WEEE Directive Evaluation

ECOS assessment for the European public consultation

Brussels, 22 September 2023

ECOS welcomes the evaluation of the WEEE Directive to overhaul e-waste rules in the EU and put an end to the e-waste tsunami. Electrical and electronic equipment (EEE) is one of the fastest growing waste streams in the EU with annual growth rates of 2%. It was the first key product value chain selected in the Commission's 2020 Circular Economy Action Plan requiring "urgent, comprehensive and coordinated actions".

Moreover, the European WEEE Directive requirements are outdated, not aligned with other EU strategy goals (e.g. the Critical Raw Materials Act, Circular Economy Action Plan) or legislation (e.g. the Waste Framework Directive, the Persistent Organic Pollution Regulation), nor implemented consistently throughout the EU, even though the WEEE Directive came into force in 2012. Since then, the EU has grasped the urgent need to shift away from a purely waste management-focussed approach towards a circular economy.

UN data shows natural resource extraction and processing is responsible for more than 90% of biodiversity loss and water stress and for 50% of climate change impacts. Other indicators also reveal alarming signs of environmental degradation from primary resource extraction for EEE production and disposal including deforestation, land degradation, the disruption of the Earth's freshwater cycle and chemical pollution as well as the rapid depletion of stocks of non-renewable resources.

The twin challenge facing societies globally is therefore to identify and implement effective actions for conserving resources for present and future generations and for preventing, mitigating and reversing damage to the environment resulting from resource use and waste generation. The EU should grasp the opportunity of the present review to prevent and reduce WEEE, for example by reinforcing sustainable design principles. This would hereby help foster the recovery of products, components and valuable materials, such as critical raw materials (CRMs).

Similarly, the European WEEE standards do not help meet these European strategic objectives as they do not adequately support product and component recovery, just material recovery through end-of-life WEEE management. These standards are also inconsistently applied throughout EU Member States.

This paper aims to provide a baseline for the WEEE Directive evaluation with supporting evidence and literature review.

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1) Evaluation of the WEEE Directive effectiveness

This section highlights the great improvement potential of the WEEE Directive effectiveness in terms of waste prevention, separate WEEE collection, product and component recovery through refurbishment, repair and remanufacturing (such as 'preparing for reuse'), recovery of secondary raw materials (recycling), as well as promotion of product design that facilitates upgrading, direct re-use, the recovery of functioning products and components as well as materials. The EU should especially prioritise upstream measures that help reduce WEEE and the EEE sector's environmental and health impacts to fit within our planetary boundaries, e.g. by setting WEEE prevention targets and prioritising EEE reuse, product and component recovery (preparation for reuse) in EU legal acts and European standards.

Considering the lack of level-playing field between EU countries on WEEE management and the need to ensure better consistency with EU ecodesign policies and political strategies, the European Commission should aim for the creation of a WEEE Regulation[1]. The Regulation should set out minimum requirements to achieve sustainable and circular resource recovery from WEEE Associated European standards would provide normative requirements and guidance for the implementation of these minimum requirements. In the Annex to this paper, we provide a proposal for such minimum EU legal requirements and the nature and content of associated standards.

In addition, Member States should be allowed to go beyond its minimum environmental requirements based on a dual legal basis, such as in the EU Batteries Regulation.

a) Progress towards its objectives

Waste prevention

ECOS asks

- A horizontal ecodesign regulation aimed at enhancing the material efficiency of all electrical and electronic products is needed to ensure their longevity and recoverability of functioning products and components via refurbishment, repair and remanufacturing, as well materials via recycling, hence preventing e-waste and reducing our impacts on climate and resources[2]. The new Batteries Regulation sets a good example of horizontal approach through replaceability requirements[3]. Such an EEE ecodesign regulation should be closely aligned with a revised WEEE Directive by focusing on issues affecting WEEE recovery such as ease of dismantling, refurbishment and repair and the presence of hazardous substances.
- Resource efficiency requirements, such as for example the principle of non-destructive disassembly of spare parts, the ability to update software linked to security, could be applied to all EEE at once[4].
- In case a horizontal ecodesign approach were not adopted earlier (e.g. within the Ecodesign and Energy Labelling process), the current WEEE Directive review should aim to harmonise policies on both EEE design and end-of-life stages into a single EU Regulation. This would be in line with current legal developments, e.g. the EU Batteries Regulation or the EU proposal for a Regulation on circularity requirements for vehicle design and on management of end-of-life vehicles. Nevertheless, such 'DEEEWEEE' legislation would unfortunately take more time to be

[1] Further reading: Further reading: Joint position of European Environmental Associations Organisations on the Revision of the Directive on Waste from Electrical and Electronic Equipment, September 2023.

[2] Further reading: CoolProducts and EEB report, *ICT: A top horizontal priority in sustainable product policy*, July 2023.
Alfieri, F. and Spiliotopoulos, C., *ICT Task Force study: Final Report*, Publications Office of the European Union, Luxembourg, 2023.

[3] EU Batteries Regulation (EU) 2023/1542, article 11 'Removability and replaceability of portable batteries and LMT batteries'.

[4] Further reading: Joint call for horizontal ecodesign requirements to improve the material efficiency of electronic products, July 2023.

adopted than a horizontal ecodesign regulation for all EEEs, whereas there is urgency to reinforce EU sustainable policies for EEE by design.

- In addition, the EU needs **quantitative WEEE prevention targets**, as well as effective national measures[5].

Relevant data and literature:

The EU has faced a rapid increase in electrical and electronic equipment (EEE) put on the EU market (over 20 kgs / person / year) due to the rise in consumption trends, shorter lifetimes and increasing obsolescence of electronic products. On average EEE lifetime is 2.3 years shorter than intended by design, e.g. due to premature obsolescence or hardware compatibility issues[6].

The equivalent of 111 tons of gold in terms of rarity, and a staggering 571 million tons of displaced materials – comparable to the weight of 9.20 billion humans – were used in the production of digital devices and services in the EU-27+UK alone[7].

Worldwide, WEEE is the fastest growing and most complicated waste stream. Yearly waste from EEE could grow from 58 Mt in 2021 to 75 Mt in 2030, and 112 Mt in 2050[8].

In the EU, WEEE quantities are growing and will continue to grow. In 2019, 12 Mt of WEEE was generated in the EU – corresponding to 16.2 kg per person, compared with 11.6 Mt (15.6 kg/person) in 2014[9].

"WEEE legislation targets for WEEE collection are now put on end-of chain. How should measurable targets be given to the producer at the start- of-chain? This is still an unsolved challenge. As long as these operational targets are lacking in the legislation, WEEE amounts will steadily increase"[10].

