IEC Global Impact Fund

Project Concept

Catalysing Innovation for Circular Models in Africa - Turning Battery E-Waste into E-Resources

This foundational document accompanies the Call for Expressions of Interest (CEI) for the first project of the IEC Global Impact Fund. The IEC solicits feedback on its contents from all interested stakeholders. An updated version will be issued based on the feedback received from respondents and before a Request for Proposals (RfP) is issued.

Acronyms:

ACEA	Advisory Committee on Environmental Aspects
CA	Conformity Assessment
CEI	Call for Expressions of Interest
ESG	Environmental, Social and Governance
EV	Electric Vehicle
ICT	Information and Communications Technology
IEC	International Electrotechnical Commission
IEC CA	IEC Conformity Assessment
IECEE	IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components.
IECEx	IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres
IEC GIF	IEC Global Impact Fund
IECQ	IEC Quality Assessment System for Electronic Components.
IECRE	IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications
LVDC	Low-voltage direct current
NC	National Committee
NEC	National Electrotechnical Committee
RfP	Request for Proposals
SDGs	UN - Sustainable Development Goals
SMEs	Small and Medium-sized Enterprises
TC/SC	Technical Committee/Subcommittee
ToC	Theory of Change

Problem Statement

Global society is currently facing a range of overlapping grand challenges, including the climate emergency. Governments are increasingly called upon to respond to security threats related to health, the environment and energy. Access to energy is a very important pillar of the wellbeing of people and planet and global electrification enables both energy efficiency and the reduction of greenhouse gasses. It also fuels economic activity, social development, and helps to reduce local pollution. Electrification directly contributes to the United Nations' seventh Sustainable Development Goal (SDG) which aims to "ensure access to affordable, reliable, sustainable and modern energy for all" and indirectly to other SDGs. Sustainable electrification must be accelerated and coordinated in order to reach global climate targets and the SDGs.[1]

The International Electrotechnical Commission (IEC)

The IEC is a global, not-for-profit membership organization that brings together 174 countries and coordinates the work of 20 000 experts globally. They provide instructions, guidelines, rules, or definitions to enhance safety and efficiency of electric, electronic and information and communications technology (ICT). These are then used to design, manufacture, install, test and certify, maintain and repair electrical, electronic, and ICT devices and systems. IEC International Standards and conformity assessment work underpins international trade in electrical and electronic goods. It facilitates electricity access and verifies the safety, performance and interoperability of electric and electronic devices and systems, including, for example, consumer devices such as mobile phones or refrigerators, office and medical equipment, information technology, electricity generation, and much more. IEC makes critical contributions to global trade, the environment, cyber security, digitalization, energy efficiency, and the future of business and technology.

Conformity assessment refers to any activity that determines whether a product, system, service and sometimes people fulfil the requirements and characteristics described in a standard or specification. Such requirements can include performance, safety, efficiency, effectiveness, reliability, durability, or environmental impacts such as pollution or noise. Verification is generally done through testing and/or inspection. Through its Conformity Assessment Systems, the IEC also provides a framework that enables testing to be transparent, predictable, comparable, and affordable.

IEC International Standards and Conformity Assessment Systems provide the foundation that allows all countries to put in place sustainable, resilient infrastructure to stimulate economic development and innovation and apply global best-practices to manage safety, quality and risk. They enhance access to technology and innovation, promote the development, transfer, and dissemination of environmentally sound technologies, and facilitate participation in global value chains and world trade.

The IEC Global Impact Fund

The IEC Global Impact Fund will advance the IEC vision for "***a safer and more efficient world***" and demonstrate the catalytic impact of IEC International Standards and IEC Conformity Assessment Systems in addressing many of today's social, economic and environmental challenges. As a reflection of this commitment, the IEC launched the Fund through a three-year annual contribution of 1% of its Capital & Reserves over the 2022-2025 pilot phase. This seed funding will build a global partnership aligned with the IEC's values and mission.

