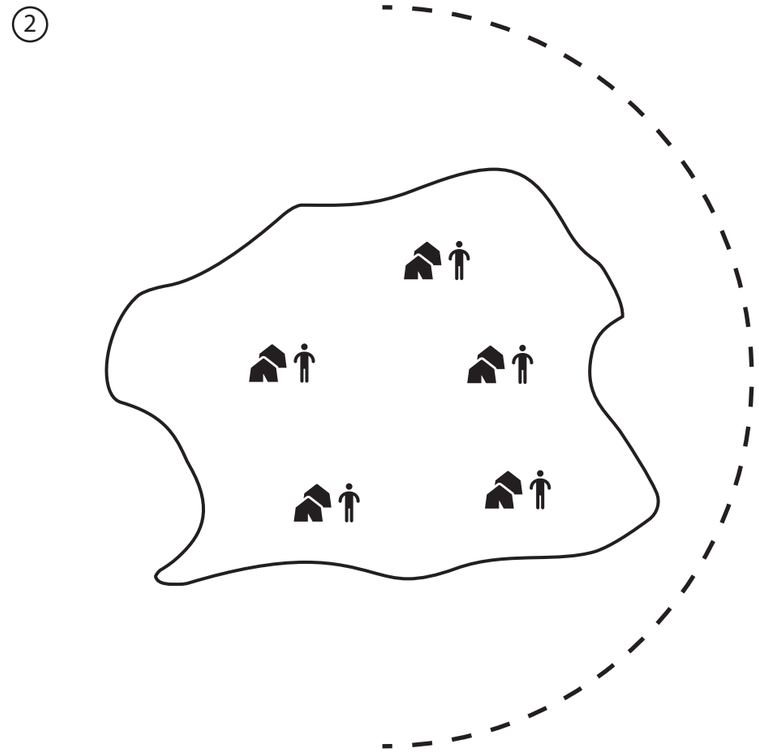
TECHNOLOGY AND CONTEXT

LOW CONTEXT TECHNOLOGIES

① These are technologies or technical systems that are designed to be used across multiple social, economic, political, geographic, and climatological terrains. They are designed for uses or social-cultural categories of user that are assumed to share characteristics across multiple places, locations and times.

② These technologies assume universality in their operation and use. They are highly standardised and globally mobile. They are assumed and intended to achieve the same impacts and effects where-ever they are used or operated. All UNHCR core relief items are designed and developed as low context technologies – that is they are presumed capable of meeting basic and emergency human needs regardless of context.

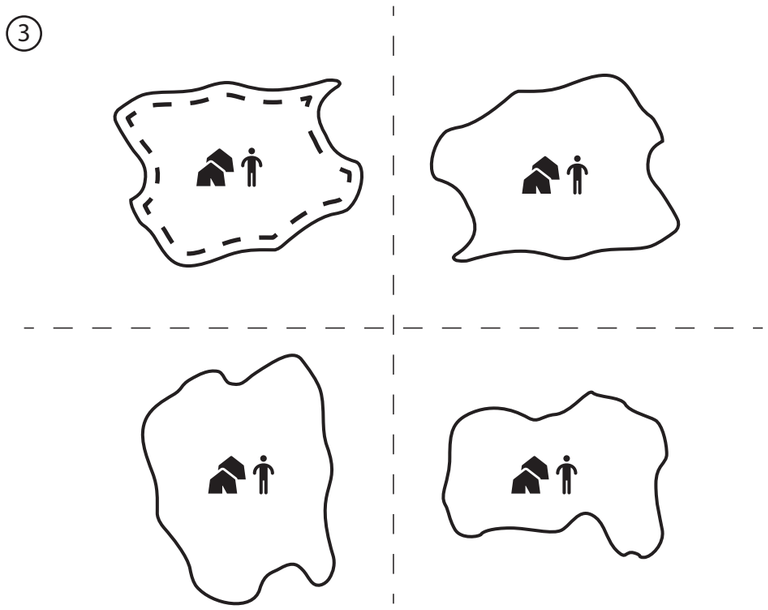


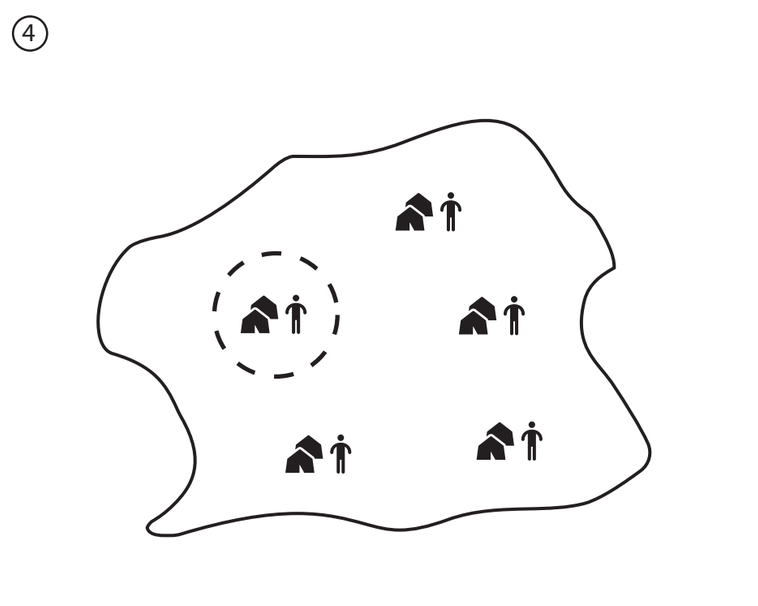


HIGH CONTEXT TECHNOLOGIES

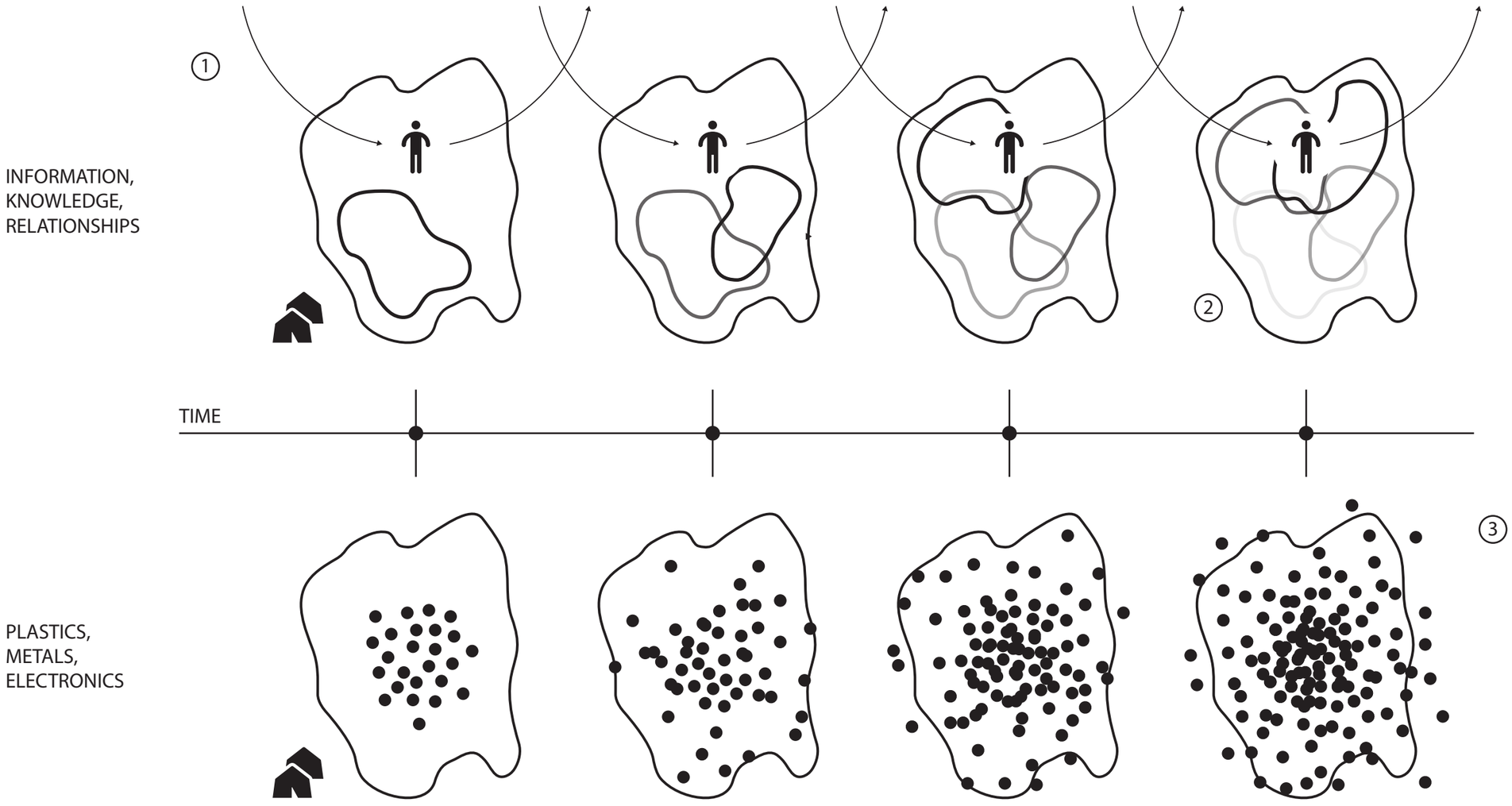
③ These are technologies or technical systems that are highly context specific. They are designed and development for use in specific social, economic, political, geographic, and climatological environments and/or for use by specific groups or communities of people. Context has been built into the technology or system and is a vital part of the successful operation of the technology or technical system.

