



# CEWASTE

Voluntary certification  
scheme for waste treatment

## **BASELINE AND GAP/OBSTACLE ANALYSIS OF STANDARDS AND REGULATIONS**

**DELIVERABLE 1.1**



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## ACRONYMS

Ag	Silver
Au	Gold
BEV	Battery Electric Vehicle
CDD	Compact disc drive
CRM	Critical Raw Material
EEE	Electrical and Electronic Equipment
ELV	End-of-life Vehicle
EPR	Extended producer responsibility
EU	European Union
CRT	Cathode ray tube
HDD	Hard disc drive
HEV	Hybrid Electric Vehicle
Ir	Iridium
KCE	Key CRM-Equipment
IT	Information technology
Nd	Neodymium
NdFeB- magnets	Neodymium iron boron (NdFeB) magnets
NiMH	Nickel metal hydride
ODD	Optical disc drive
Pd	Palladium
PGM	Platinum Group Metal (Pd, Pt, Rh, Ru, Os, Ir), sub-group of precious metals
PHEV	Plug-in Hybrid Electric Vehicle
PM	Precious Metal (Ag, Au, PGMs)
Pt	Platinum
REE	Rare Earth Elements
Rh	Rhodium
Ru	Ruthenium
Sa	Samarium
SRM	Secondary Raw Material

TR	Thermal runaway (of lithium-ion batteries)
TV	television
UPS	Uninterruptable power supply
WEEE	Waste Electrical and Electronic Equipment

# GLOSSARY

## **Accreditation**

Third-party attestation related to a conformity assessment body conveying formal demonstration of its competence to carry out specific conformity assessment tasks.

## **Certification**

Third-party attestation related to products, processes, systems or persons.

## **Conformity assessment**

Demonstration that specified requirements relating to a product, process, system, person or body are fulfilled.

## **European Standards**

A standard is a document that provides rules, guidelines or characteristics for activities or their results, for common and repeated use. Standards are created by bringing together all interested parties, including manufacturers, users, consumers and regulators, of a particular material, product, process or service, to reach consensus on what can be considered best practice and 'state of the art'. A European Standard is a standard that has been adopted by one of the three recognized European Standardization Organizations: CEN, CENELEC or ETSI and is identified by a unique reference code which contains the letters 'EN'.

## **First-party conformity assessment activity**

Conformity assessment activity that is performed by the person or organization that provides the object (source: ISO IEC DIS 17029)

## **Requirement**

A normative (prescriptive) element, quality or qualification, applicable to the whole or part of a business process that should be followed in order to comply with regulations or a voluntary certification scheme.

## **Removal**

Manual, mechanical, chemical or metallurgic handling with the result that hazardous substances, mixtures and components are contained in an identifiable stream or are an identifiable part of a stream within the treatment process. A substance, mixture or component is identifiable if it can be monitored to verify environmentally safe treatment (source: Directive 2012/19/EU (WEEE Directive)).

## **Recovery**

Any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy; (source: Directive 2008/98/EC (Waste Framework Directive))

## **Recycling**

Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations; (source: Directive 2008/98/EC (Waste Framework Directive))

## **Technical Reports**

A Technical Report (TR) is an informative document that provides information on the technical content of standardization work. A Technical Report is established by a CEN Technical Body and approved through a simple majority vote by the CEN national members. It involves no obligation at national level and has no specified time limit.

## **Technical Specification**

A Technical Specification (TS) is a normative document developed in anticipation of future harmonization when there is not yet sufficient agreement on a European Standard (EN), or for providing specifications in experimental circumstances and/or evolving technologies.

**Treatment**

Recovery or disposal operations, including preparation prior to recovery or disposal; (source: Directive 2008/98/EC (Waste Framework Directive))

# 1 SUMMARY

The H2020-project CEWASTE aspires developing and testing a voluntary certification scheme with requirements enabling the recycling of valuable and Critical Raw Materials (CRMs). In the first work package ‘Baseline and Gap Analysis’, the consortium identified 14 types/categories of Key CRM Equipment (KCE) from WEEE and end-of-life vehicles (ELVs) with four principle types of components and fractions containing valuable and CRMs which technically can be recycled:

1. Printed circuit boards from IT equipment, hard disc drives (HDDs) and optical disc drives (ODDs)
2. Waste batteries from WEEE and ELVs
3. NdFeB-magnets from household appliances, hard disc drives and electrical engines of ELVs
4. Fluorescent powders from cathode ray tubes (CRTs; TVs and monitors) and fluorescent lamps

The economic viability of the collection and CRM recycling processes under the current economic and legislative framework conditions was not required to qualify as KCE. Economic framework conditions, within certain limits, can be changed and adapted by legislation. Waste products with CRMs but foreseeably excessive cost for collection and treatment for CRM-recycling were nevertheless excluded from the KCE list.

More than 60 normative requirements such as legislation, standards and their certification schemes applicable to valuable and CRMs in general or more specifically for the identified KCE were analysed for stipulations that could be referenced and used for the CRM recycling standard and certification scheme. A gap and obstacle analyses revealed that, while non-technical requirements applicable to the collection and treatment of KCE – environment, health and safety aspects and management systems, traceability and documentation of material flows, reporting, etc. – could be identified in several of the documents, specific and in particular technical requirements for the collection, transport and treatment of the identified KCE were found to be largely missing.

Therefore, technical criteria mainly need to be developed specifically for the CEWASTE certification scheme, while non-technical requirements may be referenced from current

legislation and standards as a first priority. New requirements would be produced only if the available ones are not applicable.

The economic side of CRM recycling from magnets, fluorescent powders, and from batteries is a main obstacle under the current economic framework. Large scale recycling of CRMs from these KCEs requires a different economic framework establishing a stable and sustainable financing obligation and mechanism, for example either via additional EPR-obligations (extended producer responsibility), or alternative financing mechanisms such as recycling fees from consumers, or from taxes.

The results of this first work package serve as input for the development of normative requirements in work package 2.

## 2 INTRODUCTION

### 2.1 THE CEWASTE PROJECT

The CEWASTE (Voluntary Certification Scheme for Waste Treatment) project contributes to an improved recycling of valuable and critical raw materials (CRMs)<sup>1</sup> from key types of waste through the auditing and certification of traceable and sustainable treatment processes in the entire supply chain of secondary raw materials. CEWASTE addresses the specific challenge to secure the sustainable access to CRMs for the EU economy as well as objectives set by the EU action plan for the Circular Economy, the issue of illegal trade of wastes within the EU and to non-EU countries, and the need to support the development of environmentally and socially sound recycling systems globally.

Specifically, the project will develop, validate and launch a voluntary certification scheme for collection, transport and treatment facilities of key types of waste containing significant amounts of valuable and critical raw materials. To ensure a comprehensive approach and a robust result, the project will be developed along the following six specific objectives:

- **Objective 1:** Understand existing recovery practice, standards and verification schemes related to valuable and critical raw materials and how these can be leveraged for CEWASTE.
- **Objective 2:** Leverage existing normative requirements to develop technical, sustainability and traceability requirements for the voluntary certification scheme.
- **Objective 3:** Develop an assurance system and related verification procedures that effectively ensure that facilities and raw material streams are compliant with sustainability and traceability requirements.
- **Objective 4:** Validate the new voluntary scheme through pilots with selected and committed stakeholders of the value chain.

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<sup>1</sup> For the list of CRMs see <https://ec.europa.eu/transparency/regdoc/rep/1/2017/EN/COM-2017-490-F1-EN-MAIN-PART-1.PDF>

- **Objective 5:** Ensure long term sustainability of the scheme, reflecting on the needs from existing governance mechanisms, and resulting in a roadmap addressing the amendments of new requirements or mechanisms needed.
- **Objective 6:** Ensure a transparent stakeholder process that allows for broad acceptance and dissemination of the essentials of the scheme.

CEWASTE will deliver tangible results in the form of analysis of reports, a set of rules (normative requirements), related administrative and procedural mechanisms to ensure compliance with the rules, practical guidelines, and an implementation plan as outlined in detail in the work plan of project's Grant Agreement. In addition, the project will produce a series of recommendations as part of these results. Face to face events, presentations, webinars, and publications will support project implementation, enabling stakeholder participation, communication, dissemination and the launch of the scheme.

CEWASTE will not develop the new voluntary scheme from scratch nor formally amend existing standards. In view of the two years implementation condition set by the call, the project will focus on developing the scheme based on the current developments in recovery technologies and on the existing normative landscape in the field of waste treatment and responsible sourcing of raw materials, while presenting a clear roadmap for necessary amendments of existing mechanisms and a large-scale roll-out of the scheme. This strategy will ensure that despite the limited resources, the specific objectives as presented above can be achieved in a realistic timeframe.

## 2.2 PURPOSE OF THIS DELIVERABLE AND OVERVIEW OF WORK PACKAGE 1

This Deliverable 1.1 describes and illustrates the tasks, approaches, and results of work package 1 (Baseline & Gap Analysis) of the CEWASTE project:

- Task 1.1: Mapping of Key Critical Raw Material Products (KCE) and conditions enabling CRM recycling
- Task 1.2: Mapping of current normative requirements and verification mechanisms
- Task 1.3: Gap and obstacle analysis

The overall approach was to first identify KCE in task 1.1 from which CRMs and valuable metals could be recycled. Task 1.2 looked into normative requirements, i.e. legislation, standards, guidelines, that are relevant for Waste Electrical and Electronic Equipment (WEEE) and batteries from WEEE and end-of-life vehicles (ELVs), and the specific types of selected KCE, for example specific requirements for the collection and treatment of lead-acid batteries. Since CEWASTE intends building on appropriate requirements from other standards rather than setting up new ones, the applicable normative requirements were screened for stipulations that could be adopted. The same applies to certification schemes for standards. In task 1.3, the gaps in the normative requirements and certification schemes were identified (which Work Package 2 will have to address) as well as the potential obstacles that could impede the effectiveness of a voluntary certification scheme.

## 2.3 SCOPE

### PRODUCT SCOPE

The consortium decided to focus the scope on WEEE containing critical raw materials (CRMs) and valuable materials like precious metals (PMs), as agreed in the grant agreement with the Commission. In addition, batteries from both WEEE and ELVs are also included in the product scope. Batteries can be (relatively easily) removed from ELVs without pre-treatment of the ELV and, with the exception of lead-acid batteries, can be processed together with batteries from WEEE, or with the same end-processes.

Other parts of ELVs (electronic components containing CRMs) were considered but given the fact that the expertise on pre-treatment of ELVs is not available within the CEWASTE consortium, and the work would depend only on literature data, it was decided to leave it out of the scope.

### VALUE CHAIN SCOPE

The CEWASTE project and the voluntary certification scheme focus on the End-of-Life (EoL) of products, consisting of the following steps:

- Collection
- Logistics (may include accumulation of WEEE, sorting, loading and shipment to treatment facilities)

- Treatment
  - Pre-treatment (may include preparation for reuse, manual or mechanical pre-sorting, depollution, shredding and sorting of output fractions)
  - End-treatment (i.e. downstream treatment of output fractions from pre-treatment, e.g. metal refining, smelting, plastics recycling etc.)

## 3 IDENTIFICATION OF KEY CRM EQUIPMENT

### 3.1 CRITERIA FOR IDENTIFYING KEY CRM EQUIPMENT

As a first step, the consortium identified KCE which were then characterized according to:

- 1) The type or the class of WEEE or battery containing the CRM, e.g.
  - a) mobile phones, lithium-ion batteries, ceramic catalytic converters (types);
  - b) or, where it is possible to be less specific: information technology (IT), batteries, catalytic converters (classes).
- 2) The one or several CRM(s) to be recycled from a type or class of products
- 3) The component(s) which contain the respective CRM(s).

In order to qualify as a valuable KCE suitable for CRM recovery, the following conditions had to be fulfilled:

- 1) The product contains a **concentration of CRM(s) that is technically relevant for recycling**, at least higher than the minimum technical threshold concentration, or such a relevant concentration can be achieved by separating the CRM-containing component(s) from the product in pre-treatment;
- 2) An **industrially feasible end-treatment technology is available or foreseeable**, i.e. a technology readiness level (TRL)<sup>2</sup> of at least 7, that facilitates the recycling of the CRM(s) from this type or class of product, its component(s) or fractions thereof from pre-treatment;
- 3) The **pre-treatment is technically capable to deliver the input** needed for the end-process required for the recycling of the CRM(s);
- 4) The recycling of the CRMs from the product **does not impede the recycling of precious metals (PMs)** from the product, its component(s), or fractions thereof;

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<sup>2</sup> C.f. page 22 for the explanation of the technology readiness levels

- 5) The collection, transport, pre- and end-treatment required for recycling of CRMs from a product may not (always) be economically attractive under the current conditions, but **the costs should not be excessive and prohibitive.**

Conditions 1) - 3) are sine-qua-non conditions. Recycling of CRMs technically cannot happen from products containing concentrations of CRMs that are below technical thresholds enabling the recycling, or if appropriate pre- and end-treatment for recycling is technically not feasible.

Condition 4) is based on economic and ecological considerations. PMs are the economic drivers of the recycling business. Recycling of PMs is highly desirable also from an environmental and resource perspective due to their scarcity and the related efforts for mining, as well as the resulting high energy consumption of mining and refining PMs as primary metals from ores. Interfering with PM recycling for the sake of CRM recycling would therefore adversely affect the entire recycling business and create additional environmental impacts.

This approach excluded some electronic components with marginal concentrations of REEs. Tantalum capacitors could not qualify either as KCE because the end-treatment routes of PMs and tantalum are incompatible, which would result in losses of PMs. To enable a separate treatment, tantalum capacitors would have to be removed from the printed circuit boards (PCBs). The tantalum capacitors contain, however, PMs as well, which would be lost in the tantalum recycling process. Adding to this, these capacitors are very small<sup>3</sup>, so that their removal would require high efforts, thus be very costly, and would only yield small amounts of tantalum.

Condition 5) addresses the economic side of CRM recycling. When identifying KCE, the consortium tried to avoid cases where the ratio of costs and benefits are highly imbalanced, e.g. due to extremely low CRM concentrations in the products or in their components, or excessive pre-treatment requirements.

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<sup>3</sup> Example sizes are 1206 (3,2 mm x 1,6 mm), 0805 (2 mm x 1.25 mm), 06030 (1.6 mm x 0.8 mm), 0402 (1.02 mm x 0.5 mm), c.f. <http://www.avx.com/products/tantalum/high-reliability/medical/other-medical-applications/>

The technology readiness levels are defined as follows<sup>4</sup>:

- TRL 1 – Basic principles observed
- TRL 2 – Technology concept formulated
- TRL 3 – Experimental proof of concept
- TRL 4 – Technology validated in lab
- TRL 5 – Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – System prototype demonstration in operational environment
- TRL 8 – System complete and qualified
- TRL 9 – Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

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<sup>4</sup> C.f. <https://enspire.science/trl-scale-horizon-2020-erc-explained/>

## 3.2 KEY CRM EQUIPMENT

Data from the ProSUM project (elaborated further in the SCRREEN project) and from the Umicore database were the main sources for identifying valuable and CRM contents in WEEE and batteries.

### 3.2.1 CEWASTE KEY CRM EQUIPMENT

Table 2 shows the WEEE and batteries that qualified as KCE according to the selection criteria described in the previous section.

*Acronyms used in the table for WEEE and components:*

<b>CDD</b>	<i>compact disc drive, incl. DVDs and blue ray drives</i>
<b>CUPM</b>	<i>copper and precious metals</i>
<b>HDD</b>	<i>hard disc drive</i>
<b>IT</b>	<i>information technology</i>
<b>NiMH</b>	<i>nickel metal hydrid</i>
<b>ODD</b>	<i>optical disc drive</i>
<b>TV</b>	<i>television</i>
<b>UPS</b>	<i>uninterruptable power supply</i>

*Acronyms for ELVs and ELV-related components:*

<b>BEV</b>	<i>battery electric vehicle</i>
<b>HEV</b>	<i>hybrid electric vehicle</i>
<b>PHEV</b>	<i>plug-in hybrid electric vehicle</i>

Table 2: List of Key CRM Equipment

Waste Type	Key CRM Equipment	(Collect.) Category	CRMs	Components with CRM	Input Required/Viable for End-processing	Current Economic Feasibility	
WEEE	CRT monitors and TVs	2	Y, Tb, Eu, Gd,La, Ce	Fluorescent powder	Fluorescent powder	No	
WEEE	Fluorescent lamps	3	Eu, Tb, Y, Ce, La	Fluorescent powder	Fluorescent powder	No*	
WEEE	Temperature exchange equipment	1	Nd, Pr, Dy, Gd, Tb	Magnets in engines/compressors	Magnets	No	
WEEE	Household appliances	4, 5	Nd, Pr, Dy, Gd, Tb	Magnets in electric motors/drives	Magnets	No	
WEEE	Mobile phones	6	Co	Li-ion battery	Battery	Yes	
			Au, Ag, Bi, Pd, Sb	PCB	Phone without battery; PCBs (shredded, unshredded); CuPM granulate	Yes	
			Sb	Plastic casing	Phones without battery	Yes	
WEEE	Laptops	2	Co	Li-ion battery	Battery	Yes	
			Nd, Pr, Dy, Gd, Tb	Magnets in HDD	Magnet	No	
			Au, Ag, Bi, Pd, Sb	PCB	PCB (shredded, unshredded), CuPM granulate	Yes	
			Sb	Plastic casing	Shredded plastic	Yes	
WEEE	Tablets	2	Co	Li-ion battery	Batteries	Yes	
			Au, Ag, Bi, Pd, Sb	PCB	PCB (shredded, unshredded), CuPM granulate	Yes	
WEEE	Desktop computers, prof. IT	6, 4	Nd, Pr, Dy, Gd, Tb	Magnets in HDD	Magnets	No	
			Au, Ag, Bi, Pd, Sb	PCB	PCB (shredded, unshredded), CuPM granulate	Yes	
WEEE	External CDDs, ODDs, devices with internal CDDs/ODDs	6, others (internal)	Au, Ag, Bi, Pd, Sb	PCB	PCB (shredded, unshredded), CuPM granulate	Yes	
WEEE	Batteries in WEEE	Various	Co, (Ce, La, Nd, Pr)	NiMH battery	Batteries	Yes (Co)	No (REEs)
			Co	Li-ion battery	Batteries	Yes	
WEEE	Lead acid batteries from UPS	4, 5	Sb	PbSb alloy	Batteries	Yes	
WEEE	Lead acid batteries from PV systems	Batteries					
ELV	Lead acid batteries from ELVs						
ELV	BEV, (P)HEV	Batteries	Co	Li-ion battery	Batteries	Yes	
			Co, (Ce, La, Nd, Pr)	NiMH battery	Batteries	Yes (Co)	No (REEs)
		ELV	ELV	Nd, Pr, Dy, Gd, Tb	Magnet in electro-engine	Magnets	No

\*Recent developments in countries outside the EU have been reported but detailed information about the economic feasibility is not yet available.

