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## Case Study

# Cathode Ray Tubes (CRTs) Reuse and Recycle Challenge

Innovate UK Global Alliance Africa collaborates with the WEEE Centre in Kenya to promote partnerships that address key sustainability challenges in the electronic waste sector

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# The Challenge



The Waste Electrical and Electronic Equipment Centre (WEEE Centre) is leading efforts in Nairobi, Kenya, to develop effective and sustainable solutions to recycling cathode ray tube (CRT) displays. CRT units contain hazardous materials, including up to 1.5kg of lead within the funnel glass, which needs to be disposed of safely.<sup>1</sup>

As one of Africa’s largest ISO certified e-waste management companies,<sup>2</sup> the WEEE Centre was keen to develop an innovative solution for CRT recycling based on the principles of circular economy and environmental sustainability. *“We want to make sure that CRTs are being disposed of in ways that are safe; that protect our soils and our water,”* explains Catherine Masolia, Chief Operating Officer at the WEEE Centre.

Global Alliance Africa is a six-year project, building new and stronger UK-African partnerships leading to self-sustaining economic growth. Our efforts align with the UK’s Official Development Assistance (ODA) by supporting new innovations that address current and future socio-economic challenges, generating positive change.



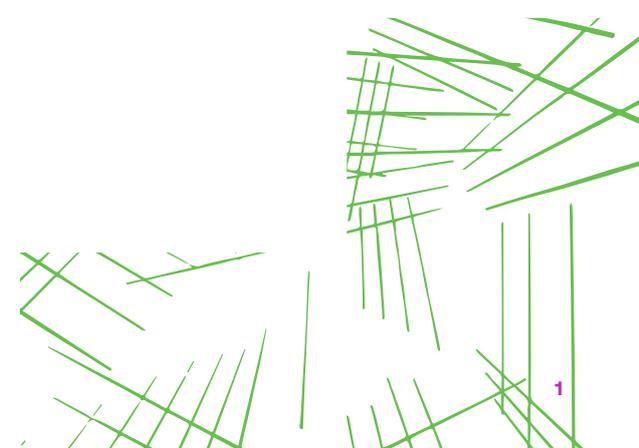
Quinnovations and Blue Planet Environmental Solutions were excited to be part of this challenge because it opened up the possibility of working within new global markets, as well as presenting them with the chance to apply their technical expertise to new types of e-waste materials:

*“We focus on how to exploit technology to create a commercial value for ourselves and our partners... For this project, we were able to apply a similar process to CRT glass that we had already used to extract precious metals from auto catalysts”,* explained Jonathan Quinn, founder of Quinnovations.



Working with the Global Alliance Africa team, the WEEE Centre launched an Open Innovation Challenge for solutions, with the UK-based R&D engineering specialists, Quinnovations and Blue Planet Environmental Solutions, successfully securing the contract to deliver a solution.<sup>3</sup>

1. weee-forum.org  
2. weee-centre.com  
3. Quinnovations and Blue Planet Environmental Solutions



## There were three key aspects to the solution developed for CRT glass processing that were critical to its success:<sup>4</sup>

- ✓ **A high-pressure Hastelloy reactor.** A one litre Hastelloy reactor capable of withstanding high temperatures and industrial processes was retrofitted by Quinnovations and Blue Planet Environmental Solutions with the technology needed for CRT lead extraction before being shipped to the WEEE Centre for on-the-ground testing as part of the pilot process.
- ✓ **Precise measurements of reactants.** The Quinnovations and Blue Planet Environmental Solutions team had to identify the exact ratio of concentrated sodium hydroxide to crushed leaded glass in order to extract the lead without creating excess chemical waste. Adding sodium sulphide at the end of the process allowed the lead to be recovered in a stable, solid form. The precision achieved with the reactants meant that 99.9% of the lead was extracted using this method.
- ✓ **Controlled reaction conditions.** By maintaining a constant temperature of 100°C for a time period of four hours at 10-12 bar pressure, the team were able to significantly reduce the energy consumption and emissions needed to extract the lead compared with a traditional smelting process.

The partnership between the WEEE Centre and Quinnovations and Blue Planet Environmental Solutions was also a great success. Both partners benefitted from bi-lateral knowledge exchange across their respective specialisms in e-waste management and extractive technologies.