④ These are technologies or systems that have been designed or developed as solutions to problems in a particular place, with no or little ambition to scale up or be replicated. When low context technologies and technical systems are repaired or repurposed, they become high context technologies. Repaired or repurposed technologies have been adapted or re-designed for the specific context of use.





MEMORY AND MATERIALS



① UNHCR staff bring specialist knowledge/expertise of technology and technical systems into duty stations and acquire area specific knowledge/expertise that is unique to operations in this location. This knowledge/expertise informs practical delivery of UNHCR programmes and support. When staff rotate out of a duty station, they may take their specialist knowledge/expertise and the area specific knowledge/expertise that has been acquired in this location with them.

② Over time, repeated staff rotations create multiple areas of knowledge/expertise in each duty station but rarely spilling over outside the area of concern. Sometimes areas of knowledge/expertise overlap, producing new understanding and insight that informs practical delivery of UNHCR programmes and remains held in an institutional memory. When areas of knowledge/expertise are not replaced, knowledge/expertise fade from an institutional memory. New staff may not be able to understand related decisions or appreciate why they were made.

③ Material technologies last longer than forms of specialist expertise and knowledge. Over time, plastic, metals, and electronic components - like those in the solar lamps distributed by UNHCR in specific duty stations - do not fade. On the contrary, they will outlast the movement of staff, the acquisition and deployment of knowledge/expertise and, in some cases, the location of persons of concerns in this space. Over time, these materials spill over – outside the original area of concern.

5 REPAIR AS A SOLUTION TO HUMANITARIAN E-WASTE

Electrical and electronic waste from solar lamps is attracting increased scrutiny from investors, governments, and consumers.

Current efforts to manage and mitigate waste in the humanitarian sector have focussed on innovations downstream (at the end-of-use). Such work has led to important initiatives like collection, reuse, and recycling. However, this is only half of the solution. Efforts to manage and mitigate waste in the humanitarian sector must also focus upstream, and work to redesign products and processes to avoid e-waste before it is created.

The Ellen MacArthur Foundation (which develops and promotes ideas for a circular economy) has likened the problem of tackling packaging waste to that of an overflowing bathtub- you can keep mopping up the water, but the best solution is to turn off the tap.[17] This same lesson is applicable to solar lamps and many other core relief items procured by UNHCR. If these items are designed, upstream, to be reused, repurposed, and repaired- supporting practices which already exist downstream in refugee camps- this will result in less waste being created overall. In addition to having control over its own upstream processes and policies, UNHCR has considerable power to influence the upstream design and manufacture of the products it procures.

RECYCLING VS REPAIR

E-waste, waste resulting from post-consumer electrical and electronic products, is a particular concern in the contemporary humanitarian sector. Personal electronic and electrical products such as torches, solar lamps, radios, and mobile phones are abundant in all displacement contexts. Solar lamps are core relief items and widely distributed by UNHCR. These devices are difficult to collect once broken, difficult to process, and can be harmful to the environment (and those living in that environment) if disposed of improperly.

The comparably small size of solar lamps, and their ownership by individuals rather than organisations, makes any attempt at formal collection a significant challenge. When broken, devices may be kept by their owners, until they can be sold or traded for parts; they may be taken to be repaired by a technician in the camp; or they may simply end up in either a landfill site or burned alongside other types of waste.

The material complexity of these devices means that, even if successfully collected, they are then difficult to process. Various metals and plastics can be found in all solar lamps. These require careful identification and separation to be successfully recycled. This process is particularly difficult in displacement contexts where appropriate recycling or disposal facilities may be located a long way from camps or settlements and may be overseas. It, can therefore, be logistically demanding and costly to appropriately transport and store e-waste from solar lamps.

Given the environmentally hazardous materials found in solar lamps, it is important to ensure they can be reused, repurposed, repaired and properly recycled, or disposed of, wherever possible. This includes within host communities. As an activity, the repair of solar lamps is not bounded by camp walls and can be found in local markets and repair shops. The procurement of more repairable solar

17. Ellen MacArthur Foundation. 2020 *Upstream Innovation: A Guide to Packaging Solutions* (p.19) https://bit.ly/3zmVD6Q

lamps will have a positive effect on reducing the environmental impact of these products regardless of their context of use.

Some materials used in solar lamps pose a significant risk to the environment if improperly handled- for example, the rare earth elements used in semiconductors, and lithium used in batteries.[18] These are toxic to humans, flora, and fauna when they accumulate in large enough doses[19] and, as such, must be disposed of correctly. UNHCR Waste Management Standards[20] stipulate the separation of hazardous waste (including batteries and electrical equipment) from other waste streams, but anecdotal evidence suggests this is often difficult to achieve. One interviewee, working in a Technical Unit, noted that battery collection and disposal in their camp was challenging, and stated that there was no organised method, that they were aware of, for battery disposal. This challenge is understandable. As discussed above, these materials are found in devices which are widely sold or distributed to individuals, rather than existing in centrally owned or controlled spaces. At the moment, in order for these products to be properly sorted and processed, a successful reverse logistics process must liaise with all users.

By contrast, supporting the repair and repurposing of solar lamps is a cost effective and practical strategy for reducing the build-up of e-waste and lessening its negative impacts.

Repair and repurposing keep materials in use for longer, slowing consumption and reducing both the waste produced and the demand for new products. Products which are designed to be repaired or repurposed are also intentionally straightforward to disassemble. This allows components and materials to be more easily reused, to be separated into suitable waste flows, and to be recycled where appropriate facilities exist. Repair practitioners can also serve as nodal collection points for e-waste, such as used batteries, within a camp, making it easier for authorities to collect this waste for separation and processing.

THE RIGHT TO REPAIR

Occasionally suppliers and manufacturers of solar lamps – as well as NGOs and humanitarian organisations - conflate attempts by users to repair products with attempts to tamper with them. Tamper proofing features are often added to solar lamps by manufacturers to protect intellectual property or prevent users from bypassing features. Many models of solar lamp use 'tamper-proof' or 'tamper-resistant' screws in their assembly; at the extreme some models are ultra-sonically welded shut so the product cannot be opened at all. These features limit the ability of a product to be disassembled and so limit its repairability.

Likewise, a product's ability to retain functionality during sustained use, withstanding general wear and tear, is sometimes considered to be at odds with repairability. Concerns are often raised by solar lamp manufacturers that the increased ease of disassembly, which accompanies increased product repairability, will lead to less robust products.[21] There is no empirical evidence for this assumption and, in Right to Repair legislation, the EU in fact relates a product's durability directly to its repairability.[22]

Right to Repair legislation is in place in the EU, UK, South Korea, and Japan.[23] It is in progress in South Africa and has been proposed in Australia and Canada.[24] The Federal Trade Commission in the United States recently voted unanimously to enforce laws around the Right to Repair.[25] Many States either have existing Right to Repair legislation or are in the process of drafting legislation.