The Fund's mission is to promote the application of IEC International Standards and IEC Conformity Assessment Systems by Small and medium-sized enterprises (SMEs) and positively impact the capacity of IEC Members and Affiliates to sustainably address global environmental, social and governance (ESG) challenges. This will allow the Fund to help drive the critical need for a coordinated

[1] https://www.enerdata.net/publications/executive-briefing/world-electrification-decarbonisation.html

consensus-driven approach to electrification and avoid the fragmentation that will perpetuate barriers to the green energy transition.

The IEC envisages that each project will involve multiple partners, including NCs/Affiliates, SMEs and other partners either directly or indirectly involved in implementation. The first project of the Global Impact Fund will focus on ***turning battery e-waste into e-resources.***

Project Introduction

As the world increasingly swaps fossil fuel power for emissions-free electrification, batteries are becoming a vital storage tool to facilitate the energy transition. Batteries typically retain significant capacity once they have come to the end of their original application, creating a significant market for reuse, or repurposing. Recycling battery components is extremely important, both from a materials standpoint and an environmental one. During their life-cycle, batteries can be reused through charging and discharging, while at the end-of-life stage, they can be taken apart and the components recycled to make, amongst other things, new batteries. [2]

The initial project of the Global Impact Fund has the working title of **"Catalysing Innovation for Circular Models in Africa - Turning Battery E-Waste into E-Resources".**

This Project aims to:

- ✓ **Positively impact** battery e-waste challenges through the **application of electrical, electronic and information technologies**
- ✓ Demonstrate how IEC International Standards & Conformity Assessment activities in this area can **make a difference** to the environment, to the economy and to society
- ✓ Increase **knowledge sharing and the capacity** of countries to apply IEC work to address national ESG issues
- ✓ **Build awareness and understanding** about the IEC and further **increase the diverse stakeholder involvement** and reach of IEC work

An SME (or SMEs in partnership) will be granted financial support to propose and implement solutions to challenges in the repair, reuse, repurposing and recycling of batteries, simultaneously allowing IEC Members and Affiliates to learn how to support SMEs to apply IEC work. This project concept proposal will serve as a basis for interested parties to propose their solutions through the support of the IEC Global Impact Fund. It gives information on the possible different components of the project. Applicants should propose solution-focused expertise and specifics of a **theory of change[3],** including **outputs** and how these relate to the project **objectives**.

This document will serve as a working document that will be updated following feedback from respondents and will enable co-creation of the project amongst stakeholders.

Project Background

Batteries support our digital life, boost growth and development, expand education, enable connectivity and are associated to reductions in carbon emissions. They are used everywhere and are the most common power source for basic handheld devices through to large scale industrial applications. They are set to play an essential role in decarbonising electricity supply and are becoming the standard power

[2] https://www.weforum.org/agenda/2021/09/batteries-lithium-ion-energy-storage-circular-economy/
[3] A theory of change is a detailed description of the mechanisms through which a change is expected to occur in a particular situation. A theory of change identifies the goals, preconditions, requirements, assumptions, interventions, and indicators of a program, providing important insight into and guidance on intervention and impact evaluation design (World Bank)

source for electric vehicles (EVs). Several billion lithium-ion cells and batteries are manufactured each year.

Batteries are used for different applications:

- Non-electrical vehicles (car, motorcycle, truck) functions including ignition and lighting
- industrial (telecom, UPS, reliable power supply and traction)
- EVs (full electrical, hybrid, bicycle)
- portable (computer, tool, lamp)
- onboard batteries (aircraft, railway, ship, motorhome)
- energy storage (renewable, on- grid and off-grid, especially for the growing photovoltaic energy sector for rural electrification where energy storage is needed for time shift, peak shaving[4] and grid stabilisation to increase energy efficiency)

Consequently, there have been large increases in the global demand for batteries as billions of people use electrical equipment that consumes electricity. The global demand for batteries is expected to increase from 185 GWh in 2020 to over 2,000 GWh by 2030.[5] Low-voltage direct current (LVDC) improved technologies have implications for the battery sector. In developed economies, the use of LVDC will help improve energy efficiency and reduce global carbon footprint. It can power data centres, office buildings or hospitals. In developing countries LVDC provides affordable and sustainable electricity access to people who would otherwise have to wait many years for a connection to the main electricity grid.

