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Technical aspects of e-waste management

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Question

Provide an annotated summary of available guidance on the technical aspects of e-waste management (this will include guidance, training and technical materials)

Contents

1. Summary

Population growth, increasing prosperity and changing consumer habits globally are increasing demand for consumer electronics. Further to this, rapid changes in technology, falling prices, increased affordability and consumer appetite for new products have exacerbated e-waste management challenges and seen millions of tons of electronic devices become obsolete. This rapid literature review collates evidence from academic, policy focussed and grey literature on the technical aspects e-waste value chains. The report should be read in conjunction with two earlier reports on e-waste management[1].

E-waste is any electrical or electronic equipment, including all components, subassemblies and consumables, which are part of the equipment at the time the equipment becomes waste. The exact treatment of Waste from Electrical and Electronic Equipment (WEEE) can vary enormously according to the category of WEEE and technology that is used. Electrical and electronic items contain a wide variety of materials. As a result of this complex mix of product types and materials, some of which are hazardous (including arsenic, cadmium, lead and mercury and certain flame retardants) multiple approaches to WEEE are required, each with specific technical guidelines. This report is structured as follows:

- Section two provides an introduction to the technical aspects of e-waste management, including a reflection on the challenges and complexities of managing a range of product types involving a range of components and pollutants.
- Section three provides an annotated bibliography of key readings that discuss elements of the technical aspects of managing e-waste. This bibliography includes readings on national guidelines, training manuals and technical notes produced by the Basel convention and courses.

WEEE recycling can be a complex and multifaced process. In order to manage e-waste effectively, the following must be in place

- **Legislative and regulatory frameworks**
- **Waste Prevention and minimisation guidelines**
- **Identification of waste mechanisms**
- **Sampling, analysis and monitoring expertise**
- **Handling, collection, packaging, labelling, transportation and storage guidelines**
- **Environmentally sound disposal guidelines**

Management is further complicated by the speed of technological advance with technologies becoming redundant much sooner than initially planned. Case studies show that the average actual lifetimes of certain electronic products are at least 2.3 years shorter than either their designed or desired lifetimes.

[1] Avis, W. (2021). *Drivers, barriers and opportunities of e-waste management in Africa.* K4D Helpdesk Report No. 1074. Institute of Development Studies. https://doi.org/10.19088/K4D.2022.016

Avis, W. (2022). Avis, W. (2022). *Responsible E-Waste Value Chains in Africa*. K4D Helpdesk Report No. 1074. Institute of Development Studies. https://doi.org/10.19088/K4D.2022.015

2. Technical aspects of e-waste management

Recycling of WEEE is a specialist part of the waste and recycling industry. Of the estimated 53.6 million Mt of e-waste generated globally in 2019, 82.6% or 44.3 million Mt was not documented (of this figure 43.7 million Mt of e-waste is unknown (this is dumped, traded or recycled) and 0.6 million Mt of e-waste is estimated to have ended up in residual waste bins in EU countries) (Forti et al., 2020). The remaining 17.4% or 9.3 million Mt of e-waste is documented as collected and properly recycled. Small equipment (38%) and large equipment (20%) represent the main forms of e-waste (Forti et al., 2020).

Box 1: ***What is e-waste? (WHO, 2021)***

E-waste is any electrical or electronic equipment, which is waste, including all components, subassemblies and consumables, which are part of the equipment at the time the equipment becomes waste. Such items include:

• computers, monitors and motherboards, chips • wireless devices and other peripheral items • printers, copiers and fax machines • telephones, mobile phones and tablets • video cameras • televisions • stereo equipment • cathode ray tubes • transformers • cables and batteries • lamps and light bulbs (including mercury-containing CFL and fluorescent bulbs) • large household appliances (refrigerators, washers, dryers, microwaves) • toys and sports equipment • tools • medical devices (some microscopes, electronic blood pressure monitoring devices, electrocardiogram machines, spectrophotometers, etc.).

E-waste management is thus a rapidly growing sub-sector due to population growth, increasing prosperity and changing consumer habits which are increasing demand for consumer electronics. Further to this, rapid changes in technology, falling prices and consumer appetite for new products have exacerbated e-waste management challenges and seen millions of tons of electronic devices become obsolete.

Challenges in e-waste management are exacerbated by a lack of awareness and environmental legislation and limited financial resources. These issues are particularly evident in low- and middle-income countries (LMICs). Proper disposal of e-waste requires training and investment in recycling and management technology as improper processing can have severe environmental and health effects. Countries that import Used Electrical and Electronic Equipment (UEEE) and e-waste often lack policies, knowledge, and appropriate disposal facilities, thus resulting in the accumulation of e-waste (Nganji & Brayshaw, 2010). Increased attention is focussed on how to encourage the better management of e-waste across the value chain.

Treatment of Waste from Electrical and Electronic Equipment (WEEE)

The exact treatment of WEEE can vary enormously according to the category of Waste from Electrical and Electronic Equipment (WEEE) and technology that is used. Some treatment facilities utilise large-scale shredding technologies, whilst other use a disassembly process, which can be manual, automated or a combination of both. Electrical and electronic items contain a wide variety of materials, for example an TV contains 6% metal and 50% glass, whereas a cooker is 89% metal and only 6% glass. Other materials found include plastics, ceramics and precious metals.

As a result of this complex mix of product types and materials, some of which are hazardous (including arsenic, cadmium, lead and mercury and certain flame retardants) WEEE recycling poses a number of health risks that need to be adequately managed. For example, exposure to substances released during processing, examples include mercury released from fluorescent tubes or lead and phosphorous pentachloride released from cathode ray tubes).

The environmentally sound management of e-waste is thus a complex and multifaceted process, complicated by both the nature of waste (i.e., products being recycled), the content of that waste (i.e., the raw materials involved) and the available infrastructure. Different types of goods will require different approaches and different chemicals will need different types of treatment. There are also multiple stages required in the environmentally sound management of e-waste. These include (see UNEP, 2015 and the technical guidelines on disposal of waste generated by the Basel Convention):