In 2020 the European Standards Body published a methodology framework titled 'EN 45554:2020

18. In Ethiopia (Melkadida), UNHCR staff report refugee children opening up batteries to extract lead for use in drawing and writing.
19. Pagano, G., et al. 2015. *Rare earth elements in human and animal health: State of art and research priorities*. Environmental Research, [online] 142, (pp.215-220)
20. UNHCR Emergency Handbook: Waste Management Standards Version: 1.6. https://bit.ly/3AsMN8N
21. Spear, R. Cross, J, Tait, J. and Goyal, R. 2020. *Pathways to Repair in the Off Grid Solar Industry*. Efficiency for Access. (p.22).
22. Right to Repair. 2021. *European Parliament calls for ambitious right to repair*. https://bit.ly/3nRJbda
23. From 2021 the French Government will make the manufacturers of electronic equipment - from lamps and refrigerators to televisions and irons - give their products a new repairability rating. The new rating will provide consumers with important information about how easy it will be to fix products if they break down.
24. See: https://bit.ly/39p0DgE
25. See: https://bit.ly/2XBCjpm

- General methods for the assessment of the ability to repair, reuse and upgrade energy-related products'. The framework gives suppliers a means to 'score' how repairable their products are and it covers a wide range of product and support-related criteria affecting overall product repairability, including classifications for:

- Disassembly depth (steps required to remove a part from a product)
- Fasteners and connectors (whether they are reusable or removeable)
- Availability of spare parts
- Tools (whether basic or specialised tools are required)
- Skill level (whether specialist skills are required)
- Work environment (whether repair can occur in the use environment, or it requires a workshop or production equivalent environment)

These legislative changes and new standards will impact UNHCR's suppliers in the near future, if they are not already doing so.

Incorporating rights to repair into procurement – and positive engagement with repair movements, policies and legislation - will allow UNHCR to pioneer action on the circular economy within the UN system. It provides a valuable opportunity for UNHCR to act as a global leader in repair and the circular economy, and directly aligns with UNHCR's existing strategies to provide sustainable energy.[26] The financial and environmental costs of acting now will be judged against the financial and environmental costs of inaction.

PROCUREMENT PATHWAYS TO REPAIR AND REPAIRABILITY

International (ISO/Verasol) quality assurance standards for off-grid solar lamps do not currently evaluate the ecological design or repairability of products, and there is currently no timetable for updating these. UNHCR technical specifications and frame agreements for the procurement of solar lamps do address key aspects of ecological design and repairability, but they are not well enforced. There is scope for these to be updated and expanded, alongside greater emphasis on compliance and enforcement. At the same time, such efforts should not detract from the benefits of problem solving with current and potential suppliers.

UNHCR's purchasing power means that it has the institutional capacity to drive changes across the supply chain. Changes to procurement protocols and frame agreements in support of the right to repair and the circular economy would allow UNHCR to leverage its position as the world's largest institutional purchaser of solar lamps and drive a sector-wide transformation.

UNHCR's share of the global solar lamp market grants it the power to green global supply chains, by working with suppliers and incentivising competitors to produce more repairable products. UNHCR can demand increased product sustainability and repairability from equipment manufacturers. We contacted senior executives in three off-grid solar manufacturers and distributers for this report. All reported that they were eager to work with UNHCR on precisely these issues. They are fully aware of the competitive advantages from increased sustainability and from supplying to the humanitarian sector.

Such feedback indicates that procurement is a lever to greening UNHCR. Procuring solar lamps that can be repaired in context of use is a beneficial, achievable, and desirable route to reducing electrical and electronic waste, and CO^2 emissions. There is widespread support for this goal across UNHCR – in procurement teams, energy teams and field teams – that informed the Climate Action Framework.

It is too late to start thinking about repairability when something breaks. It must be factored into the procurement decision. Interviewees working in camps in Ethiopia and Rwanda commented that a product's repairability was often not considered until it had stopped working. Addressing repairability at the point of procurement (or at the design phase for manufacturers) lessens the burden on Global Operations staff of managing these scenarios. However, there is a latency in the system. Estimated internal UNHCR procurement timelines suggest that will take between 12-36 months to update specifications and for manufacturers to respond to these new specifications.

26. See: https://www.unhcr.org/5db16a4a4.pdf

6 REPAIR AND PANDEMIC RESILIENCE

There is ongoing concern about the impact of the COVID-19 pandemic on the world's most vulnerable populations. The UN has called on governments to focus attention and resources on the risks to refugees and forcibly displaced populations living in areas of violent conflict, political instability, and state fragility.

A significant effect of the pandemic is the immense pressure that has been put on global supply chains for electrical and electronic components.[27] In sub-Saharan Africa the pandemic has revealed the vulnerability of global production facilities, assembly lines, and transportation networks that supply humanitarian energy technologies.

Since early 2020 Supply chains for off-grid solar lamps and components have all experienced severe constraints. In April 2020, the UN's Sustainable Energy for All Consortium reported widespread disruption in the provision of spare parts for off-grid energy systems and after sales services as a result of Covid-19.[28] That same month research by GOGLA, a global trade association for the off-grid solar energy sector, suggested that 50% of off-grid energy companies operating in sub-Saharan Africa would experience severe cash flow issues due to the pandemic.[29] GOGLA later reported anecdotal evidence from some suppliers that they did not ship any products in the first of 2020 as order numbers dropped and supply chains failed. The continued disruption throughout the pandemic has serious implications for governments and humanitarian agencies serving vulnerable refugee populations and displaced people, and working to deliver basic off-grid lighting, electrical charging, and cooling services. The collapse of supply chains results in rising costs for all stakeholders and the prospect of long-term breakdowns in the procurement of essential humanitarian technologies.

These challenges are particularly acute in countries where they overlap with accelerating crises of forced displacement. In Burkina Faso, for example, the Covid-19 pandemic overlapped with a dramatic increase in internally displaced people as a result of an escalating regional conflict, creating an unprecedented situation for UN agencies and the national government. By the end of 2020 the number of internally displaced people in Burkina Faso had risen above 800,000, with the majority living off the grid in temporary settlements. Meeting the everyday needs of this displaced population, for artificial light and electrical power, refrigeration, and cooling, demands the rapid distribution of humanitarian technologies, including off-grid solar powered systems. Parallel emergencies exist across sub-Saharan Africa – specifically in Cameroon, South Sudan, and Rwanda.

Against this backdrop, the repair and repurposing of old technologies and systems, as well as the continued maintenance of existing humanitarian technologies has become an urgent and essential humanitarian task; one that requires the mobilisation of locally situated repair cultures (skills, knowledge, and practices) as well as the local sourcing of spare parts and components. At the Innovation Hub, in Zataari, Jordan, for example, UNHCR staff and refugees used repurposed and donated parts to construct several prototype sanitation devices

27. Disruptions in global supply chains are not only pandemic related – but are also impacted by the climate emergency and extreme weather events, as well as ongoing environmental degradation and overexploitation, affecting both animal and human health.
28. SEforALL. 2020. *How is SEforALL supporting the global fight against COVID-19?* https://bit.ly/3kperOu
29. GOGLA. 2020. *Webinar: COVID-19: Coordinating an industry response for the off-grid solar sector* [Youtube] https://bit.ly/3ENgiVN

during the pandemic. We have collected countless positive examples of repair and repurposing as a response to the pandemic. But we have also collected examples of cases where the pandemic has restricted repair and repurposing activities.

A steriliser for face masks made in Zataari, Jordan, from repurposed parts and donated items. Image credit: UNHCR Jordan

FLEXIBILITY THROUGH REPURPOSING

An interviewee working in Bangladesh, described how their team used oxyacetylene in the early stages of the pandemic for the essential task of burning the medical waste at high temperatures. Oxyacetylene is commonly used in metalworking, across Bangladesh. UNHCR staff were able to use existing, in-country supply chains - sourcing the chemical from welders. During this time private companies, such as Total, were offering oxygen burners for purchase. However, with the ongoing disruptions to global supply chains, it would have taken at least 3 months for the burners to arrive in country.

