

Impact case study (REF3)

Institution: University of Edinburgh		
Unit of Assessment: 22 – Anthropology and Development Studies		
Title of case study: Enhancing the Sustainability of Off Grid Solar Technology in South Asia and Sub-Saharan Africa		
Period when the underpinning research was undertaken: 2014 - 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): Jamie Cross	Role(s) (e.g. job title): Professor	Period(s) employed by submitting HEI: Since 2011
Period when the claimed impact occurred: 2014 - 2020		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact		
<p>Since 2014, Cross's research on the social lives of solar energy technologies in South Asia and Sub-Saharan Africa has substantially changed how renewable energy organisations engage with global challenges of energy access and electronic waste from solar equipment. It led directly to the development of:</p> <ol style="list-style-type: none"> 1. an open-source mobile platform that increased access to clean energy for people in one of India's most underdeveloped regions; 2. an online scorecard for solar-powered devices which has set new standards for best practice in sustainable design across the global off-grid solar industry; and 3. a fully recyclable solar-powered lamp, which was included by the leading industry association as an exemplar of sustainable design for reparability and compatibility in their E-waste Toolkit, and has won the prestigious global iF Product Design Award. 		
2. Underpinning research		
<p>There is nothing inevitably sustainable about solar energy. Efforts to increase access to energy for 1.2 billion people who live without electricity by accelerating the growth of consumer markets for cheap, solar powered technologies have also created a new challenge of electrical and electronic waste. In 2017, over 6 million solar powered lighting devices were sold across Sub Saharan Africa and South Asia, and over 1.67 million solar devices were estimated to enter regional electronic waste flows. Both the UK's Department for International Development (DfID) and the Global Off Grid Lighting Association (GOGLA) – a membership-based trade body for solar manufacturers and distributors – have identified the 'end of life' of solar technology in Sub-Saharan Africa and South Asia as an area of concern. Against this backdrop, there is an emerging consensus that centralised take back and recycling schemes provide a solution to solar electronic waste. However, since 2014 research by Cross has challenged this consensus, demonstrating that such schemes do not work well in underdeveloped regions with weak service infrastructures.</p> <p>Funded by the Leverhulme Trust, the ESRC, the EPSRC and the Scottish Government, this research has tracked the growth of markets for solar energy technologies in contexts of humanitarian intervention and rural development across India, Kenya and Burkina Faso. Key studies include:</p> <ul style="list-style-type: none"> • an ethnographic study of everyday repair practices and ad hoc innovations in relation to energy technologies in refugee camps in Burkina Faso and Kenya; • a survey of solar failure and breakdown rates across 1,082 un-electrified households across three districts in the Indian state of Odisha; 		

- a systematic analysis of approaches to product failure and the 'end of life' by off grid solar manufacturers in Kenya;
- a systematic analysis of design practices by solar companies distributing products in humanitarian emergencies and spaces of rural development.

This research has revealed the extent to which the design of small-scale solar technologies for people living at the bottom of the economic pyramid are shaped by intellectual property rights, competition for market share, and the logistics of global manufacturing networks. The research has also gathered data on the propensity of solar powered technologies to break in contexts of chronic energy poverty and humanitarian emergency, documenting the strategies people use to fix technology, access to specialist repair services and spare parts, and build relationships with local mechanics and fixers. These studies have led to four key research findings which, in turn, have led to impact on businesses, product standards and technology design in the off grid solar industry:

- unsustainable solar technologies are the outcome of poor product design decisions (3.1, 3.2, 3.3);
- repair and maintenance ecosystems are flourishing around broken solar technologies in India, Kenya and Burkina Faso, and place-specific cultures/economies of repair can extend the life of solar technologies (3.4, 3.5);
- designing technologies for repair can reduce electronic waste and embed renewable energy systems in local contexts of use (3.6).