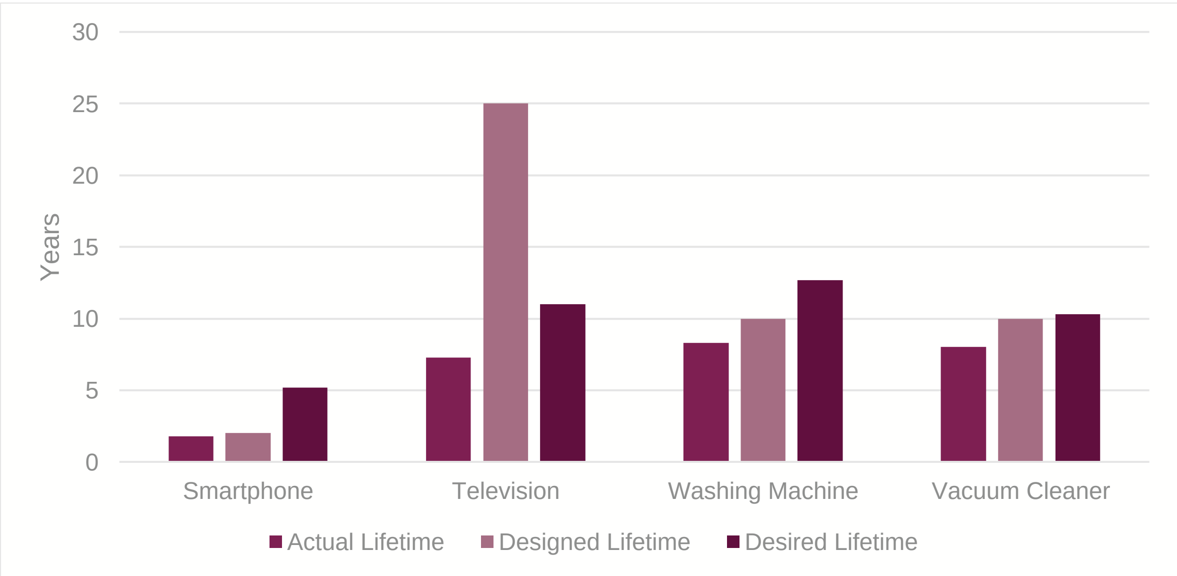
- **Legislative and regulatory frameworks**: Elements of a regulatory framework should include measures to prevent the generation of wastes and to ensure the environmentally sound management of generated wastes. Such elements could include the following etc:
    - Environmental protection legislation establishing a regulatory regime, setting release limits and establishing environmental quality criteria;
    - Guidance on the production, sale, use, import and export of e-waste;
    - Transportation requirements for hazardous materials and waste;
    - Specifications for containers, equipment, bulk containers and storage sites
    - Requirements for waste management and disposal facilities
- **Waste Prevention and minimisation**: Guidance and policies that encourage reduction, reuse and recycling of waste should be developed:
- **Identification of waste** e.g., what is and isn't reusable, what can be recycled and what must be disposed of in what way.
    - **Identification**: Facilities and expertise should be developed to support the identification of different types of e-waste and facilities that are able to manage these.
    - **Inventories**: To support the above, inventories are an important tool for identifying, quantifying and characterizing wastes.
- **Sampling, analysis and monitoring**: Ensuring that e-waste management is undertaken in a sound manner, it is important to ensure that those responsible undertake sampling, analysis and monitoring. This will involve:
    - **Sampling**
    - **Analysis**
    - **Monitoring**
- **Handling, collection, packaging, labelling, transportation and storage**: Guidance is needed to ensure the efficient, effective and safe handling, collection and transportation of e-waste. This will include that generated domestically and internationally. This will include the labelling of waste and its safe storage. This is particularly important if waste contains toxic chemicals. Key elements will include:
    - **Handling**
    - **Collection**
    - **Packaging**
    - **Labelling**

- Transportation
- Storage

- **Environmentally sound disposal**: Whilst reduction, reuse and recycling of e-waste is to be encouraged, a proportion of waste will also need to be disposed of. Guidance on the effective treatment and disposal of different types of waste will be needed. Particularly for older e-waste that may contain toxic chemicals. This will involve guidance on the following stages.
    - **Pre-treatment:** The cutting, milling or disassembling of waste.
    - **Destruction and irreversible transformation methods**: Approaches to the retrieval of required components.
    - **Other disposal methods when neither destruction nor irreversible transformation is the environmentally preferable option**: this may be the cleansing or decomposing of waste.
- **Remediation of contaminated sites**. In instances where waste treatment sites become contaminated, guidance and approaches to remediation will be required.

The technical aspects of e-waste management are further impacted by the pace of change of technology. Case studies of four different electronic product groups show all have average actual lifetimes that are at least 2.3 years shorter than either their designed or desired lifetimes (European Environment Agency, 2020).

Table 1: ***Lifetimes for smartphones, televisions, washing machines and vacuum cleaners in years.***



Source: European Environment Agency, 2020 reproduced under CC BY 2.5 DK

3. Annotated Bibliography

In what follows, I provide a range of readings that touch on the above. The section is structured as follows:

- **International examples of e-waste management**: an overview of different national efforts to better manage e-waste management. These examples touch upon the development of nationally relevant technical guidelines to the management of electrical and electronic waste and its safe disposal.
- **E-waste training materials and technical guides**: an overview of a range of training materials and technical guides. These examples include assessments of technologies available, approaches to e-waste management, advice on establishing centres to manage waste and technical specifics of different approaches.
- **Basel Convention technical guidance notes**: an overview of technical guidance notes for the transportation and treatment of hazardous wastes as outlined by the Basel convention. These notes touch on the content rather than the specific nature of waste. This includes how to manage mercury and Polychlorinated biphenyls (PCBs) for example.
- **Solving the E-waste Problem (StEP) initiative**: an overview of outputs published by StEP that aim to design strategies that address all dimensions of electronics in an increasingly digitized world. StEP applies an integrated, science-rooted approach to create salient solutions to global e-waste challenges along the entire electronics life cycle.
- **Courses**: a summary and links to a Massive Open Online Course that discuses waste management.
- **Other initiatives**: an overview of various initiatives (principally UN system) that have been launched to address the growing challenge of e-waste management.

International examples of e-waste management

United Nations University (2011). E-Waste Management in Germany. UNU.
https://globalewaste.org/proxy/?publication=/v1/file/98/E-waste-Management-in-Germany.pdf

This report describes the German e-waste management system. It explains the key players and their roles, shows the performance of the system, and discusses the positive and negative experiences obtained during the five years operation of the German e-waste management system.

Each producer putting electrical and electronic equipment (EEE_ on the German market is responsible to take back the amounts of e-waste corresponding to the market share in the EEE put on the market (PoM). Producers establish takeback systems or otherwise organise the takeback of the e-waste. Collective takeback systems are not common in Germany. Producers normally directly contract end-of-life service providers (ESPs) organising the logistics, treatment and disposal of e-waste.

The German e-waste management system exceeds the minimum collection, recovery and recycling targets stipulated in the (WEEE Directive 2003). Nevertheless, Germany collects less than 50 % of e-waste arising, and treatment operators complain about the quality of collection because of damaged e-waste hindering proper treatment. The report notes that the collection of e-waste needs better financing mechanisms to increase the rates and quality of collection. Higher collection rates could also help reducing the illegal transboundary shipments of e-waste to LMICs, which are a persisting problem in Germany.

Energy Africa & Sofies (2017). Sustainable Management of E-Waste in the Off-Grid Renewable Energy Sector in Rwanda. Evidence on Demand. https://assets.publishing.service.gov.uk/media/5aec19eded915d42f7c6beb2/Sustainable_Management_of_E-Waste_in_the_Off-Grid_Renewable_Energy_Sector_in_Rwanda.pdf

The report analyses extended producer responsibility (EPR) and assesses the framework conditions in Rwanda for establishing a sustainable e-waste take-back and recycling system and provides key policy recommendations on policy and legislation as well as stakeholder engagement, awareness and capacity building.