Table 3 displays the KCEs sorted according to the source components containing the CRMs.

Table 3: Components in KCE containing valuable and CRMs

Source Comp.	KCE	Waste Type	CRMs	Required/Viable Input for End-processing	Current Economic Feasibility	
Fluorescent powders	Fluorescent lamps	WEEE	Eu, Tb, Y, Ce, La	Fluorescent powder	No*	
	CRT monitors and TVs		Y, Tb, Eu, Gd, La, Ce	Fluorescent powder		
Nd-magnets	Temperature exchange equipment (engine, compressor)	WEEE	Nd (+ Dy, Gd, Pr, Tb)	Magnets	No	
	Household appliances other than temperature exchange equipment (motors/drives)					
	Laptops (HDD)					
	Desktop Computers, prof. IT (HDD)					
	BEV, (P)HEV (electro engine)	ELV				
PCBs	Desktop computers, prof. IT	WEEE	Au, Ag, Bi, Pd, Sb	Entire devices w/o battery (mobile phones), PCBs (shredded, unshredded), CuPM granulate	Yes	
	Laptops					
	Mobile phones					
	Tablets					
	External CDDs, ODDs, devices with internal CDDs/ODDs					
Li-ion batteries	Laptops	WEEE	Co	Batteries	Yes	
	Mobile phones					
	Tablets					
	Li-ion batteries in other WEEE					
	BEV, (P)HEV	ELV				
NiMH battery	NiMH batteries in WEEE	WEEE	Co, Ce, La, Nd, Pr	Batteries	Yes (Co)	No (REEs)
	HEV	ELV				
Lead acid batteries	Lead-acid batteries	WEEE	Sb	Batteries	Yes	
		ELV				

\*Recent developments in countries outside the EU have been reported but detailed information about the economic feasibility is not yet available.



## 3.3 TREATMENT OF KCE

The high prices of precious metals are the strongest economic driver of the WEEE recycling business. The recycling of these metals from PCBs and other waste materials is therefore a well-established standard recycling path.

Recycling of antimony from lead-acid batteries and of cobalt from lithium ion and nickel-metal-hydride batteries is economically viable under the current economic framework conditions as well and is practiced already.

Recycling of REE from fluorescent powders and waste NiMH-batteries as well as recycling of Nd from magnets is inhibited economically and therefore no common practice under the given economic framework conditions. In the absence of readily available practiced standard technologies, this section gives basic technical insights into the treatment possibilities of these fractions of WEEE and ELVs to enable the recycling of the contained CRMs.

### 3.3.1 PRE-TREATMENT OF CRTs AND FLUORESCENT LAMPS

Table 2 shows that the end-treatment requires the CRM source components, e.g. printed circuit boards and waste batteries, or even fractions of these components as inputs, for example the fluorescent powders from CRTs or fluorescent lamps, and NdFeB-magnets. The WEEE Directive stipulates the removal of the fluorescent layer in CRTs<sup>5</sup>, which, according to the definition of “removal”<sup>6</sup> in the WEEE Directive, does not mean the separation of these layers from the CRTs prior to further processing. The current standard treatment is their removal at a later stage in the course of the pre-treatment process. The situation is similar for fluorescent lamps. Clarification is currently still in progress as to whether the end-treatment operators would accept fluorescent powders that were not separated prior to further treatment steps.

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<sup>5</sup> C.f. Annex 7(2)(a) of the WEEE Directive

<sup>6</sup> For the definition see the Glossary

### 3.3.2 IDENTIFICATION OF NEODYMIUM MAGNETS IN HOUSEHOLD AND OTHER EQUIPMENT

While all hard disc drives and engines of electrical vehicles can be assumed to contain NdFeB-magnets, household appliances may apply both Nd- as well as other magnets in electrical engines, which poses additional challenges in pre-treatment.

NdFeB-magnets may be used in both main and other motors such as in pumping motors, cooling ventilations, water distribution valves and feeding valves. Generally, the use of NdFeB-magnets can differ from brand to brand and from model to model of the same brand. A rough differentiation whether engines contain NdFeB-magnets is viable by size. NdFeB-magnets are preferably used in small motors and pumps while larger ones in tendency use other magnets or non-permanent magnets. The large motor in washing machines, e.g., may use magnets without Nd. In refrigerators and tumble dryers, where space is critical, NdFeB-magnets are used preferably also in main engines. Other household appliances like dish washers, vacuum cleaners and kitchen hoods may use both NdFeB-magnets as well as magnets without REEs.<sup>7</sup>

Given the above situation, it may be difficult for pre-treatment operators to know for each brand and type of household appliance whether and where NdFeB-magnets are used. The producers should make this information available to the treatment operators. The EU member states can oblige the producers to provide such information.<sup>8</sup> Pre-treatment of WEEE containing NdFeB-magnets

The removal of engines from all types of electrical vehicles and the subsequent separation of the NdFeB-magnets should be viable even manually to the large size of both the engines as well as their NdFeB-magnets. This poses, however, a major challenge for recycling of Nd from NdFeB-magnets in WEEE like household appliances other than temperature exchange equipment. Neither are the engines separated from these devices, nor the magnets from the engines during pre-treatment due to their mostly small size. Waste household appliances other than temperature exchange equipment are generally shredded as a whole after the

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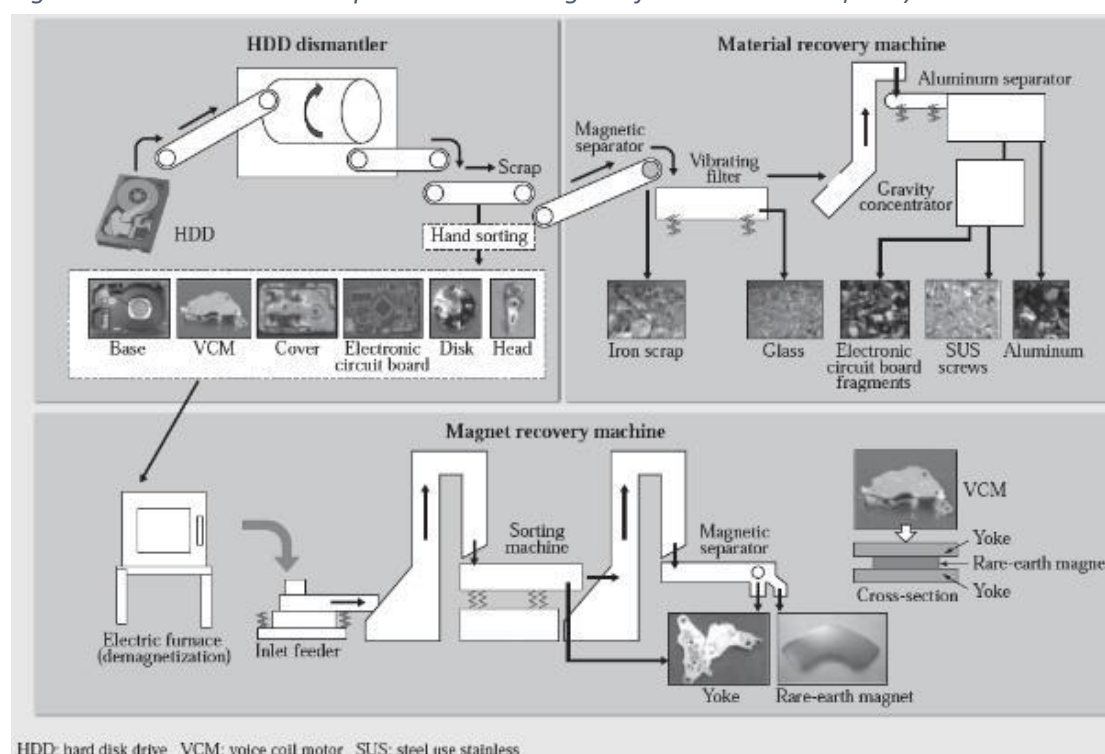
<sup>7</sup> Source: Miele & Cie. KG, Technical Product Management and Environmental Office

<sup>8</sup> Art. 15(1) of the WEEE Directive, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02012L0019-20180704&from=EN>

removal of hazardous components/materials or difficult to shredder materials. The small but strong NdFeB-magnets and other permanent magnets stick to ferrous scrap after shredding and physical separation using for example magnetic separators. In addition, smaller amounts of these magnets are trapped to the non-ferrous particles if the magnets are not liberated during the crushing, and some of the liberated ones stick to the walls of the shredder from which they could in principle be harvested. As a result, almost all small NdFeB-magnets used in consumer electronics are lost into ferrous or nonferrous scrap in the pre-treatment phase.<sup>9</sup>

The initial separation of NdFeB-magnets from household appliances prior to subsequent shredding is thus key to Nd-recycling from these magnets. The same applies to hard disc and optical disc drives. For the liberation of NdFeB-magnets from HDDs, Hitachi developed the process depicted in Figure 1.

Figure 1: Pre-treatment to separate NdFeB-magnets from HDDs developed by Hitachi



Source: SCRREEN Deliverable D4.2

<sup>9</sup> Yang et al. 2017 in SCRREEN Deliverable D4.2

No further information was accessible as to the status of the above pre-treatment process in Japan. In the EU, so far no specific pre-treatment processes are in practice for WEEE containing NdFeB-magnets.

#### **FINAL TREATMENT OF NdFeB-MAGNETS**

REE recycling from NdFeB-magnets is technically feasible, but the economic feasibility may be critical under the current economic conditions. The technology readiness level of end-treatment is probably below 9.

Hitachi Metals has developed a pyrometallurgical method in Japan using molten Mg as an extraction medium to recycle Nd and Dy from NdFeB-magnets. Santoku Corporation is said to have started in 2012 a recycling route for neodymium and dysprosium from magnets of air conditioner motors and magnet production scrap.<sup>10</sup> Details about the actual status of these processes are not available.

Another process for recycling of REEs from NdFeB-magnets is Momentum's hydrometallurgical MSX technology process. The MSX technology was able to recycle more than 99 % of the rare earth content from HDDs dissolved in acid while operating at room temperature and pressure.<sup>11</sup> Finally, the Ames Laboratory acid-free dissolution recycling technology is described as having the potential to recycle Nd from shredded HDD samples without pre-concentration of the magnet contents, even though a pre-concentration is desirable to reduce the amounts of chemicals needed.<sup>12</sup> Both processes produce mixed REE-oxides, which are less favorable for NdFeB-magnet production than separated ones. In the EU, there is currently only one major producer of NdFeB-magnets<sup>13</sup>, VAC, which could be a

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<sup>10</sup> For recycling technologies see page 126 et sqq. of SCRREEN deliverable D4.2 (<http://screen.eu/wp-content/uploads/2018/03/SCRREEN-D4.2-Production-technologies-of-CRM-from-secondary-resources.pdf>) and <https://www.urbanminingco.com/index.php?cat=about>

<sup>11</sup> For details see page 41. of the iNEMI report "Value Recovery Project 2, <https://www.inemi.org/value-recovery-2-final-report>

<sup>12</sup> For details see pages 41 et sq. of the iNEMI report "Value Recovery Project 2, <https://www.inemi.org/value-recovery-2-final-report>

<sup>13</sup> Source: Dr. Matthias Buchert, Oeko-Institut, communication via e-mail; <https://vacuumschmelze.com/Products/Permanent-Magnets>

potential downstream buyer for such REE oxides. Several EU-projects address recycling of REEs from magnets, e.g. REE4EU (pilot scale plant<sup>14</sup>, REEcover<sup>15</sup>, and others.<sup>16</sup>

Besides recycling REE from NdFeB-magnets, waste NdFeB-magnets can be used to produce new NdFeB-magnets. The US-based Urban Mining Company claims to have commercialized its process for producing recycled sintered NdFeB-magnets with their patented Magnet-to-Magnet process.<sup>17</sup> In the EU, the SDS-process<sup>18</sup>, another process to produce new NdFeB-magnets from waste ones, was developed in the ReproMag<sup>19</sup> project. The development is being continued in the SusMagPro<sup>20</sup> project.

Further principle alternatives are the reuse of NdFeB-magnets from HDDs in applications others than HDDs, or the reuse of NdFeB-magnets from HDDs in newly produced HDDs.<sup>21</sup> The latter is a dwindling option since HDDs are more and more replaced by SSDs, which do not use NdFeB-magnets.<sup>22</sup>

#### **END-TREATMENT OF FLUORESCENT POWDERS**

Recycling of fluorescent powders from fluorescent lamps had been practiced until 2016 before the operations were stopped for economic reasons. The price decrease of REEs after the peak in 2011 undermined the economic base of these recycling operations.<sup>23</sup> These past recycling

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<sup>14</sup> REE4EU project, c.f , and video (<https://youtu.be/6b0CS65a1Ro>)

<sup>15</sup> REEcover project, <https://cordis.europa.eu/project/rcn/110976/factsheet/en>

<sup>16</sup> For an overview of EU and international developments also see Yang et al.: REE Recovery from End-of-Life NdFeB Permanent Magnet Scrap; <https://repository.tudelft.nl/islandora/object/uuid:92b1afee-41e4-429d-b381-965673f893ef/datastream/OBJ/download>

<sup>17</sup> A more detailed description of the process can be found on pages 31 et sqq. of the iNEMI report “Value Recovery Project 2, <https://www.inemi.org/value-recovery-2-final-report>

<sup>18</sup> <https://www.youtube.com/watch?v=FWcEjTjSYbE>

<sup>19</sup> ReproMag project, <https://repro-mag-project.eu/>

<sup>20</sup> Sustainable Recovery, Reprocessing and Reuse of Rare-Earth Magnets in a Circular Economy (SusMagPro project), <https://sc5.easme-web.eu/?p=821114> and [https://www.steinbeis-europa.de/susmagpro\\_en](https://www.steinbeis-europa.de/susmagpro_en)

<sup>21</sup> For details see Demonstrators 1 and 2 in the iNEMI report “Value Recovery Project 2, <https://www.inemi.org/value-recovery-2-final-report>

<sup>22</sup> For details see Maximilian V. Reimer, Heike Y. Schenk-Mathes, Matthias F. Hoffmann, Tobias Elwert, TU Clausthal: Recycling Decisions in 2020, 2030, and 2040—When Can Substantial NdFeB Extraction be Expected in the EU?, <https://www.mdpi.com/2075-4701/8/11/867/pdf>

<sup>23</sup> For historical REE prices check

<http://static5.businessinsider.com/image/5418482469bedd2b4285259f-1200-1000/rare%20earth%20pricing.jpg>

activities prove, however, that the recycling of REEs from fluorescent powders is technically feasible with an established technology. If policies are installed to create a long-term solid financing mechanism and to ensure stable supplies of recycling material, REE recycling operations would become practicable.

Since the operations had been stopped, it could not be clarified whether the previously installed commercial REE recycling process would have been appropriate for CRT fluorescent powders as well. Relight runs, however, another plant which could process 400 t per year<sup>24</sup> of fluorescent powders from CRTs and from fluorescent lamps for REE recycling in case the financing would be ensured.<sup>25</sup>

#### **END-TREATMENT OF REE FROM WASTE BATTERIES**

Recycling of antimony from lead-acid batteries and of cobalt from lithium ion and nickel-metal-hydride batteries is economically viable under the current economic framework conditions and is practiced already. Cerium, lanthanum, neodymium and praseodymium recycling from NiMH batteries is currently economically not feasible, but in principle technically possible. The REEs from NiMH batteries can be concentrated in a residue after smelting (Umicore), and this REE concentrate can be treated by dedicated REE hydro refining processes (Solvay). Solvay suspended, however, this REE refining operation in La Rochelle in France when REE prices dropped after 2011. Like for the recycling of REE from fluorescent powders, the processes could be reestablished if a stable and durable financing of the recycling operations can be established.

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<sup>24</sup> Information obtained from RELIGHT <https://www.relightitalia.it/en/> via e-mails

<sup>25</sup> Information obtained from RELIGHT <https://www.relightitalia.it/en/> via e-mails

## 4 MAPPING AND ANALYSIS OF NORMATIVE REQUIREMENTS AND VERIFICATION SCHEMES

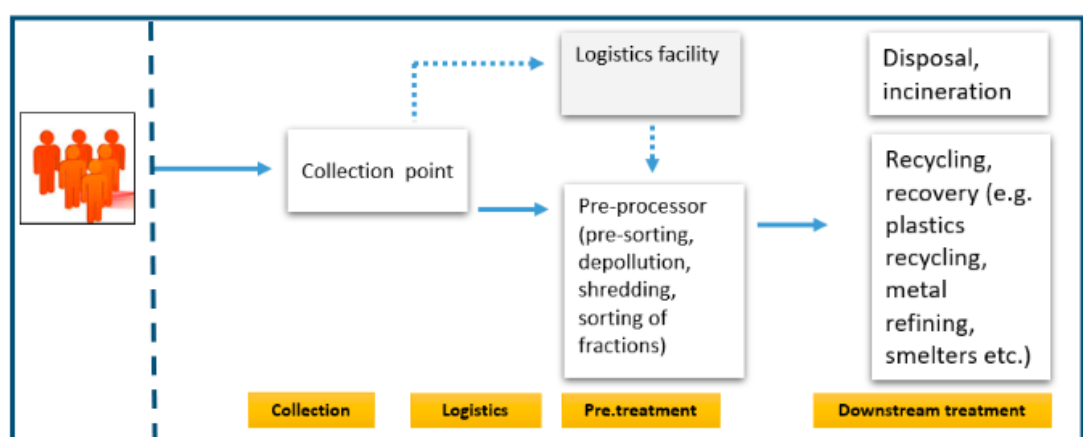
One of the objectives of work package 1 is to understand the scope, objectives and design of current normative requirements, embedded in legislation, standards, certification schemes and guidelines, and of international and EU waste management and shipment regulations with relevance for WEEE and batteries. The Work Package also seeks to analyze current conformity assessments (of standards/guidelines) as well as verification and assurance systems for certification schemes.