Batteries can also have a negative impact on the environment and society. Extraction and processing of the minerals required for battery manufacturing impact natural resources and contribute to climate change. In parallel, human rights abuses are linked to companies extracting minerals essential for the energy transition, including cobalt, copper, lithium, manganese, nickel and zinc.[6] Additionally, batteries contain hazardous, toxic and corrosive materials that, if not properly managed throughout the lifecycle, can have serious adverse consequences for the environment as well as human and animal health.

Proper disposal, reuse, repurposing and recycling in the context of the circular economy are solutions to preserve the natural resources used for batteries and prevent their negative impact. If the above listed activities can be managed appropriately and at scale, significant social, environmental and economic impact is possible.

The African Context

Today 770 million people live without access to electricity, mostly in Africa and Asia. The COVID-19 pandemic curtailed several years of continued progress and worsened the already low energy purchasing power of many households in developing countries. As an example, in Sub-Saharan Africa, the proportion of people without access increased in 2020 for the first time since 2013. Sub-Saharan Africa's share of the global population without access to electricity rose to 77% from 74% before the pandemic.[7]

Batteries are platform technologies that can be used to improve the state of the world and combat climate change. They support off-grid and mini grid solutions to supply electricity to millions of people living in remote communities lacking access to energy. A lot of resources and investment is moving into this industry. This not only impacts batteries themselves, but allows other industries connected to

[4] In the energy industry, peak shaving refers to leveling out peaks in electricity use by industrial and commercial power consumers
[5] https://www.statista.com/statistics/1103218/global-battery-demand-forecast/
[6] https://www.business-humanrights.org/en/from-us/media-centre/mineral-extraction-necessary-for-net-zero-at-risk-as-human-rights-abuses-slow-energy-transition/
[7] https://www.iea.org/reports/sdg7-data-and-projections/access-to-electricity

batteries to be optimized, such as new mining technologies, battery recycling innovation, charging infrastructure and vehicle-to-grid applications. Africa is a huge market for batteries particularly when including applications of batteries for cars and portable devices. The African battery market is predicted to grow sevenfold by 2030.[8]

The management of e-waste is an increasingly serious issue in Africa. In many African countries, a lot of battery e-waste is mixed with other waste and ends up in landfills. Most of the time, this waste is burned in open and urban areas. While national regulations about e-waste exist in most Western countries, only 11 of the 52 African countries in the IEC Family are listed as having such regulation (Cameroon, Côte d'Ivoire, Egypt, Ghana, Kenya, Madagascar, Nigeria, Rwanda, South Africa, Tanzania, Uganda and Zambia), rendering the continent very vulnerable to such issues.

Project scope

The scope of the first Global Impact Fund project - *Catalysing Innovation for Circular Models - Turning Battery E-Waste into e-Resources* - is to support an SME-led project in Africa to promote sustainable battery e-waste management. The specific country or countries of implementation will be selected through consultation with stakeholders and a Call for Expressions of Interest issued by the IEC to which NCs, NECs, Affiliates, SMEs and other interested parties may respond.

Projects will be measured based on the impact that they bring to society, the scalability potential and the sustainability of the activity after the funding has ended. A theory of change will be co-developed in advance of the implementation of the project to link the programme activities to the desired objectives and impact.

Projects activities (examples)

The project will be in one or more fields of activity including:

1- Repurposing, i.e., operation by which batteries (secondary cells, modules, battery packs, battery systems) that are originally manufactured for other applications are used again in different applications. The process consists of:
   a. safe removal of the product from original equipment
   b. inspection and assessment of used product
   c. storage of repurposing product
   d. design of system using repurposing product

2- Reuse of batteries (secondary lithium and nickel metal-hydride cells batteries after extraction from original market application) are used again in the same application originally intended from the design stage, after refurbishing. The process consists of:
   a. Determination of the suitability for reuse (based on battery lifetime traceability data)
   b. Evaluation of the safety of the batteries for reuse
   c. Coordination with the original manufacturer (reuse manufacturers should coordinate with original manufacturers or the battery provider to ensure that safety and performance can be maintained in reused batteries, including information related to end of service life)
   d. Removal of the original cell or battery label and markings

3- Recycling
   Most batteries can be recycled. The following table shows the state of recyclability of batteries.