Preparing for reuse

ECOS asks

- The EU should foster separate targets for **waste prevention, product and component recovery (reuse and preparing for reuse) from WEEE that are distinct from the existing recycling (material recovery) targets** so that waste collection systems better preserve re-usability and recyclability of electronic products and prevent leakage.
- **The WEEE Directive should set requirements for WEEE collection, handling, transport, storage and sorting practices that facilitate the recovery of WEEE as functioning products and components.** We provide a set of relevant minimum requirements in the Annex to this paper[11].
- Moreover, product and component recovery (reuse and preparation for reuse) operators should get **priority access to WEEE collection points and/or formal partnerships between collection operators and product and component recovery operators should be made mandatory to ensure that WEEE suitable for recovery as functioning products and components can be separated prior or immediately after collection**. Product and component recovery (preparing for re-use) operators should also get access to manufacturer's **repair and service information**, as well as detailed product recall information, in an easily accessible standardised format free of charge[12].

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[5] Further reading: Joint Paper – Waste Framework Directive review: why we need waste prevention targets now, July 2022.

[6] EEA Briefing, 2020.
L. Magnier, & R. Mugge (2022), *Replaced too soon? An exploration of Western European consumers' replacement of electronic products*, Resources, Conservation and Recycling.

[7] GreenIT, 2021.

[8] Global E-Waste Monitor, 2020.
Parajuly, et al., (2019). *Future E-waste Scenarios*. StEP Initiative, UNU ViE-SCYCLE, UNEP IETC.

[9] Habib, H., et al. (2022), *What gets measured gets managed – does it? Uncovering the waste electrical and electronic equipment flows in the European Union*, *Resources*, Conservation and Recycling.

[10] Román, E. (2012) *WEEE management in Europe: learning from best practice*, *In Woodhead Publishing Series in Electronic and Optical Materials.*

[11] Further reading: Joint NGO paper – Urgent call to improve WEEE treatment, collection, logistics and preparation for re-use in Europe, 2021.

[12] Further reading: Joint NGO paper – Urgent call to improve WEEE treatment, collection, logistics and preparation for re-use in Europe, 2021.

- In addition, **mandatory reusability assessment requirements** should be set, especially for CRM-containing equipment and components collected as waste. Tests should determine whether it is technically possible and economically reasonable (including if there is a market) for CRM equipment and components to be refurbished, repaired or remanufactured[13].

Relevant data and literature:

Many EEE that could be collected for preparing for reuse are actually leaking outside the collection regime: "between 13% and 16% of these waste streams could immediately be prepared for reuse, depending on the type of waste. A further potential of 13%–29% could be unlocked through changes to the mode of collection, storage and the overall treatment of wastes at Bavaria collection points. Most notably, 86% of identifiable damage causes of WEEE are attributed to a lack of sufficient weatherproof"[14].

Another study identifies several barriers for reuse, much of it related to the current WEEE treatment focus on WEEE as waste, not a potential value for reuse and recovery[15].

Preparing for re-use targets separate from those for recycling are recommended as necessary to align the interests of the Producer Representative Organisations and organisations which seek to promote it. Other success factors include: "involving social enterprise, requiring the use of quality standards, providing preparation for re-use organizations access to material at the point of end user surrender, and facilitating positive relationships between preparation for re-use organizations and the producer representative organizations organizing the waste streams"[16].

Combining preparing for re-use targets and re-use targets have already been implemented in Member States and help prevent premature recycling[17].

Separate WEEE collection

ECOS asks

- Producers should have more financial responsibility to collect electronic waste through an **obligatory participation in nation-wide networks for WEEE return** for which collection and product recovery targets should become legally binding. Their responsibility should also be expanded, including the coverage of the costs of collection of WEEE from household, collecting more systematically WEEE when delivering a new EEE according to the 1 to 1 rule, or even 0 to 1 rule for small devices, ensuring a proper density of collection points and dedicating more efforts to enhancing consumer awareness.
- In addition, **WEEE collection mixed with metal scrap should be forbidden**, especially for Temperature Exchange Equipment (TEE) to prevent unsafe handling of the refrigerants, and regular inspections should be performed. This is also true for boilers, for which there is no coherent treatment at their end-of-life and the liability of producers to finance their collection, treatment, recovery and environmentally sound disposal differ between Member States.
- As regards **small WEEE, a deposit refund system (DRS) or a voucher system** could be introduced, whereby consumers would be reimbursed upon the return of the WEEE to a collection point. Alternatively, a compensation scheme could be set up, where, for instance, any

[13] Further reading: ECOS, DUH, RREUSE paper – How to reduce our dependency on critical raw materials by stimulating circularity, June 2023.
[14] Lukas Messmann, et al. (2019) Potentials of preparation for reuse: A case study at collection points in the German state of Bavaria, *Journal of Cleaner Production*.
[15] Parajuly K, & Wenzel H (2017), *Potential for circular economy in household WEEE management*, *Journal of Cleaner Production*.
[16] McMahon K, et al., (2019) *Enabling preparation for re-use of waste electrical and electronic equipment in Ireland: lessons from other EU member states*. *Journal of Cleaner Production*.
[17] RREUSE factsheet – Re-use targets: why they matter and what initiatives already exist, 2022.

new smartphone sold should be 'compensated' by the collection of an old repairable one (organised collectively through EPR schemes)[18].

Relevant data and literature:

Nearly half of all discarded WEEE in Europe, including unreported WEEE, is not properly collected and recycled[19].

2019 data showed that 24 out of 27 member states failed to collect sufficient WEEE separately and did not reach the EU target of 65% collection. Up to 4.8 million tonnes of WEEE are still improperly disposed of every year and lost for reuse and recycling. 2 Mt of e-waste illegally exported[20].

65% of WEEE were not officially reported as collected or recycled in Europe in 2012, of which 1.5Mt of WEEE were exported from the EU in 2012, including nearly 40% of repairable products[21].

As for small WEEE, the collection rate for mobile phones is estimated at around 15% and at 47% for laptops and tablets. But these data are based on uncertain calculation methodologies[22].

Recycling and recovery of secondary raw materials

ECOS asks

- **Specific CRM recovery targets** should be set up, using the same systematic approach than in the EU Batteries Regulation[23]. For instance, for PV panels, complementary requirements on individual materials should help recover metals, especially CRMs (e.g. gallium and indium) as well as copper, electrical connections (incl. lead soldering) and polymers (incl. the backsheet containing fluorinated chemicals)[24].
- Moreover, **separate collection targets for B2B appliances**, such as PV panels, could be considered.
- As for take-back, the free removal and acceptance of WEEE for retail stores whose EEE selling area is greater than 400m² should also be acknowledged as a good practice[25].

Relevant data and literature:

Only 17.4% of the e-waste generated worldwide in 2019 reached recycling facilities or was appropriately managed. The rest, up to 82.6%, was poorly or even illegally handled, with a large portion dumped in low or middle-income countries, triggering conflicts, human rights abuses, chemical pollution, and environmental degradation[26].