It concludes with next steps and areas for further research as well as elements to support the establishing of a financing mechanism and an EPR fund for e-waste management in Rwanda.

National Environment Management Authority (NEMA) (2010), Guidelines for E-Waste Management in Kenya. NEMA. https://www.nema.go.ke/images/Docs/Guidelines/E-Waste%20Guidelines.pdf

The purpose of these guidelines is to assist the government, private sector, learning institutions and other stakeholders to manage electrical and electronic waste effectively to enhance environmental conservation. The development of these guidelines is one of the activities in the e-learning strategy for the environment sector. The e-learning strategy was developed in 2009 and adopted in April 2010. The guidelines have been developed through a consultative process involving various stakeholders in the environment sector as listed in Appendix 5. The guidelines have been developed with the strategic objective of providing a framework for the development of regulations and policies in Kenya. Specific objectives of the guidelines include:

- To enhance environmental protection from e-waste.
- To establish a basis for a policy and regulatory frameworks on e-waste management.
- To raise public awareness on sustainable management of e-waste in Kenya.

Included in the guidelines are approaches to enhance environmental protection; policy and regulatory frameworks; environmental awareness; categories of e-waste and target groups; e-waste treatment technologies; and disposal procedures.

Ministry of Information and Communications Technology (2016). Guidelines for E-Waste Management in Uganda. Ministry of Information and Communications Technology. http://kanagwa.com/wp-content/uploads/2016/05/e-waste-guidelines-uganda.pdf

These guidelines are a reference document for handling and disposal of E-Waste. They provide a situational analysis and current regulatory and institutional framework. These guidelines seek to implement the 4Rs (Reduce, Repair, Reuse and Recycle) to effectively minimise the E-Waste. The last 3Rs (Repair, Reuse and Recycle) are heavily dependent on the efficiency of the collection systems and E-Waste treatment infrastructure. In this report, the different collection systems based on the collection channels are strongly emphasized. The guidelines are a realisation of the international and national efforts to manage e-waste. The e-waste concept came to light as far back as in 1970s and 1980s following environmental degradation that resulted from hazardous waste imported to LMICs. In reaction to hazardous waste importation, the Basel Convention on the control of transboundary movements of hazardous waste and its disposal was instituted in 1992 to control the situation. In Uganda, the e-waste management policy was approved by Parliament in 2012. This report therefore presents:

- A review of the e-waste management policy, the e-waste management strategy and other relevant documents.
- Clear and separate guidelines to respective e-waste stakeholders such as consumers, learning Institutions, manufacturers, Assemblers, people living near dumping sites, Government bodies, recyclers, Transporters, disposal entities, e waste collectors, refurbishers and importers.
- Clear terms of incentives for encouraging both local and foreign investors to establish e-waste facilities in Uganda. The incentives target manufacturers, assemblers, recyclers, transporters, disposal entities, e-waste collectors, and refurbishers.

The guidelines also include collection systems as well as guidelines for setting up e-waste unit treatment facilities. This set of guidelines is seen as fundamental step towards comprehensive management of e-waste in Uganda. The guidelines provide a basis for development of e-waste regulations in Uganda.

Central Pollution Control Board (CPCB) Delhi (2016). Implementation Guidelines for E-Waste (Management) Rules, 2016. CPCB.
https://cpcb.nic.in/displaypdf.php?id=aHdtZC9HVUlERUxJTkVTX0VXQVNURV9SVUxFU18yMDE2LnBkZg==

This report provides an overview of the implementation of India's e-waste management rules. E-Waste (Management & Handling) Rules, 2011 were notified in 2011 and had come into force since the 1st of May 2012. These rules are applicable to every producer, consumer or bulk consumer, collection centre, dismantler and recycler of e-waste involved in the manufacture, sale, purchase and processing of electrical and electronic equipment or components specified in schedule–I of these Rules.

Two categories of electrical and electronic equipment namely (i) Information Technology (IT) and Telecommunication Equipment and (ii.) Consumer Electricals and Electronics, such as TVs, washing machines, refrigerators, air conditioners including fluorescent and other mercury containing lamps are covered under these Rules. The main feature, of these rules, is Extended Producer Responsibility (EPR).

A target-based approach for implementation of EPR has been adopted in the E-Waste (Management) Rules, 2016, which stipulate phase wise collection target to producers for the collection of e-waste, either in number or weight, which shall be 30% of the estimated quantity of waste generation during the first two year of implementation of these Rules followed by 40% during third and fourth years, 50% during fifth and sixth years and 70% during seventh year onwards.

The E-Waste (Management) Rules, 2016 mandate CPCB to prepare guidelines on implementation of the E-Waste Rules, which includes specific guidelines for extended producer responsibility, channelisation, collection centres, storage, transportation, environmentally sound dismantling and recycling, refurbishment, and random sampling of EEE for testing of parameters. In this document all the above guidelines have been compiled except guidelines for random sampling of EEE for testing of parameters. These guidelines are given in separate sections of this document.

E-waste training materials and technical guides

GIZ (2019). E-Waste Training Manual. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). https://www.giz.de/de/downloads/giz2019-e-waste-management.pdf

This training manual was developed within the framework of the German Cooperation programme for "Environmentally Sound Disposal & Recycling of E-Waste" (E-Waste Programme, 08/2016 – 01/2020), with its objective to support the Ghanaian Ministry of Environment, Science, Technology and Innovation (MESTI) to improve the conditions for sustainable management of e-waste in Ghana.

As a basic manual for e-waste trainers, this publication assembles compact information about e-waste in theory (definitions, global and local implications), practical dismantling of different types of equipment, output fractions after manual dismantling, the management of a small-scale recycling facility (including the calculation of business opportunities), and the organising of trainings. An annex comprises contacts and references as well as templates that can be used in future workshops.

GIZ (2019). Business Cases for Selected Recycling Technologies in Support of an Optimal Recycling Chain in Ghana/ GIZ. https://www.giz.de/en/downloads/giz2019-en-business-cases-selected-recycling.pdf

This report covers the financial assessment of the different e-waste categories with data specific to Ghana, to provide a basis for the financial viability of e-waste recycling technology options for Ghana. Due to the lack of quantitative data, some figures in this report are based on estimations and must be used with precaution and seen as a realistic range of values instead of absolute values. This report covers four categories of e-waste:

- Lighting equipment,
- Cathode-ray tube (CRT) and flat-panel display (FPD) monitors,
- Cables
- Used lead acid batteries (ULABs).

For each category the value of waste material is estimated, recycling technologies identified, investment and running costs calculated and a profit/loss projection established.