[8] https://www.weforum.org/agenda/2021/09/batteries-lithium-ion-energy-storage-circular-economy/

	Recycling process	Beneficial recycling methods	Second life	Recycling promoted to selected countries
Lead acid-batteries[9]	Well-known – very efficient	Yes	No	Possible
Nickel Cadmium batteries	Well-Known – very efficient	Good (the result is dependent on the price of other materials included in the batteries (mainly cobalt, but also nickel)	No	Possible
Lithium batteries[10]	To be improved	No	Yes, for batteries used in EV during their first life	Not yet possible

Support activities of the project implementation could be:

- Study / description of the regulatory / legal framework in the country or countries of implementation.[11]
- Industry data analysis on the country or countries of implementation
- Identification, acquisition, and appropriation of relevant IEC Standards relevant for the project
- List and appropriation on IEC CA Activities relevant for the project
- Communication and marketing (promotion of the project)
- Sustainability of the activity to turn battery e-waste into e-resources through capacity building of the NC/Affiliate and other interested parties
- Collaborative activities between currently existing projects to catalyse scale and impact

Project objectives (examples)

The successful implementation of the project could contribute ***to one or several*** of the following objectives:

- Promote the design and repurposing of batteries for reuse or application different from the initial use
- Promote the reuse of batteries
- Recycling of batteries
- NCs/Affiliates to learn from the project and understand more how to help SMEs to apply IEC work

[9] Potential for the recovery rates of lead-acid batteries can be very high (99% in the USA)
[10] The lithium-ion battery is a rechargeable battery in popular demand for portable electronics, electric vehicles and in aerospace applications amongst others. Recycling can recover nearly 25-95 per cent of the lithium-ion cell's material, depending on the type of technology used for the separation. According to a new report by Umicore SA, the global lithium-ion battery recycling market is expected to grow at a compound annual growth of 22% during the seven-year forecast period, 2021-2028. The report states that the world will produce 11 million metric tons of used lithium-ion batteries per year by 2030
[11] Due to the societal and environmental costs of the use of batteries, some countries put in place regulations to mitigate the issues. Rules are established for collection of batteries, their disposal, reuse and recycling. It is recommended that the legal situation of the country is well documented by the project partners to initiate possible action with the support of the IEC NC or NEC in the country.

- Build capacity for other SMEs in developing countries around the battery e-waste management.
- Promotion of interoperability amongst stakeholders already active in this space especially in the context of IEC standards.
- Help establish or strengthen national regulation on e-waste or other areas related to circularity.

Project impact (examples)

- Reduction in pollution
- Reduction in human health risks
- Reduction in animal health risks
- Reduction in greenhouse gas emissions
- Contribution to global climate change mitigation
- Contribution to poverty reduction
- Conservation and sustainability of the environment for future generations

Project outcomes (examples)

- Quantity of E-waste batteries sent to landfills is reduced
- Batteries are given second life (repurposed, reused, recycled)
- Trainings are provided and capacities are built for NC/Affiliate or for SMEs
- IEC Standards and CA Systems are used (required)

Project indicators (examples)

- Number of batteries collected or weight of collected batteries
- Number of batteries recycled/re-used/re-purposed or weight of those batteries
- Number of repurposing schemes implemented during the project
- Number of workshops held
- Number of awareness sessions, number of participants, gender distribution
- Number of trainings, number of participants, gender distribution
- Client satisfaction related measurements
- Length of batteries second life (if the project duration allows it)
- Number of active collection sites
- Rate of public awareness of collection programs
- Recovery rate
- Recycling rate

Role and responsibilities

The project partners, including the SME that will receive funding, will own the responsibility for implementing the project. Monitoring and evaluation are the responsibility of the IEC Global Impact Fund. A theory of change will be co-developed by these parties in consultation with NCs / Affiliates and other stakeholders.

Budget

The IEC shall commit up to CHF 350 000 for an initial 2-year duration. In addition to ongoing involvement in the project, reviews will take place at 6-monthly intervals to monitor expenditure with agreed milestones, deliverables and link to further disbursements. Additional funding shall be sought from other sources and evaluation will include applicant contributions to the Project (monetary and non-monetary).