At the EU level, e-waste recycling has increased, but only reached 39% in 2018. The rates also vary significantly from country to country[27].

For PV panels, WEEE recovery target for photovoltaics is based on weight and mainly reached with glass and aluminium (90% of PV module).[28]

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[18] Further reading: European Commission, Directorate-General for Environment, Romagnoli, V., Bruijne, E., Drapeau, P., et al., *Study on options for return schemes of mobile phones, tablets and other small electrical and electronic equipment in the EU*, Publications Office of the European Union, 2022.

[19] Habib, H., et al., (2022) *What gets measured gets managed – does it? Uncovering the waste electrical and electronic equipment flows in the European Union*, Resources, Conservation and Recycling.

[20] Further reading: NGOs' analysis of Eurostat 2019 data, 2022.

[21] Huisman, et al., (2015) *Countering WEEE Illegal Trade (CWIT) Summary Report*, Market Assessment, Legal Analysis, Crime Analysis and Recommendations Roadmap.

[22] European Commission, Directorate-General for Environment, Romagnoli, V., Bruijne, E., Drapeau, P., et al., *Study on options for return schemes of mobile phones, tablets and other small electrical and electronic equipment in the EU*, Publications Office of the European Union, 2022.

[23] Further reading: ECOS, DUH, RREUSE paper – How to reduce our dependency on critical raw materials by stimulating circularity, June 2023.

[24] Further reading: Solar photovoltaics by CoolProducts.

[25] Further reading: WEEE personal disposal rules in Croatia.

[26] Global E-Waste Monitor, 2020.

[27] Eurostat data, 2020 in EEA Briefing and Euronews article.

[28] Joint NGO position following the Consultation Forum for Ecodesign and Energy Labelling requirements on photovoltaic modules, inverters and systems, 2022.

Promotion of product design facilitating product, component and material recovery of WEEE

ECOS asks

- WEEE collection and treatment schemes should **prioritise product and component recovery from WEEE over material recovery** by improving their practices *(see further details above)*.
- Moreover, EPR schemes should incorporate tools to prevent EEE from entering the waste system, through upgrading, direct reuse (e.g. through resale via online market places), customer repair, with the allocation of a percentage of the fees collected to a fund dedicated to financing the transition to circularity. EPR fees should also finance improvements in separate collection by ensuring consumers are informed on collection points and that reusable goods do not become waste due to damage occurring during transportation and storage. Additional rules on EPR governance should help limit the negative impact that PROs have on WEEE prevention, e.g. due to mixing financial and operational responsibility, and ensure its inclusiveness[29].
- A visible label with year of manufacturing could help reuse and preparing for reuse decisions. Such information should be included in mandatory digital product passports for all EEEs, such as the battery passport in the new EU Batteries Regulation (EU) 2023/1542[30].
- A more detailed characterisation of household products in the WEEE stream could also be developed, especially for small white goods, considering the product types and their physical or functional condition to foster the separate recovery of products, components, and materials at their end of life.

Relevant data and literature:

The WEEE Directive is considered as focusing on waste and waste management, not product circularity. It is not seen as an incentive to circular product design. The EPR scheme also creates a gap between EEE manufacturing and end-of-life[31].

With its primary focus on material recovery through collection and recycling of end-of-life EEE, the WEEE Directive does not exploit other end-of-life options that help keep the value and functionality of WEEE. For instance, mixed WEEE management, especially in small WEEE plants, precludes product reuse[32].

b) Impacts on the environment, human health and safety

During collection and recovery of WEEE

ECOS asks

- The EU should require **all EEE are designed toxic-free**, e.g. banning flame retardants, persistent organic pollutants, per- and polyfluoroalkyl substances (PFAS) in EEE by design from a precautionary perspective. This means the intentional use of hazardous substances, substances meeting the criteria for CLP (classification, labelling and packaging of substances and mixtures) and SVHC (substances of very high concern) under REACH should be prohibited. For instance, the use of all flame retardants should be banned – not only halogenated flame retardants in the enclosure and stand of electronic displays (Ecodesign Regulation (EU) 2019/2021 for electronic displays). This would be in line with the European Chemicals Strategy for Sustainability[33].

[29] Joint Paper – Waste Framework Directive review: why we need waste prevention targets now, July 2022, section 5.
[30] Further reading: ECOS press release and reports, December 2020.
[31] Andersen, T., (2022) *A comparative study of national variations of the European WEEE directive: manufacturer's view*, *Environ Sci Pollut Res.*
[32] Parajuly, K., & Wenzel, H., (2017) *Potential for circular economy in household WEEE management*, *Journal of Cleaner Production.*
[33] Further reading: ECOS position paper – How the Sustainable Products Initiative should address hazardous chemicals in products, 2022.

- The WEEE Directive should lay down ambitious minimum requirements to prevent and reduce the environmental impacts associated with WEEE recovery operations supported by a credible and independent environmental management system and accompanying reporting and traceability requirements. The EN 50625 series standards and EN 50614 should be used as a **baseline for the WEEE Regulation minimum requirements** (e.g. mandatory cautious and thorough extraction of refrigerants and foam propellants from TEE in recovery facilities and strict transport rules to ensure fewer leaks during transit[34]). The European standards should accordingly be revised to set out systematic normative requirements and guidance for environmental management.
- The revised WEEE Directive should further set **legal requirements for depollution and systematically monitoring depollution performance**. The Annex to this paper provides a proposed set of minimum requirements to this aim. In addition, the forthcoming IEC 63395 'Sustainable e-waste management' standard (under development) provides methodologies for depollution and depollution effectiveness monitoring that can be adopted as European standards.
- In addition, **WEEE collection mixed with metal scrap should be forbidden** *(see further details above and in our proposed minimum requirements detailed in the Annex).*
- The introduction of **mandatory EEE passport**, through implementing acts of the ESPR on the Digital Product Passport (DPP), can contribute to improving worker's health and safety thanks to information flow in the supply chain up from EEEs to WEEE stages, such as relevant environmental parameters, user manuals, conformity certificates, etc. Information on substances of concern would especially be important for these purposes[35].
- EPR schemes should be redefined to expand their scope and cost coverage beyond the "necessary costs" to include waste prevention measures. EPR fee eco-modulation has the potential to foster eco-design and circularity in batteries and EEE. Revenues should also be earmarked for circular economy innovation and social economy actors, e.g. in the reuse and preparation for reuse sector[36].