GIZ (2019). Operationalization Model for an Optimal Recycling System in Ghana. GIZ. https://www.giz.de/en/downloads/giz2019-en-model-optimal-recycling-ghana.pdf

The main objective of this report is to present a consolidate analysis of discussions and decisions related to the operationalisation of the Hazardous and Electronic Waste Control and Management Act (Act 917). The analysis provides an input to the relevant governmental entities to further optimise the recycling system in Ghana. Specifically, the report aims to:

- systemise possible recycling options for Ghana,
- analyse the optimal allocation of actors to the Ghanaian value chain
- discuss open issues and requirements towards an implementation roadmap.

The report provides a short introduction to the background given by Act 917, the levy and the fund, as well as the current challenges for a sustainable e-waste management system in Ghana. The key framework conditions towards the implementation of Act 917 have been set by the adopted National E-Waste Management Scheme and the legally binding Ghana Technical Guidelines. Based on this, a first concept for an optimal recycling system in Ghana has been drafted in a stakeholder workshop in early 2019. The analysis suggests a more detailed interpretation of the outcome of this workshop. The concept is structured according to the schematic of a generic recycling chain and could form the basis to further operationalise the national integrated e-waste management scheme and develop the necessary sustainable business models.

The report concludes with some open questions related to the operationalisation of the national scheme, which are mainly related to the role of the “National E-Waste Recycling Facility”. The required further steps for the political process are summarised. All of them heavily depend on the correct implementation of the recycling levy and the disbursement of the fund and need to be discussed and amended through the political stakeholder process.

GIZ (2019). Downstream Technology Option for E-waste Recycling. GIZ.
https://www.giz.de/en/downloads/giz2019-en-business-option-e-waste-recycling.pdf

In support of the stakeholder process lead by the Ministry of Environment of Ghana (MESTI), this report presents an overview of downstream technology options for Ghana. The report aims to provide support to the implementation of the Ghanaian Hazardous and Electronic Waste Control and Management Act (Act 917). It should serve as a reference book, providing technology background information covering all parts of the e-waste value chain from collection to transport, manual and mechanical processing as well as refining and disposal.

Technological details are given for the categories “Screens & Monitors”, “Lamps”, “Large equipment” and “Small equipment and small IT and telecommunication equipment”. An overview of further (mechanical) processing and refining technologies of output material is given for cables, printed wiring boards lamps and other relevant fractions.

Environmental Protection Agency (2018). Technical Guidelines on Environmentally Sound E-Waste Management for Collectors, Collection Centers, Transporters, Treatment Facilities and Final Disposal in Ghana. Swiss State Secretariat for Economic Affairs (SECO). https://www.sustainable-recycling.org/wp-content/uploads/2018/03/eWaste-Guidelines-Ghana_2018_EPA-SRI.pdf

Based on analysis of existing voluntary guidelines and standards in other this report presents a first draft of the guidelines tailored to the specific needs and challenges of the national e-waste sector to public and private sector stakeholders in Ghana in August 2016. Subsequently, comprehensive feedback was included. In particular, the guidelines were extended towards an approach to differently address the various target groups of the reverse supply chain of electronic and electric equipment becoming e-waste. By this, the guidelines at hand specifically address the following five target groups:

(1) Collectors,
(2) Collection Centres,
(3) Transporters,
(4) Treatment Facilities,
(5) Final Disposal.

UN-Environment (2017). Compendium of Technologies for the Recovery of Materials from E-Waste. UN-Environment.

https://wedocs.unep.org/bitstream/handle/20.500.11822/31535/WEEE_E-waste.pdf?sequence=1&isAllowed=y

IETC aims to promote identification and implementation of environmentally sound technologies (ESTs) for collection, storage, treatment, disposal, recovery and recycling of different waste streams. In this context, UNEP DTIE-IETC has prepared a compendium of environmentally sound technologies (EST) for WEEE/e-waste management. The key audience of this compendium will be technology selection decision-makers. This work will complement the work being done globally and regionally, on the subject by UNEP and other related agencies. The following sections describe the overview of WEEE/e-waste, objectives, scope and format of the compendium.

The main objectives of this compendium include:

- To facilitate the technology decision-makers use in making more informed decisions;
- Develop criteria to facilitate the assessment of various technology options to shortlist most relevant and suitable technologies and prepare compendium of commercially available or near commercially available technologies and associated techniques for resource recovery from used WEEE/e-waste.

The scope of this compendium covers information on commercially available or near commercially available technologies and associated techniques for resource recovery from WEEE/e-waste and subsequent treatment of residual wastes. The key fields of information in the compendium are: Type of technology – detailed process description, type of waste handled, products (if any), emissions, job potential and capacities available; Operational/technical details including parameters for specifications for procurement, operation and maintenance requirements, and specific aspects for developing countries; Environmental and social considerations; Investment and operating costs; Institutional and regulatory requirements; Pros and Cons with respect to developing countries; Examples of real life applications; Photographs and sketches and Suppliers. Criteria have been developed to facilitate the assessment of various technology options to shortlist most relevant and suitable technologies. Furthermore, guidelines of the technologies have been developed based on the available techniques and technologies for WEEE/e-waste management, including collection, storage and primary and secondary dismantling for resource recovery and proper disposal of WEEE/e-waste.

WRAP (2021). Waste Electrical and Electronic Equipment Treatment Guide. WRAP.
https://wrap.org.uk/sites/default/files/2021-02/WRAP-WEEE-Treatment-Guide.pdf

This UK guide for those working in the e-waste sector focuses on treatment of Waste Electrical and Electronic Equipment (WEEE) at Approved Authorised Treatment Facilities (AATFs)/Authorised Treatment Facilities (ATFs) and re-use organisations. It is structured to allow users to focus on specific areas of interest or to read as whole chapters. This guide:

- Documents procedures considered good practice to help and improve WEEE treatment.
- Builds on statutory guidance from central Government and assumes compliance with the WEEE Regulations as a *de minimus*.
- Identifies good practice choices, allowing adoption of those most suitable.
- The guide does not replace relevant statutory guidance or the Best Available Treatment, Recovery and Recycling Techniques (BATRRT) and will not be applicable in all situations.

Further guidance and research on the collections, re-use, recycling and recovery of WEEE is available on the WRAP website at www.wrap.org.uk/sustainable-electricals.

Prasad, M. et al. (2019). Handbook of Electronic Waste Management: International Best Practices and Case Studies. Elsevier Science.
https://www.scribd.com/book/436939601/Handbook-of-Electronic-Waste-Management-International-Best-Practices-and-Case-Studies?utm_medium=cpc&utm_source=google_search&utm_campaign=3Q_Google_DSA_NB_RoW&utm_device=c&gclid=EAIaIQobChMI_864_dqW9gIVjbTtCh3Hrw5nEAMYASAAEgJ9ifD_BwE

The Handbook of Electronic Waste Management: International Best Practices and Case Studies begins with a brief summary of the environmental challenges associated with the approaches used in international e-waste handling. The book's authors offer a detailed presentation of e-waste handling methods that also includes examples to further demonstrate how they work in the real world. This is followed by data that reveals the geographies of e-waste flows at global, national and subnational levels. The handbook:

- Includes case studies to illustrate the implementation of innovative e-waste treatment technologies;
- Provides methods for designing and managing e-waste management networks in accordance with regulations, fulfilment obligations and process efficiency;
- Reference guide for adapting traditional waste management methods and handling practices to the handling and storage of electronic waste until disposal;
- Provides e-waste handling solutions for both urban and rural perspectives.