This information will help Task 1.3 identify gaps and obstacles in current normative requirements for recycling of valuable and CRMs and for the broad adoption of standards in the market. These gaps will be filled in work package 2.

### 4.1 APPROACH OF THE MAPPING PROCESS

A complete value chain consists of resource extraction, manufacturing, design, production, distribution, consumption and finally waste management including recycling. CEWASTE zooms in on the End-of-Life (EoL) process steps illustrated in Figure 2.

Figure 2: Scheme of the waste chain used for the mapping



In Task 1.2, CEWASTE participants mapped two types of CRM-relevant items related to the above EoL steps:

- Technical and non-technical normative requirements embedded in legislation, standards, guidelines and other relevant initiatives, and
- Conformity verification assessments, certification schemes.

An initial phase to identify the items to map and construct the mapping criteria was followed by the preparation of a form that would help participants perform a harmonized mapping.

In total **66 items were identified** (c.f. Annex I), of which five were found to be irrelevant in discussions within consortium partners. 61 items were mapped; 55 standards and requirements (the latter including some legislative texts), guidelines, and six certification/verification schemes. Annex II comprises the form used for the mapping exercise<sup>26</sup>.

Most of the mapped and analyzed standards have a similar structure. They are composed of a first part providing an introduction, definitions and describing the scope of the requirements in the documents, after these, the document may comprise generic, management requirements and more detailed, technical requirements, including in some cases requirements about evidence of compliance (e.g. documents). Table 4 shows the mapped normative requirements and guidelines, their product scope and the parts of the value chain addressed.

*Table 4: General aspects of the mapped normative requirements*

Name of standard or normative requirement (for full name please see complete list in Annex I)	Product or material addressed in the document	Detailed focus	Part of value chain affected	Geographical scope
AS/NZS 5377:2013	WEEE		Collection, Logistics, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use	National: Australia, New Zealand

<sup>26</sup> The on-line form can be found here: <https://goo.gl/forms/l7BmO3V53H9J1PkG2>

Name of standard or normative requirement (for full name please see complete list in Annex I)	Product or material addressed in the document	Detailed focus	Part of value chain affected	Geographical scope
ASI Chain of Custody (CoC) Standard V1 2017	Aluminium		Eligible scrap is mentioned as input but is generally not Chain of Custody (CoC) Material until it is designated ASI Aluminum following re-melting and/or refining, so is referred to separately.	World
ASI Performance Standard V2 - 2017	Aluminium	Scrap	The chain of custody	World
Commission Decision (EU) 2019/63	EEE		Product manufacturing	EU
Directive 2000/53/EC on ELVs	ELVs	Covers vehicles and end-of life vehicles, components and materials.	Product design, Collection, Logistics, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use, Government	EU
Directive 2012/19/EC on WEEE	WEEE, EEE	C&F, Screens, Lamps, LHA, SHA, IT for WEEE	Collection, Treatment, Disposal	EU
Directive 2006/66/EC on batteries	Batteries	Batteries and Accumulators	The Directive takes into consideration preventive measures (restricting the use of mercury and cadmium; promoting environmental performances and marketing of batteries with low pollutant content), Collection, Recycling, Financing and producer's responsibility (for the collection, treatment and recycling), Labels and exporting requirements	EU
Directive 2010/75/EU	Emissions	Industrial emissions (integrated pollution prevention and control) (Recast)	Cross-cutting stipulations for emissions along value chain	EU
Directive 91/271/EEC	Urban waste water	Urban waste water treatment	Treatment of waste water from industry	EU
ECOGuard	WEEE	SHA - Small household appliances	Logistics, Pre-treatment, Downstream treatment,	National: Italy

Name of standard or normative requirement (for full name please see complete list in Annex I)	Product or material addressed in the document	Detailed focus	Part of value chain affected	Geographical scope
EN 50419:2006	EEE		Identification of producer and of equipment put on the market	EU
EN 50581:2012	EEE	All EEE	Product design	EU
EN 50625-1:2014	WEEE, Batteries		Collection, Logistics, Pre-treatment, Downstream treatment	EU
EN 50625-2-1:2014 Lamps	WEEE	Lamps	Logistics, pre-treatment, downstream treatment	EU
EN 50625-2-2:2015 Displays	WEEE	WEEE containing CRTs and Flat Panel Displays	Logistics, pre-treatment, downstream treatment	EU
EN 50625-2-3	WEEE	Treatment requirements for temperature exchange equipment and other WEEE containing VFC and/or VHC	Collection, logistics	EU
EN 60086-2:2016	Batteries	primary cells and batteries	Product design	EU
EN 60086-3:2016	Batteries	primary watch batteries	Product design	EU
EN 60086-4:2015	Batteries	Primary batteries - Safety of lithium batteries	Product design, Downstream treatment	EU
EN 60086-5:2016	Batteries	Primary batteries - Safety of batteries with aqueous electrolyte	Product design, Pre-treatment	EU
EN 61960-3:2017	Batteries	secondary lithium cells and batteries in hand-held equipment, transportable equipment and in movable equipment	Product design	EU
EN 62281:2012	Batteries	Lithium cells and batteries containing lithium in any chemical form	Logistics	EU
EN 62430:2009	EEE		Product design	EU
EPSC Electronics Recycling Standard (ERS) 2015	WEEE		Downstream treatment	National: Canada

Name of standard or normative requirement (for full name please see complete list in Annex I)	Product or material addressed in the document	Detailed focus	Part of value chain affected	Geographical scope
European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)	Li-ion batteries, other dangerous goods	Li-ion batteries	Logistics	Europe
e-Stewards Standard	WEEE	Certain hazardous components/materials in WEEE (mostly IT)	Pre-treatment, Downstream treatment, Disposal, Preparation for re-use	World
eWASA Technical Guidelines	WEEE	All WEEE and appliances, as well as their components	Logistics, Pre-treatment, Downstream treatment, Disposal	National: South Africa
FprEN 45558	EEE		Product design, Pre-treatment, Downstream treatment	EU
IEC 60086-6 ED1	Batteries	Primary batteries	Product design, Logistics, Pre-treatment	World
IEC 62321- 1:2013	Electrotechnical products	It concerns determination of substances in metals, plastics and electronics (for instances PBDE)	Downstream treatment	World
IEC 62474:2018	Electrotechnical products		Material declaration data in the supply chain	World
IEC TR 62824:2016	EEE		Product design	World
IEEE 1680.1-2018	EEE	Computers and displays	Product design, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use	World
IEEE 1680.2™ – 2012	EEE	Imaging equipment	Product design, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use	World
IEEE 1680.3-2012	EEE	Televisions	Product design, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use	World
ISO/IWA 19: 2017	WEEE, ELVs, Waste, EEE, CRMs, Batteries, All types of wastes that contain metals		Product design, Collection, Logistics, Pre-treatment, Downstream treatment, Preparation for re-use	World

Name of standard or normative requirement (for full name please see complete list in Annex I)	Product or material addressed in the document	Detailed focus	Part of value chain affected	Geographical scope
NSF/ANSI 426-2017	EEE	Computer servers	Product design, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use	World
PAS 62545:2008	EEE	Environmental Information on Electrical and Electronic Equipment	Environmental Info. on EEE, - guidelines on generic environmental attributes to be considered by product committees when preparing a declaration frame suited to a concerned product category to disclose credible, relevant, and harmonized product related environmental information to whom needs or requests it.	World
prEN 45552:2018	EEE		Product design	EU
prEN 45553	EEE	refurbishment and re manufacturing of energy related products	Preparation for re-use	EU
prEN 45557:2018	WEEE		Pre-treatment, Downstream treatment, Mainly re-manufacturers of EEE	EU
prEN 50614	WEEE		Logistics, Preparation for re-use	EU
prEN IEC 61960-4:2019	Batteries	coin secondary lithium cells and batteries with a range of chemistries	Product design	EU
IEC 60086-1:2015	Batteries	Primary cells and batteries.	Product design, Disposal	EU
R2:2013	WEEE		Collection, Logistics, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use	World
Regulation (EC) No. 1013/2006	Waste		Logistics	EU
Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries	Batteries	Lead-acid batteries	Collection, logistics, treatment	World
TR 62476:2010	EEE		Product design, Product manufacturing	World

Name of standard or normative requirement (for full name please see complete list in Annex I)	Product or material addressed in the document	Detailed focus	Part of value chain affected	Geographical scope
TR 62635:2012	WEEE	Generic WEEE	Product design, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use	World
TS 50625-2-4: 2017 PVs	WEEE	Photovoltaic panels	Pre-treatment	EU
TS 50625-3-1	WEEE	all the WEEE streams	Pre-treatment	EU
TS 50625-3-2:2015 Lamps	WEEE	Lamps	Pre-treatment	EU
TS 50625-3-3 Displays	WEEE	WEEE containing and flat panel displays	Pre-treatment	EU
TS 50625-3-4 Fridges	WEEE	Temperature exchange equipment (C&F)	Pre-treatment	EU
TS 50625-3-5 PVs	WEEE	Photovoltaic panels	Pre-treatment	World
TS 50625-4:2017 Collection	WEEE		Collection, Logistics	EU
TS 50625-5:2017 end processing	WEEE, CRMs, Precious metals in WEEE	All WEEE – sub-stream containing copper and precious metals	Downstream treatment	EU
Überblick AG 1 –5 der UBA-Empfehlungen zu Behandlungsanforderungen an EAG	WEEE	WEEE with high contents of precious metals, CRT/FDPs, PV modules	Collection, Logistics, Pre-treatment Downstream treatment	National: Germany
UL 110 Edition 2 – 2017	EEE	Mobile phones	Product design, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use	World
VDI 2343 Blatt 4	WEEE		Pre-treatment	National: Germany

## 4.2 MAPPING AND ANALYSIS OF LEGISLATION

The project members mapped the following six pieces of legislation:

- Directive 2012/19/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 July 2012 on waste electrical and electronic equipment (WEEE),
- Directive 2006/66/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC,

- Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles,
- Regulation (EC) No. 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste
- Commission Decision (EU) 2019/63 of 19 December 2018 on the sectoral reference document on best environmental management practices, sector environmental performance indicators and benchmarks of excellence for the electrical and electronic equipment manufacturing sector

Each legislation was described and analysed for their relevance for the CEWASTE project objectives. The analysis of the relevance of the other four pieces of legislation can be found in the following section.

#### 4.2.1 DIRECTIVE 2012/19/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 4 JULY 2012 ON WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE)

The WEEE Directive is the most relevant legislation to be analyzed as it concerns the waste stream with the highest potential to recycle CRMs. Below the articles related to the CEWASTE project are described and analyzed.

##### FINANCING OF E-WASTE MANAGEMENT

Article 12 and 13 describes that Member states have to make sure that producers provide the financing of the collection, treatment, recovery and disposal of WEEE.

For CRM recycling, this means that producers would have to finance the operations required to facilitate the recycling if this would be legally required. In the absence of such legal obligations, any such financing would be voluntary, meaning that producers or their joint takeback systems could decide whether or not they choose to require and finance facilities that work according to standards enabling CRM recycling from WEEE.

##### COLLECTION AND TRANSPORT

Annex III of the WEEE Directive, Categories of EEE, lists 6 categories. This categorization can be assumed to also apply to the collection groups of WEEE at the municipal or other WEEE collection points. The way Key CRM Equipment (KCE) are collected influences the cost and

recycling potentials of subsequent operations, e.g. whether further sorting steps are required to enable adequate treatment of the various devices in a category.

Article 5 states that “Member States shall adopt appropriate measures to minimize the disposal of WEEE in the form of unsorted municipal waste, to ensure the correct treatment of all collected WEEE and to achieve a high level of separate collection of WEEE, notably, and as a matter of priority, for temperature exchange equipment containing ozone-depleting substances and fluorinated greenhouse gases, fluorescent lamps containing mercury, photovoltaic panels and small equipment as referred to in categories 5 and 6 of Annex III. ”

- This stipulation may be of relevance to establish measures also for collection and treatment of KCE like fluorescent lamps and IT equipment (e.g. PGMs).
- Section 2 of Article 6 states that “Member States shall ensure that the collection and transport of separately collected WEEE is carried out in a way which allows optimal conditions for preparing for re-use, recycling and the confinement of hazardous substances.” This article would allow member states to set up and enact requirements for collection and transport of KCE.
- Article 7 (1) (II) states that “From 2019 on, the minimum collection rate to be achieved annually shall be 65 % of the average weight of EEE placed on the market in the three preceding years in the Member State concerned, or alternatively 85 % of WEEE generated on the territory of that Member State.” Art. 7 (1) (IV) entitles EU Member States to set more ambitious collection targets, such as a specific collection target for KCE.

## TREATMENT

The WEEE Directive contains several articles concerning the treatment of WEEE.

- Article 14 (4-5) on the marking of EEEs and the dissemination of information could be used to make users aware of CRM contents in EEE.
- Article 15 (1) requires producers to provide information free of charge about preparation for re-use and treatment of each type of new EEE placed on the market. Even though the effectiveness is contentious, this stipulation could in principle be used to improve the (collection and) pre-treatment of KCE.
- Article 16 (4) is about Member States having to collect information, on the quantities and categories of EEE placed on their markets, collected, prepared for re-use, recycled

and recovered within the Member State, WEEE exported. This reporting could be used to include information on treated KCE and CRMs recycled to monitor the effectiveness of CRM recycling activities and to ensure progress.

#### **SHIPMENTS OF WEEE FOR RECOVERY OUTSIDE THE EU**

Article 10 authorizes shipments of WEEE for treatment outside the EU provided that such shipments are in compliance with Regulations (EC) No 1013/2006 (Waste Shipment Regulation) and (EC) No 1418/2007 (countries to which the OECD Decision on the control of transboundary movements of wastes does not apply). Such shipments only count towards the fulfilment of the WEEE recovery targets (Art. 11 of the WEEE Directive), if the exporter can prove that the treatment took place in conditions that are equivalent to the requirements of the WEEE Directive.<sup>27</sup>

The Waste Shipment Regulation allows shipments of wastes listed in Annex III or IIIA of the Waste Shipment Regulation for recovery to countries that are listed in the Annex of regulation (EC) No. 1418/2007. According to Art. 10 (3) of the WEEE Directive, the Commission shall adopt delegated acts laying down detailed criteria for the assessment of equivalent conditions. So far, these delegated acts are not yet available, but may be adopted in future.

Since exports of WEEE for recovery are possible, the CEWASTE standard and certification scheme can become relevant also outside the EU to support the treatment of WEEE equivalent to the treatment within the EU. For economic reasons – due to sometimes lower labor costs – such exports may contribute to improve the economic viability of CRM recycling.

#### **SUSTAINABILITY, ENVIRONMENTAL MANAGEMENT**

Article 8 (6) encourages the introduction of certified environmental management systems (EMAS) for WEEE treatment operators, which is important to ensure environmentally sound (CRM) recycling operations.

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<sup>27</sup> Also see the report „Equivalent conditions for waste electrical and electronic equipment (WEEE) recycling operations taking place outside the European Union, 15 October 2013, [http://ec.europa.eu/environment/waste/weee/pdf/Final%20report\\_E%20C%20S.pdf](http://ec.europa.eu/environment/waste/weee/pdf/Final%20report_E%20C%20S.pdf)

## 4.2.2 BATTERY DIRECTIVE

Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC is a key document since it establishes:

- rules regarding the placing on the market of batteries and accumulators and, in particular, a prohibition on the placing on the market of batteries and accumulators containing hazardous substances;
- specific rules for the collection, treatment, recycling and disposal of waste batteries and accumulators to supplement relevant Community legislation on waste and to promote a high level of collection and recycling of waste batteries and accumulators.
- It stipulates the EPR principle in that producers should finance the costs of collecting, treating and recycling all collected batteries and accumulators. Producers in this sense includes producers of batteries and accumulators as well as producers of other products incorporating a battery or accumulator.
- It regulates exports of waste batteries outside the EU and that such exports count towards the fulfilment of the obligations and efficiencies laid down in Annex III of the Battery Directive only if there is sound evidence that the recycling operation took place under conditions equivalent to the requirements of the Battery Directive.

The Directive focuses on all batteries since all contain substances which are harmful to the environment, if not properly managed (i.e. if incinerated or dumped in landfills). Among these substances, metals contained in batteries, such as mercury, lead and cadmium are by far the most problematic, while other metals commonly used in batteries, such as zinc, copper, manganese, lithium and nickel, may also constitute environmental hazards.

On the other hand, these substances represent also valuable materials that should be recovered and recycled. A large amount of metals, including valuable metals such as nickel, cobalt (CRM) and silver, can be recovered if batteries are properly recycled – and contribute to the EU's resource efficiency. Moreover, other types of batteries, such as Li-ion batteries and NiMH batteries are of strong interest for EU since they also contain cobalt (a Critical Raw Material).

In the Directive, treatment requirements and minimum recycling efficiencies (reported in Annex III “Detailed Treatment and Recycling Requirements”) are set for specific batteries

(lead-acid, nickel-cadmium, other batteries and accumulators), while the recycling of lead (from lead-acid batteries) and cadmium (from nickel-cadmium batteries) is promoted to the highest degree that is technically feasible while avoiding excessive costs.

In addition, the Batteries Directive aims to ensure that as many waste portable batteries and accumulators as possible are collected (Article 10 - “Collection targets”). This includes the obligations of EU Member States to ensure that battery collection schemes are in place for portable batteries and accumulators (Article 8 - “Collection schemes”). Producers of such batteries and accumulators are obliged to take back these products, and member states can require producers to set up take back schemes.