Relevant data and literature:

Over 60% of WEEE gets unreported in the EU and are either stored, locally dumped along with the municipal solid waste, treated as part of mixed metal scrap, traded internationally (legally or illegally) or recycled under inferior conditions. This poses a **huge risk to human health and the environment due to "toxic materials** (e.g. brominated flame retardants from plastics, lead-containing glass, an ozone-depleting substance like chlorofluorocarbons contained by cooling agents from refrigerators/air conditioners), toxic metals – cadmium, lead, chromium – and persistent organic pollutants"[37].

As for flame retardants, they continually migrate out of electronics cases and into indoor dust which is ingested by people and pets. Some of these chemicals are associated with lowered IQ in children, cancer, hormone disruption, and other serious health problems. Adding flame retardants to plastic enclosures also makes the reuse or recycling of electronics more difficult or impossible. However, **flame retardants in electronics casings do not provide any fire safety benefit[38]**.

As regards TEEs (Temperature Exchange Equipment), 6.3 million tonnes of CO2 equivalent each year could be saved if the CENELEC standards for treatment of discarded fridges and freezers were made mandatory across Europe. This is notably due to the removal of CFC/HCFC/HFC/HCs from refrigeration circuit before the recycling

[34] Further reading: Joint NGO paper – Urgent call to improve WEEE treatment, collection, logistics and preparation for re-use in Europe, 2021.
[35] Further reading: By mid-2024, the European CIRPASS project is expected to provide a proof of DPP concept for batteries, textiles and electronics.
[36] Further reading: Sachdeva, A. et al. (2021), Ecologic Institute for RPa and BFFP, *Extended Producer Responsibility and Ecomodulation of Fees*.
[37] Habib, H. et al., (2022) *What gets measured gets managed – does it? Uncovering the waste electrical and electronic equipment flows in the European Union*, Resources, Conservation and Recycling.
[38] Green Science Policy Institute.

facility. It could be explained by the design of the appliances and a lack of education of the users, as well as illegal processing of the TEEs[39].

The standard EN 50625-1 requires depollution monitoring only 'where appropriate' and for a narrow scope. It affects just capacitors, batteries, and Brominated Flame Retardants (BFRs) – only in materials from fractions ≥ 20% of input material, that might contain BFRs and are likely to contain at least 10% by mass of plastic. It thus excludes significant quantities of plastics from the depollution monitoring, especially for the WEEE streams and treatment processes where a high number of small fractions is generated[40].

As for mercury, despite being a priority substance for safe removal from WEEE and mercury phase outs, mercury emissions are still high because of inappropriate WEEE management, historic WEEE, professional WEEE and batteries, especially from "inappropriate gas discharge lamp handling at scrap metal sites and in municipal wastes"[41].

As regards workers' health, manual workers in disassembly lines can use better information to avoid being exposed to hazardous materials. A Digital Product Passport would help provide the right information on disassembly and anticipate risks, especially linked to hazardous substances in WEEE[42].

"**The current cost coverage in an EPR system**, due to its limited focus on covering necessary costs, **does not take into the social and environmental costs of the products**. Even if the cost coverage covers the real end-of-life costs, it is limited in its scope as it excludes the environmental and social costs incurred due to the focus on end-of-life management"[43].

Impacts on primary resource use

ECOS asks

- **Where WEEE cannot be recovered as a functioning product or components, cost-effective methods to disassemble WEEE, isolate CRM bearing components, and upgrade/ concentrate CRMs** should also be scaled up for industrial adoption[44].
- **CEWASTE normative requirements** (and further standards depending on the waste stream) should be integrated in a revised WEEE Directive to define requirements for treatment, collection, logistics and recovery of products and components containing CRMs[45].
- Here again, the introduction of **mandatory EEE passport** including information on CRMs, their location and how to dismantle them can support the safe recovery of valuable resources. Essential information on EEE safe dismantling and composition should flow throughout the supply chain to facilitate the preparation for re-use, preparation for repurposing, repurposing or remanufacturing of EEEs, as well as recovery of components and valuable materials (CRMs).

Relevant data and literature:

Recycling of WEEE mainly addresses bulk metals, and to a lower extent CRMs. **Better product design for disassembly** will help increase CRM recovery and component reuse, including cost-effective processes to disassemble WEEE and access CRM bearing components[46].

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[39] European Commission, Directorate-General for Environment, Tesar, M., Karigl, B., Lampert, C., et al., *Study on quality standards for the treatment of waste electrical and electronic equipment (WEEE) : final report*, Publications Office, 2021.

[40] ECOS paper – Review of the CENELEC standards on collection and treatment of WEEE, 2019.

[41] Ryan-Fogarty, Y. et al., (2023) *Uncaptured mercury lost to the environment from waste electrical and electronic equipment (WEEE) in scrap metal and municipal wastes*, *Resources, Conservation and Recycling*.

[42] Further reading: European CircThread project, especially user stories (Deliverables 2.2).

[43] Sachdeva, A. et al. (2021), Ecologic Institute for RPa and BFFP, *Extended Producer Responsibility and Ecomodulation of Fees.*

[44] Further reading: ECOS, DUH and RREUSE paper – How to reduce our dependency on critical raw materials by stimulating circularity, July 2023.

[45] Further reading: Joint NGO paper – Urgent call to improve WEEE treatment, collection, logistics and preparation for re-use in Europe, 2021.

[46] Charles, R. et al., (2020) *Towards Increased Recovery of Critical Raw Materials from WEEE– evaluation of CRMs at a component level and pre-processing methods for interface optimisation with recovery processes*, *Resources, Conservation and Recycling.*

Ferrous metal, copper, aluminium and various precious metals are efficiently recovered from WEEE, whereas several CRMs are lost in shredding residues or diluted into other recycled fractions, such as indium, tantalum and rare earth elements[47].

The EU-funded project CEWASTE developed normative requirements to improve the recycling rates of CRMs from e-waste and batteries by producing and pilot testing requirements for collection, transport and treatment of products containing sufficiently high concentrations and amounts of critical raw materials[48].

2) Evaluation of relevance

This section points out the needs to update the WEEE Directive for ensuring its relevance with current needs and problems, new challenges and developments, as well as overall coherence with EU policies and standards. Its review should especially support EEE material footprint reduction, sustainable design of EEEs, EU's green and digital transition by enabling urban mining, as well as help prevent free riding from online platforms and illegal exports.

a) Alignment with current needs and problems

Developments in treatment technologies

ECOS asks

- Focus should not be only on 'treatment'/recovery technology to facilitate material recovery, but also on **improved collection system, facility and equipment design** that allows the recovery of functioning products to be maximised.
- Better EEE product design for CRM disassembly and recovery is essential to meet EU's growing demand for CRMs through **urban mining**[49].
- Suitable **CRM recovery infrastructures** should be further developed, based on improved collection and treatment practices[50].