Basel Convention technical guidance notes

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted on 22 March 1989 by the Conference of Plenipotentiaries in Basel, Switzerland, following the discovery, in the 1980s, in Africa and other parts of the global south of deposits of toxic wastes imported from abroad.

The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as “hazardous wastes” based on their origin and/or composition and their characteristics, as well as two types of wastes defined as “other wastes” - household waste and incinerator ash. The Convention has developed a range of technical guidance notes for the environmentally sound management of wastes including the below

UNEP (2015). Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with PCBs, PCTs or PBBs, including HBB. UNEP. http://www.basel.int/Portals/4/download.aspx?d=UNEP-CHW.12-5-Add.5-Rev.1.English.pdf

The general technical guidelines in this technical note are intended to serve as an umbrella guide for the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants (POPs) and provide more detailed information on the nature and incidence of wastes consisting of, containing or contaminated with polychlorinated biphenyls, polychlorinated terphenyls or polybrominated biphenyls including hexabromobiphenyl, for purposes of their identification and management.

- Pre-treatment
- Destruction and irreversible transformation methods
- Other disposal methods when neither destruction nor irreversible transformation is the environmentally preferable option
- Other disposal methods when the POP content is low.

Box #: ***PCBs, PCTs and PBBs in E-wastes (Ceballos and Alvarez, 2021)***

The utility of PCBs is based largely on their chemical stability, including low flammability and high dielectric constant. In an electric arc, PCBs generate incombustible gases.

Because they don't burn easily and are good insulating materials, PCBs were used widely as coolants, sealants, and lubricants in transformers, capacitors, and other electrical equipment. PCBs were used in hundreds of industrial and commercial applications. PCBs were used in electrical equipment because of performance and safety attributes such as fire resistance and flame retardancy. Today, PCBs are found mainly in transformers and capacitors manufactured before 1977. PCBs are often found in the following e-waste:

- Old industrial equipment (e.g., welding equipment).
- Medical equipment (e.g., X-ray).
- Household appliances and electronics (e.g., refrigerators, microwaves, televisions, old computers).
- Electrical equipment components in transformers, voltage regulators, capacitors, switches, and lamp ballasts, among others.

PCTs were used in almost exactly the same applications as PCBs but in much smaller amounts.

The principal use of PBBs was as flame retardants. PBBs are an additive type flame retardant. In the United States and Canada, FireMaster was used as a flame retardant in three main commercial products: acrylonitrile-butadienestyrene (ABS) thermoplastics (10 per cent PBBs) for housing business machines, industrial equipment (e.g., motor housing) and electronic products (e.g., radio and TV parts).

UNEP (2015). Technical guidelines on the environmentally sound management of wastes containing or contaminated with unintentionally produced PCDD, PCDF, HCB, PCB or PeCB. UNEP. http://www.basel.int/Portals/4/download.aspx?d=UNEP-CHW.12-5-Add.4-Rev.1.English.pdf

Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with the pesticides aldrin, alpha hexachlorocyclohexane, beta hexachlorocyclohexane, chlordane, chlordecone, dieldrin, endrin, heptachlor, hexachlorobenzene, lindane, mirex, pentachlorobenzene, perfluorooctane sulfonic acid, technical endosulfan and its related isomers or toxaphene or with hexachlorobenzene as an industrial chemical

In particular, those note identifies the use of Aldrin until the early 1970s to control soil pests, such as corn rootworm, wireworms, rice water weevil and grasshoppers. It was also used to protect wooden structures and plastic and rubber coverings of electrical and telecommunication cables.

This Technical note provides guidance on the following areas:

- Pre-treatment
- Destruction and irreversible transformation methods
- Other disposal methods when neither destruction nor irreversible transformation is the environmentally prefer
- Other disposal methods when the POP content is low able option

UNEP (2011). Technical guidelines for the environmentally sound management of wastes consisting of elemental mercury and wastes containing or contaminated with mercury. UNEP. http://www.basel.int/Portals/4/download.aspx?d=UNEP-CHW-GUID-PUB-Mercury.English.pdf

Mercury is or has been widely used in products, such as medical devices (thermometers, blood pressure gauges), switches and relays, barometers, fluorescent light bulbs, batteries and dental fillings, and in industrial production, such as chlor-alkali plants, vinyl chloride monomer (VCM) production, acetaldehyde production and mercury-added product manufacturing. Mercury may also be a by-product of raw materials refining or production processes such as non-ferrous mining and oil and gas operations. Mercury is recognised as a global hazardous pollutant. Mercury emissions and releases can be human-caused (anthropogenic) and may also come from natural sources. Once mercury is released into the environment, it persists in the atmosphere (mercury vapour), soil (ionic mercury) and aquatic phase (methylmercury (MeHg, or CH3Hg+)).

Some mercury in the environment ends up in the food chain, because of bioaccumulation and biomagnification, and is eventually ingested by humans. Improper handling, collection, transportation or disposal of wastes consisting of elemental mercury and wastes containing or contaminated with mercury can lead to releases of mercury, as can some disposal technologies. Wastes consisting of elemental mercury (e.g., elemental mercury recovered from waste containing mercury and waste contaminated with mercury and surplus stock of elemental mercury designated as waste). Mercury may be found in the following:

- Wastes containing mercury (e.g., waste of mercury-added products):
- Wastes of mercury-added products that easily release mercury into the environment when they are broken (e.g., waste mercury thermometers, fluorescent lamps);
- Wastes of mercury-added products (e.g., batteries);
- Stabilised or solidified wastes containing mercury that result from the stabilization or solidification of wastes consisting of elemental mercury;
- Wastes contaminated with mercury (e.g., residues generated from mining processes, industrial processes, or waste treatment processes).

The present guidelines focus on wastes consisting of elemental mercury and wastes containing or contaminated with mercury categorized as hazardous waste.

This note introduces the concept of life-cycle management provides an important perspective for ESM of wastes consisting of elemental mercury and wastes containing or contaminated with mercury. Life-cycle management provides a framework for analysing and managing the performance of goods and services in terms of their sustainability.