During these early stages of the pandemic, UNHCR staff also used repurposed materials to construct the incinerators themselves. Normally incinerators would be constructed of fire bricks, but supply shortages, again, meant these were unavailable. Instead, standard bricks were used, in 2 or 3 layers deep, to build temporary incinerators until the orders of fire bricks arrived.

Repurposing locally available materials in this way allowed UNHCR Bangladesh to quickly meet hygienic requirements in a rapidly evolving emergency.

Despite this success, the interviewee warned that UNHCR's procurement system struggled to cope with global supply chain disruptions and the new ways in which people were forced to work. Their team had to employ various workarounds to secure the supply of oxyacetylene in particular. They advocated for increased flexibility in procurement at times of exceptional crisis; for a greater awareness within UNHCR of appropriate technologies and existing local knowledge as sources of solutions; and for agency wide audits to collect feedback on the performance of specific sectors, rather than audits completed internally by those sectors.

RESTRICTIONS TO REPAIR

As a myriad of lockdowns have affected the stability of supply chains around the world, so too have they affected the movement of individuals and organisations at regional and local levels. Every interviewee working or living in a refugee camp during the pandemic spoke of how national and regional lockdowns had restricted their movement. It became harder to cross camp boundaries, and between different provinces and regions within countries. These restrictions disrupted in-country businesses and local supply chains, and often made repair activities more expensive and more challenging in the camps they affected.

> A common barrier to any repair activity is a lack of access to spare parts.

The increased difficulty of accessing refugee camps has been a particular barrier to repair during lockdowns. In Rwanda, Practical Action reported that pandemic-related restrictions meant that many refugees were unable to repair their solar home systems.[30] The products were under warranty and required formal repair by external suppliers who struggled to access the camps. In Uganda, interviewees described how repair activities came to a standstill in early lockdowns.

30. See: https://bit.ly/3AtFAWh

People were unable to travel from one district to another, or a refugee from one settlement to another. Providing repair services across multiple camps became impossible. Interviewees in Uganda did note that it was easier for repair companies to gain access to camps during the more recent lockdowns in the country. Special permission to move between camps and districts was granted to specific organisations by the Ugandan government. Repair companies granted permission in this way were able to perform limited repair work across a wider area than in previous lockdowns.

A common barrier to any repair activity is a lack of access to spare parts. Interviewees based in Uganda, Ethiopia, and Kenya all reported that repair activities in their camps had been hindered as technicians were unable to source appropriate spare parts for products brough to them. Disruptions to international manufacturing and logistics limited the production and transportation of parts around the world. In-country travel restrictions slowed, or stopped, the movement of parts across camp boundaries. Without access to new replacement parts, technicians must rely on those already circulating in their area. If two or more of the same product are broken, but in different ways, parts may be combined from them and reused to create a working version of that product. This is far easier to do when the products are purposefully designed to be repaired. It is not ideal, as one or more of the products will not be repaired, but it avoids a complete loss of functionality and the resultant creation of waste.

In Uganda, various interviewees commented that technicians would usually travel to major towns where they would be able to find a greater variety of spare parts, at a lower cost, than in markets nearer the camp. When travel restrictions prevented this, technicians would use messaging services such as WhatsApp to order parts from shops and get them brought to the camp by drivers who were still allowed to travel. The increase in demand for these services, and reduced number of vehicles allowed to travel, drove up the prices which had to be passed on to customers. Before the pandemic, technicians also ordered specific parts from overseas retailers. This was still necessary during the pandemic but, naturally, was more expensive and less reliable than before. Parts ordered remotely, either from a shop in-country or from abroad, might also need replacing. They might have been damaged in transit or be incorrect, the technician or seller having made a mistake. Interviewees noted that these additional complications all slowed the repair process and increased the costs for all parties.

Disruptions also affected the ability of solar companies to supply spare parts for their products. Practical Action examined the technical problems encountered by users of solar home systems in Gihembe, Nyabiheke, and Kigeme refugee camps in Rwanda between January and March 2021. Their data showed that, where problems with solar home systems could not be repaired, 52% of the time it was due to spare parts being unavailable. They attribute this to global supply chain disruptions and restrictions to domestic and international travel.

> Increasing the repairability of products circulating in refugee camps would [...] increase the resiliency of camps to supply chain shocks.

The increase to repair costs during the pandemic is likely to have been mirrored by a decrease in earnings for refugees. Interviewees in Kenya and Uganda suggested that the pandemic had affected the income of many refugees, resulting in them either not seeking out repair technicians or being unable to pay the inflated prices they encountered. Either way, technicians noticed a drop in business.

INCREASED SUPPLY CHAIN RESILIENCE

The COVID-19 pandemic has highlighted the fragility of supply chains across the world. It is arguable that refugee camps are especially vulnerable to these types of disruption due to their intrinsically bounded and separate nature. Yet repairing and repurposing are essential to parts of everyday life in refugee camps and are especially required when external support is unavailable. Though they are affected by external disruptions to supply chains and travel restrictions, repairing and repurposing activities introduce flexibility into a system. They create opportunities to solve problems in different ways and with

limited resources, building resilience.

Supply chain resilience is increasingly important given the current climate emergency and growing frequency of climate-related natural disasters. As humanity continues to exploit resources and encroach on animal habitats, events such as the COVID-19 pandemic are also likely to become more frequent.[31] Humanitarian organisations need to be prepared for these events.

Increasing the repairability of products circulating in refugee camps would naturally support repair and repurposing activities. It would increase the availability of parts that could be used to repair similar products or that could be repurposed for other uses. It would reduce dependence on external supply chains (though not negate it) and it would increase the resiliency of camps to supply chain shocks.

31. IPBES. 2020. *IPBES Workshop on biodiversity and Pandemics.* (p.2) https://bit.ly/3EGBNrg

7 BENEFITS AND BARRIERS TO REPAIR

Repair and repairability is a net good. Increasing the repairability of core relief items distributed to refugees has social, economic, and environmental benefits through the supply chain and contexts of use (these include: cost savings; reduced material flows; reduced Co2 emissions; support for livelihoods as well as increased self-reliance).

The tables below summarise the benefits that could result from the introduction of more repairable solar lamps. These are separated into environmental, economic, and social factors, and further divided into the sectors or actors they affect. Also listed are any barriers to realising these benefits.

ENVIRONMENTAL FACTORS

Manufacturing	
Benefits	Barriers
• Cheaper for UNHCR to source parts rather than new and complete products • Cheaper to transport and store parts than new and complete products	• Limited resources, human and financial, within UNHCR to analyse and assess impacts of change and instigate findings

Transportation and Storage	
Benefits	Barriers
• Decreased emissions from transportation and storage as spare parts take up less space than fully assembled products • Easier to retest battery health of products in storage • Non-chemical spare parts can be stored for longer than fully assembled products	• Additional burden to inventory management from tracking spare parts and ensuring they reach the correct destination • Lithium-based batteries require careful handling

Inside Refugee Camps	
Benefits	Barriers
• Reduction in e-waste within refugee camps and in host communities • Easier to separate materials and components into appropriate waste streams at a product's end-of-life	

ECONOMIC FACTORS

UNHCR

Benefits	Barriers
• Cheaper for UNHCR to source parts rather than new and complete products • Cheaper to transport and store parts than new and complete products	• Limited resources, human and financial, within UNHCR to analyse and assess impacts of change and instigate findings

Refugees

Benefits	Barriers
• Creates repair-related jobs and livelihoods • Lower cost to repair due to increased availability of spare parts and reduction in complexity of the repair process • More refugee-run businesses can stay open after dark • Stimulates secondary markets	

SOCIAL FACTORS

UNHCR

Benefits	Barriers
• Building capacity for sustained access to lighting in camps • Support for existing and increased repair and repurposing activities	

Refugees

Benefits	Barriers
• Sustained access to lighting • Increased availability of repair • Increased engagement with host communities • Psycho-social benefits, repair as a form of cultural and material expression	• Need increased access to repair knowledge and tools

8 KEY RECOMMENDATIONS FOR ACTION

This chapter summarises recommendations for future action aimed at supporting 'circular economy' thinking within UNHCR and the wider humanitarian sector, specifically, supporting the repair of solar lamps in refugee camps. It presents the context, rationale and systems behind repair and repurposing activities and discusses ways in which UNHCR can support, and benefit, from them.