Relevant data and literature:

Pre-processing methods are being researched to overcome barriers to CRM recovery and component reuse, and perform it cost-efficiently, e.g. through "automated disassembly and novel CRM recovery processes". Information on such processes should also be widely available[51].

Recovering rare earth elements (REE) from WEEE by hydrometallurgical processes is the most studied. Studies are however missing for recovering from a mix of different WEEE residues[52].

Resource use and critical raw materials

ECOS asks

- To secure CRM supply chains, the EU should target both sufficiency and resource-efficiency. Sufficiency by targeting the reduced consumption of EEEs – hence CRMs – and focusing on

[47] European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, *3rd Raw Materials Scoreboard – European innovation partnership on raw materials*, Publications Office, 2021.
[48] CEWASTE Requirements for Improving CRM Recycling from WEEE and Waste Batteries, EU's Horizon 2020 project, April 2021.
[49] Further reading: ECOS, DUH, RREUSE paper, How to reduce our dependency on critical raw materials by stimulating circularity, June 2023.
[50] Further reading: CEWASTE Requirements for Improving CRM Recycling from WEEE and Waste Batteries, EU's Horizon 2020 project, April 2021.
[51] Charles, R. et al., (2020) *Towards Increased Recovery of Critical Raw Materials from WEEE– evaluation of CRMs at a component level and pre-processing methods for interface optimisation with recovery processes*, *Resources, Conservation and Recycling*.
[52] Comprehensive review of studies on REE recovery from secondary sources, such as WEEE in Sagrillo Pimassoni, Y. et al., (2023), *The recovery of rare earth elements from waste electrical and electronic equipment: A review*, *Hydrometallurgy*.

WEEE prevention and reuse before recycling; resource-efficiency by improving collection and recycling of CRM-rich products.

- End-of-life products and infrastructure containing CRMs (e.g. WEEE and renewable energy infrastructure), and the manufacturing of scrap and materials (e.g. black mass from batteries), should be kept within the EU for high-quality recycling[53].

Relevant data and literature:

In the EU, CRM demand is expected to increase by a factor of 20 for certain materials to meet the climate and energy targets[54].

Demand for REE growth together with the growing consumption of EEEs. "Demand for CRMs will inevitably increase with wider penetration of consumer and industrial markets, and adoption of industry 4.0 and internet of things (IoT) technologies. Low-carbon technologies currently account for 20% of global CRMs consumption, and demand will increase with widescale deployment to meet the goals of the Paris Agreement."
Considering their criticality, **urban mining is essential** with WEEE remaining a "commercially unexplored REE source with the potential to fill the gap between industrial demand and the decrease in raw material availability"[55].

Product design – sustainable products

ECOS asks

- Up to 80% of the environmental impact of products is determined at the design phase. The revision of the WEEE Directive should thus aim to implement the Chemicals Strategy for Sustainability by **phasing out toxic substances in EEEs**, such as in EEE plastics, **i.e. substances that are harmful for human health or the environment, or that prevent product recovery and clean recycling**. For instance, flame retardants should be banned in all EEEs[56].
- Where such hazardous substances are essential, **information on chemical content and safe use** should be provided for and passed on to the end-of-life stage of WEEE to protect human health and the environment.

Relevant data and literature:

"Using EPR as a guiding concept has failed in the eco-design field addressing the responsibility to the very first step on planning the design of new electrical and electronic products"[57].

On average, plastics amount to about 30% of WEEE. An effective way to improve its recyclability is to "reduce the use of hazardous substances and the number of used materials and material combinations, including plastic resins". For instance, no bromine was observed in bromine-free materials, but it was found in other WEEE classes together with antimony[58].

Printed circuit boards (PCBs) used for electrical conduction in mobile phones and laptops are the most complex and hazardous component of WEEE[59].

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[53] Further reading: ECOS, DUH, RREUSE paper, How to reduce our dependency on critical raw materials by stimulating circularity, June 2023.
[54] European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, *3rd Raw Materials Scoreboard – European innovation partnership on raw materials*, Publications Office, 2021.
[55] Charles, R. et al., (2020) *Towards Increased Recovery of Critical Raw Materials from WEEE– evaluation of CRMs at a component level and pre-processing methods for interface optimisation with recovery processes*, *Resources, Conservation and Recycling.*
Sagrillo Pimassoni, Y. et al., (2023), *The recovery of rare earth elements from waste electrical and electronic equipment: A review*, *Hydrometallurgy.*
[56] Further reading: Green Science Policy Institute.
[57] Román, E. (2012) *WEEE management in Europe: learning from best practice*, *In Woodhead Publishing Series in Electronic and Optical Materials.*
[58] Lahtela, et al., (2022), *Assessment of critical factors in waste electrical and electronic equipment (WEEE) plastics on the recyclability: A case study in Finland*, *Science of The Total Environment.*
[59] European Commission, Directorate-General for Environment, Romagnoli, V., Bruijne, E., Drapeau, P., et al., *Study on options for return schemes of mobile phones, tablets and other small electrical and electronic equipment in the EU*, Publications Office of the European Union, 2022.

WEEE exports

ECOS asks

- The WEEE Directive should **include minimum functional requirements** and **precise testing procedures for EEEs to be classified as reused products**. This would help support better control of exported used EEEs. "Future research should aim to expand the analysis of lost EPR fees and evaluate the impact of not transferring these fees from the EU to African countries when the associated products are exported for reuse"[60].

Relevant data and literature:

4.3 megatonnes of EEE are annually exported from the EU to Africa. EPR fees not following them are estimated at 340,000,000 - 380,000,000 EUR. The lost fees are collected and retained by European PROs, and the fees fail to follow the products and prevent proper end-of-life management. However, this number could be even higher with a substantial quantity of illegal or unreported shipments in EEE[61].

A large percentage of used EEE exported from the EU to third countries, such as in Africa, are WEEE, while other WEEE are not reported because of poor border control, despite the Basel Convention export ban. Shipment of new electronic products, second-hand equipment and e-waste are usually registered under the same trade codes[62].

b) Fitness for purpose for new challenges and developments

Growing resource consumption

ECOS asks

- While e-waste recovery measures can bring marginal benefits in terms of reducing the extraction and use of natural resources and the associated environmental impacts, demand reduction (sufficiency) measures should be introduced alongside them in the form of an **EU-wide material footprint reduction target in EEEs, including CRMs.** This will help to build the resilience of supply chains by reducing the EU's dependence on imports of large volumes of primary (critical) raw materials. It will also reduce environmental damage and socially unjust practices in countries of extraction[63].

Relevant data and literature:

The number of EEE placed on the European market have grown by about 50% from 2000 to 2020. This growth has mainly been driven by screens, small equipment and small IT[64].