After their collection, batteries should be removed from the appliances. In Article 11 - “Removal of waste batteries and accumulators”, it is highlighted how Member States should ensure the removal of waste batteries and accumulators, thus facilitating their treatment and recycling (Article 12 - “Treatment and recycling”) as well as extending the life-time of the appliances in which they are used thanks to their replacement.

The Battery Directive is of specific importance for recycling of CRMs since it targets high collection rates and includes the EPR principle for financing the end-of-life of batteries. Should it be decided that CRMs are recycled from batteries and accumulators, either by individual producers or by legislation, producers would have to bear the additional costs unless the financing of CRM recycling would be regulated differently.

### 4.2.3 DIRECTIVE 2000/53/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 18 SEPTEMBER 2000 ON END-OF LIFE VEHICLES

This Directive on End-of-Life Vehicles (ELVs) aims at making dismantling and recycling of ELVs more environmentally friendly. It sets clear quantified targets for reuse, recycling and recovery of the ELVs and their components. Annex I requires the removal of batteries from ELVs (requirement 3 (I)).

#### RELEVANCE FOR CEWASTE PROJECT

Annex I is very relevant since waste batteries from ELVs are in the scope of CEWASTE and their removal from ELVs is thus of crucial importance for their proper recycling. Among the several

other requirements defined in this directive, and according to the scope of CEWASTE, some may contribute more for the project:

- Requirements to facilitate the collection and recycling of Secondary Raw Materials;
- Sustainability requirements: about safe, healthy and equitable working conditions; about environmental management and sustainable natural resources; about management approach and government; requirements stimulating preparation of reuse);
- Traceability requirements: about management systems and responsibilities on materials traceability; about chain of custody and procedures in line with mass balance, physical segregation etc.; about compliant claims (on-product or off-product claims) and communication.).

## 4.3 STANDARDS AND OTHER DOCUMENTS OF RELEVANCE

Of all the mapped standards, only six contained specific requirements relating to CRMs. These are listed in Table 14. It should however be noted that, if CRMs are not addressed in a document, it does not necessarily mean that it is not relevant for the work in WP1 and WP2.

*Table 5: Items containing specific requirements on CRMs identified*

Name of document	CRMs affected	Requirements to improve the collection of waste containing CRMs	Requirements to improve the processing and the recycling/recovery of CRMs	Other specific requirements
FprEN 45558	All (generic)	yes	yes	yes
IEEE 1680.1-2018	Conflict minerals	yes	yes	no
NSF/ANSI 426-2017	Rare earth elements, conflict minerals	yes	no	no
TS 50625-5:2017 end processing	Precious metals: Au, Silver, Palladium, possibly some CRMs	yes	no	no
Überblick AG 1 –5 der UBA-Empfehlungen zu Behandlungsanforderungen an EAG	Precious metals including PGM (palladium is a CRM)	yes	no	yes
UL 110 Edition 2 – 2017	Conflict materials	no	yes	no

A more detailed analysis of the above documents follows in the subsequent sections.

### 4.3.1 FprEN 45558 GENERAL METHOD TO DECLARE THE USE OF CRITICAL RAW MATERIALS IN ENERGY RELATED PRODUCTS

FprEN 45558 proposes a standardized format for reporting use of CRMs in energy-related products, based on the IEC 62474 materials declaration standard, to ensure that declarations from different suppliers can easily be understood and exchanged. This facilitates information on the use of CRMs to be exchanged up and down the supply chain and with other relevant stakeholders. The declaration of regulated CRMs should be carried out according to the requirements and thresholds specified in legislation. Yet the flexibility of the IEC 62474 declaration format allows users to report on different or multiple levels of the product (part). For instance, one can declare a personal computer (product) with a motherboard (product part 1) with a coin cell battery (part of product part 1) that contains a CRM. Eventually, the information gathered on CRMs can be used during recycling and recovery processes.

However, the standard does not provide or determine any specific method or tool to collect CRM data<sup>28</sup>, and non-regulated CRMs are not automatically included in the IEC Declarable Substance List. In the case of unregulated CRMs (which are most of them) it is up to the manufacturer to decide what kind of information they want to collect.

### 4.3.2 IEEE 1680.1-2018 FOR ENVIRONMENTAL AND SOCIAL RESPONSIBILITY ASSESSMENT OF COMPUTERS AND DISPLAYS

This IEEE standard “defines environmental and social responsibility performance criteria for computers (i.e. desktop computers, notebook computers, integrated desktop computers, portable all-in-one computers, slates/tablets, small scale servers, thin clients, and workstations) and displays (i.e. monitors and signage displays)”. Section 4 on environmental performance, and corporate social responsibility includes a clause (4.10) on Conflict minerals

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<sup>28</sup> IEC 62474 sets the format and rules for communication and offers a list of declarable substances (DSL). These can then be used by a software tool developer to build a material declaration tool that can support the communication and transfer of data from responder to requester.

with information on CRM-related requirements, of which some are obligatory, and some are optional requirements:

- 4.10.2.1 - Manufacturer have to disclose information every year on the conflict minerals used in their product at a minimum for the product that are declared to conform to the standard.
- 4.10.2.2 - Participation in an in-region program that advances responsible sourcing of conflict minerals.
- 4.10.2.3 - Smelter and refiner participation in OECD-aligned third party Mechanisms. “The manufacturer shall demonstrate that  $\geq 90$  % of the number of smelters and refiners of all conflict minerals reported to be in its supply chain (at a minimum for products covered by this standard) participate in a third-party mechanism that: aligns with OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas, and assesses due diligence for sourcing from covered countries or conflict-affected and high-risk regions”<sup>29</sup>.

### 4.3.3 NSF/ANSI 426-2017 ENVIRONMENTAL LEADERSHIP AND CORPORATE SOCIAL RESPONSIBILITY ASSESSMENT OF SERVERS

The purpose of this Standard for servers is “to establish product environmental performance criteria and corporate performance metrics that exemplify environmental leadership and corporate social responsibility in the market. These performance criteria are intended to form the basis of conformity assessment programs, such as third-party certification or registration”. Section 7 on Preferable materials use includes a subsection (7.1) on Recycled content. The requirement 7.1.4 - on postconsumer recycled content of rare earth elements in hard drives states that “Products that contain a hard drive(s) with actuator/voice coil or spindle magnets shall contain 5 % or more PCR content neodymium or dysprosium by weight of neodymium or

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<sup>29</sup> [https://standards.ieee.org/project/1680\\_1a.html](https://standards.ieee.org/project/1680_1a.html)

dysprosium in the magnet. The neodymium or dysprosium shall be provided through the recycling of magnets from used devices, not limited to electronic devices”.

Sub section 12.3 on Responsible mineral sourcing part of Section 12 on Corporate responsibility includes three clauses that contain CRM relevant information:

- 12.3.1 – Disclosure on public website of information on use and sourcing of conflict minerals in product;
- 12.3.2 - Demonstrate conflict minerals are from recycled, scrap or conflict free smelter/refiner sources;
- 12.3.3. - Participate in or source minerals from in-region conflict free controlled chain-of- custody sourcing programs.

#### 4.3.4 TS 50625-5:2017 COLLECTION, LOGISTICS & TREATMENT REQUIREMENTS FOR WEEE - PART 5: SPECIFICATION FOR THE FINAL TREATMENT OF WEEE FRACTIONS - COPPER AND PRECIOUS METALS

This Technical Specification addresses the processes regarding the recycling of copper and/or precious metals contained in WEEE and fractions of WEEE. In particular, it relates to the chemical and metallurgical processes used for the recycling of copper and/or precious metals contained in WEEE and fractions of WEEE, thereby differentiating it from manual/mechanical processing. The main precious metals concerned are gold, silver and palladium. The majority of the WEEE volumes that are processed by final treatment operators consists of fractions of WEEE (e.g. circuit boards) containing copper and/or precious metals, however there may be whole small WEEE that can be treated directly in final treatment (e.g. USB sticks). Chemical and metallurgical processes are processes in which a chemical reaction takes place for example: pyrolysis, smelting, refining, solvent extraction, ion exchange, leaching/dissolution in water acids or base, precipitation, cementation or pressure leaching. They differ from mechanical / physical processes such as sorting and separation based on physical properties (e.g. density, magnetism, color) and size reduction processes such as shredding and grinding. In general, these final treatment facilities are covered by the IED 2010/75/EU, e.g. copper smelters or refiners.

The document deals with other topics such as management principles, requirements for acceptance of materials and environmental, health and safety requirements. Technical requirements include sections on acceptance, sampling and assaying, plant and process conditions and output wastes at the final facility. A specific area on monitoring and reporting is also comprised in this TS, which addresses the calculation of the recycling and recovery rates, classification and metal yield.

#### 4.3.5 OVERVIEW AG 1 -5 OF THE UBA RECOMMENDATIONS FOR TREATMENT REQUIREMENTS FOR WEEE

The document “Überblick AG 1 –5 der UBA-Empfehlungen zu Behandlungsanforderungen an EAG“ is an overview sheet containing the German Umweltbundesamt’s (Federal Environment Agency) recommendations to the Ministry for Environment concerning legal requirements for the recycling of PMs and CRMs:

- Separation of devices with high contents of precious metals (Pd= CRM) prior to further treatment;
- Generation of pure printed wiring board fraction;
- End-treatment with minimum output rates of precious metals fulfilling defined environmental performance criteria;

#### 4.3.6 UL 110 EDITION 2 – 2017 STANDARD FOR SUSTAINABILITY FOR MOBILE PHONES

This Standard is designed to reduce adverse environmental and social impacts associated with the design, manufacture, use, and end of life management of mobile phones. Subsection 3 on 3TG Minerals (3TGs are the so called “Conflict minerals” as defined by the US legislation, which currently include the metals tantalum, tin, tungsten and gold). Section 15 on Manufacturing and Operations includes three relevant requirements:

- 15.3.1 Requirement to disclose the use and sources of conflict materials used.
- 15.3.2 - Demonstrate that the origin of conflict minerals are recycled/scrap sources or smelters/refiners that;

1. “Appear on the list of validated smelters and refiners from the Responsible Minerals Initiative (RMI), Responsible Jewellery Council (RJC), London Bullion Market Association (LBMA), or equivalent; or
  2. Independently verified by a third-party that the manufacturer, or a relevant industry or other association has conducted a Reasonable Country of Origin Inquiry (RCOI) regarding the source and chain of custody of the 3TG mineral and implemented the OECD due diligence guidance, where appropriate; or
  3. Not sourcing 3TG minerals from a conflict-affected region as determined through an RCOI, including review of the chain of custody of the mineral and due diligence, where Appropriate”.
- 15.3.3 - Participation in conflict mineral responsible sourcing program<sup>30</sup>.

## 4.3.7 NORMATIVE REQUIREMENTS RELATED TO SECONDARY RAW MATERIALS

The documents addressing secondary raw materials (SRM) are listed in Table 6. More than half (31) of the texts in the scope of the mapping were identified as containing requirements for secondary raw materials, which thus may also be applicable to recycled CRMs. Many requirements deal with the depollution of waste streams such as WEEE.

*Table 6: Overview of requirements dealing with SRMs*

Document	SRMs Addressed	Sections/clauses	Description of the Requirements
AS/NZS 5377-2013	Scope - minimum requirements for the safe and environmental sound collection, transport and treatment of EoL EE to maximize re-use and material recovery.	Sections 2, 3, 4 and 5	administration, management, governance, collection, traceability, treatment
COMMISSION DECISION (EU) 2019/63	Copper, plastics	3.1.4, 3.3.4	treatment

<sup>30</sup> [https://peat.net/documents/verification-round/UL %20110 %20Verification %20Requirements %20- %20FINAL.pdf](https://peat.net/documents/verification-round/UL%20110%20Verification%20Requirements%20-%20FINAL.pdf)

Document	SRMs Addressed	Sections/clauses	Description of the Requirements
Directive 2000/53/EC on ELVs	-	Article 4 - 1.(a)/1.(b); Article 6-3.(c); Article 7-1.; Article 8 - 1.;	administration, management, governance, traceability, treatment, Prevention
Directive 2012/19/EC on WEEE	Article 05, Article 07, Article 11	Article 5, Article 6, Article 7, Article 11	administration, management, governance, collection, treatment, collection targets
Directive 2006/66/EC on batteries	Recycling requirements are set for specific batteries. Indirectly also the recycling of lead (from lead-acid batteries) and cadmium (from nickel-cadmium batteries) is promoted to the highest degree that is technically feasible while avoiding excessive costs.	Annex III	treatment
ECOGuard	General sentence regarding the maximization of material recovery, dedicated section to the final treatment of plastics and of printed circuit boards	Along the all sections of the standard (there is a dedicated section for each subject involved like the Waste Transporter etc.)	administration, management, governance, traceability and minimum recycling targets for metals on PCBs:  - Ag (90 %) - Au (90 %) - Cu (90 %) - Pd (90 %) - Pb (NA)  And at least two elements out of - Ni (NA) - Sn (NA) - Sb (NA)
EN 50419:2006	Request to mark the product with the symbol of the crossed out wheeled bin	Section 4.2 (pages 8-9)	administration, management, governance
EN 50625-1:2014	General technical requirements, not specific for CRM	Part 4 and 5 and 6	administration, management, governance, collection, traceability, treatment
EN 50625-2-1:2014 Lamps	Lamp fractions	5.1	treatment
EN 50625-2-2:2015 Displays	CRT and FPD equipment fractions	5.5.1	treatment
EPSC Electronics Recycling Standard (ERS) 2015	Materials are identified as Focus Materials of EOL EEE and/or electronic assemblies, if they contain hazardous materials:	Chapter 2.0 - Downstream Recyclers of Focus Materials, Chapter 3.0 - Downstream	R2:2013 certification is a prerequisite for ERS 2015. Focus materials are requested to be processed in accordance with the Recycler Qualification Office (RQO) scope.

Document	SRMs Addressed	Sections/clauses	Description of the Requirements
	A. Polychlorinated biphenyls (PCBs); B. Mercury; C. CRT glass (with some exceptions); D. Batteries; E. Whole or shredded circuit boards containing lead solder.	Recyclers of Non-Focus Materials	Administration, management, governance, treatment
eWASA Technical Guidelines	-	C.2.1;  Directive 2 - 2.3/2.4;	treatment
FprEN 45558	all (generic)		traceability
IEC 60086-6 ED1	Metals and plastics	6.2 Environmental assessment	For design
IEEE 1680.1-2018	Plastics, packaging material	4.3.2.1; 4.3.2.2;	Design
IEEE 1680.2™ – 2012	Plastic, packaging materials, materials in imaging equipment	4.3.1.1;4.3.2.1; 4.3.2.2; 4.3.2.3; 4.3.4.3; 4.8.2.1; 4.8.2.2; 4.9.4.1;	Treatment, design
IEEE 1680.3-2012	Plastics, packaging materials, materials in televisions	4.3.1.1; 4.3.2.1; 4.3.2.2; 4.3.2.3; 4.3.2.5; 4.3.4.2; 4.8.2.1; 4.8.2.2;	Treatment, design
ISO/IWA 19: 2017	All types of waste that contain metals	In sections 6.2, 6.3, 6.4, 6.5, 6.6	Administration, management, governance, collection, traceability, treatment
NSF/ANSI 426-2017	Plastics, Packaging materials	8.2.1; 9.1.1; 9.1.2; 9.1.3; 11.1.1; 11.1.2;	Collection, treatment, Design
prEN 45557:2018	Plastics, metals, glass (no requirements on CRMs, but it's possible to add in the Annex A a list of CRMs)	Section 6, Section 7 + Annex A	Traceability
R2:2013	Focus Materials	2.(a).(2)	Treatment
TR 62635:2012	Metals and non-metals	1) Description of EoL principles including scope and description of generic WEEE treatment proces. 2) Description of key product information relevant for product EoL and exchange of EoL treatment scenario information for manufacturers and	Providing information by manufacturers and by producers in order to determine recyclability and recoverability rates of products. In order to improve ECD and potentially improve the EoL handling of WEEE, manufacturers need to know the processes taking place at the recyclers and recyclers need to know some specific information such as parts which may need to be treated selectively to carry out effective treatment;

Document	SRMs Addressed	Sections/clauses	Description of the Requirements
		recyclers. 3) Method of recyclability and recoverability calculation	
TS 50625-2-4: 2017 PVs	Fractions subject to depollution such as metallic lead and lead solder, hazardous substances in the semiconductor layer.	5.5 De-pollution	Treatment. All specific requirements are highlighted in 50625-3-5:2017. Technologies should allow the removal of metallic lead or lead solder to achieve de-pollution targets. Additionally, treatment of non-silicon based photovoltaic panel shall use technologies that allow to remove hazardous substances in the semiconductor layer. Given that Si is typically present in PV, if it is possible the following should be added in the corresponding EN: technologies to monitor the Si fraction, methodologies to monitor the downstream destiny of Si and obligation to send these fractions to authorized and certified treatment operators.
TS 50625-3-1	Material of the critical components (capacitors, batteries, printed circuit boards) and components.	Annex C	Treatment. For the material of the critical components (capacitors, batteries, printed circuit boards) there are indirect targets. In fact the targets are not focused on SRM but on the whole component
TS 50625-3-4 Fridges	Refers in the depollution part to oil, VFCs/VHCs, polyurethane and printed circuit (that may contain CRMs)	Article 12 "Sampling and analytical methods"	Separation, depollution. In the depollution phase it's required to properly separate oil, VFCs/VHCs, polyurethane . Printed circuit boards that contain CRMs are not manually dismantled but they undergo shredding
TS 50625-3-5 PVs	Cadmium, selenium, lead in glass fractions from the PV treatment	Chapter 12	treatment
TS 50625-4:2017 Collection	E-waste undergoing collection and logistics	chapters 4 and 5	administration, management, governance, collection
TS 50625-5:2017 end processing	Precious metals in WEEE (mostly copper, gold, silver and palladium).	Chapter 5 Technical requirements	administration, management, governance, treatment The technical requirements comprise acceptance, sampling and validation, plant conditions, process conditions, recovery and disposal of any waste arising from final treatment.
UL 110 Edition 2 – 2017	Plastic, materials in mobile phones, packaging materials	11.4.1; 11.4.2; 12.2.1; 12.2.1;	Design

Document	SRMs Addressed	Sections/clauses	Description of the Requirements
VDI 2343 Blatt 4	Metals, plastics, glass	Chapter 3 - Collection group 1 - 3rd paragraph; Chapter 3 - Collection group 2 - 2nd paragraph; Chapter 3 - Collection group 3 - 2nd paragraph; Chapter 3 - Collection group 5 - 3rd paragraph;	Treatment

#### 4.3.8 NORMATIVE REQUIREMENTS RELATED TO SUSTAINABILITY

##### COMMISSION DECISION (EU) 2019/63 RELATED TO REGULATION (EC) No 1221/2009 (EMAS)

Commission Decision (EU) 2019/63 on the sectoral reference document on best environmental management practices, sector environmental performance indicators and benchmarks of excellence for the electrical and electronic equipment manufacturing sector is a sectoral reference document (SRD) related to Regulation (EC) No 1221/2009 of the European Parliament and of the Council on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS). It is directed to EEE manufacturers to implement in order to achieve improvements in the environmental performance over the whole EEE value chain. Chapter 1 describes EMAS' legal background and the use of the document. Chapter 2 defines the scope of this SRD. Chapter 3 briefly describes the different best environmental management practices (BEMPs) together with information on their applicability. They also include specific environmental performance indicators and benchmarks of excellence where they could be formulated. The document is divided into three main sections which - from the perspective of the manufacturers - cover the main environmental aspects along the value chain of the electrical and electronic equipment. These three sections focus on best environmental management practices (BEMPs): for manufacturing processes, for supply chain management and BEMPs fostering a more circular economy. Chapter 4 presents a comprehensive table with a selection of the most relevant

environmental performance indicators, associated explanations and related benchmarks of excellence<sup>31</sup>.