Our recommendations distinguish between pre-distribution (or upstream) actions and post-distribution (or downstream) actions. These are not mutually exclusive: building a circular economy involves them both.

Our recommendations are intended to directly support the key principles and strategic objectives outlined in UNHCR's Strategic Framework for Climate Action.[32]

Timeframes for Recommendations		
Short term- next 12 months	**Medium Term- 1 to 2 years**	**Long Term- 2+ years**
Develop new guidelines for circular procurement and use them	Engage with refugees and repair practitioners (technicians)	Work to remove barriers to repair in displacement settings
Update, enforce and extend existing technical specifications for solar lamps	Support co-ordinated action across the humanitarian sector	Provide spare parts for solar lamps to refugees
Consult with existing suppliers		
Support the "right to repair" everywhere		

32. See: https://www.unhcr.org/604a26d84.pdf

PRE-DISTRIBUTION: USING PROCUREMENT TO BUILD A CIRCULAR ECONOMY IN UNHCR

Our pre-distribution actions and recommendations focus on the reform of technical specifications and procurement agreements. Key indicators of success for these pre-distribution actions are relatively straightforward to achieve, and in the short term.

1. Develop new guidelines for circular procurement and use them

UNHCR procurement is based on principles which include "best value for money" and "the best interest of the organization".[33]

Repairable products use the same transport, storage, and distribution networks as non-repairable products. So, in the long term, procuring repairable products will result in a reduction in the quantity and cost of items, leading to budget savings and carbon emissions reductions.[34]

Managing changes to procurement practices requires co-ordination and strategic direction. The timing of changes to procurement is critical. Frame Agreements with suppliers are developed for specific products. Frame agreements are usually for 3 years but may be extended to 5 years. Global Operations are also often likely to procure the same item year on year, if they are satisfied. This both streamlines the process and ensures a sense of equality: beneficiaries all receive the same brand and model of lamp. These factors, though necessary, add latency and reduce flexibility in the system. It is therefore crucial that action is taken as soon as possible to incorporate increased product repairability into procurement decisions so the benefits can begin to be realised.

Frame agreements are for specific products manufactured by companies. It is important to get them right first time as new products will require new frame agreements to supply. UNHCR can develop new guidelines for circular procurement that introduces minimum criteria into Frame Agreements for all procured items.[35] At a minimum, new guidelines would include the following:

- **Choose** items that are designed and manufactured to be durable, repaired or refurbished.
- **Purchase** items that use packaging made from reusable, recyclable, or compostable materials.
- **Purchase** items that are made to be made again- reuse, refurbishment, repurposing, remanufacturing.

At a maximum, new guidelines could include innovations in contracting/procurement that aim to support product development for a circular economy, embed co-creation methodologies into the process, and include the expertise of refugees and UNHCR staff in the production process.

- **Rapid-technology prototyping:** UNHCR invites companies to build inexpensive prototypes within a short period of time and tests product repairability with user communities to determine the viability before making a substantial investment.
- **Milestone-based competitions:** UNHCR selects a qualified pool of vendors to work with and then uses fixed-price, milestone-based payment with companies for them to develop solar lamps. UNHCR pays only when the product successfully meets pre-defined milestone criteria (including for repairability). Companies are required to pay for part of the development cost to ensure that they build something that is commercially valuable and meets environmental considerations.
- **Staged contracts:** Companies with existing products that meet UNHCR's goals would prepare short concept papers to enable UNHCR to identify vendors who are most likely to receive an award. This helps vendors who
- are less likely to receive an award and UNHCR to avoid the transaction cost of developing a detailed proposal.

33. See: https://www.ungm.org/Shared/KnowledgeCenter/Pages/UNHCR
34. Many of the environmental and carbon impacts of the humanitarian sector can be linked to the logistical operations involved in reaching those affected by disasters with essential relief items. Negative impacts include carbon emissions linked to the transport of goods and personnel, the manufacturing of disaster relief items and the waste generated through their packaging, with some of these impacts somewhat hidden, occurring long before a response and long after (e.g. suppliers' impacts, impacts from crop production). See : https://www.urd.org/wp-content/uploads/2020/09/Groupe-URD-Inspire-studypublic.pdf (p.29)
35. See, for example: https://emf.gitbook.io/circular-procurement/-MB3yM1RMC1i8iNc-VYj/overview

2. Update, enforce and extend existing technical specifications for solar lamps

UNHCR has an opportunity to update, enforce and extend existing technical specifications for solar lamps. Existing technical specifications already contain the basic elements required to procure solar lamps that can be repaired by users or any independent repair service providers in a context of use.[36] These specifications list a set of additional functionalities for solar lamps, including 'easily replaceable batteries'.[37] To support a circular economy, UNHCR can:

- **Investigate** why Point 7 in the existing General Specifications for solar lamps is not enforced.
- **Increase the weighting of these points** within the technical specifications and raise their priority in evaluating different products.
- **Add these points to minimum criteria for procurement.**
- **Stipulate that the cleaning, maintenance and replacement of component parts must be possible using only basic tools** such as 'Phillips' or 'Pozidriv' screwdrivers, and soldering irons by expanding Point 7.
- **Stipulate that batteries are easily replaceable.** Easily replaceable batteries may make testing units held in global stockpiles easier and would significantly extend the life of individual units.
- **Reject tamper proofing measures in solar lamps.**
- **Communicate future intentions to suppliers** to ensure manufacturers are given enough time to comply and design new products where necessary. (Interviews with two large suppliers of solar lamps to UNHCR showed willingness from their side to engage with repairability- they see it as a USP. Procurement and technical teams within UNHCR HQ are also enthusiastic about increasing repairability of these products.)
- **Avoid incremental changes to technical specifications.** These would likely increase the variety of products circulating in camps and in UNHCR's supply chain, complicating downstream repair activities and upstream logistics.
- **Draw on new EU repair standards to update technical specifications for solar lamps and the wider procurement process.** UNHCR could use this metric to filter products and encourage repairability amongst suppliers.
- Explore the addition of additional specifications to ensure that the manufacturing/assembly process for the lamps, materials and electronic components are ethically sourced, in line with international/ILO conventions on labour rights in the workplace.

3. Consult with existing suppliers, and refresh the supplier pool

Engage existing and potential suppliers in dialogue to assess how much of a lead time they would need to respond to significant changes in technical specifications, i.e. to design new products or make changes to existing models.

Where possible and/or appropriate, 'localising' procurement structures and suppliers can fundamentally help to establish resilience and stability in supply chains, and minimise disruption in the event of unplanned or unforeseen global logistics failures.

4. Support the "right to repair" everywhere

Undertake UNHCR wide communication and advocacy work on the circular economy. Repair is gaining international recognition as an important means to reduce waste, lower emissions, and move towards a circular economy, and is supported by new legislation around the world. **Incorporating repairability now is to get ahead of the curve:** most solar lamps are designed in Europe or the United States with products also sold to users in these regions.

36. For example, they note that: "The light shall be manufactured to allow cleaning, maintenance and replacement of component parts. Suppliers shall detail all spare parts which can be supplied separately to repair damaged lights. The supplier shall also provide prices of each spare part should additional procurement be required of individual items" (Point 7).
37. Ibid (Point 10)

POST-DISTRIBUTION: SUPPORTING REPAIR IN REFUGEE AND HOST COMMUNITIES

Our post-distribution recommendations are focused support to repair economies in refugee and host communities. Key indicators of success for these actions are more complex and longer term, and likely to require further research beyond the scope of this study.

1. Work to remove barriers to repair in displacement settings

Key barriers to repair faced by refugees include:

- Lack of access to parts
- Lack of access to tools
- Lack of access to education and training
- Inability to disassemble / reassemble products

2. Acknowledge the expertise of refugees and repair practitioners (technicians)

Actively engage with existing repair practitioners and other refugees in camps to utilise their knowledge and expertise, determine how best to support them, and to inform them of changes to products. Involve refugees in decision making, program design and consequent program implementation around repair.

Examine the role of refugees in a circular economy, and the role of UNHCR in supporting them. For example, examine how individual users or recipients of solar lamps (alongside other core relief items) can be supported with product maintenance, troubleshooting, and/or basic repair during distribution in ways indended to extend product lifespans.