Efficiency for Access Coalition (EFAC) (2021). Innovations and Lessons in Solar E-Waste Management. EFAC. https://www.clasp.ngo/research/all/innovations-in-off-grid-solar-e-waste-management/

The Efficiency for Access Coalition launched the Global LEAP Solar E-Waste Challenge in 2019 to catalyse the development of sustainable approaches to off-grid solar e-waste management. By addressing the barriers to effective management of off-grid solar e-waste, the Challenge seeks to promote sustainable industry growth and enhances the sector's reputation as a leader in environmental responsibility.

The aim of this report is to share the good practice that emerged from these projects, to inform future efforts to address growing amounts of e-waste and advance the state of practice in the sector. In examining and analysing the experiences of these eight companies, the authors gleaned data and insights for others to replicate their successes and avoid some of their pitfalls.

The report was written for off-grid solar company staff involved in developing and implementing e-waste strategy and operations. However, it is also relevant for e-waste service providers (such as recyclers), investors, sector support programmes and governments, each of whom has a role to play in ensuring that solar e-waste is more responsibly managed in the future.

ITU (2021). Policy practices for e-waste management: Tools for fair and economically viable extended producer responsibility. ITU. https://www.itu.int/en/ITU-D/Environment/Documents/Publications/2021/Toolkit_Africa_final.pdf?csf=1&e=OHEtlM

This is a toolkit for policymakers. Its purpose is to provide national and local government with a guide setting out the requirements of a system for the management of e-waste. It considers the need for an all-actors approach and for the fair, inclusive and timely application of the extended producer responsibility principle. The report draws on experiences from developing countries and emerging markets, with a focus on emerging e-waste management systems in African countries.

Solving the E-waste Problem (StEP) initiative

The Solving the E-waste Problem (StEP) Initiative emerged in 2004 as an independent, multi-stakeholder platform for designing strategies that address all dimensions of electronics in an increasingly digitised world. StEP applies an integrated, science-rooted approach to create salient solutions to global e-waste challenges along the entire electronics life cycle.

StEP (2009). E-waste Take-Back System Design and Policy Approaches. StEP. https://www.step-initiative.org/files/_documents/whitepapers/StEP_TF1_WPTakeBackSystems.pdf

This document begins with a description of the generic structure of a take-back system, followed by details on the alternatives available to fulfil each component of the system and strengths and weaknesses of various alternatives. A list of key considerations in system design and examples of current system models is included at the conclusion of the document.

StEP (2012). Recommendations on Standards for Collection, Storage, Transport and Treatment of E-waste Principles, Requirements and Conformity Assessment. StEP. https://www.step-initiative.org/files/_documents/green_papers/StEP_GP_End%20of%20Life_final.pdf

The goal of this paper is to be a guide for the setup of country- or region-specific end of life (EoL) standards taking into account best practices and best available technologies (BAT). This paper is not an EoL standard. Rather, it gives an overview of the principles for the setup of EoL standards, suggests requirements standards for EoL of EEE should address and proposes approaches for translating the requirements into stipulations of an EoL standard.

Because standards, alone, will have little effect if EoL operators' compliance is not reliably audited, this paper also addresses principles and practices of sound auditing and certification. Finally, as several EoL standards have been set up and are about to be implemented, care must be taken to ensure that EoL operators do not have to work under multiple standards, which would increase both administrative burdens and operational costs. This paper proposes strategies for the application and harmonisation of EoL standards, and for increasing their overall quality and effectiveness over time.

StEP (2014). Recommendations for Standards Development for Collection, Storage, Transport and Treatment of E-waste. StEP. https://www.step-initiative.org/files/_documents/whitepapers/StEP_WP_Standard_20140602.pdf

A set of standards that clearly defines how e-waste should be handled from the point of collection to final disposal is one aspect of addressing the issues related to e-waste. The goal of this White Paper is to present the recommendations of the StEP Initiative on what characteristics and practices a comprehensive program should include to ensure that e-waste is collected, handled and treated responsibly, with minimal impact to the environment and communities and maximum recovery of valuable resources. Reuse and refurbishment are key steps at the beginning of the processes covered by these standards, and they are considered in this context in this document. While the recommendations presented here would apply to standards for reuse and refurbishment programs, they do not provide specific information regarding standard development for these systems.

The recommendations presented represent the issues an interested party should account for when designing a standard to address one or more stages of the EoL phase. This document is not intended to be used as a standard itself, but as a set of guidelines for standard-setting organisations.

The precursor to this work, "Recommendations on Standards for Collection, Storage, Transport and Treatment of E-waste" provides greater detail on the issues, best practices and potential implementation routes for solutions that extend beyond the current standards space.

StEP (2015). E-waste Prevention, Take-back System Design and Policy Approaches. StEP. https://www.step-initiative.org/files/_documents/green_papers/Step%20Green%20Paper_Prevention%26Take-backy%20System.pdf

This paper explores the large variety of policy options that have been implemented around the world and it draws some conclusions about the nature of responses to the e-waste problem and potential policy recommendations.

In the first decade of the 2000s, policymakers in industrialised and emerging countries focused their efforts on developing financing and awareness schemes aimed at ensuring better participation of both the private sector and individuals aimed at ensuring higher collection rates while maintaining the finances to meet the treatment costs.

The authors of this paper encourage further research on reducing overall e-waste volumes arising worldwide, encouraging repair and reuse both by producers and consumers and promoting eco-design, which are currently underrepresented in the literature.

In terms of policy recommendations, this paper seeks to present a variety of policy options, most of them having already been implemented to some degree in both in high-income countries and LMICs. A minority of recommendations are suggestions gathered from scientific work, the private sector or civil society organisations. The authors have tried to identify the advantages and disadvantages of each policy option, as there is no one-size-fits-all for e-waste policy and what works under some conditions may be inappropriate in others.

StEP (2016). Guiding Principles to Develop E-waste Management Systems and Legislation. StEP. https://www.step-initiative.org/files/_documents/whitepapers/Step_WP_WEEE%20systems%20and%20legislation_final.pdf

The following guiding principles resulted from the compilation of a SWOT analysis of thirteen existing e-waste management systems and pieces of legislation enacted in various regions of the world. The principles were conceived following an analysis of strengths, opportunities and threats, of existing systems and legislation, considering common patterns and loopholes, highlighting what currently works well and what needs to be improved.

These principles are intended to provide guidance to all stakeholders in LMICs developing solutions for e-waste management. As the input of the project is mainly based on e-waste systems in LMICs, the recommendations will best apply to LMICs, while most will hold true for developed countries as well.

Knowing that no one-size-fits-all solution exists, these recommendations are guiding elements that should be tailored and implemented taking local conditions into account.

1. Establish a clear legal framework for e-waste collection and recycling.
2. Introduce extended producer responsibility to ensure producers finance the collection and recycling of e-waste.
3. Enforce legislation for all stakeholders and strengthen monitoring and compliance mechanisms across the country to ensure a level playing field.
4. Create favourable investment conditions for experienced recyclers to bring the required technical expertise to the country.
5. Create a licensing system or encourage certification via international standards for collection and recycling.
6. If an informal collection system exists, use it to collect e-waste, and ensure e-waste is sent to licensed recyclers through incentives.
7. When no local end-processing facilities exist for an e-waste fraction, ensure good and easy access to international licensed treatment facilities.
8. Ensure that costs to run the system are transparent and stimulate competition in the collection and recycling system to drive cost effectiveness.