Catherine Masolia, Chief Operating Officer at the WEEE Centre, described how the Quinnovations and Blue Planet Environmental Solutions team was always very generous in sharing their knowledge and expertise with the local team, saying:

*“Jonathan [Quinn] taught our workshop supervisor the things he was doing, increasing knowledge for him and for the team and helping them to better understand the components of the glass.”*



# Project Impact

The project has led to three core areas of impact, highlighted below, showing the outcome of a truly collaborative effort that has resulted in the expected benefits plus additional unexpected outcomes.

Firstly, the lead extraction process developed by Quinnovations and Blue Planet Environmental Solutions means that the WEEE Centre can now become a driving force behind CRT recycling in Kenya.

Secondly, the operational cost (once an industrial scale Hastelloy reactor has been secured) is sufficiently low for it to represent a commercially viable revenue stream for the WEEE Centre-Quinnovations and Blue Planet Environmental Solutions team.

Finally, it creates broader social and economic impact through the training and employment of specialist chemical operators and promotes environmental sustainability by ensuring that potentially hazardous materials are recycled rather than becoming a source of pollution.

The project has also generated additional solutions that employ innovative solutions to effective e-waste management. Once the lead has been extracted in solid form, the by-product of the process is a compound called sodium silicate. Quinnovations and Blue Planet Environmental Solutions already possessed the technology to use this sodium silicate to produce geopolymer blocks that can be used as a substitute for traditional concrete blocks within the construction sector.

Geopolymer blocks also bring additional social and environmental impact as they have a lower carbon footprint than traditional blocks; they are less expensive to produce; and successful manufacture of these blocks would also lead to further job creation at the WEEE Centre.

*“With this technology, we’re able to separate out the hazardous components and then make construction blocks. Construction is really big in Kenya so being able to separate out the hazardous lead components and then make construction blocks is a big win for us”* explains Catherine Masolia, Chief Operating Officer at the WEEE Centre.

Furthermore, during a site visit, the Quinnovations and Blue Planet Environmental Solutions team realised that the same technology used to extract lead from CRT displays could be used to extract tin from low-grade circuit boards – a form of e-waste that the WEEE Centre currently ships abroad because they are unable to process them on-site.

**Scaling the circuit board process would create significant cost savings for WEEE Centre, as they are currently shipping circuit boards to Europe for processing, costing \$80,000 per year. It would also generate a new income stream when reusing the extracted metals.**

The Global Alliance Africa team are thrilled with the multiple positive outcomes from this project, with Open Innovation Lead, Babar Javed, highlighting the impact of this collaboration: *“Our goal of creating a dynamic UK-Africa innovation collaboration has been fulfilled. These talented partners have solved a genuine technical challenge, that of valorising CRTs, and created wider socio-economic benefits by upskilling local staff and reducing e-waste pollution.”*

# Next Steps and Learning

The next step for the Quinnovations and Blue Planet Environmental Solutions and WEEE Centre partnership is to secure investment for an industrial scale Hastelloy reactor to be built with a capacity of at least 500 litres (500x the capacity of the pilot reactor) in order to scale up the solution and become commercially viable.

Once the machinery is secured, the WEEE Centre and Quinnovations and Blue Planet Environmental Solutions team can continue their successful partnership in both lead and tin extractions, as well as manufacturing of geopolymers blocks. Jonathan Quinn, founder of Quinnovations, sees huge potential for the partnership going forwards: *"we have ended up with three projects off the back of one."*

For Quinnovations and Blue Planet Environmental Solutions, the partnership with WEEE Centre represents a first step into African markets with the potential to expand their work across the region and partner with other e-waste management companies.

The team at Quinnovations and Blue Planet Environmental Solutions are also working with Liverpool John Moores University on a R&D project using the same retrofitted Hastelloy reactor to explore other waste materials that may be recycled using the extractive process developed for this challenge.



If successful, this could extend the impact of the new technology developed for CRT and circuit board recycling to other waste streams including steel slag from furnaces, aggregate waste from skips and other construction waste.

*"It is wonderful to see our partners collaborating so enthusiastically on scaling their initial pilot outcome", says Babar Javed, "We are hopeful of generating positive change whose impact will be felt in both the UK and Kenya, across multiple industries including e-waste and construction."*





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