3. Co-design the ecosystem for repair

One method of directly engaging refugees in conversations around repair would be for UNHCR to connect suppliers directly with refugees, hosting feedback and co-design sessions. These would focus on how products could be made easier to repair, and what other features refugees might want in a solar lamp.[38]

This approach could benefit all parties, with suppliers able to offer products better suited to the needs of refugees rather than UNHCR. Refugees need to know when products are repairable, what to do when they break, and where they can go to get them repaired. Likewise, technicians should be empowered to conduct these repairs through knowledge exchange with suppliers.

This could be as simple as suppliers providing step-by-step guides on to repair common faults, but would ideally be expanded so technicians could provide feedback on product repairability to suppliers and inform the design of future products.

4. Increase access to spare parts

There is increased interest in the repair and maintenance of larger solar powered devices used in refugee camps - including water pumps, mini grids, and telecommunications towers in refugee camps. Spare parts are more procurable for these, and it is often easier to set up a maintenance contract with a supplier over the equipment's lifetime. The same is not true for core relief items like solar lamps.

Key spare parts for solar lamps (batteries and switches/switch mechanisms) could be provided alongside new products. These parts must be sourced in bulk from the original equipment manufacturers or from reputable third parties to ensure quality at quantity for a sustainable price. Repair technicians in camps or in host communities are unlikely to be able to source parts themselves. Or, if they can, they will be expensive and likely available in very limited numbers.

UNHCR can begin to address the supply of spare parts by:

- **Standardising key components in product specifications:** UNHCR can use its purchasing power in the off grid solar market to promote

38. For example, it was through customer feedback that some solar lamps began to offer mobile phone charging capabilities.

the standardisation of key components. Minor changes to product specifications for solar lamps that require the use of specific, standardised components (like batteries) would significantly increase the opportunities for cross-repairability and inter-operability across manufacturers and brands.

- **Collecting data:** Working with UNHCR procurement teams to determine the average frequency at which operations reorder solar lamps. This will enable UNHCR to quantify the financial impacts from supporting the repair of solar lamps and assess the quantity of spare parts required by operations.
- **Examining existing internal processes:** Working with the Supply Management and Logistics Service, and with key suppliers, to understand how the procurement, storage and transportation of spare parts might affect existing practices. What are the most significant barriers to implementing the distribution of spare parts? What can be trialled?
-

UNHCR may also consider partnering with suppliers to sell or distribute spare parts in camps or set up centralised repair workshops employing technicians from the refugee community. UNHCR could work with suppliers to begin supplying spare parts for some solar lamps already in circulation.

For example, the SunTurtle, from BRIGHT Products, has batteries which are relatively straightforward to replace. Another option would be to specify in Frame Agreements that suppliers must provide spare parts as an 'after-sales service' in camps. This would remove the onus on UNHCR to provide spare parts and shift responsibility on to the suppliers.

In the ideal end scenario, spare parts will be supplied to camps where repairable solar lamps are also in circulation. However, it is important to note that the supply of spare parts and the procurement of repairable products do not have to be concurrently implemented.

5. Support co-ordinated action across the humanitarian sector

There are multiple projects currently in planning or implementation phases across the humanitarian sector which incorporate the repair of solar products into their workplans (two are detailed in the appendix to this report). IOM, UNITAR, Bright Products, and Practical Action all have projects which are producing valuable data to help inform the sector on how best to support solar repair in refugee camps.

Supporting, observing, and learning from these projects will help to answer questions of how to best supply spare parts to refugees and who should take responsibility for conducting repairs. The projects will also help to answer questions of how refugees can be better supported and engaged in repair activities.

Solar lamps are sold or distributed in refugee camps by many organisations outside UNHCR. By working with operational and implementing partners, UNHCR can cover a wider range of products and serve a higher number of refugees.

APPENDIX 1:
REPAIR IN PRACTICE

Our interviews with practitioners and humanitarian professionals resulted in additional examples of repair and repurposing activities from refugee camps around the world.

The examples listed here represent only a small portion of the repair and repurposing activities which occur in displacement settings. In our interviews, people described the repair of televisions, speaker systems, and radios, as well as machines to create charcoal briquettes, to grind flour, and to make yoghurt. There was even an instance where a technician in a camp repaired a coffee maker for an interviewee (although the repair took two and half months, and involved parts bought from a city 4 hours' drive away it was ultimately successful).

GENERATORS

Electrical generators are commonly used as primary or back-up sources of off-grid power in many refugee camps. They consist of two main elements: an engine and an alternator. The diesel, or petrol, powered engine turns a shaft, which connects to, and drives, the alternator. This then generates electricity via electromagnetic induction.

Generators provide a ready, if dirty, source of energy that can be accessed at any time of day. Interviewees noted their use in Bangladesh, in Haiti, and across the African continent. Generator designs have remained fairly stable over time and repair knowledge for them is often widespread amongst formal and informal technicians both inside camps and in host communities. Parts for repair may be available locally but can also be purchased from manufacturers in India or China.

The main mechanical difficulty with these generators, from a displacement perspective, often comes at the point of installation. The parts of a generator- the engine, shaft, and alternator- need to be perfectly aligned to prevent damage during operation. Expertise is

Rubber strips used as a coupling for a generator in Ethiopia. Image credit: UNHCR / Paul McCallion

required both to ensure initial alignment during installation and to construct a sound foundation to maintain alignment during future use. Where the expertise is unavailable this requirement can be circumvented by repurposing rubber tyres. Usually, a part called a flange coupling is installed to connect the shaft of the generator to the alternator. This part can be replaced by cutting used rubber tyres, from cars or trucks, into strips. These strips are doubled or trebled up and bolts are threaded through holes drilled in the ends. The bolts are then used to connect the strips between the engine and alternator. This results in a generator which will operate at a lower efficiency, but, due to the elastic properties of the tyres, does not require all parts to be precisely aligned. This alternative coupling is also straightforward to repair: new strips can be cut from tyres, and nuts and bolts either reused or bought locally.

BICYCLES

Bicycles are used for transportation in many different displacement settings. Their near global ubiquity, their standardised form factor and the interoperability of their components makes them relatively simple products to repair. Spare parts are often readily available locally, either to buy new or as repurposed parts from other bicycles. Repair knowledge is also common and highly transferable between brands and product types, whilst repairs require a low level of technical expertise to perform.

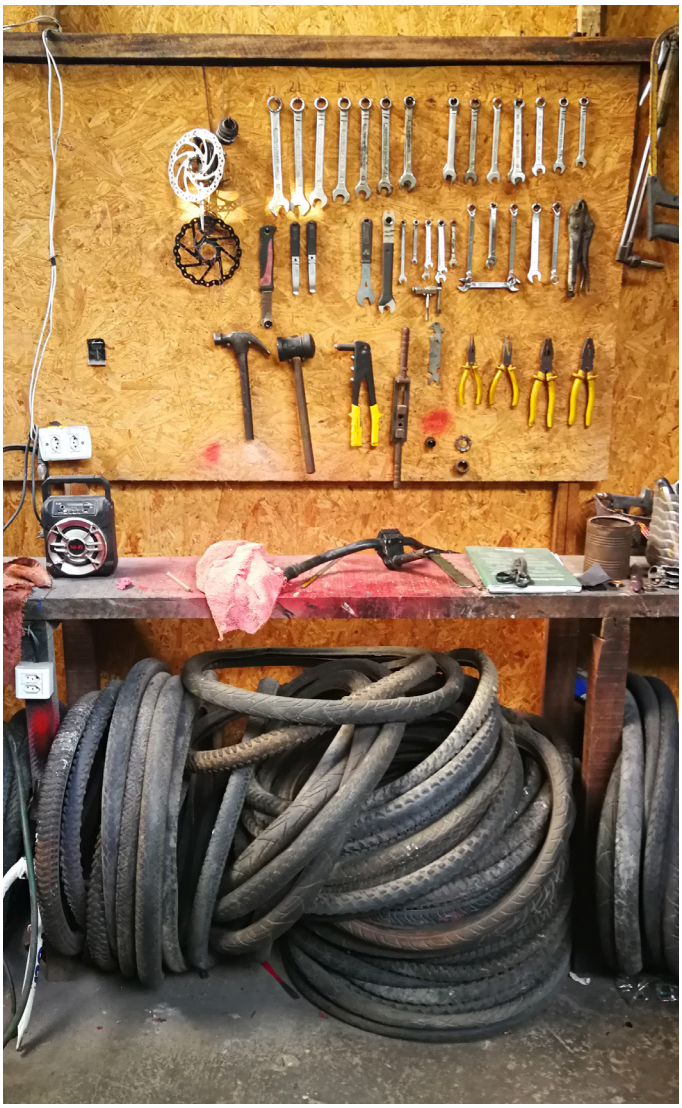
Context is the main differentiator of bicycle repair in refugee camps. On the surface, examples from Saõ Vicente 2, in Brazil, and Nyarugusu, in Tanzania, present the same rationale for repair in both cases: to return a bicycle to a working condition, increasing the speed and distance a user can travel. Nyarugusu, however, is a large refugee camp in rural Tanzania, whilst Saõ Vicente 2 is one of several refugee camps embedded in the city of Boa Vista, Brazil. In Saõ Vicente 2 refugees are not allowed to work to earn money, but in Nyarugusu bicycle repair technicians charge for their services. These differences present some of the various social and economic factors associated with repair activities.