Digitalisation

ECOS asks

- Despite the resource savings that can come from digitalisation, it is essential to recognise the growing energy consumed to store data and the materials extracted to build digital devices, emphasising the importance of responsible and eco-conscious practices within the tech industry. ECOS supports an **EU ecodesign regulation for all ICT products** aiming at improving their

[60] Further reading: Circular Innovation Lab (CIL) for the EEB, *Study on items shipped for reuse and Extended Producer Responsibility fees*, May 2023.

[61] Circular Innovation Lab (CIL) for the EEB, *Study on items shipped for reuse and Extended Producer Responsibility fees*, May 2023.

[62] Habib, H., et al. (2022), *What gets measured gets managed – does it? Uncovering the waste electrical and electronic equipment flows in the European Union, Resources, Conservation and Recycling.*
Baldé, C.P. et al. (2022), *Global Transboundary E-waste Flows: Monitor 2022*.

[63] Further reading: ECOS, DUH, RREUSE paper, How to reduce our dependency on critical raw materials by stimulating circularity, June 2023.

[64] Urban Mine Platform.

longevity and repairability, hereby reducing the demand for critical resources and the energy used in manufacturing, thus lessening their overall environmental impacts[65].

Relevant data and literature:

in 2021, the equivalent of 111 tons of gold in terms of rarity, and a staggering 571 million tons of displaced materials – comparable to the weight of 9.20 billion humans – were used in the production of digital devices and services in the EU-27+UK alone. ICT environmental impacts is mainly driven by end-user equipment (laptops, phones, screen, TVs, printers, etc.), followed by data centres (from large hyperscale data centres to small company servers) and networks (fixed, mobile, core)[66].

Renewable energy production (PV)

ECOS asks

- To deploy EU's green and digital transition, urban mining of WEEE becomes essential. It also means **the scope of the WEEE Directive should be extended to cover these technologies, such as solar thermal and inverters as well as wind turbines**.

Relevant data and literature:

The deployment of renewable energy technologies and electric vehicles is increasing EU's reliance on CRM supplies: "PV deployment will increase In, Si, Ga, Te, and Ag demand. Production of permanent magnets for wind turbines and EV motors will increase demand for Dy, Nd and Pr. Battery systems for stationary renewable energy storage and EVs will increase V demand for reflow batteries; Li, Co, Y and natural graphite demand for Li-ion batteries (LIBs); and platinum group metal (PGM) demand for hydrogen generation catalysts"[67].

Online sales

ECOS asks

- ECOS is concerned illegal imports into the EU are increasingly problematic since these products evade fulfilling producer and retailer responsibilities e.g. take-back obligations for WEEE and often do not provide liability in case of environmental or safety violations. The WEEE Directive should thus introduce **liability and due diligence obligations for online platforms in WEEE regulation comparable to those for retailers**[68].

Relevant data and literature:

In the EU-27, retail sales via mail order houses or the Internet increased by 30% between April 2019 and April 2020, while total retail sales diminished by 17.9%, due to the COVID-19 crisis[69].

Online shopping has continued to grow in the EU until 2022. Computers, tablets and mobile phones are the 7th most online purchased goods[70].

However, EPR fees are unpaid for around 5-10% of the value of the EEE placed on the market in OECD countries. Free-riding also involves not undertaking physical 'take-back' obligations, hence under-estimating the number of products placed on the market[71].

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[65] Further reading: Joint NGO letter – Call for horizontal ecodesign requirements to improve the material efficiency of electronic products, July 2023.
[66] Bordage, F. et al., E. GreenIT.fr, (2021) *Digital technologies in Europe: an environmental life cycle approach*.
[67] Charles, R. et al., (2020) *Towards Increased Recovery of Critical Raw Materials from WEEE– evaluation of CRMs at a component level and pre-processing methods for interface optimisation with recovery processes*, *Resources, Conservation and Recycling*.
[68] Further reading: Joint NGO letter – Stop sale and imports of illegal products via online marketplaces, July 2021.
[69] OECD, (2020) *E-commerce in the time of COVID-19*.
[70] Eurostat.
[71] OECD Policy Highlights: *Extended Producer Responsibility (EPR) and the Impact of Online Sales*, October 2018.

3) For a better coherence

a) Enhance coherence with EU environmental legislation

WFD

The WEEE Directive should not only aim to reduce the generation or waste, but should firstly aim to **prevent and reduce the generation of waste**, in line with the EU WFD article 1. In addition, it should apply **the best environmental outcome** in both legislation and mandated standards, in accordance with article 4 of the WFD.

ESPR

As detailed above, the WEEE Directive should be aligned with the ESPR in terms of material efficiency measures for EEE reusability, upgradability, reparability, remanufacturability, maintenance, and refurbishment, without exception, toxic substance phase-out, liability of online marketplaces.

Batteries Regulation

The legislative gap of portable batteries in the EU Batteries Regulation should be filled by the WEEE Directive to ensure all waste portable batteries collected undergo preparation for reuse, preparation for repurposing or a recycling process. Minimum common part design requirements should be applied to facilitate these processes.

POPs & SVHCs

The WEEE Directive should be better aligned with the POPs (Persistent Organic Pollutant) and REACH Regulations. This can, for instance, be done by aligning thresholds and conditions to distinguish plastic fractions 'containing' and 'not containing' brominated flame retardants, or by including more systematic **depollution monitoring processes** – not only for 'each step of the process' but also for each output fraction likely to contain hazardous substances.

The reverse burden of proof should also be applied so that WEEE are treated as containing hazardous substances or POPs unless it can be proved that levels in the item are below the concentration limits of the POPs Regulation.

WSR: prevent illegal exports of WEEE

The financial responsibility to ensure a proper end of life/waste management should be ensured even when EEE are exported for reuse (not as WEEE), for example through an EPR fee following the product and being made available to the receiving country, or through a system of compensation scheme (one collected for one being exported). Special customs code for used EEEs should also be set up, EU cooperation against illegal exports reinforced.

CRM Regulation

The CRM Regulation proposal aims at strengthening the EU's recycling capacity to provide at least 15% of the total consumption of strategic raw materials. It should be supported by sector-specific legislation, such as the WEEE Directive, e.g. through reporting and checking obligations during collection, preparation for reuse, reuse, treatment and recycling of products and components that contain CRMs, as well as targets of recycled content CRMs in specific products and equipment.

The EU-funded project CEWASTE developed normative requirements to improve the recycling rates of CRMs from e-waste and batteries by producing and pilot testing requirements for collection, transport

and treatment of products containing sufficiently high concentrations and amounts of critical raw materials. These requirements should be legally binding within the revised WEEE Directive, and incorporated in the European standards for WEEE treatment (EN 50625 series)[72].

b) Enhance coherence between these EU objectives, the WEEE Directive and WEEE standards

As regards its review process, **the WEEE Directive should be revised every 5 years by means of a democratic process and involvement of all relevant stakeholders.** As mentioned above, we would like to stress again the European study on quality standards for the treatment of waste electrical and electronic equipment (WEEE) pointed out the enormous environmental benefits the implementation of the CENELEC standards **EN 50625 series and EN 50614** would bring about, but the project was dropped despite this option being provided for in the WEEE directive article 8.5. Their requirements should be embedded in a revised WEEE Directive.