9. Ensure that all stakeholders involved in e-waste collection and recycling are aware of the potential impacts on the environment and human health as well as possible approaches to the environmentally sound treatment of e-waste.
10. Create awareness on the environmental benefits of recycling among consumers.

StEP (2020). Case studies and approaches to building Partnerships between the informal and the formal sector for sustainable e-waste management. StEP. https://www.step-initiative.org/files/_documents/publications/Partnerships-between-the-informal-and-the-formal-sector-for-sustainable-e-waste-management.pdf

The main purpose of this paper is to present approaches to and case studies on current informal-formal partnership models in different countries. The partnership concept in this document aims to support the achievement of high recycling rates and legislative requirements, under extended producer responsibility (EPR) or other take-back systems in low and middle-income countries. Exploring potential benefits and challenges in different partnerships or alliances between formal and informal sector is of importance in order to promote integrated solutions among different actors, provide social, financial and health benefits as well as to guarantee a sustainable management of waste material throughout the value chain. This paper is the result of a joint effort by members of the Solving the E-waste Problem (StEP) initiative, who conducted a review of existing e-waste partnerships. The information gathered is based on practical experience, secondary literature research as well as case studies obtained through a survey with Producer Responsibility Organisations and other initiatives in different countries.

StEP (2018). Developing Legislative Principles for e-waste policy in developing and emerging countries. StEP. https://www.step-initiative.org/files/_documents/whitepapers/Step_White_Paper_7_180221_low_compressed.pdf

The aim of this paper is to present core legal principles based on Extended Producer Responsibility (EPR) that can be reviewed, contextualised, and adapted by decision makers in countries that are developing legislation that will implement Extended Producer Responsibility programmes into the local context and in order to avoid a 'copy-paste' approach from post-industrialised to industrialising country legislation, except in critical areas such as 'definitions'. In establishing a clear legal framework for e-waste collection and recycling, the following building block principles should be included:

1. **Objectives** – typically the legislative objectives should focus on the protection of the environment and human health, through sustainable management of e-waste along with any other specific goals or targets.
2. **Definitions** – clear definitions are necessary to ensure all stakeholders understand concepts as simple as what is e-waste, a producer, or a collector.
3. **Roles and Responsibilities** – determining what roles the stakeholders play in the e-waste take-back system is essential for all stakeholders to work together effectively.
4. **System design** – introducing producer responsibility systems is essential to ensure that both fractions with negative and positive value are collected and treated appropriately.
5. **Enforcement** – clear provisions for enforcement must ensure all stakeholders meet the requirements of the legislation. Having the best e-waste legislation in the world means nothing if it is not effectively enforced.
6. **Social dimensions** – Impacts and opportunities for stakeholders and the general public should be considered and, where appropriate, measures taken.

7. **International alignment** – aligning the legislation with internationally recognised conventions, such as the Basel Convention, and internationally recognised recycling standards will avoid complications.
8. **Transparency** – the more transparent the system is to all stakeholders and the public the less prone it will be to issues such as the misuse of funds or misreporting of data.

StEP (2016). Leaded Glass from Cathode Ray Tubes (CRTs) A Critical Review of Recycling and Disposal Options. StEP. https://www.step-initiative.org/files/_documents/green_papers/GREEN_paper_CRT%20formatted_reel_final_%28update3%29.pdf

This report provides a critical review of products in which cathode ray tube (CRT) leaded glass can replace raw materials. Additionally, this report reviews current disposal options. The focus of the review is the fate of lead in the new products and repositories. The results complement available evaluations of the technical feasibility and direct environmental impacts of the options. As a result of the replacement of CRT screens by flat screens, the world is confronted with stranded end-of-life CRTs. CRTs contain 1 to 1.5 kg of lead per screen; mainly found in the funnel and neck glass for radiation protection purposes. The lead content makes this CRT glass unsuitable in most glass applications. Thus, there is an urgent need for alternative recycling options that are able to use up the CRT leaded glass while safely retaining the lead out of contact with humans and the environment.

StEP (2016). Business Plan Calculation Tool for Manual Dismantling Facilities. StEP. https://www.step-initiative.org/files/_documents/green_papers/Step_GP_BCT_final.pdf

The StEP-Business-Plan-Calculation-Tool supports entrepreneurs to set up an economic viable e-waste recycling business in an environmental sound manner. It can be further helpful for policy makers to understand the present economic framework conditions for e-waste recycling in their region. This paper gives an introduction into the design and structure of the calculation tool explaining its features. Further, possible use and benefits are illustrated in the report.

Courses

The E-waste Challenge Massive Open Online Course (MOOC)
http://www.basel.int/Implementation/TechnicalAssistance/MOOC/tabid/4966/Default.aspx

The E-waste Challenge MOOC is presented in five stand-alone and comprehensive online mini-courses, it is self-paced and introduces challenge and possible solutions for the environmentally sound management of e-waste. Participants can follow a long track following all the five mini-course or a short track by selecting some mini-courses.

This course will help the participants to understand why and how to manage e-waste in an environmentally sound manner and how action on e-waste could be taken in their own life, business, or organization.

The aims of the course are to:

- Show how sound management of e-waste can help reduce GHG emissions, mitigate climate change and prevent hazards to health and the environment in accordance with the Basel, Rotterdam, and Stockholm conventions;

- Share best practices, technological innovations, and sustainable e-waste recovery and inclusive recycling business models;
- Present innovative research on technological solutions to reduce hazard by design;
- Explore how the value in e-waste can be extracted in a way that supports the local economy and protects people's health and the environment, evaluating the socio-economic impacts of this change into more sustainable business models;
- Explore incentives and opportunities for e-waste recycling;
- Advocate for the Environmentally Sound Management (ESM) of e-waste.

Learners who complete the first and second mini-courses, and each of the other mini-courses will receive a certificate. Learners who complete all the five mini-courses will receive a United Nations Environment Programme/Secretariat of the Basel, Rotterdam and Stockholm conventions (BRS) and EIT Climate KIC certificate of course completion, including the contributing organizations. From the launch, on 18 February 2020, the MOOC will be accompanied by webinars live events, chat room discussions forums, and interactive features. After this period, the E-waste challenge MOOC will be available as an e-learning course.

This course is open to all and designed for university graduate students, policy makers, e-waste operators, administrators, business managers and anyone who is interested in the topic.