In Saõ Vicente 2 bicycle repair is a social activity, not an economic one. The workshops are run by members of the community who either use the bicycles themselves or offer their services to others. They learn skills from each other and combine parts from found or donated bicycles in their repairs. The interviewee who presented this example also noted that refugees in Saõ Vicente often have a lot of spare time in the camp and that bicycle repair can give them something interesting to do. Repair in this context increases mobility, but it also serves as a pastime and means to help and engage with others in the camp.

In contrast, bicycle repair workshops in Nyarugusu are economic ventures. The camp is one of the largest in the world, it has bumpy roads and a ban on motorcycles. As such, bicycles are a popular method of transport, but they are also frequently in need of repair. Bicycle repair shops are, therefore, commonplace and provide an income for many refugees.

MOTORCYCLES

A workbench, tools, tyres and other spare parts in a bicycle repair workshop in Saõ Vicente 2, in Brazil.
Image credit: UNHCR / Fabiano Sartori



Motorcycles are another popular means of transport in some of the world's largest refugee camps. Though banned in some camps- such as Nyarugusu, in Tanzania- in others they are a core part of the transportation network. In Kakuma, Kenya, for example, motorcycles owned by refugees are used to run taxi services .

The demand for motorcycles, in camps such as Kakuma, is mirrored by the demand for repair services and spare parts for these vehicles. One interviewee described several shops in the camp which do much of their business through repair services. They often repair both motorcycles and bicycles and will sell refurbished versions of both alongside new ones.

These repair shops source spare parts from cities like Nairobi, Kitale, and Lodwar. Occasionally, a business will also have contracts with large manufacturers such as Yamaha and Honda. These businesses will bulk order a shipment of new motorcycles or bicycles and sell them in the camp (sometimes on finance plans). The shipments will also include spare parts from the manufacturer. Parts from older bicycles or motorcycles will also be used in repairs. Offering both brand new and second-hand spare parts allows the shop to cater to different budgets within the community.

TV ANTENNAE

A good example of high context repurposing in refugee camps is the combination of old fluorescent lights and wire to make TV antennae. This example, documented in Afghanistan and Liberia, and involves attaching two lengths of bell wire to a 38W fluorescent tube, one to either end, an connecting the other ends to the coaxial port of a TV. The tube is roughly the right length to pick up TV signals and can be mounted on top of shelters.

This technology could only be replicated in areas with bell wire and fluorescent tubes, as well as access to those with the skills necessary to properly construct and install the antennae.

A TV antenna using repurposed bell wire and a fluorescent tube. Image credit: UNHCR / Paul McCallion

Mobile phones serve many important purposes in refugee camps. In addition to serving as a means to stay in touch, share information, and organise, mobile phones also give refugees access to mobile money payment services and can be used as a source of light. These features make them valuable items and mean their repair is a high priority when they break.

Mobile phone repair shops are a ubiquitous feature of refugee camps. Our interviewees described specific examples from Tanzania, Kenya, Bangladesh, Jordan, Ethiopia, and Uganda. Though commonly repaired, the complexity and diversity of mobile phones in circulation makes their repair challenging. In interview, technicians explained that this enormous variety of products impacts their repair activities. Though there are commonalities, each model of mobile phone requires some specific knowledge to aid in the disassembly, diagnosis and repair of faults and breaks. New models enter the camp all the time, and technicians must continually update their knowledge, learning from each other or from online resources, such as videos hosted on YouTube. Many components are also non-standard and need to be either repurposed from the same model of phone or purchased from suppliers, who may be overseas. This can significantly increase the cost of repair.

MOBILE PHONES

TENTS

In the refugee camps in Boa Vista, Brazil, a transition from tents to Refugee Housing Units (RHUs) generated a significant volume of disused fabric. In one camp this fabric was used by a woman's group to produce tote-style bags which they then sold. Some of the metal poles from the tents were also used to create clotheslines which could be installed close to their RFU. The interviewee commented that this was valued by refugees as they generally avoid hanging clothes in collective spaces due to fear of theft.

TORCHES (FLASHLIGHTS)

Torches present a relatively cheap and highly portable means of providing light in refugee camps. Electronically, they are a relatively basic. This makes them straightforward to repair and to construct from repurposed electrical components. Unlike solar lamps, however, most use non-rechargeable batteries as a power supply, this means a consistent generation of e-waste in the form of used batteries.

Almost every interview with a person living or working in a refugee camp mentioned the repair of torches. Accountants from Uganda, Kenya, Jordan, Rwanda, Bangladesh, and Ethiopia all included reference to torches being repaired by technicians, often operating repair shops handling a wide variety of electronic and electrical items.

In interview and in its report 'Energy access in refugee camps in Rwanda'[39], Practical Action describe an interesting example of repurposing from Gihembe, Rwanda. There are a variety of models and brands of torch used in the camp: some have been bought by refugees and some have been distributed by humanitarian agencies. It can be difficult to find the right replacement battery to fit a particular torch, so some people will connect whatever batteries they can buy or find to the outside of their torch instead. In addition, improvised torches used for personal and space lighting, were found by researchers. These items can be made from repurposed bulbs, string, packaging, switches, and other objects.

39. See full report: https://bit.ly/3zodp9N

Torches made from found materials and repurposed electronics. Image credit: Practical Action

APPENDIX 2:
HUMANITARIAN REPAIR CASE STUDIES

INTERNATIONAL ORGANIZATION FOR MIGRATION

The International Organization for Migration (IOM), is implementing an innovative project in Bidibidi, Uganda, titled "Greening humanitarian response through recovery, repair and recycling of solar products in camps – The E-waste Project", which will run until the end of July 2022. Its core aim is to respond to the problem of ill-managed disposal of solar products in displacement settings by finding a cost-effective solution for the repair, reuse and recycling of these products and components through a circular economy.

> Extending the lifecycle of existing solar products will result in improvements to human health and the environment.

The E-waste Project includes multiple activities undertaken by IOM's three private-sector partners (Bright Products, Solvoz and TotalEnergies Offgrid Solar Solutions) to holistically address the waste value-chain from manufacture and distribution, to repair, recovery, recycling and procurement. The Project will repair existing solar lamps in Bidibidi, through the provision of spare parts and tools, and refurbish/revalorise batteries through the Batlab - a facility to test battery packs and cells and break down/integrate them into new packs. The solar lamp repairs and operation of the Batlab will be undertaken by local beneficiaries, who will be provided technician training and sales skills to enable them to effectively operate a sustainable business. In addition, the Project promotes sustainable procurement through the development of sustainable procurement documentation for use by organisations in the humanitarian sector, and to contribute to an open-access knowledge in an online platform including a range of solar solutions from small to complex, from both local and international suppliers.

IOM expect meaningful social, environmental, and economic benefits to result from the project. Solar products contain elements which are toxic to humans and the environment when improperly stored, disposed or processed. Extending the lifecycle of existing solar products will result in improvements to human health and the environment by reducing the quantity of these items which are stored or dumped. Further, socio-economic, benefits will be realised by creating jobs, supporting existing livelihoods, and providing business opportunities to beneficiaries.