Their provisions should also be upgraded for improving WEEE protection against damage during their collection and logistics so as to safeguard their reusability, and their requirements integrated into the new WEEE Regulation. And these requirements should be integrated into a new EU WEEE Regulation[73].

Additionally, a new horizontal European standard should be mandated based on the **international standard project IEC 63395 on the sustainable management of e-waste.** It aims to introduce the recovery pathway methodology to implement the best environmental outcome and link with environmental management to prevent and mitigate environmental impacts of WEEE management. By mitigating such environmental impacts, health & safety impacts both for workers and people living near waste management facilities will also be mitigated (see Annex below).

[72] Further reading: ECOS, DUH, RREUSE paper, How to reduce our dependency on critical raw materials by stimulating circularity, June 2023.

[73] Further reading: Joint position of European Environmental Associations Organisations on the Revision of the Directive on Waste from Electrical and Electronic Equipment, September 2023.

Annex: How EU legal requirements and associated European standards can foster sustainable and circular e-waste management

1. Need for a new focus: sustainable and circular WEEE management

ECOS advocates a significant overhaul of the WEEE Directive to bring the Directive (or follow-on legislation) into alignment with flagship EU resource and waste management initiatives, most importantly with the Circular Economy Action Plan (CEAP2).

Since the inception of the WEEE Directive more than a decade ago, there has been a significant shift away from a purely waste management-focussed approach to WEEE (and other waste streams). Instead, it has become accepted that there is an urgent need for a circular economy to replace the linear economic model.

E-waste generation has increased by 60% between 2010 and 2019. Globally, 50 million tons of e-waste is generated per year, and by 2030, that number will grow to 75 million tons. E-waste is the fastest growing waste stream globally.

The twin challenge facing societies globally is to identify and implement effective actions for conserving resources for present and future generations and for preventing, mitigating and reversing damage to the environment resulting from resource use and waste generation.

The WEEE Directive needs to contribute to these aims in a more direct and impactful way by focussing directly on three objectives:

1. increase the recovery of functional electrical and electronic products and components,
2. increase the range, volumes and quality of materials recovered from WEEE,
3. improve the sustainability of e-waste recovery through sound environmental management.

ECOS has been strongly involved in the drafting of an international standard, IEC 63395 Sustainable Management of E-waste (publication expected in 2024), that provides a practice-focused framework for achieving these goals.

The following sets out how the WEEE Directive and the associated European standards could be revised to set EU member states on a course of sustainable and circular e-waste management.

2. Conceptualisation of sustainable and circular e-waste management

The current WEEE Directive is a product of its time and as such is rooted in waste management thinking, with no consistent attention given to the need for sound environmental management by WEEE recovery operators or to the achieving the best environmental outcome by increasing the circularity of product and component as well as materials to reduce demand for new EEE.

A move to a sustainable circular economy requires a shift in thinking from the notion of managing waste to the idea of managing resources, with a focus on **resource conservation, waste prevention and reduction, resource recovery and circularity and environmental impact reduction**.

This shift is facilitated by implementing **the best environmental outcome principle** that aims at delivering the best environmental outcome from a lifecycle perspective by generally prioritising waste prevention and extending product life through product and component recovery over material recovery (recycling), energy and other forms of recovery and disposal, in line with article 4 of the EU Waste Framework Directive.

All aspects of the resource recovery system (replacing the term 'waste management system'), including collection, handling, transport and storage, should be designed in such a way that maximises the range,

quantity and quality of products, components and materials to be recovered and prevents and minimises potential environmental impacts arising from recovery operations.

A critical step in achieving the best environmental outcome is the systematic application of **a recovery pathway methodology** that assesses the **recovery potential** of collected WEEE and facilitates the determination of **the recovery pathway**, i.e. the types and the sequence of processes required to recover products, components and materials from WEEE collected.

Using this methodology, WEEE that is suitable for product recovery via refurbishment, repair and remanufacturing can be identified immediately after collection and physically routed towards suitable operators. Where WEEE is not deemed suitable for the recovery of functional products, it will then be considered for component and material recovery and routed towards the appropriate recovery operations.

An overview of this approach is provided in the following figure:

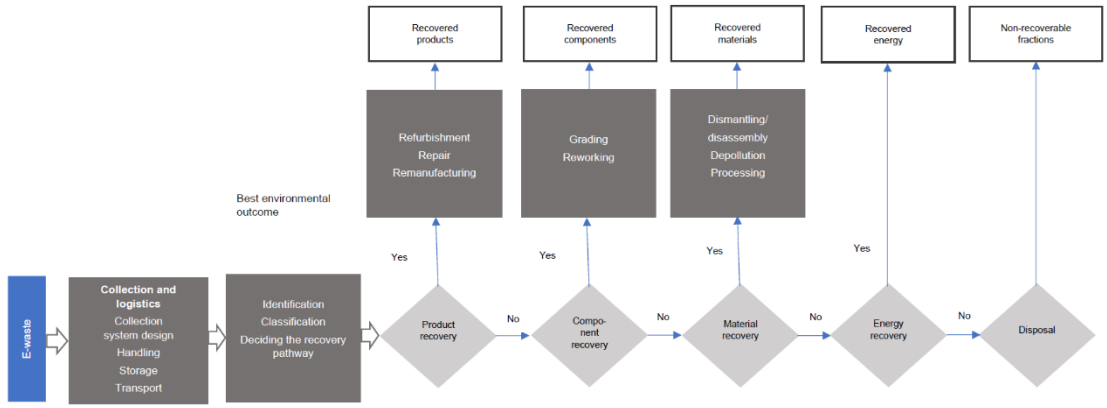

Figure 1: Sustainable and circular WEEE recovery system

The recovery pathway methodology can be detailed in an associated European standard.

3. Terminology

We propose streamlining the terminology to focus on **resource recovery** to support a shift away from waste management thinking and to simplify the description of the different types of recovery, namely recovery of resources as functioning products and components or as materials:

- **Product recovery**: Application of processes with the aim of recovering functional products from WEEE for their subsequent re-use,
- **Component recovery**: Application of processes with the aim of recovering functional components from WEEE for their subsequent re-use,
- **Material recovery**: Application of processes with the aim of recovering materials from WEEE.