3. References to the research

- 3.1 Cross, J., 2014. The 100th object: Solar lighting technology and humanitarian goods. *Journal of Material Culture*, 18(4), pp.367-387. DOI: [10.1177/1359183513498959](https://doi.org/10.1177/1359183513498959)
- 3.2 Cross, J., 2017. Off the grid. *Infrastructures and Social Complexity* (Vol. 198, No. 209, pp. 198-209). DOI: [10.4324/9781315622880](https://doi.org/10.4324/9781315622880)
- 3.3 Cross, J. 2018. Solar Basics. *Limn* #9. <https://limn.it/articles/solar-basics/>
- 3.4 Cross, J. and Murray, D., 2018. The afterlives of solar power: Waste and repair off the grid in Kenya. *Energy Research & Social Science*, 44, pp.100-109. DOI: [10.1016/j.erss.2018.04.034](https://doi.org/10.1016/j.erss.2018.04.034)
- 3.5 Cross, J., Douglas, M., Grafham, O., Lahn, G., Martin, C., Ray, C. and Verhoeven, A. 2019. Energy and Displacement in Eight Objects. London, Chatham House. <https://www.chathamhouse.org/2019/11/energy-and-displacement-eight-objects>
- 3.6 Cross, J. 2019. The Solar Good: Energy Ethics in Poor Markets. *Journal of the Royal Anthropological Institute*, 25(5), pp. 47-66. DOI: [10.1111/1467-9655.13014](https://doi.org/10.1111/1467-9655.13014)

4. Details of the impact

Cross's research has had impact on the business practices of renewable energy organisations, the development of new standards for sustainability in the off-grid solar industry, and the design of new solar powered lighting and charging systems.

Impact on business practices of renewable energy organisations in the UK and India

The research changed how renewable energy organisations engage with global challenges of energy access and electronic waste from solar equipment. In 2014, Cross's work encouraged Scene Consulting Ltd., a renewable energy consultancy, to translate these findings into a non-profit, solar repair business: "Cross was fundamental in bringing to our attention the problems of breakdown and lack of maintenance services in the off-grid solar sector" (5.1). In collaboration

with Cross, Scene Consulting Ltd developed 'Urjaa Samadhan', an open source SMS-based mobile reporting platform for solar technology failures. In regions where Cross's research had revealed insufficient service networks and haphazard repair practices, this platform enabled people with broken devices to connect with people who could fix them.

In 2015, the mobile platform was runner up 'Social Impact Technology of the Year' in the UK's annual Business Green Technology Awards (5.2). In 2016, Urjaa Samadhan was registered as a private limited company in India, co-funded by the Scottish Government and private investment, with Cross as a co-director. By 2017, the company had established a local repair service centre and, through the use of its mobile platform, it extended the working life of 500 solar home systems and solar lanterns, increasing access to clean energy for ~2,000 people in Koraput, one of India's most underdeveloped regions (5.3).

In 2018, Scene integrated the lessons learned from Urjaa Samadhan, i.e. SMS software architecture and business principles, to launch a new company (Connected Energy), which was entirely focused on energy access in low and middle-income countries. Urjaa Samadhan became their implementing partner for the first commercial trial in India of a new product, which allows any solar company to roll out pay-as-you-go mobile payment systems by installing a simple charge controller within their solar home systems (5.3).

Impact on sustainable design standards across the off-grid solar industry

Since 2014, Cross has worked in collaboration with the Silicon Valley Toxics Coalition, a leading research and advocacy organisation, to develop an online tool which addresses the issue of unsustainable solar design. This 'Off-Grid Solar Scorecard' allows users to dismantle, analyse and rate solar powered lighting devices based on their reparability and recyclability. It was launched in 2016, has since then evaluated over 80 products and was endorsed by the largest distributors of brand name solar powered lighting systems in Africa (SolarAir/SunnyMoney, whose work has impacted 11 million lives) and India (FrontierMarkets, whose work has impacted 3.5 million lives) as improving their ability of product selection (5.4). In 2017, the World Bank's Lighting Global programme whose quality assurance system has impacted 180 million people's lives across Africa, Asia and the Pacific region, used the Scorecard to describe minimum criteria for good practice in the field of eco-design (5.5).

In 2018, Azuri Technologies, a leading UK commercial provider, which has sold over 150,000 off-grid solar systems in Sub Saharan Africa, invited Cross to use the Scorecard to undertake a corporate sustainability review. As a result of Cross's review, Azuri made modifications to design and packaging of its flagship solar product and introduced, for the first time, a sustainability policy (5.6, 5.7). In June 2019, an industry body, the Global Off-Grid Lighting Association (GOGLA), used the Scorecard to describe best practices for sustainable design in a 2019 E-waste Briefing to more than 150 members worldwide (5.8).

The fundamental impact of Cross's research on awareness, debate and practices in this sector was summarised by a senior executive of Scene Consulting Ltd as follows: "E-waste in the off-grid solar sector was something I had never thought about 5 years ago, But Jamie and his team had already been thinking about it as a future issue. It's a very good example where academia is at its best: The rest of the sector are picking up on e-waste as an issue just now, in 2018, 2019, so a lot of groundwork, of evidence around it is already in place because of the work of Jamie and his team" (5.1).