IEC International Standards and Conformity Assessment Systems

IEC International Standards and CA Systems will play a role in the project. The below is demonstrative of areas of IEC work that may be of relevance and is not complete description of what could be applicable to the project when implemented.

E-waste falls within IEC's scope (focus on electronics, electrical and ICT goods) through the work of the following groups, TCs or CA Systems: **ACEA, TC 111, TC 21, SC21A, TC 35, IECEE, IECQ, IECRE.**

IEC ACEA conducted advocacy on the circular economy to raise awareness of the benefits of recycled content or the re-use of components.

- ***IEC GUIDE 109:2012 Environmental aspects - Inclusion in electrotechnical product standards***

The Guide is intended for standards writers and gives guidance on how to consider aspects relating to the impact on the environment of electrotechnical products when preparing standards for such products.

IECQ, promotes Eco-design to increase the lifetime of products, a way to reduce e-waste. Repair, re-use, recyclability of e-products are promoted by IEC TCs taking into account environmental aspects.

Standardization

TC 21, SC21A, TC 35 and **TC 111** work on batteries. TC111 has also produced a preliminary mapping tool that can be found here: https://mapping.iec.ch/#/maps/105

Some standards from these TCs/SCs are listed below:

- **IEC 63218:2021, Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium, nickel cadmium and nickel-metal hydride cells and batteries for portable applications - Guidance on environmental aspects** (published)

This document provides requirements and recommendations on environmental aspects of secondary lithium, nickel cadmium and nickel-metal hydride cells and batteries for portable applications (hereafter referred to as "relevant secondary cells and batteries").

*Relevant secondary cells and batteries are specified within the scopes of **IEC 61960-3, IEC 61960-4, IEC 61951-1, and IEC 61951-2.***

Note: Portable applications are defined in IEC 61960-3 as comprising hand-held equipment, transportable equipment, and movable equipment. See IEC 61960-3 for examples.

This document is not intended to be applied to batteries embedded in end-use products. Once the embedded battery is removed from an end-use product, this document becomes applicable to it. The safety and control circuits as well as cases associated with relevant secondary batteries, except for those forming part of an end-use product, are covered by this document as parts of the relevant secondary batteries.

- **IEC 61960-4:2020, Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for portable applications - Part 4: Coin secondary lithium cells, and batteries made from them**

Specifies performance tests, designations, markings, dimensions and other requirements for coin secondary lithium cells and batteries for portable applications and backup power supply such as memory backup applications.

- **IEC 61960-3:2017, Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for portable applications - Part 3: Prismatic and cylindrical lithium secondary cells and batteries made from them**

Specifies performance tests, designations, markings, dimensions and other requirements for secondary lithium single cells and batteries for portable applications. The objective of this document is to provide the purchasers and users of secondary lithium cells and batteries with a set of criteria with which they can judge the performance of secondary lithium cells and batteries offered by various manufacturers.

- **IEC 61951-1:2017, Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary sealed cells and batteries for portable applications - Part 1: Nickel-Cadmium**

Specifies marking, designation, dimensions, tests and requirements for secondary sealed nickel-cadmium small prismatic, cylindrical and button cells and batteries, suitable for use in any orientation, for portable applications.

- **IEC 61951-2:2017+AMD1:2022 CSV Consolidated version, Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary sealed cells and batteries for portable applications - Part 2: Nickel-metal hydride**

Specifies marking, designation, dimensions, tests and requirements for secondary sealed nickel-metal hydride small prismatic, cylindrical and button cells and batteries, suitable for use in any orientation, for portable applications

- **IEC 62902:2019 Secondary cells and batteries - Marking symbols for identification of their chemistry (published)**

Specifies methods for the clear identification of secondary cells, batteries, battery modules and monoblocs according to their chemistry (electrochemical storage technology). The markings described in this document are applicable for secondary cells, batteries, battery modules and monoblocs with a volume of more than 900 cm3. The marking of the chemistry is useful for the installation, operation and decommissioning phases of battery life

- **IEC 61429:1995 Marking of secondary cells and batteries with the international recycling symbol ISO 7000-1135**

This International Standard defines the conditions of utilization of the recycling symbol of the International Organization for Standardization (ISO) associated with the chemical symbols indicating the electrochemical system of the battery. This standard applies to lead-acid batteries (Pb) and nicke-cadmium batteries (Ni-Cd).