On a broader scale, the Project will promote knowledge transfer and information sharing within the humanitarian, private, academia and NGO sectors. Evidence generated from the Project will allow solar manufacturers to modify future designs to extend their durability, allow assessment of the Project's replicability and scalability in other humanitarian contexts, and provide evidence to influence humanitarian procurement policies.

BRIGHT PRODUCTS REPAIR PROGRAMME

Bright Products (BRIGHT) is a Norwegian solar product company that designs, manufactures and distributes off-grid solar products. BRIGHT caters to anyone who needs to be less dependent on the electrical grid, whether by choice or by living in off-grid or bad-grid communities. The company has supplied UNHCR with core relief items since 2014 and have, through this partnership, provided people in displacement settings with more than 2.5 million solar lamps.

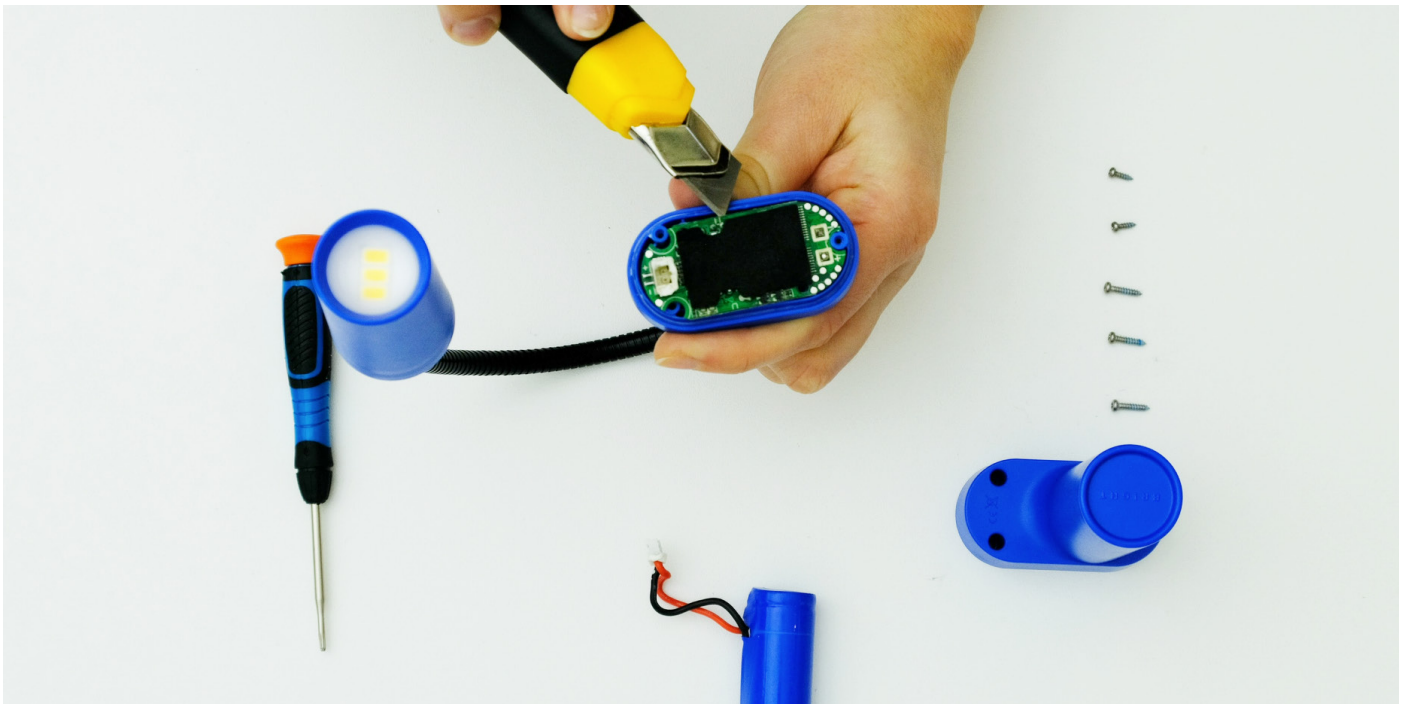
BRIGHT recognises that there is an increasingly important need for effective e-waste management in displacement settings due to the high numbers of solar lamps distributed as core relief items. Following research trips to Jordan and Kenya, it became apparent to them that supporting refugee-led repair activities should form part of the answer to this need. During these trips, BRIGHT identified a lack of access to spare parts and repair training as a clear hindrance to the proper repair of solar lamps. Their new Products Repair Programme seeks to address those limitations.

The Programme focuses on supporting the repair and refurbishment of BRIGHT solar lamps in UNHCR's refugee camps where BRIGHT have distributed products. BRIGHT will provide spare parts, and a toolkit to each camp, as well as a digital learning platform designed for refugee settings. Selected refugees will be given access to knowledge and materials to enable them to carry out repairs locally. This will benefit the end-user by (1) continued access to light and charging; (2) the trained technician by providing an income and capacity building through the digital learning platform; and (3) the camp management by saving money. Instead of buying new lamps, humanitarian organizations will be able to repair existing lamps for a fraction of the price. The programme also considers gender-based inequalities regarding repair skills and will specifically offer job opportunities to women where possible.

An additional motivation for the programme is BRIGHT's commitment to sustainability and the UN's Sustainable Development Goals. The company utilises the triple bottom line sustainability framework, aiming to fulfil its commitment to those principles, as well as to their pledge to the Future Fit Benchmark. They believe that being in the forefront of tackling the issue of solar e-waste through repair, will enable them to drive the agenda amongst customers and competitors.

BRIGHT hopes this programme can be part of the effort to improve e-waste management, build capacity of the refugees within the sphere of electrical repair, and shed light on the possibilities for repair and reuse in displacement settings.

As a partnership programme, this work must be implemented by local partners in each refugee camp.



COMMUNITY TECHNOLOGY EMPOWERMENT NETWORK

Based in Rhino Camp, Uganda, Community Technology Empowerment Network (CTEN) is a refugee-led organisation offering a wide variety of services to refugee communities. One such service is the running of daily repair cafés from their Innovation Centres. Technicians in these cafés offer repairs for an array of electronic products, including laptops and solar lamps, as well as for furniture and other non-electronic items. In addition to Rhino Camp, the organisation also operates in Imvepi, Lobule, Bidibidi, and Kiryandongo.

Since its founding, CTEN has been acutely aware of the importance of repair services within the refugee community. Peter Batali, CTEN's Executive Director and Co-Founder, explains that most households within the camps own some sort of electronic device, be it a mobile phone, laptop, radio, or solar lamp. These devices enable people to communicate, organise, source information, and move safely about in the dark. When they break, they can be expensive to replace, but repair offers a more attainable solution.

CTEN's repair cafés are run by technicians with a mix of formal and informal training. They do their best to repair any items brought to them: evaluating faults and estimating costs for the owner; sourcing spare parts; and learning new skills online.

The organisation faces many challenges to running its repair service. For instance, a lack of access to appropriate tools and facilities, particularly to conduct repairs on more complex products, can mean that repairs take longer or are simply not possible. Limited fuel for transportation also requires technicians to carefully schedule journeys to source spare parts. Additionally, technicians service a wide variety of products and frequently encounter new models and brands of hugely varying quality. Each new product is likely to require different methods and tools to disassemble it, and different parts to repair. Whilst an internet connection can alleviate some of these issues- helping technicians to continually learn new skills and source appropriate parts- the process remains time consuming and the internet connection itself is expensive to maintain.

CTEN is also aware of barriers to repair faced by their customers. Good quality spare parts are costly to source and can make the repair service prohibitively expensive for customers. They also know there are many people who own broken products but live too far away, either for the technicians to reach, or for the owners to afford to travel to the repair cafés.

To address these challenges, CTEN plans to train more technicians to run the cafés and wants to expand its repair services both to other camps and to people from host communities. A key part of this expansion would include purchasing a van to carry repair equipment to areas currently outside of their reach; conducting on-the-spot repairs, where possible, and to transport products requiring more complex repairs back to the main facilities. CTEN also wants to directly partner with solar lamp distributors, such as UNHCR, to conduct repairs on a larger scale, and gain increased access to spare parts and repair information.

A CTEN technician works with a client to repair a laptop in Rhino Camp, Uganda. Image credit: CTEN

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