### Relevant sections for sustainability aspects

Section 3.3.3 Remanufacturing or high-quality refurbishment of used products. This BEMP is to prevent waste by remanufacturing or refurbishing used electrical and electronic equipment and bringing them into the market for reuse.

### Relevant sections for substitution of hazardous substances

Section 3.2.1 deals with assessment tools for cost-effective and environmentally sound substitution of hazardous substances. Best environmental management practice is to use reference tools to identify and assess hazardous substances in purchased materials in order to substitute them. Manufacturers will use input data from suppliers, provided ideally as full material declarations or declarations of conformity, to track substances.

### Further sustainability-related normative requirements

In order to provide input to WP2 the mapping tried to identify requirements dealing with the following topics (as per description of WP2):

- A. Requirements about safe, healthy and equitable working conditions;
- B. Requirements about local community impacts and resilience;
- C. Requirements about environmental management and sustainable natural resources;
- D. Requirements about management approach and governance;
- E. Requirements stimulating preparation of reuse.

Annex III provides a summary of the requirements dealing with the topics above. Table 7 below identifies the documents containing such types of requirements.

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<sup>31</sup>[https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L\\_.2019.017.01.0094.01.ENG&toc=OJ:L:2019:017:TOC](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2019.017.01.0094.01.ENG&toc=OJ:L:2019:017:TOC)

Table 7: Sustainability-related requirements

Name of document	A	B	C	D	E	CRM affected	SRM affected
AS/NZS 5377-2013	Yes	Yes	Yes	Yes	Yes		
ASI Chain of Custody (CoC) Standard V1 2017	No	No	No	Yes	No		
ASI Performance Standard V2 - 2017	Yes	Yes	Yes	Yes	No		
COMMISSION DECISION (EU) 2019/63	No	No	Yes	No	Yes		Copper, plastics
Directive 2000/53/EC on ELVs	Yes	No	Yes	Yes	Yes		
Directive 2012/19/EC on WEEE	Yes	Yes	Yes	Yes	Yes		Article 05, Article 07, Article 11
Directive 2006/66/EC on batteries	No	No	Yes	Yes	No		Recycling requirements are set for specific batteries. Indirectly also the recycling of lead (from lead-acid batteries) and cadmium (from nickel-cadmium batteries) is promoted to the highest degree that is technically feasible while avoiding excessive costs.
ECOGuard	Yes	No	Yes	No	No		General sentence regarding the maximization of material recovery, dedicated section to the final treatment of plastics and of printed circuit boards
EN 50581:2012	No	No	Yes	No	No		
EN 50625-1:2014	Yes	No	Yes	Yes	Yes		General technical requirements, not specific for CRM
EN 50625-2-1:2014 Lamps	Yes	No	Yes	Yes	Yes		Lamp fractions
EN 50625-2-2:2015 Displays	Yes	No	Yes	Yes	No		CRT and FPD equipment fractions
EN 60086-4:2015	Yes	No	No	No	No		
EN 60086-5:2016	Yes	No	No	No	No		
EN 61960-3:2017	Yes	No	No	No	No		
EN 62281:2012	Yes	No	No	No	No		
EPSC Electronics Recycling Standard (ERS) 2015	Yes	No	No	No	No		Materials are identified as Focus Materials of EOL EEE and/or electronic assemblies, if they contain hazardous materials: A. Polychlorinated biphenyls (PCBs); B. Mercury; C. CRT glass (with some exceptions); D.

Name of document	A	B	C	D	E	CRM affected	SRM affected
							Batteries; E. Whole or shredded circuit boards containing lead solder.
e-Stewards Standard	Yes	No	Yes	Yes	Yes		
eWASA Technical Guidelines	Yes	Yes	Yes	Yes	No		
IEEE 1680.1-2018	Yes	Yes	Yes	No	Yes	Conflict minerals	Plastics, packaging material
IEEE 1680.2™ – 2012	No	Yes	Yes	Yes	Yes		Plastic, packaging materials, materials in imaging equipment
IEEE 1680.3-2012	No	Yes	Yes	Yes	Yes		Plastics, packaging materials, materials in televisions
ISO/IWA 19: 2017	Yes	Yes	Yes	Yes	Yes		All types of waste that contain metals
NSF/ANSI 426-2017	Yes	Yes	Yes	Yes	Yes	rare earth elements, conflict minerals	Plastics, Packaging materials
PAS 62545:2008	No	No	Yes	No	No		
prEN 45553	Yes	No	Yes	No	Yes		
prEN 50614	Yes	No	Yes	Yes	Yes		
R2:2013	Yes	Yes	Yes	Yes	Yes		
Regulation (EC) No. 1013/2006	No	No	Yes	Yes	No		
TS 50625-2-4: 2017 PVs	Yes	No	No	No	No		Fractions subject to depollution such as metallic lead and lead solder, hazardous substances in the semiconductor layer.
TS 50625-3-2:2015 Lamps	No	No	No	Yes	No		
TS 50625-3-3 Displays	Yes	No	Yes	No	No		
TS 50625-4:2017 Collection	No	No	Yes	No	Yes		
TS 50625-5:2017 end processing	Yes	Yes	Yes	Yes	No	Precious metals: Au, Silver, Palladium, possibly some CRMs	Precious metals in WEEE (mostly copper, gold, silver and palladium).
Überblick AG 1 –5 der UBA-Empfehlungen zu Behandlungsanforderungen an EAG	Yes	No	No	No	No	Precious metals including PGM (palladium is a CRM)	

Name of document	A	B	C	D	E	CRM affected	SRM affected
UL 110 Edition 2 – 2017	No	Yes	Yes	Yes	Yes	Conflict materials	Plastic, materials in mobile phones, packaging materials
VDI 2343 Blatt 4	Yes	No	Yes	Yes	Yes		Metals, plastics, glass

Annex III gives an overview of further details concerning stipulations related to sustainability aspects in analyzed normative requirements.

### 4.3.9 REQUIREMENTS ON TRACEABILITY

Traceability requirements were identified and broken down into (as per description of WP2):

- A. Management systems and responsibilities on materials traceability;
- B. Requirements about procurement of services and procedures about it;
- C. Requirements about chain of custody and procedures in line with mass balance, physical segregation etc.;
- D. Requirements about product documentation and records including confirming eligible input (traceable origin of waste materials);
- E. Requirements about compliant claims (on-product or off-product claims) and communication

Annex IV provides a summary and details of the requirements dealing with the topics above.

Table 8 identifies the documents containing such types of requirements.

*Table 8: Documents with traceability requirements*

Name of document	A	B	C	D	E	CRM	Addressed Materials/Aspects
AS/NZS 5377-2013	Yes	No	Yes	Yes	Yes		
ASI Chain of Custody (CoC) Standard V1 2017	Yes	Yes	Yes	Yes	Yes		
COMMISSION DECISION (EU) 2019/63	Yes	No	No	Yes	No		Copper, plastics
Directive 2000/53/EC on end-of life vehicles	Yes	No	Yes	No	Yes		

Name of document	A	B	C	D	E	CRM	Addressed Materials/Aspects
Directive 2012/19/EC on WEEE	No	No	No	Yes	No		Article 05, Article 07, Article 11
Directive 2006/66/EC on batteries	No	No	No	Yes	Yes		Recycling requirements for specific batteries. Indirectly also recycling of lead (from lead-acid batteries) and cadmium (from nickel-cadmium batteries) promoted to highest technically feasible degree without excessive costs.
ECOGuard	Yes	No	No	No	No		General sentence regarding maximization of material recovery, section for final treatment of plastics and printed circuit boards
EN 50419:2006	Yes	No	No	No	No		
EN 50581:2012	RoHS	No		No	No		
EN 50625-1:2014	Yes	No	Yes	No	No		
EN 50625-2-1:2014 Lamps	Yes	No	No	Yes	No		Lamp fractions
EN 50625-2-2:2015 Displays	Yes	No	Yes	No	No		CRT and FPD fractions
EN 60086-4:2015	No	No	No	Yes	Yes		
EN 60086-5:2016	No	No	No	Yes	Yes		
EN 62281:2012	No	No	Yes	Yes	No		
EN 62430:2009							
e-Stewards Standard	Yes	No	No	Yes	Yes		
eWASA Technical Guidelines	Yes	Yes	Yes	Yes	Yes		
IEC 62474:2018	Yes	No	No	Yes	No		
IEC TR 62824:2016	No		No	No	No		
IEEE 1680.1-2018	Yes	Yes	Yes	Yes	Yes	Conflict minerals	Plastics, packaging material
IEEE 1680.2™ – 2012	Yes	Yes	Yes	Yes	Yes		Plastic, packaging materials, materials in imaging equipment
IEEE 1680.3-2012	Yes	Yes	No	Yes	Yes		Plastics, packaging materials, materials in televisions
ISO/IWA 19:2017	Yes	No	Yes	Yes	Yes		All types of metal containing waste

Name of document	A	B	C	D	E	CRM	Addressed Materials/Aspects
NSF/ANSI 426-2017	Yes	Yes	Yes	No	Yes	Rare earth elements, conflict minerals	Plastics, packaging materials
prEN 45553	No	No	Yes	No	No		
prEN 45557:2018	No	No	Yes	No	No		Plastics, metals, glass (no requirements on CRMs, but possible to add list of CRMs in Annex A)
prEN 50614	No	No	Yes	Yes	No		
R2:2013	Yes	Yes	Yes	Yes	Yes		
Regulation (EC) No. 1013/2006	Yes	No	No	Yes	Yes		
TR 62476:2010	Yes	Yes	No	Yes	No		
TR 62635:2012	No	No	No	Yes	No		
TS 50625-3-1	No	No	No	Yes	No		Material of critical components (capacitors, batteries, printed circuit boards).
TS 50625-3-2:2015 Lamps	No	Yes	analysis	No	No		
TS 50625-3-3 Displays	Yes	Yes	Yes	No	No		
TS 50625-3-4 Fridges	No	No		Yes	No		Reference in depollution part to oil, VFCs/VHCs, polyurethane and printed circuit (that may contain CRMs)
TS 50625-4:2017 Collection	Yes	No	Yes	No			E-waste undergoing collection and logistics
TS 50625-5:2017 end processing	Yes	Yes	Yes	Yes	Yes	Precious metals: Au, Silver, Palladium, possibly some CRMs	Precious metals in WEEE (mostly copper, gold, silver and palladium).
UL 110 Edition 2 – 2017	Yes	Yes	Yes	No	Yes	Conflict materials	Plastic, materials in mobile phones, packaging materials
VDI 2343 Blatt 4							Metals, plastics, glass

## 4.4 MAPPING AND ANALYSIS OF VERIFICATION SCHEMES

### 4.4.1 OVERVIEW OF THE MAPPED AND ANALYZED VERIFICATION SCHEMES

Table 9 provides an overview of the verification schemes mapped.

Table 9: List of verification schemes

No.	Name of the verification scheme	Type of scheme	Type of scheme	Product or material focus (+ detail)
1.	WEEELABEX	Private	Accredited certification scheme	WEEE
2.	R2:2013 Checklist	Public	Verification scheme (not accredited)	WEEE
3.	e-Stewards	Private	Accredited certification scheme	WEEE
4.	Recycler qualification program	Private	Verification scheme (not accredited)	WEEE
5.	EPEAT	Public	Verification scheme (not accredited)	EEE
6.	AS/NZS 5377-2013	Public	Accredited certification scheme	WEEE

More details about the verification schemes can be found in Table 10 and in Annex V. The numbers in the left column of the below Table 10 refer to the verification schemes in the above Table 9.

Table 10: Characteristics of verification schemes

No.	Part of value chain affected	Who is certified/verified?	Standards of reference	Scope of the certificate
1.	Collection, Logistics, Pre-treatment	Collection companies, Logistics operators and WEEE pre-treatment operators	CENELEC WEEE Standards	Per facility, per WEEE stream
2.	Collection, Pre-treatment, Downstream treatment, preparation of re-use	Collection companies, WEEE pre-treatment and downstream treatment operators, preparation for re-use operators	R2:2013 Standard	Per facility (for pre-treatment), for materials (downstream treatment)
3.	Logistics, Pre-treatment, Downstream treatment, Preparation for re-use	Logistics operators Pre-treatment operators, downstream operators, preparation for reuse operators	e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment	Per company
4.	Pre-treatment, Downstream treatment	Pre-treatment operators, and downstream operators	Electronic Recycling Standard (ERS)	Per facility (for pre-treatment), for materials (downstream treatment)
5.	Product design, product manufacturing	Manufacturers of IT devices	NSF/ANSI 426-2018, NSF/ANSI 426-2017, IEEE 1680.1-2018, IEEE 1680.2-2012, IEEE 1680.2a-2017, EEE 1680.3-2012, IEEE 1680.3a-2017, UL 110 Edition 2 2017.	Per product

No.	Part of value chain affected	Who is certified/verified?	Standards of reference	Scope of the certificate
6.	Collection, Logistic, Pre-treatment, Disposal, Preparation for reuse, storage	Collectors, Logistics operators and WEEE pre-treatment operators, re-use operators	AS/NZS 5377-2013	Per facility

Table 11 lists the number of companies certified to the analyzed certification schemes. The verification scheme with most facilities certified (status February 2019) was R2, which listed 856 facilities in its webpage in 12 different geographical areas around the world<sup>32</sup>. R2 is followed by WEEELABEX that listed 188<sup>33</sup> facilities in Europe, e-Stewards<sup>34</sup> counted with 51 facilities in five countries (USA, Canada, Mexico, Singapore and UK), the Canadian RQP<sup>35</sup> follows with the list of 47 facilities in Canada, AS/NZS 5377:2013 counts around 45 certified facilities in Australia and New Zealand<sup>36</sup>. EPEAT counts a total of 10 485 IT products registered in 33 countries over the world<sup>37</sup>.

*Table 11: Number of companies certified in verification schemes and their locations*

Scheme	Total number of certificates issued for 2018	Number of countries with certified/ verified facilities	List of countries
WEEELABEX	188 - Sent by WEEELABEX Office	16	AT, BE, CZ, FR, DE, GR, IE, IT, LT, NL, PL, PT, RO, SE, ES, GB
R2:2013 Checklist	856 recyclers (source: <a href="https://sustainableelectronics.org/recyclers?style=list">https://sustainableelectronics.org/recyclers?style=list</a> )	33	Argentina, Australia, Belgium, Brazil, Canada, Chile, China, Colombia, Costa Rica, Czech Republic, Ecuador, France, Germany, Hong Kong, India, Indonesia, Ireland, Japan, Korea, Malaysia, Mexico, New Zeland, Peru, Philippines, Singapore, South Africa, Spain, Sweden, Taiwan, Thailand, The Netherlands, United Kingdom, United States
e-Stewards	51	5	Recyclers: Canada (1); Mexico (2); Singapore (1); United Kingdom (1);

<sup>32</sup> <https://sustainableelectronics.org/recyclers>

<sup>33</sup> <https://www.weeelabex.org/conformity-verification/operators/>

<sup>34</sup> <http://e-stewards.org/find-a-recycler/>

<sup>35</sup> [https://reporting.recyclemyelectronics.ca/?process=extranet\\_rqo\\_list&language=en](https://reporting.recyclemyelectronics.ca/?process=extranet_rqo_list&language=en)

<sup>36</sup> Mousa Sharif, Certification Manager, Global Compliance Certification.