Impact on the design of new solar-powered lighting and charging technologies

The research informed the design of a new solar-powered device that set out to accelerate access to basic levels of solar powered lighting without increasing electronic waste flows in Sub Saharan Africa and South Asia. Between 2017 and 2018, Cross worked with design agencies to develop a solar-powered lighting and charging device built around sustainable design principals. The resulting product, Solar What?!, can be built using recycled plastics and ethically-sourced

electronic components, it can be repaired with non-specialist tools and is compatible with a range of second-hand solar photovoltaic modules and mobile phone batteries. The design is open source. In January 2019, the UK Charity SolarAid piloted 25 devices with schoolchildren and their families in Zambia (5.9).

At the same time, the National Museums of Scotland acquired the first SolarWhat?! prototype for their permanent technology collection as an example of an innovation designed in Scotland to address global challenges of energy access and electronic/plastic waste (5.10). Most recently, GOGLA included SolarWhat?! as an exemplar of sustainable design for repairability and compatibility in their E-waste Toolkit (5.8), and it won the prestigious global iF Product Design Award (5.11).

5. Sources to corroborate the impact

5.1 Testimonial Senior Executive, Scene Consulting Ltd.

5.2 Urjaa Samadhan - solar maintenance platform: Runner up 'Social Impact Technology of the Year' in the UK's annual Business Green Technology Awards 2015

- <https://web.archive.org/web/20200923152850/https://www.businessgreen.com/news/2430639/businessgreen-technology-awards-2015-shortlist-announced>

5.3 Impact of Urjaa Samadhan

- Urjaa Samadhan end of project report to the Scottish Government (2017)
- Current Urjaa Samadhan activities:
https://web.archive.org/web/20200923160843if_/https://www.urjaasamadhan.com/

5.4 Off-Grid Solar Scorecard

- Description of accreditation:
<https://web.archive.org/web/20200923160325/http://www.offgridsolarscorecard.com/index.php>
- University of Edinburgh engagement
<https://web.archive.org/web/20200923160607/http://www.offgridsolarscorecard.com/about.php>
- Impact of SolarAid/SunnyMoney's work:
<https://web.archive.org/web/20210114113524/https://solar-aid.org/our-history/>
- Impact of FrontierMarkets' work:
<https://web.archive.org/web/20210114113732/https://ashden.org/winners/frontier-markets/>

5.5 Lighting Global (2017) Product Repair Part II: Manufacturer Best Practices. Eco Design Note Issue 7, using the Off-grid Solar Scorecard to describe minimum criteria for good practice.

- Eco Design Note:
<https://web.archive.org/web/20200923154005/https://www.lightingglobal.org/resource/product-repair-part-ii-manufacturer-best-practices/>
- Impact of Lighting Global program:
<https://web.archive.org/web/20210114112811/https://www.lightingglobal.org/about/our-impact>

5.6 Azuri Technologies, Sustainability Policy

- <https://web.archive.org/web/20200923161718/https://www.azuri-group.com/sustainability-policy/>

5.7 Testimonial Vice President Product Management, Azuri Technologies

5.8 GOGLA E-waste Toolkit Module 2 Briefing Note, using the Scorecard to describe best practices for sustainable design (p 14), and using SolarWhat?! as an exemplar for sustainable design (p 15).

- https://web.archive.org/web/20200923155117/https://www.gogla.org/sites/default/files/resource_docs/gogla_e-waste-module-briefing-2_def-web_opt.pdf

5.9 Solar Aid Report (2019): A school, a lion and solar lights in rural Zambia (describing the pilot with SolarWhat?! devices)

- <https://web.archive.org/web/20200923155236/https://solar-aid.org/a-school-a-lion-and-solar-lights-in-rural-zambia/>

5.10 National Museum of Scotland

- Testimonial Curator for Technology
- Museum Blog May 17, 2019 about SolarWhat?!
<https://web.archive.org/web/20200923160510/https://blog.nms.ac.uk/2019/05/17/solar-what-shining-a-light-on-a-new-innovation/>

5.11 SolarWhat?! iF Design Award 2020

- <https://web.archive.org/web/20200923160906/https://ifworlddesignguide.com/entry/282706-solar-what>
- <https://web.archive.org/web/20200923161048/https://www.ed.ac.uk/news/2020/sustainable-solar-lamp-wins-global-design-award>
- <https://web.archive.org/web/20200213091005/http://www.solarwhat.xyz/>