The MOOC has been developed by the Secretariat of the Basel, Rotterdam and Stockholm conventions (www.brsmeas.org), the EIT Climate-KIC (https://eit.europa.eu/our-communities/eit-climate-kic), the University of Leuven (KU Leuven, Belgium), (https://www.kuleuven.be/english) with contributions from The EIT RawMaterials Academy (https://eit.europa.eu/our-communities/eit-rawmaterials), the International Telecommunication Union (https://www.itu.int/en/Pages/default.aspx), the World Resources Forum (www.wrforum.org/) and the contribution of the World Health Organization (www.who.int) .

Other reading

Africa Clean Energy (2019). E-Waste Policy Handbook. Africa Clean Energy.
https://www.ace-taf.org/wp-content/uploads/2019/11/ACE-E-Waste-Quick-Win-Report20191029-SCREEN.pdf

This report provides an overview of e-waste policy highlighting that there are three fundamental elements in designing and implementing sustainable solutions for e-waste management:

- **Volumes and flows**: What quantities of waste are generated annually? What are the main routes of disposal from consumers? How can the volumes be best estimated? Modelling, surveys and literature can be combined to develop national baselines. Volumes and flows have direct impact on the dimensioning of proper collection and recycling infrastructure at national or regional level.
- **Economics**: The main fractions resulting from recycling processes need to be identified, including what happens to them downstream. The intrinsic economic value of various product types and the economics of collection and recycling also need to be considered. The key question to ask is: how can the financials of the system be calculated to estimate the baseline for proper collection and recycling, and which are the main leverages for cost-effectiveness of the system?

- **Engagement of consumers**: Off-grid solar companies have revolutionised the distribution of solar products, creating new business models to tackle the challenges of various customer segments. Although some of these models include important assets when it comes to end-of-life products, ultimately customers are the key interface between waste generated and any formal or informal collection and recycling system.

GPA et al. (2022). Electronic Waste (E-waste) Management for Off-grid Solar Solutions in Displacement Settings. GPA. https://reliefweb.int/sites/reliefweb.int/files/resources/e-waste-management-for-off-grid-solar-solutions-in-displacement-settings.pdf

This report provides an overview of opportunities and challenges associated the management of e-waste in displacement settings. As the number of initiatives focusing on improving energy access for displaced and host communities increases, so does the quantity of electronic waste (e-waste) in displacement settings. E-waste management practices in displacement settings are not present or sufficient in eliminating or reducing health and environmental hazards due to leaking batteries or exposure to heavy metals. Initial research shows that only 1% of the e-waste generated reaches a formal recycler. Most of the waste ends up unused, buried, burned, or informally disposed of on the ground.

The report includes an analysis of the current e-waste management landscape and highlights several challenges for establishing appropriate e-waste management programmes in displacement settings including: a lack of rules and regulations concerning e-waste in countries with displacement situations; the absence of established mechanisms for repair, recycling, and collection of end-of-life products; the logistical disconnect between solar manufactures and distributors and after-sales services; the lack of expertise on safer e-waste management practices within humanitarian organisations; the lack of awareness concerning recycling and disposal of electrical products within vulnerable communities; and the limited economies of scale associated with e-waste management programs in displacement settings as a result of the low number of off-grid solar products. With only a few projects initiated, e-waste management efforts are still in their infancy and require substantial coordination to foster a collective learning environment within the humanitarian energy space and reduce the duplication of efforts.

To address a number of these challenges, the GPA Coordination Unit is presently establishing a task force dedicated to sharing lessons learned around past, ongoing, and future e-waste projects, raising awareness around e-waste at the decision-making level, supporting the implementation of e-waste pilot projects, and organising webinars and workshops to disseminate findings. To be effective, the E-Waste Task Force will require inputs from host governments, humanitarian organisations, research institutes, private sector partners, and energy and environmental specialist, including those on the NORCAP Energy Expert Roster.

Other initiatives

- The Global E-waste Statistics Partnership, which includes ITU, the United Nations University (UNU) and the International Solid Waste Association (ISWA). The Global E-waste Statistics Partnership publishes the Global E-waste Monitor which provides a global overview of the e-waste situation, based on data gathered and statistical estimations. Several Regional E-waste Monitors are produced by the Partnership, providing further clarity on the status of the world's e-waste challenges.
- The Global E-waste Statistics Partnership has launched a new open-source portal globalewaste.org that visualises e-waste data and statistics globally, by region and

by country, for policy-makers, industry, academia and the public. The portal includes e-waste data from Global and Regional E-waste Monitors for most countries, such as: the amount of e-waste generated in total and per capita and discarded prior to any collection, reuse, treatment, or export; the amount of e-waste formally collected in total and per capita and regulated by environmental protection laws specifically designed for e-waste; and e-waste legislation by country, where applicable.

- The UN E-waste Coalition was launched in 2018, including a number of other UN system organisations, with support from the World Economic Forum and World Business Council for Sustainable Development.
- The WEEE Forum organises International E-waste Day in October each year. This global awareness initiative aims to raise the public profile of e-waste recycling and encourages consumers to recycle their e-waste.
- ITU helps Member States build capacity in addressing e-waste, by supporting them in identifying their national e-waste policy framework. Such a framework should comprise e-waste policies and legislation with innovative financing mechanisms and monitoring and control capabilities.
- the Solving the E-waste Problem (StEP) initiative, is a programme dedicated to facilitating global and collaborative efforts in reducing e-waste through policy change, product re-design, re-use, recycling and capacity building. The Global E-waste Monitor report is one of the results of this collaboration.
- The ITU-T Study Group 5 “Environment, climate change and circular economy" has developed a series of international standards (i.e. ITU-T Recommendations) to support city stakeholders and the ICT sector in developing a sustainable e-waste management system, evaluating the environmental impacts of WEEE, defining a safe procedure for recycling rare metals in ICTs, implementing the e-waste reduction target of the Connect 2030 Agenda, moving towards a circular economy and more. A complete list of ITU-T Recommendations on e-waste and circular economy can be found here.
- ITU organises the Green Standards Week (GSW), a global platform where policy-makers, field experts, city planners, regulators, standardization experts, civil societies, and other stakeholders can come together to discuss the role of ICT in facilitating smart sustainable cities and unlocking the potential of a circular economy. The 9th edition of GSW, which was held in Valencia from 1 to 4 October 2019, hosted a forum “Frontier Technologies to Tackle Climate change and Achieve a Circular Economy". For more information on the GSW, see here.
- The United for Smart Sustainable Cities (U4SSC) initiative is a UN initiative dedicated to support the transition to smart sustainable cities, is developing deliverables that encourage circularity actions in cities, including guidelines on strategies for circular cities.
- ITU has published a report entitled “Turning digital technology innovation into climate action" and has published “Frontier technologies to protect the environment & tackle climate change", to highlight the emerging role of ICTs and digital technologies in accelerating climate actions and tackling the e-waste challenge.

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About this report

This report is based on six days of desk-based research. The K4D research helpdesk provides rapid syntheses of a selection of recent relevant literature and international expert thinking in response to specific questions relating to international development. For any enquiries, contact helpdesk@k4d.info.

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