<sup>37</sup> <https://ww2.epeat.net/Companies.aspx?stdid=0&epeatcountryid=0>

Scheme	Total number of certificates issued for 2018	Number of countries with certified/ verified facilities	List of countries
	(source: <a href="http://e-stewards.org/data/list-recyclers/#sf-{%22search-id%22:%22recycler-filter%22}">http://e-stewards.org/data/list-recyclers/#sf-{%22search-id%22:%22recycler-filter%22}</a> )		USA (46) Enterprises: USA
RECYCLER QUALIFICATION PROGRAM	47 (source <a href="https://reporting.recyclemyelectronics.ca/?process=extranet_rqo_list&amp;language=en">https://reporting.recyclemyelectronics.ca/?process=extranet_rqo_list&amp;language=en</a> )	12	Mainly Canada. But approved downstream processors are also present: Belgium, China, Germany, Hong Kong, Japan, Mexico, Malaysia, North Korea, Sweden, United Kingdom, United States
EPEAT	Servers: 467, Computers and Displays 2018: 4287, Imaging equipment: 5209, Mobile phones: 44, TVs: 298,	33 countries	US, Canada, New Zealand, Bulgaria, Belgium, Austria, Australia, Brazil, China, Czech Republic, Denmark, Finland, France, Greece, Germany, Hungary, Italy, Japan, Latvia, Lithuania, Bulgaria, India, Mexico, Netherlands, Norway, Sweden, Switzerland, Poland, Portugal, Romania, Slovakia, Spain, Taiwan, UK
AS/NZS 5377-2013	45	2	Australia and New Zealand

Certificates have a certain duration after which period they have to be renewed. To make sure that certified bodies continuously comply with the requirements set by the given schemes, they are reviewed by given time intervals. The duration of the certificates, the frequency of audits and the type of audits conducted are listed in Table 12 for every verification scheme.

*Table 12: Validity periods of certificates, and frequency and types of audits of verification schemes*

Scheme	Duration of certificates	Frequency of audits	Type of audits
WEEELABEX	2 years	Every 2 years + annual surveillance audit	On site audits
R2:2013 Checklist	3 years	Annual surveillance audit	On site audits
e-Stewards	3 years	Annual	On site and non on-site audits
RECYCLER QUALIFICATION PROGRAM	2 years - pre-treatment, 3 years-downstream	Annual	Documents review and on site audits

EPEAT	Needs to update upon standard revision, if not product will be de-listed	Ongoing verification by qualified conformity assurance bodies	“Declare and verify” system
AS/NZS 5377-2013	3 years	Every 3 years	On site audits

## 4.4.2 AUDITS AND AUDITORS

All verification schemes mapped involve a pool of trained auditors. Third party auditors are available for e-Stewards, WEEELABEX, EPEAT, AS/NZS 5377:2013 and R2 standards, whilst the RQP programme counts with first party auditors.

**WEEELABEX** certified auditors must comply with the eligibility criteria stated in one of the WEEELABEX Organisation’s procedures<sup>38</sup> and pass a five-day face-to-face training. There are specific trainings for auditors conducting audits of facilities treating lamps and temperature exchange equipment, such as refrigerators. The list of auditors can be consulted at the WEEELABEX Organisation’s website. Auditors must attend an annual qualification workshop and conduct audits regularly. Auditors with more experience become lead auditors and can perform full audits, whilst auditors with less auditing experience can be part of the auditing team and perform technical tests at treatment facilities (the so called “batches”). The WEEELABEX Office implemented a quality assurance system for certified auditors that comprises regular revisions of the auditor’s performance, including on-site audits.

For **R2 standard**, a training Program for R2 Auditors has been developed aiming at ensuring consistent implementation of the R2 Standard, auditing techniques, and auditor qualification. The training program consists of a pre-course exam, a 3-day on-site training course (4 days for International Courses) and a final examination. Every year after the first year, all auditors must take a web-based refresher course as well as an exam to maintain their status as a R2 auditor.

**e-Stewards** uses a third-party audit system which employs accredited certification bodies (CBs) that conduct audits to assure that audited operations conform to the e-Stewards Standard. In addition to this, e-Stewards conducts its own Performance Verification Program.

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<sup>38</sup> A02 Auditors profile: <https://www.weeelabex.org/accreditation/>

This includes unannounced inspections and the use of EarthEye™ GPS tracking to ensure that electronic equipment goes to approved locations where it is supposed to go under the terms of the e-Stewards Standard.

Auditors who participate in the e-Stewards program must be qualified according to ANAB and ISO 19011 Guidelines for quality and/or environmental management systems auditing requirements. In addition they need to upload the specific requirements for e-Stewards auditor qualification which include being fully qualified as an ISO 14001 auditor, completion of a 5 day BAN designated e-Stewards auditor training course and successful completion of exams and continuing education requirements for an auditor refresher training course approved by BAN, usually every 36 months following completion of the initial training.

The **Recycler Qualification** Office operating under EPRA carries out the recycler qualification program (RQP) certifying e-waste management companies in Canada. As a reference they use the Electronic Recycling Standard (ERS).

**EPEAT** is a global rating system for greener electronics. Using EPEAT (“Electronic Product Environmental Assessment Tool”), purchasers in 43 countries can evaluate, compare and select electronics based on environmental attributes. EPEAT currently includes categories for PCs and Displays, Televisions, Imaging Equipment, Servers and Mobile Phones (printers, copiers, scanners, multifunction devices, fax machines and mailing machines).

Manufacturers register products in EPEAT based on their attainment of standards developed in voluntary consensus processes that are open and transparent for all interested stakeholders. There are 6 conformity assurance bodies (CABs) operating in 3 countries - USA, China and Germany – who verify the declarations of the manufacturer. Manufacturers’ declarations are subject to ongoing verification to assure the EPEAT Registry’s credibility<sup>39</sup>.

Auditors work for the conformity assurance bodies and have to participate in an auditors’ training which consists of a 5 days course.

The **AS/NZS 5377:2013** scheme is based on the standard with the same name. The standard was developed by the Australian Government Department of the Environment and the New

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<sup>39</sup> <https://greenelectronicscouncil.org/epeat/epeat-overview/>

Zealand Ministry of Environment. Accreditation of Conformity Assurance Bodies (CBAs) is done by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ)<sup>40</sup>. Currently there are two accredited CBAs that work in the territory of Australia and New Zealand; Compass Assurance Services Pty Ltd and Global Compliance Certification Pty Ltd. Upon contacting them, Global Compliance Certification told us that they had 6 auditors and audited 40 facilities up to now. The other accredited CBA is called Compass Assurance Services and it has certified approximately 10-15 facilities. There are no training programs for auditors programmed at regular intervals, but they can be organised upon request<sup>41</sup>.

### 4.4.3 AUDITING CRITERIA

Task participants looked for information regarding the types of accounting models for materials flows in the chain used for verifying compliance.

There is no specific evidence required for monitoring of CRMs in any of the verification systems assessed, nor labelling schemes to trace metals from the mine to the market. Some systems, however, such as e-stewards with the GPS tracker system and WEEELABEX and AS/NZS 5377:2013, have some criteria to check the traceability of the waste with the downstream monitoring.

### 4.4.4 CONFORMITY WITH ISEAL PRINCIPLES AND THE ISO 17000 SERIES

The verification schemes were to be examined from the point of view of their conformity with the ISEAL principles and the ISO 17 000 series.

The ISEAL Credibility principles represent the core values on which effective sustainability standards are built. The principles provide a guide for any standard that assesses sustainability.<sup>42</sup> There are 10 principles that can be used by companies, governments and NGOs can also use them as a reference point for benchmarking, which are the following:

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<sup>40</sup> <http://www.jas-anz.org/about-us>

<sup>41</sup> Mousa Sharif, Certification Manager, Global Compliance Certification

<sup>42</sup> <https://www.isealliance.org/credible-sustainability-standards/iseal-credibility-principles>

- Sustainability,
- Improvement,
- Relevance
- Rigour
- Engagement
- Impartiality
- Transparency
- Accessibility
- Truthfulness
- Efficiency

ISO/IEC 17000:2004 specifies general terms and definitions relating to conformity assessment, including the accreditation of conformity assessment bodies, and to the use of conformity assessment to facilitate trade<sup>43</sup>. Each verification scheme has been contacted in order to assess whether they conform to the ISEAL principles and the CENELEC ISO/IEC 17 000:2004 standards. The e-mail sent to them can be found in Annex VI. Three verification schemes have sent responses to the conformity related questions. EPEAT, WEEELABEX and JAZ-ANS, the organization who introduced the AS/NZS 5377:2013 standard.

#### **CONFIRMATION OF CONFORMITY WITH ISO/IEC 17 000**

JAZ-ANS will provide further explanations but declared that they fully meet the ISO/IEC 17 000 standard. They said that the JAS-ANZ E-waste scheme is established as a management systems scheme (accreditation standard ISO IEC 17021-1:2015, along with supporting scheme requirements) and with the certification standard being AS NZS5377:2013. AS NZS5377-2013 is currently undergoing revision by way of a Standards Australia project. It is expected to see the revised certification standard published in 2020, and at that time JAS-ANZ will revise the certification scheme requirements.

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<sup>43</sup> So <https://www.iso.org/standard/29316.html>

WEEELABEX declared that they also fully comply with the ISO 17 000 standard. The WEEELABEX certification schemes are accredited as per the ISO 17024 (certification of WEEELABEX Auditors), accreditation certificate: <https://www.weeelabex.org/wp-content/uploads/2016/07/013.jpg> and the ISO 17065 (certification of the WEEE treatment Operators), accreditation certificate: <https://www.weeelabex.org/wp-content/uploads/2016/07/012.jpg>.

EPEAT declared that they fully meet the ISO 17 000 standard. The explained that the EPEAT Program oversees conformity assurance bodies that operate under either ISO 17065 or ISO 17020 accreditation. The EPEAT program operates under ISO 14024, which incorporates elements of ISO 17065. All of the approved conformity assessment bodies' certificates could be found online in their respective accreditation list, c.f. <https://greenelectronicscouncil.org/>.

### ISEAL CREDIBILITY PRINCIPLES

As for the conformity with the ISEAL principles, only EPEAT declared unto the preparation of this deliverable that they are compliant with them. They provided references in their guidance document to each of the credibility principles, which are shown in the following:

- *Sustainability*, Section 1 of the EPEAT Program Guidelines<sup>44</sup>
- *Improvement*, Section 4.2 of the EPEAT Program Guidelines
- *Relevance*, Section 5 of the EPEAT Program Guidelines
- *Rigour*, Section 5.2 and 6.1 of EPEAT Program Guidelines
- *Engagement*, Section 5 of EPEAT Program Guidelines
- *Impartiality*, Section 4.3 of EPEAT Program Guidelines
- *Transparency*

EPEAT criteria and program information can be viewed and full text can be downloaded.<sup>45</sup>

#### *Accessibility*

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<sup>44</sup> EPEAT Program Guideline: [https://www.epeat.net/documents/manufacturer-resources/program\\_guidelines/EPEAT\\_Program\\_Guidelines\\_P1.pdf](https://www.epeat.net/documents/manufacturer-resources/program_guidelines/EPEAT_Program_Guidelines_P1.pdf)

<sup>45</sup> C.f. <https://greenelectronicscouncil.org/epeat-criteria/>

All information about the EPEAT program, including how to participate, public policy documents, contracts, fees, and criteria are disclosed and can be downloaded.<sup>46</sup>

### *Truthfulness*

EPEAT has a verification and conformity assurance system that checks the ‘truthfulness’ of claims made in the EPEAT Registry. It is described in detail in section 6 and 7 of the EPEAT Program Guidelines

### *Efficiency*

All EPEAT Criteria references existing programs and/or standards in order to prove conformance with EPEAT criteria. For example, they may cite various ISO standards and request ISO certificates for showing conformance rather than requiring individual audits of the criteria.

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<sup>46</sup> C.f. <https://greenelectronicscouncil.org/epeat-criteria/>

## 5 GAP AND OBSTACLE ANALYSES

### 5.1 WEEE

#### 5.1.1 ASSESSMENT OF CEN CLC STANDARDS AGAINST ISEAL CREDIBILITY PRINCIPLES<sup>47</sup>

The EN 50625 series is supposed to reflect the state-of-the art when it comes to collection, logistics & treatment of WEEE, which it does to some extent, even though there is still room for improvement on certain aspects. Overall, the EN standards tend to be rather generic; requirements are formulated in a general way so they can be applied to different situations, but as a result they provide limited technical guidance to companies. Especially related to sustainability issues and environmental management, the standards only refer to the need to have an environmental system and licenses in place without specifying concrete requirements. The question is whether this is sufficient to avoid (potential) negative impacts by CRM recycling which can lead to significant air and water pollution (especially in the case of smelting) if not managed properly.

Furthermore, the standardisation system is not always very transparent or accessible for all stakeholders (e.g. for small SMEs or environmental NGOs). And since EN standards are voluntary, the verification & assurance is not as strict as for certification schemes and is mostly based on first-party conformity assessments. Even in the case the standards are made mandatory, market surveillance is inadequate in many countries.

In short, the CEN CLC standards comply with the ISEAL credibility principles at a minimum level. For the CEWASTE certification scheme it is desirable to be more ambitious and concrete in terms of both technical and sustainability requirements as well as verification & assurance mechanisms and balanced stakeholder representation.

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<sup>47</sup><https://publications.europa.eu/en/publication-detail/-/publication/c0bc6046-651c-11e7-b2f2-01aa75ed71a1>

<sup>47</sup> Secretariat of the Basel Convention: Basel Convention Technical Guidelines for the Environmentally Sound Management of Waste L

## 5.1.2 NORMATIVE GAPS IN THE WEEE END-OF-LIFE CHAIN

The end-of-life chain for WEEE consists of the steps illustrated in Figure 3.

Figure 3: Schematic overview of the End-of-Life value chain for WEEE

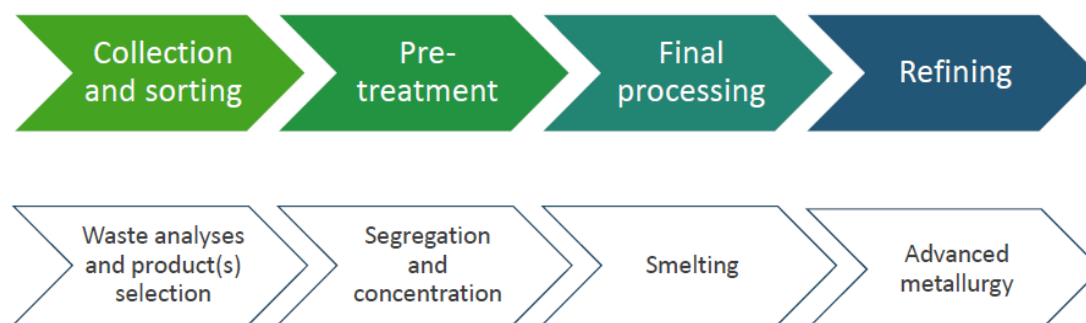


Table 13 gives a general overview of the analysed standards to the end-of-life above downstream steps of WEEE.

Table 13: Relation between mapped standards and the different WEEE process steps.

Standard	Product stream	Detailed focus	Part of value chain affected
AS/NZS 5377	WEEE		Collection, Logistics, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use
EN 50625-1	WEEE		General treatment and depollution requirements
EN 50625-2-1	WEEE	Lamps	Pre-treatment
EN 50625-2-2	WEEE	WEEE containing CRTs	Pre-treatment
e-Stewards Standard	WEEE	Certain hazardous components/materials in WEEE (mostly IT)	Downstream treatment
eWASA Technical Guidelines	WEEE	All WEEE and appliances, as well as their components	Collection, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use
ISO/IWA 19: 2017	WEEE, ELVs, Waste, Batteries, All types of wastes that contain metals	Secondary metals	Collection, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use
prEN 50614	WEEE		Preparation for re-use

TS 50625-3-1	WEEE	All the WEEE streams	Pre-treatment
TS 50625-3-2 Lamps	WEEE	Lamps	Pre-treatment
TS 50625-3-3 Displays	WEEE	WEEE containing CRTs	Pre-treatment
TS 50625-3-4 Fridges	WEEE	Temperature exchange equipment (C&F)	Pre-treatment
TS 50625-4 Collection and Logistics	WEEE	All WEEE	Collection and Logistics
TS 50625-5:2017 end processing	WEEE	All WEEE – sub-stream containing copper and precious metals and CRMs	Final treatment

Taking into account the identified KCE (Table 2 on page 24) and based on the results of mapping exercise in chapter 4, the gaps and obstacles for recycling of CRMs from the KCE were identified for each of the above steps in the EoL chain of WEEE to guide the development of requirements in work package 2.

### COLLECTION

To reach a large volume of products containing valuable and CRMs and to concentrate CRMs, segregating the KCE at collection sites i.e. municipalities, retailers and businesses would be a good possibility.

Table 14 presents the standards that cover collection of WEEE. Specific requirements for sorting and storing WEEE in separate receptacles or containers are indicated in the right columns (“separate storage required”).

Table 14: Standards of relevance for the collection of KCE

Name of the standard	Key CRM Equipment	Requirements for separate collection	Separate storage stipulated
AS/NZS 5377	• CRT monitors and TVs	Yes	Yes
	• Fluorescent lamps	Not specific	No
	• Large house hold appliances like washing machines, dish washers, dryers	Not specific	No
	• Mobile phones	Not specific	No
	• Laptops	Not specific	No
	• Tablets	Not specific	No
	• Desk top computers	Not specific	No
TS 50625-4 Collection and Logistics	• CRT monitors and TVs	Yes	Yes
	• Fluorescent lamps	Yes	Yes
	• Large house hold appliances like washing machines, dish washers, dryers	Not specific	No
	• Mobile phones,	Not specific	No
	• Laptops,	Not specific	No
	• Tablets,	Not specific	No
	• Desk top computers	Not specific	No
ISO/IWA 19: 2017	• CRT monitors and TVs	Not specific	No
	• Fluorescent lamps	Not specific	No
	• Large house hold appliances like washing machines, dish washers, dryers	Not specific	No
	• Mobile phones,	Not specific	No
	• Laptops,	Not specific	No
	• Tablets,	Not specific	No
	• Desk top computers	Not specific	No
eWASA Technical Guidelines	• CRT monitors and TVs	Not specific	No
	• Fluorescent lamps	Yes	Yes
	• Large house hold appliances like washing machines, dish washers, dryers	Not specific	No
	• Mobile phones	Not specific	No
	• Laptops	Not specific	No
	• Tablets,	Not specific	No
	• Desk top computers	Not specific	No

\* Large Household Appliance:s e.g. washing machines, dish washers, dryers

Examining these standards covering collection, an analysis was made to what extent they cover the sections in Figure 4, which represents the structure commonly used in standards.