In line with the best environmental outcome approach outlined above, we also propose the following two terms to be introduced:

- **Recovery potential**: Potential of e-waste to be recovered as products, components or materials,
- **Recovery pathway**: Type and sequence of processes applied to recover products, components and materials from WEEE collected.

4. Proposed minimum requirements to be included in the WEEE Directive and role and content of associated European standards

Using the conceptualisation of sustainable circular WEEE recovery, a set of minimum requirements to support its practical implementation should be enshrined in a revised WEEE Directive. These can be related to each stage of the recovery process flow as detailed above.

Associated European standards can provide detailed requirements or guidance for the implementation of these minimum requirements. In the proposal below, we indicate where we see a role for European standards. IEC 63395 (under development) provides further details upon which the proposed European standard can be based.

We propose the following requirements to achieve the twin goal of increasing WEEE recovery and preventing and reducing environmental impacts:

Collection and logistics

These requirements cover collection system design, handling, transport, sorting and storage.

1. WEEE shall be collected separately from other waste streams.
2. WEEE shall not to be mixed with other types of waste within the same container or receptacles.
3. WEEE shall be sorted from non-EEE waste prior to or at the point of collection.
4. WEEE shall be sorted into WEEE types prior to treatment as soon as practicable and to be kept separate throughout all process steps.
5. Collection, handling, transport and sorting of WEEE shall be undertaken with due care and using suitable containers, packaging and equipment so as to prevent the release of hazardous substances into air, water, or soil, as a result of damage and/or leakage.
6. Storage facility design shall ensure that:
    - WEEE is stored separately from other waste,
    - WEEE that is suitable for subsequent recovery is stored separately and in such a way that does not reduce its product recovery potential,
    - WEEE containing hazardous substances is stored in a way that prevents the release of these substances and the emission to air, water or soil in case of accidental release.
7. Collection, handling and sorting of WEEE shall be undertaken with due care to prevent any damage to the WEEE collected that could adversely affect subsequent recovery of functioning products, components or materials.
8. WEEE shall not be crushed or compacted prior to treatment.
9. Formal partnerships between collection organisations and suitable product recovery organisations (e.g. refurbishers, repairers, remanufacturers) shall be established to facilitate product recovery.

Identification, classification and deciding the recovery pathway

10. A list of relevant attributes (e.g. type of WEEE, presence of hazardous substances or radioactive material, recovery potential) shall be established and maintained up-to-date.
11. The list of attributes shall be consistently applied in the identification of WEEE and in the determination of the recovery pathway.

12. An appropriate recovery pathway methodology to facilitate the identification of WEEE suitable for product recovery as well as component and material recovery shall be applied to each inbound WEEE delivery.
13. Recovery pathway decisions for each inbound WEEE delivery shall be recorded in alignment with relevant regulatory requirements and the recovery organisation's own traceability system.
14. When deciding the recovery pathway, a more thorough assessment (e.g. LCA according to ISO 14040 and ISO 14044) shall be conducted where taking a lifecycle perspective does not provide sufficient evidence for defining the best environmental outcome.
15. Visual inspection, checking or initial functionality testing shall be undertaken at the point of collection, at a collection facility, at a logistics facility or on arrival at the recovery organisation's facilities to establish the recovery potential of incoming WEEE.
16. Functional WEEE shall be routed towards product recovery through refurbishment.
17. If the WEEE item is not functional, the reason for non-functioning shall be identified. Where the fault can be identified and is deemed to be repairable, the WEEE item shall be routed toward product recovery through repair.
18. Where the fault cannot be identified, the WEEE item shall be routed towards product recovery through remanufacturing of products or components or towards component recovery through refurbishment.

Product and component recovery through refurbishment, repair and remanufacturing

19. WEEE that has been routed towards one of the product recovery pathways shall be inspected and tested for functionality and safety before and after undergoing the relevant product and component recovery processes.
20. Recovery processes shall be designed to ensure human and environmental health and safety. In particular, the release of hazardous substances shall be prevented and mitigation measures to be put in place to deal with potential accidental releases.

Detailed methodologies for product and component recovery processes through refurbishment, repair and remanufacturing can be set out in associated European standards. IEC 63395 (under development) provides further details upon which a European standard can be based.

Material recovery

21. Material recovery infrastructure, technology and practices shall be designed and maintained to:
    - be appropriate to the type of WEEE received for material recovery,
    - maximise the types, quantity and quality of materials recovered,
    - minimise risks to human and environmental health and safety during recovery.
22. The organisation shall regularly review their operations and strive to maintain state of the art infrastructure, technologies and practices.
23. Dismantling and disassembly shall be given preference over shredding as a first treatment step in order to maximise the types, quantity and quality of materials recovered and minimise risks to human and environmental health and safety.
24. Materials shall be sorted into different material types at the earliest feasible point and be kept separate during processing.

25. Dismantling and disassembly shall be undertaken in such a way that prevents the release of hazardous substances into air, water, or soil, as a result of damage and/or leakage and mitigation measures shall be put in place to deal with potential accidental releases.
26. E-waste containing batteries shall be identified and any batteries contained in the e-waste shall be removed in a safe manner in order to avoid explosion, fire and leakage risks.
27. WEEE containing hazardous substances shall be depolluted in accordance with an associated European standard. IEC 63395 (under development) provides further details upon which a European standard can be based.
28. Depollution effectiveness shall be monitored in accordance with a methodology set out in an associated European standard. IEC 63395 (under development) provides further details upon which a European standard can be based.

Energy recovery

29. For any WEEE that cannot be recovered as a product, component or material, energy recovery shall be considered as a treatment.
30. Energy recovery shall only be undertaken by licensed organisations and shall be designed not to have negative effects on environmental and human health and safety.
31. WEEE containing hazardous substances, materials or mixtures shall only be transferred to facilities that meet applicable legal and regulatory requirements to receive and dispose this type of WEEE.
32. Final disposal of WEEE containing hazardous substances, materials or mixtures shall be in accordance with applicable international and national laws and regulations including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.

Traceability and record keeping

33. Traceability data shall be collected and recorded to facilitate the monitoring of the flow of WEEE received and routed towards different recovery pathways.

Requirements for traceability and record keeping can be set out in an associated European standard. IEC 63395 (under development) provides further details upon which a European standard can be based.

Monitoring and evaluation of recovery performance

34. Recovery performance shall be monitored and evaluated to assess the following:
    - WEEE flow: monitoring of the flow of WEEE received through an organisation's WEEE recovery chain,
    - Recovery efficiency: monitoring and evaluation of the recovery efficiency achieved for WEEE routed towards product, component or material recovery against recovery effectiveness targets,
    - Recovery quality: monitoring and evaluation of the quality of products, components and material recovered from the organisation's WEEE received.

Monitoring and evaluation methodologies can be set out in an associated European standard. IEC 63395 (under development) provides further details upon which a European standard can be based.