

Scientists urge action over life-threatening pollution from solar power waste in Africa

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Recycling activities for lead-acid batteries. Credit: Dr. Chris Kinally. Credit: Dr. Chris Kinally

Researchers from The University of Manchester investigating waste management practices for off-grid solar technologies in Malawi have

discovered life-threatening quantities of lead pollution from improperly managed battery waste.

Common informal recycling activities for lead-acid batteries used in solar energy systems were recorded to release 3.5-4.7 kg of lead pollution from a typical battery, which is equivalent to more than 100 times the lethal oral dose of lead for an adult.

Off-grid [solar technologies](#) are used to provide power to areas lacking traditional grid connections and are crucial for expanding electricity access across sub-Saharan Africa. The private market for off-grid solar electrification technologies is expected to provide electricity access to hundreds of millions of people by 2030, subsidized by global energy companies in the Global North, including the UK.

Meanwhile, household-scale off-grid solar energy systems in sub-Saharan Africa mostly depend on lead-acid batteries as the most affordable and established energy storage technology.

However, the scientists warn that the absence of formal [waste](#) management infrastructure presents major human health and [environmental risks](#) and urge government intervention immediately.

This research, published in the journal [Applied Energy](#), was led by Dr. Christopher Kinally for his Ph.D. at The University of Manchester.

Dr. Kinally said, "The private market for off-grid solar products is a very effective way to increase access to electricity, which is crucial for sustainable development. However, the resulting toxic waste flow is growing rapidly across regions that do not have the infrastructure to manage electronic waste safely."

"Without developing infrastructure, legislation, and education around

these technologies, there are severe public health risks. Significant social, economic, and legislative interventions are required for these solar products to be considered as a safe, low-carbon technology in sub-Saharan Africa."

Toxic informal waste management practices are known to be common for automotive batteries and electronic waste in low- and [middle-income countries](#), but the environmental and health impacts of these practices have been widely overlooked. Now, efforts to promote sustainable development and electricity access are adding to these life-threatening waste streams.

Dr. Kinally recorded that within suburban communities in Malawi, lead-acid batteries from solar energy systems are being refurbished openly on busy market streets by self-taught technicians, who are not aware of the toxicity of the materials they are handling.

He found that batteries are broken open with machetes, lead is melted over charcoal cooking stoves, and improvised lead battery cells are made by hand. In the process, approximately half of the lead content from each battery is leaked into the surrounding environment, releasing the equivalent of more than 100 lethal oral lead doses from a single battery into densely populated communities.

This is the first data to quantify lead pollution from the informal recycling of lead-acid batteries from solar energy systems.

Dr. Alejandro Gallego Schmid, primary supervisor of the Ph.D. and Senior Lecturer in Circular Economy and Life Cycle Sustainability Assessment at The University of Manchester, added, "The problem is not the use of a renewable source like solar energy, but the lack of appropriate treatment of the batteries at the end of life. We urgently need further research to reveal the health impacts of the identified flows

of toxic pollution from solar batteries."

Lead is a [potent neurotoxin](#), and very low levels of lead exposure are known to impact a child's brain development permanently. UNICEF has estimated that 800 million children across low- and middle-income countries have lead poisoning.

This widespread lead pollution is largely driven by improperly managed automotive battery waste and is expected to have substantial health and economic impacts across the Global South, yet continues to be overlooked.

Prior publications from the research team also highlight that the private off-grid solar market suffers from a general lack of supplier accountability, and substandard, short-lived, and counterfeit off-grid solar products were found to be common in Malawi, exploiting vulnerable energy-poor populations.

A lack of education about how to build and use these solar energy systems, which are particularly vulnerable to damage from improper use, is also severely limiting the lifetimes of batteries in off-grid solar energy systems.

Batteries in Malawi were recorded to often fail within a year, far shorter than the 3-5 year expected lifetime, accelerating the toxic waste flow. Meanwhile, the environmental impacts (including carbon emissions) from manufacturing and replacing short-lived lead-acid batteries are compromising the sustainability and environmental benefits of solar energy systems.

Dr. Fernando Antoñanzas, co-supervisor of the Ph.D., added, "This study brings more light on the maintenance and end-of-life phases of small off-grid solar projects, indeed left unattended in most cooperation

projects. While informal lead-acid battery recycling offers a short-term solution for electrification for the poorest, at the same time, represents an enormous public health risk across Sub-Saharan Africa."

The research team has also provided policy recommendations for waste management solutions, including changes to how solar energy companies receive investments from the UK and Global North.

More information: Christopher Kinally et al, Life cycle assessment of solar home system informal waste management practices in Malawi, *Applied Energy* (2024). [DOI: 10.1016/j.apenergy.2024.123190](https://doi.org/10.1016/j.apenergy.2024.123190)

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