Figure 4: Generic structure of standards

Section 1	• Scope/Objective/Definitions
Section 2	• General -> Legislation/Licenses • Organisational -> General/Management/Risk assessment/Training/Records management
Section 3	• Storage -> Access/Handling/Sorting/Storage/Facilities • Transport -> Packaging
Section 4	• Operational/Technical -> General/Acceptance/Sampling/Plant and process conditions/Wastes
Section 5	• Monitoring and reporting -> General/Classification/Recycling and recovery rates/CRM yield
Section 6	• Documentation

Table 15 shows the results.

Table 15: Overview of standards on collection of WEEE relevant for valuable and CRMs

	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6
AS/NZS 5377						
TS 50625-4 Collection and Logistics						
eWASA Technical Guidelines						
ISO/IWA 19: 2017						
		Present				
		Not covered				
		Partly covered				
Note: A Technical Specification - TS 50625 standard is directly linked to the relevant EN 50625 standard						

From this we can conclude that the standards on collection cover all basic sections. This means that the content of these standards could be a good basis. Certain parts in these standards could be adopted or referred to, if deemed suitable.

#### PRE-TREATMENT: GENERAL OVERVIEW

In the pre-treatment phase, the components that contain valuable metals and CRMs need to be segregated from the KCE listed in Table 2 in order to prepare the adequate input for the final treatment. Table 16 displays the standards that are relevant for pre-treatment of the identified KCE.

Table 16: Applicable standards for the pre-treatment of the KCE

Standard	Detailed focus	Part of value chain affected
AS/NZS 5377		Collection, Logistics, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use
EN 50625-1 General Treatment		General treatment and depollution requirements
EN 50625-2-1 Lamps	Lamps	Pre-treatment
EN 50625-2-2 Displays	CRTs	Pre-treatment
e-Stewards Standard	Certain hazardous components/materials in WEEE (mostly IT)	Downstream treatment
eWASA Technical Guidelines	All WEEE and appliances, as well as their components	Collection, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use
ISO/IWA 19: 2017	Secondary metals	Collection, Pre-treatment, Downstream treatment, Disposal, Preparation for re-use
TS 50625-3-1 Depollution	All WEEE streams	Pre-treatment
TS 50625-3-2 Lamps	Lamps	Pre-treatment
TS 50625-3-3 Displays	CRTs	Pre-treatment

Table 17: provides an overview of the mapped pre-treatment standards in relation to whether or not they cover the six sections of standards (see Figure 4 on page 73).

Table 17: Overview of pre-treatment standards and sections in standards

	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6
AS/NZS 5377						
EN 50625-1 General treatment						
EN 50625-2-1 Lamps						
EN 50625-2-2 CRT s						
e-Stewards Standard						
eWASA Technical Guidelines						
ISO/IWA 19: 2017						
TS 50625-3-1 Depollution						
TS 50625-3-2 Lamps						
TS 50625-3-3 Displays						
TS 50625-5:2017 End processing						
<div> <div></div> Present           <div></div> Not covered           <div></div> Partly covered         </div>						
Note: A Technical Specification - TS 50625 standard is directly linked to the relevant EN 50625 standard						

With the exception of the Technical Specifications (TS), all standards apply the generic structure and cover the sections presented in Figure 4 on page 73.<sup>48</sup>

In theory, the generic structure could be suitable for pre-treatment requirements of the CEWASTE voluntary (certification) scheme. However, the question is whether or not it is sufficient to refer to the texts in the sections of the pre-treatment-related standards in Table 17.

A key standard for WEEE recycling is EN50625-1 (General Treatment), which currently does not cover the recycling of CRMs. Specific requirements to improve the standard and include CRMs have been suggested by the SCREEN project:

- Formulate and include definition of CRMs;
- Components identified as containing CRMs should be properly separated into identifiable streams.
- Components containing CRMs should undergo treatments in state-of-the-art facilities.

#### **PRE-TREATMENT: SEGREGATING COMPONENTS FROM KEY CRM EQUIPMENT**

In the previous section we identified the standards that cover pre-treatment. In this section we analyse whether these standards contain requirements to actually separate the components listed in Table 3 that contain CRMs.

#### **Segregation of magnets**

Table 3 illustrates that magnets with relevant CRMs are found in household appliances (electro-motors, compressors), and in desktop computers and laptops/notebooks (hard disc drives). Table 18 shows that none of the analysed standards for pre-treatment stipulates normative requirements for the removal of magnets from these product streams.

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<sup>48</sup> The TS do not cover sections 2 and 3 because they are directly linked to the EN 50625 standards which cover these sections.

Table 18: Pre-treatment standards with requirements to remove magnets

Relevant Standard	Normative requirement for removal of magnets
AS/NZS 5377	No
EN 50625-1 General treatment	No
EN 50625-2-2 CRT and FDP	No
e-Stewards Standard	No
eWASA Technical Guidelines	No
ISO/IWA 19: 2017	No
TS 50625-3-1 Depollution	No
TS 50625-3-3 Displays	No

This means that the gap between the normative requirements in current standards and the need to segregate magnets for further downstream processing is 100 %. However, it does not mean that magnets are not segregated in daily practice by pre-treatment operators. For instance, magnets in CRTs are removed together with the deflection coil and sent to specialised downstream operators. The same applies for electro-motors in large household appliances which are being removed by pre-treatment operators.

### Segregation of fluorescent powders

In Table 3, fluorescent powders are applied in (compact) fluorescent lamps and in CRTs. According to Annex VII, section 1 of the European WEEE Directive, CRTs and mercury-containing components (e.g. fluorescent lamps used as backlights) have to be removed from separately collected WEEE. Annex VII, section 2 of the WEEE Directive stipulates the removal of fluorescent coatings from CRTs so that these powders become available as a separate waste stream that could be sent to CRM recycling. The WEEE Directive does not stipulate any requirements as to the removal of fluorescent powders from the removed backlights or from separately collected fluorescent lamps (collection category 3).

The only normative requirements specifically dealing with the pre-treatment of lamps are standards EN 50625-2-1 and the TS 50625-3-2. In the EN standard there is an indirect normative requirement for the removal of fluorescent powders because they are considered to be hazardous. These powders could be sent to CRM recycling. So, for the pre-treatment of lamps and CRTs there is no gap with respect to the segregation of these powders. The new

CEWASTE standard could make reference to the two CENELEC standards on lamps and to the WEEE Directive.

### Segregation of batteries from WEEE

Annex VII of the WEEE Directive requires the removal of batteries because they are considered hazardous waste, not because of resource-efficiency reasons, although policy developments are moving in this direction. Regulatory requirements have priority over standards. The removal of batteries is therefore only mentioned in the standards listed in Table 19.

*Table 19: Overview of standards that require the removal of batteries*

Standard	Batteries
AS/NZS 5377	All types
EN 50625-1 General treatment	All types
e-Stewards Standard	All types
eWASA Technical Guidelines	All types
ISO/IWA 19: 2017*	All types
TS 50625-3-1 Depollution	All types

\* requirement is limited to storage

Li-ion batteries coming from WEEE are addressed by the ADR<sup>49</sup> regulation, which requires the transport of equipment containing these batteries in receptacles < 3 m<sup>3</sup>. Therefore, batteries are ever more removed at collection centres instead of during the pre-treatment process. This is only the case if batteries can be removed without using tools. The embedded batteries are predominately removed in the pre-treatment process.

### Printed circuit boards

The recycling of printed circuit boards (PCBs) has been one of the priorities in the industry for decades, especially since it is economically interesting for IT and telecom equipment. More importantly, the removal of PCBs of more than 10 cm<sup>2</sup> is legally required (Annex VII of the

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<sup>49</sup> European Agreement concerning the International Carriage of Dangerous Goods by Road, retrievable from [https://www.unece.org/trans/danger/publi/adr/adr\\_e.html](https://www.unece.org/trans/danger/publi/adr/adr_e.html)

WEEE Directive) because the boards consist of plastics that contain Brominated Flame Retardants.

For the sector, the driver behind the removal of PCBs is the recycling of Au, Ag and Pd in copper smelters. The feedstock from WEEE is predominantly a copper and precious metal containing fraction. The removal of PCBs is also a normative requirement in the parts referring to pre-treatment in the standards listed in Table 20.

*Table 20: Overview of standards that require the removal of printed circuit boards.*

Standard	Type of WEEE
AS/NZS 5377	All WEEE. PCB > 10 cm <sup>2</sup>
EN 50625-1 General treatment	All WEEE. PCB > 10 cm <sup>2</sup>
e-Stewards Standard	All WEEE
TS 50625-3-1 Depollution	All WEEE. PCB > 10 cm <sup>2</sup>

The conclusion is that the removal of the PCBs of more than 10 cm<sup>2</sup> surface area is covered by a number of standards and also in applicable legislation in the EU and some other countries (e.g. Australia and New Zealand). No gap is observed for the PCBs of this size and the new CEWASTE standards may refer directly or indirectly to the standards given in the above Table 20 for the removal of those PCBs.

## **END-TREATMENT**

The recycling of valuable and CRMs is done in the final refining stage where further concentration and separation of the various metals takes place at smelters. There is only one standard, the TS 50625-5 Specification for the final treatment of WEEE fractions - *Copper and Precious Metals*<sup>50</sup>, that encompasses normative requirements for the final processing and refining of WEEE fractions. Five copper smelters in the world have undergone verification audits for compliance with the preceding standards.

The TS 50625-5 has the generic structure as is given in Figure 4 and covers most of the subjects of the six sections. The focus of the standard is on the recycling of copper, as well as the

<sup>50</sup> "<https://echa.europa.eu/de/rmoa/-/dislist/substance/100.239.187>" <https://echa.europa.eu/d>

valuable metals Au and Ag and the CRM Pd. The source of the latter three metals is mainly printed circuit boards. It is therefore recommended to follow this standard for the end-treatment of printed circuit boards.

For the other CRM-components in KCE in Table 3, there are no final processing and refining standards. This means that for these components the CEWASTE scheme should develop new technical requirements for the recycling process.

## 5.2 WASTE BATTERIES

### 5.2.1 LACKING STANDARDS

#### WASTE LEAD-ACID BATTERIES

Lead and its compounds are restricted through a number of sector specific legislations such as Directive 2011/65/EU (RoHS Directive) applicable to EEE and Directive 2000/53/EC (ELV Directive) applicable to ELVs. Both regulations stipulate the removal of batteries from waste EEE and ELVs, but do not contain further requirements as to the transport and treatment of the removed batteries. Lead and its compounds have been subject to a regulatory management option analysis (RMOA) by the European Chemicals Agency (ECHA) in light of concerns of the metal being carcinogenic, mutagenic and toxic for reproduction<sup>51</sup>. European sector documents are limited to Best Available Techniques (BATs)<sup>52</sup>.

In the course of the analysis conducted in WP 1, no specific battery collection, transport and treatment standards could be identified. Instead, it was found that in the EU some criteria are spread over numerous documents, each addressing single aspects regarding mainly battery treatment. Lead recycling industries, for example, are subject to stringent and well monitored general emission and discharge controls and industrial hygiene standards in many industrialized countries.

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<sup>51</sup> <https://echa.europa.eu/de/rmoa/-/dislist/substance/100.239.187>

<sup>52</sup> <https://publications.europa.eu/en/publication-detail/-/publication/c0bc6046-651c-11e7-b2f2-01aa75ed71a1>

For Li-Ion batteries, specifically safety issues are addressed in various documents, as for example the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)<sup>53</sup>.

Against this background of these stringent stipulations, although spread over numerous documents, additional specific standards for the collection, transport, treatment and disposal of batteries have not been a priority in the EU. On international level, the Basel Convention Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries<sup>54</sup> is currently the only reference document with official global status. The Guidelines outline procedures which cannot serve as a standard with operational and auditable requirements that can be verified by independent auditors on a facility or at supply-chain level.

#### OTHER BATTERIES

The relevance of NiMH batteries was evaluated to be significantly lower than the one of lead-acid and Li-Ion batteries, with even further decreasing relevance forecasted for the future due to the successive phase-out of this battery type in many applications. Based on that, the main focus was decided to be put on lead-acid and Li-ion batteries.

### 5.2.2 HOT SPOTS IN THE END OF LIFE OF WASTE LEAD-ACID BATTERIES

In developing countries, there are numerous examples where end-of-life management and recycling of waste lead-acid batteries (WLABS) are associated with severe pollution and adverse human health impacts. Atmospheric pollution mostly results from the emission of sulphur dioxide, lead and lead compounds. Effluent discharges of untreated or partially treated battery electrolyte result in environmental contamination of ground water sources, rivers and lakes. Discharges of battery electrolyte can occur at any stage in the waste recovery

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<sup>53</sup> European Agreement concerning the International Carriage of Dangerous Goods by Road, retrievable from [https://www.unece.org/trans/danger/publi/adr/adr\\_e.html](https://www.unece.org/trans/danger/publi/adr/adr_e.html)

<sup>54</sup> Secretariat of the Basel Convention: Basel Convention Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries, retrievable from <http://www.basel.int/Portals/4/Basel%20Convention/docs/pub/techguid/tech-wasteacid.pdf>

process, but atmospheric emissions are only associated with the pyro-metallurgical recycling and refining processes. While spent sulfuric acid is classified as a hazardous waste and has a high acidification potential, lead, which makes up around 65 % of the weight of a lead-acid battery, is a toxic heavy metal. Various recent reports have shown that unsound waste lead-acid battery recycling is widespread in many developing countries and emerging economies and if undertaken in an improper and environmentally unsound manner often leads to land contamination and severe adverse health effects to workers and neighboring communities<sup>55</sup>. For that reason, unsound lead-acid battery recycling was classified as one of the world's worst pollution problems by the US-American Organization Pure Earth and Swiss Green Cross<sup>56</sup>. From this perspective, it is most important that CRMs (mostly antimony or antimony-containing alloys) sourced from lead-acid battery recycling activities are from reliable and environmentally sound supply chains. In that context it needs to be noted that many lead-acid battery recycling plants and lead refineries source waste batteries, lead scrap and crude lead from foreign sources so that a system of supply chain due diligence is needed to ensure the provenance of the materials. Besides due diligence, sound occupational health and safety measures, control of blood lead level and emission control were identified as overarching aspects. Furthermore, process specific hot spots like manual battery breaking, improper collection and disposal of battery acid and unsound smelting and refining of lead were identified.

Regarding Li-ion batteries, safety issues were identified to be the most critical issue along all steps of end-of-life treatment, including collection, transport, storage, and processing. Furthermore, unlimited exposure of workers to cobalt was mentioned by a consulted industry expert to produce adverse health impacts.

Latest for the sound end-of life management of WLABs and Li-ion batteries outside the EU and countries with stringent environmental and health regulations, reliable standards and verification schemes would be helpful to control and avoid hazards. In the absence of any specific standards for sound end-of-life management of lead-acid and Li-ion batteries that could be referenced, the development of a full set of holistic standards for Li-ion and lead-

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<sup>55</sup> <https://www.oeko.de/oekodoc/2549/2016-076-de.pdf>

<sup>56</sup> <https://www.worstpolluted.org/2016-report.html>

acid batteries collection, transport and treatment is out of the scope of this project due to time and budgetary reasons. It was therefore decided to develop in WP2 at least a set of minimum criteria addressing the above hot spots in the end-life of these batteries during their collection, transport, treatment and disposal.

## 5.2.3 HOT SPOTS IN THE END OF LIFE OF WASTE LI-ION BATTERIES

### THERMAL RUNAWAY

Thermal runaway (TR) of lithium-ion batteries, i.e. they may heat up and start burning, represents the greatest risk in the recycling chain. Fire incidents are repeatedly reported caused by the heating of a cell, the subsequent ignition of the electrolyte in the cell and finally the bursting of the cell and subsequent combustion. External short circuits, internal short circuits due to external damage or the exposure of the cells to high temperatures can initiate TRs. The TR of a single lithium-ion cell stored together with other Li-ion cells can lead to particularly rapid and large fires which may also emit soot and highly toxic hydrogen fluoride. Areas where lithium-ion batteries are collected, transported, stored and treated must therefore be organized and technically equipped in such a way that the TR of a cell can be quickly detected and countermeasures be initiated.

### LOW COLLECTION RATES OF LI-ION BATTERIES FROM WEEE

Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators stipulates a collection target of 45 % for EU Member States for all portable batteries, which 14 Member States failed<sup>57</sup> to meet in 2016. Important causes for the collection losses are:

- Batteries disposed of in municipal waste,
- Losses through WEEE (batteries are not removed from WEEE and are instead shredded together with the appliances) and

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<sup>57</sup> Stahl et al.,  
<https://ec.europa.eu/environment/waste/pdf/Published%20Supporting%20Study%20Evaluation.pdf>

- Export (outside the EU) of used EEE with their batteries still incorporated.

Especially high collection losses can be observed for lithium-ion portable batteries via the household waste path, the export of used EEE (including batteries) and insufficient removal of lithium-ion portable batteries from WEEE prior to shredding. <sup>58</sup>

Insufficient collection, inadequate treatment and disposal paths result in additional risks and shortcomings:

- Lithium-ion batteries in household waste increasingly cause fires in waste containers, waste collection vehicles, waste storage bunkers and waste treatment plants.
- Fires in WEEE treatment as consequence of improper storage of separated lithium-ion batteries and shredding of WEEE without prior separation of Li-ion batteries;
- Lithium-ion batteries exported to countries outside the EU-28 without adequate framework conditions for storage and treatment may cause fires and dangerous emissions.
- Significant losses of valuable and CRMs like cobalt, lithium and copper;

Finally, it should be emphasized that the totally inadequate collection results for portable lithium-ion batteries in the EU-28 lead to a significant loss of the valuable target metals cobalt, lithium and copper. Measures aimed at significantly improving the collection rate must therefore be given high priority, not least in the forthcoming revision of the EU Battery Directive.