- **IEC 60086-6:2020 Primary batteries - Part 6: Guidance on environmental aspects**

Applies to all chemistries of portable primary cells and batteries standardized in the 60086 series.

The purpose of this document is to provide guidance on the proper scientific protocols for testing the environmental performance of batteries; the symbols used to convey messages for collection, recycling, or other ideas; and the aspects and functional unit(s) to be included in assessing the environmental impact of batteries with modern life-cycle analysis techniques

Standards Under Development

- **IEC 63369, Methodology for the Carbon Footprint calculation applicable to Lithium-ion batteries (Under development)**

This document provides general guidance for the specific application of ISO 14067 to Li-ion cells and batteries. It defines the parameters allowing an improved comparability of results for all Li-ion batteries. It covers industrial cells (dealt in WG5) and batteries, to the exclusion of batteries for automotive use.

- **IEC 63338, General guidance for reuse of secondary cells and batteries (to be published 15th December 2023)**

This document provides general guidance for reuse of secondary lithium cells, batteries, and battery systems after extraction from the application they were first placed on the market with (hereafter "relevant cells and batteries"). This document provides guidance for reuse that covers environmental aspects, risks, and coordination between the original manufacturer and the reuse application manufacturer.
Note: Reuse can be divided between refurbishing and repurposing. Compare with 3.15 "originally intended reuse" and 3.16 "originally unintended reuse".

- **IEC 62933-4-4 ED 1 – Electrical energy storage (EES) systems – Part 4-4: standard on environmental issues battery-based energy storage systems (BESS) with reused batteries – requirements (to be published 31st March 2023)**

This part of IEC 62933, which is a Technical Specification, describes environmental issues associated with BESS, focusing on recycled products as inputs and / or outputs of ESS system life cycle, and presents guidelines to address the environmental impacts to and from BESS including the impacts to humans due to chronic exposure associated with the mentioned environmental impacts.

- **IEC 63330 ED1, Requirements for reuse of secondary batteries (to be published 31st December 2023)**

This document provides requirements for repurposing of secondary cells, modules, battery packs and battery systems, herein also referred to as "PRODUCT", that are originally manufactured for other applications such as vehicle application. It specifies the procedure to evaluate the performance and safety of used PRODUCT for repurposing. IEC 63330 ED 1 also provides basic requirements for application of repurposed PRODUCT. This document targets lithium PRODUCT mainly, but not exclusively. The redox flow batteries are not covered by this document.
Note: General guidance for reuse of secondary lithium cells and batteries is provided in IEC 63338 (under development).

- **IEC 63333 ED1 General method for assessing the proportion of reused components in products (forecasted publication date 31st August 2023).**
- **IEC 63366 ED1 Product category rules for life cycle assessment of electrical and electronic products and systems (forecasted publication date 31st October 2023).**

- **IEC 63395 ED1 Sustainable management of waste electrical and electronic equipment (e-waste) (forecasted publication date March 2024).**

- **IEC TS 63428 ED1 Guidance on material circularity considerations in environmentally conscious design (forecasted publication date November 2023).**

Conformity Assessment

- **IECEE** has a scheme for batteries certification
    - 58 IEC Standards are used as reference for certification or tests.
    - Thousands of certificates are issued by IECEE

- **IECQ** From the IECQ schemes, the IECQ Hazardous Substance Process Management (HSPM) Scheme can be leveraged for the Project.

    - The IECQ HSPM Certification to IECQ QC 080000 that was introduced and implemented by IECQ, the IEC Quality Assessment System for Electronic Components, allows companies to develop processes to identify, control, quantify and report the amounts of hazardous and toxic substances in the products they manufacture or supply. IECQ QC 080000 builds upon the ISO 9001 quality management system framework that businesses use to manage the systematic and transparent quality processes within their organization.

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