#### **DISMANTLING OF LI-ION BATTERIES FROM ELECTRIC VEHICLES**

Batteries in electrical vehicles often weigh several hundred kilograms, which requires safety precautions for their safe storage including appropriate fire protection devices (heat sensors, fire extinguishing system), suitably trained personnel and appropriate equipment such as safety shoes, lifting equipment, chemical resistant protective gloves, etc. Good exhaust air extraction is important in order to protect employees from possible hydrogen fluoride

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<sup>58</sup> The depth of battery removal from installations was confirmed to vary widely across the EU (personal communication of M. Buchert, Oeko-Institut, with management of e-waste treatment plant);

emissions (e.g. caused by a single damaged cell). In recent years professional recycling companies in Europe have already gained valuable experience with such plants.<sup>59</sup> The export of electric vehicles with large lithium-ion batteries to countries outside the EU can give rise to risks like the export of portable batteries to these countries.

#### RECYCLING OF LITHIUM-ION BATTERIES FROM WEEE AND ELV

Lithium-ion portable batteries and lithium-ion modules or cells (from electric mobility) are often further processed in the same recycling plants. Occupational safety and the prevention of hazardous emissions into air such as hydrogen fluoride, cobalt particles must be given high priority, as well as comprehensive fire protection equipment.

## 5.3 OBSTACLES IN LEGAL STIPULATIONS AND FRAMEWORK CONDITIONS

### Mass-based recycling targets in the WEEE Directive

Recycling rates of CRMs for most CRMs besides platinum group metals are currently very low (especially for REEs), either because it is not economic, or no suitable technology exists. Current policies hardly (or not all) address CRM recycling. Generic, weight-based collection and recycling targets for WEEE in the EU leads to producers and members states focusing on overall tonnages rather than quality recycling of small amounts of CRMs.

To stimulate recycling, the most effective solution would be to make recycling of CRMs for which recycling technologies are available mandatory through policies and create incentives for designing products with recycled CRMs. Furthermore, designing products in such a way to facilitate the recycling/remanufacturing of WEEE (components) containing CRMs is considered a more effective measure than focusing on materials declarations or assessing recyclability of products. Digitisation and artificial intelligence will certainly also enable digital certification of recycled content in products.

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<sup>59</sup> The first such facility has been operated by Umicore in Hanau, Germany, for almost ten years.

### Economic framework conditions

Recycling of CRMs is economically not attractive for most CRMs other than platinum group metals (PGMs) under the present economic framework conditions. These framework conditions are, however, the result of political and economic decisions, and could be amended to make recycling of CRMs from the identified KCE economically attractive. Most of nowadays waste management would not be economic feasible if it was not financed by taxes, fees paid by consumers, or by producers in the course of obligations arising from extended producer responsibility as stipulated, e.g., for the management of WEEE in the WEEE Directive. Should national governments and the European Union consider the recycling of CRMs a societal priority, it should adapt economic framework conditions to secure adequate financing.

### Other obstacles and potential solutions

Besides the above ones, there are more problems, obstacles, and gaps that make recycling of CRMs difficult and may also negatively affect the implementation of the CEWASTE certification scheme:

- Difficult access to components containing CRMs in products. Bad design (no Design for Remanufacturing/recycling) results in, for instance, glued components;
- Technical trends like miniaturization and increasingly complex material mixtures in particular in EEE result in use of small quantities of CRMs which make recycling inefficient or even technically impossible;
- Low collection rates of WEEE result in losses of KCE and their CRMs;
- Insufficient separation of KCE from other WEEE further dilutes the CRMs over collected WEEE;
- Access to a comprehensive knowledge base (investors require robust, harmonized data in a knowledge base to make relevant investment decisions) ;
- Lack of (detailed, quantitative) information about the components and chemical composition of EoL products;
- Lag between use of CRM in products and availability for recycling (long-life assets);
- Difficult for some CRMs to achieve high-quality secondary materials suitable to be incorporated in new products;

Potential solutions for the above issues in order to stimulate the recycling of CRMs and facilitate the adoption of the CEWASTE (certification) scheme are:

- Ecodesign, in particular better access to CRM source components, avoiding incompatible mixtures, facilitation of reuse, dismantling and recycling) ;
- Amend WEEE and Batteries Directive, i.e. include CRM recycling into Extended Producer Responsibility;
- Improve critical metallurgical infrastructure;
- Upgrade producer information for recyclers as to source components for CRMs and their location in products;
- Tracking and tracing of CRMs in applications and end-of-life (through the Raw Material Information System), more detailed reporting requirements throughout the value chain;
- Create closed loop systems: leasing models and deposit/take-back schemes with advance recycling fees;
- Better implementation, monitoring & enforcement of environmental regulations (Basel) to prevent illegal exports of WEEE incl. KCE;
- Clear guidelines to improve collection, separation & treatment processes for CRM recycling;
- Make voluntary standards legally binding;
- Digital certification of recycled content.

## 5.4 CONCLUSIONS

The recycling of precious metals from printed circuit boards contained in the KCE is a strong economic driver and is thus a well-established processing route. A standard specifies requirements for final processing of WEEE fractions to ensure high recycling rates. Further stipulations for collection and pre-treatment of KCE containing relevant concentrations of precious metals may be useful to maximize the recycling of precious metals from WEEE. Recycling of cobalt from waste Li-ion and NiMH batteries is technically and economically viable and practiced, which also applies to recycling of antimony from lead-acid batteries.

CRM-recycling from KCE other than the above is economically not feasible with the current economic framework. This applies to REEs in fluorescent powders from fluorescent lamps and cathode ray tubes, to REEs in NdFeB-magnets from household equipment, hard disc drives and electrical vehicles, as well as to recycling of REEs from NiMH-batteries. REE recycling from fluorescent powders had been practiced already for several years until the dropping REE prices undermined the economic base for these operations so that they were stopped. A stable financing provided, the technically well tried operations could be reestablished, which would at the same time open up a final processing route for the final processing of REE-containing fractions from NiMH batteries.

REE recycling from NdFeB-magnets has never been practiced in industrial scale for technical and in particular for economic reasons. Nevertheless, processes for pre- and final treatment have been developed, even though not all necessarily ready for industrial scale operation within short time. The CEWASTE consortium assumes, however, that a stable supply with NdFeB-magnets combined with adequate financing may enable establishing collection and treatment technologies for REE recycling, next to the production of new NdFeB-magnets from old ones. Systematic Information provided by producers in particular of household equipment where the use of NdFeB-magnets may differ between producers and their models would help pre-treatment operators to identify quickly devices containing NdFeB-magnets thus avoiding cost for effectless dismantling operations. Normative requirements addressing valuable and CRMs or e-waste and batteries containing CRMs were mapped and analyzed for applicable technical and non-technical requirements - sustainability requirements like environmental management, social, and labor issues – as well as documentation and tracking/traceability of material flows.

Products containing CRMs were found to be hardly addressed specifically in the analyzed normative requirements. Nevertheless, there are requirements that are of relevance for the KCE in Table 2 on page 24. There are legal obligations in the WEEE Directive for categories of WEEE which apply to the KCE, such as collection categories, specific treatment requirements, and financing obligations in the course of producers' EPR obligations. Legislative requirements like the removal of batteries from WEEE and ELVs support subsequent treatment steps for CRM recycling, even though they do not address CRMs specifically.

For waste batteries and parts of end-of-life vehicles, there are no specific standards guiding their proper treatment or the recycling of CRMs. Standards including technical stipulations for the treatment of WEEE could be identified, e.g. the CENELEC standard series, e-stewards and the Australian/New Zealand AS/NZS 5377 standard. Specific requirements for the collection and treatment of KCE are missing in the analyzed standards. They do, however, contain non-technical and some technical requirements with relevance for WEEE and waste batteries.

WP2 therefore will have to develop in particular technical requirements enabling the sound collection and sorting of KCE, and the recycling of CRMs. These requirements should be integrated into and aligned with the current collection and treatment procedures – which may also go back to normative requirements – so that collectors and treatment operators can maintain their established routines as far as possible.

The implementation and practice of the KCE-specific requirements may cause especial environmental, health and safety implications and conditions. In the light of these challenges, the non-technical requirements and the auditing schemes identified in the analyzed normative requirements can be examined to decide whether they can be referenced with or without adaptations in the CEWASTE standard and verification scheme, or whether new non-technical requirements have to be developed.

The main obstacle for CRM recycling from magnets, fluorescent powders, and from batteries, which, even though technically feasible, is the uneconomic cost-benefit ratio under the current framework conditions. Producers, in the course of their extended producer responsibility (EPR) can have their end-of-life treatment operators apply the CEWASTE standard and certification scheme voluntarily to the WEEE for which they are responsible. In a competitive environment, a stronger, legislative requirement, or alternative financing mechanisms other than EPR, for example recycling fees from consumers or taxes, are probably necessary to actually achieve recycling of CRMs from KCE in a larger scale.

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## 7 ANNEX I - LIST OF MAPPED ITEMS

Type	Name	Comment
certification/verification systems	EPEAT	
certification/verification systems	WEEELABEX	
certification/verification systems	R2 - THE RESPONSIBLE RECYCLING STANDARD For ELECTRONICS RECYCLERS	
certification/verification systems	e-Stewards®	
certification/verification systems	Recycler Qualification Program (RQP)	
certification/verification systems	AS/NZS 5377-2013	
Legislation	Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)	
Legislation	Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC	
Legislation	Directive 2000/53/EC of the European Parliament and of the council of 18 September 2000 on end-of life vehicles	
Legislation	Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste	
Legislation	ElektroAltgerätebehandlung in Österreich	NOT RELEVANT
Legislation	Commision decision 2019/63 on the sectoral reference document on best environmental management practices, sector environmental performance indicators and benchmarks of excellence for the electrical and electronic equipment manufacturing sector under Regulation (EC) No 1221/2009 of the European Parliament and of the Council on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS)	
Legislation	Directive 2010/75/EU (Industrial emissions (integrated pollution prevention and control) (Recast))	
Legislation	Directive 91/271/EEC (Urban waste water treatment)	
Standards & guidelines in development	German ElektroAltgerätehehandlungsverordnung (concept)	
Standards & guidelines in development	prEN IEC 61960-4:2019 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary	

Type	Name	Comment
	lithium cells and batteries for portable applications - Part 4: Coin types (button) lithium secondary cells and batteries	
Standards & guidelines in development	prEN 45553, General method for the assessment of the ability to remanufacture energy related products	
Standards & guidelines in development	prEN 45558, General method to declare the use of critical raw materials in energy related products	
Standards & guidelines in development	prEN 45557, General method for assessing the proportion of recycled material content in energy related products	
Standards & guidelines in development	prEN 45552, General method for the assessment of the durability of energy related products	
Standards & guidelines in development	Standardisation Request Material-efficient Recycling of WEEE and Waste batteries	NOT RELEVANT
Standards & guidelines in development	IEC 60086-6 Part 6: Guidance on environmental aspects (under development);	
Standards, guidelines	eWASA Technical Guidelines on Recycling	
Standards, guidelines	R2:2013 standard	
Standards, guidelines	e-Stewards Standard V3.1	
Standards, guidelines	AS/NZS 5377-2013 - Collection, storage, transport and treatment of end-of-life electrical and electronic equipment	
Standards, guidelines	VDI 2343 Sheet 4: 2012-01 - Recycling of electrical and electronic equipment - Preparation techniques	
Standards, guidelines	Italian standard ECOGuard	
Standards, guidelines	EPEAT - NSF/ANSI 426-2017 Environmental Leadership and Corporate Social Responsibility Assessment of Servers	
Standards, guidelines	EPEAT - IEEE 1680.1™ – 2018 Standard for Environmental and Social Responsibility Assessment of Computers and Displays	
Standards, guidelines	EPEAT - IEEE 1680.2™ – 2012 Standard for Environmental Assessment of Imaging Equipment and amendment (IEEE 1680.2a)	
Standards, guidelines	EPEAT - IEEE 1680.3™ – 2012 Standard for Environmental Assessment of Televisions and amendment (IEEE 1680.3a)	
Standards, guidelines	EPEAT - UL 110 Edition 2 – 2017 Standard for Sustainability for Mobile Phones (including revisions through September 28, 2018)	
Standards, guidelines	50625-1. General treatment requirements	
Standards, guidelines	50625-2-1. Lamps requirements	
Standards, guidelines	50625-2-3. Treatment requirements for temperature exchange equipment and other WEEE containing VFC and/or VHC	
Standards, guidelines	50625-2-2. Displays requirements	
Standards, guidelines	50625-2-4. Photovoltaic panels requirements	
Standards, guidelines	50625-3-1. General Technical Specification	
Standards, guidelines	50625-3-2. Lamps Technical Specification	
Standards, guidelines	50625-3-3. Displays Technical Specification	
Standards, guidelines	50625-3-4.C&F Technical Specification	
Standards, guidelines	50625-3-5. PV panels Technical Specification	

Type	Name	Comment
Standards, guidelines	50625-4. Collection and Logistics requirements (TS)	
Standards, guidelines	50614 Requirements for the preparing for re-use of waste electrical and electronic equipment	
Standards, guidelines	50625-6 TR alignment report	NOT RELEVANT
Standards, guidelines	50625-5 End-treatment of fractions (TS)	
Standards, guidelines	EN 62430:2009, Environmentally conscious design for electrical and electronic products	NOT RELEVANT
Standards, guidelines	EN 50419:2006, Marking of electrical and electronic equipment in accordance with Article 11(2) of Directive 2002/96/EC (WEEE)	
Standards, guidelines	EN 50581:2013, Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances	
Standards, guidelines	IEC 62542:2013, Environmental standardization for electrical and electronic products and systems - Glossary of terms	NOT RELEVANT
Standards, guidelines	EN 62321-1:2013, Determination of certain substances in electrotechnical products - Part 1: Introduction and overview	
Standards, guidelines	ISO IWA 19 on Guidance Principles for the Sustainable Management of Secondary Metals	
Standards, guidelines	TR 62635:2012 Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment	
Standards, guidelines	EVS-EN 62281:2017 Safety of primary and secondary lithium cells and batteries during transport	
Standards, guidelines	IEC 60086-1:2015 RLV Primary batteries - Part 1: General	
Standards, guidelines	IEC 60086-2:2015 Primary batteries - Part 2: Physical and electrical specifications	
Standards, guidelines	IEC 60086-3:2016 RLV Redline version Primary batteries - Part 3: Watch batteries	
Standards, guidelines	IEC 60086-4:2015 Primary batteries - Part 4: Safety of lithium batteries	
Standards, guidelines	IEC 60086-5:2016 RLV Redline version Primary batteries - Part 5: Safety of batteries with aqueous electrolyte	
Standards, guidelines	IEC 61960-3:2017 Secondary lithium cells and batteries for portable applications	
Standards, guidelines	IEC 62133-1:2017 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications - Part 1: Nickel systems	
Standards, guidelines	IEC 62474:2018 Material declaration for products of and for the electrotechnical industry	
Standards, guidelines	PAS 62545:2008 Environmental information on Electrical and Electronic Equipment (EIEEE)	

Type	Name	Comment
Standards, guidelines	IEC/TR 62476:2010 Guidance for evaluation of product with respect to substance-use restrictions in electrical and electronic products	
Standards, guidelines	TR 62824:2016 Guidance on material efficiency considerations in environmentally conscious design of electrical and electronic products	
Standards, guidelines	Electronics Recycling Standard (2015)	
Standards, guidelines	ASI Performance Standard V2 - 2017	
Standards, guidelines	ASI Chain of Custody (CoC) Standard V1- Guidance	
Standards, guidelines	European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)	
Standards, guidelines	Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries	

## 8 ANNEX II – FORM USED FOR THE MAPPING EXERCISE

The full on-line form can be found at <https://goo.gl/forms/l7BmO3V53H9J1PkG2>

1/16/2019

CEWASTE T1.2 mapping form

### CEWASTE T1.2 mapping form

Please complete the form for each normative requirement and verification mechanism identified and allocated to your organisation (each partner involved in the task received a list of items to map). Please, for any queries, contact [lucia.hamasas@weee-forum.org](mailto:lucia.hamasas@weee-forum.org)  
Deadline for mapping: 15 February

\* Required

### 1/3 General information



1. Please identify yourself (name and organisation).  
E.g. Lucia, WF

2. Please indicate the type of item you wish to map \*

Mark only one oval.

- ☐ Mapping of normative requirements      Skip to question 3.  
☐ Mapping of verification scheme      Skip to question 62.

### I. General information

[https://docs.google.com/forms/d/1EUyv9Qkqj8OY\\_AW/GQEO4rCJbbm-q6EUC3Wvvi2dm4/edit](https://docs.google.com/forms/d/1EUyv9Qkqj8OY_AW/GQEO4rCJbbm-q6EUC3Wvvi2dm4/edit)

1/17

## 9 ANNEX III SUSTAINABILITY REQUIREMENTS

Requirements on health and safety, impact and resilience, environmental management.

Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
AS/NZS 5377-2013	1.6.3 Risk assessment and management 3.3.(b);	A documented risk assessment to identify and control any potential environmental, health or safety hazard associated with the operator. Requirement to implement a risk assessment of parts for re-use;	1.6.3.;	Requirement to implement a risk assessment to control environmental hazards;	1.5.; 1.6.2; 1.6.4.; 1.6.6.; 1.8.; 1.9.; 2.1; 2.5.; 4.1.; 4.3.(a)/(b)/(c);	Requirement to comply with legal, regulatory and international requirements; Requirement to be authorized; Requirement to implement an emergency response plan; Requirement to remove private and confidential data; Requirement to dispose of waste in licensed facilities; Requirement to manage broken or dumped material; Requirement to train transportation staff (staff training, appropriate equipment);
ASI Performance	Chapter 11.	11. Occupational health and safety	9.1 Human Rights Due Diligence	a. The Entity shall respect the legal and customary	2. Policy and Management	2.1 Environmental, Social, and Governance Policy. 2.2 Leadership.



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
Standard V2 - 2017			9.7 Local Communities	rights and interests of local Communities in their lands and livelihoods and their use of natural resources. b. The Entity shall take appropriate steps to prevent and address any adverse impacts on local Community livelihoods resulting from its activities. c. The Entity shall explore with local Communities opportunities to respect and support their livelihoods. These criteria apply where the outcome of the Human Rights Due Diligence conducted as part of criterion 9.1 has identified the presence of issues affecting local Communities.		2.3 Environmental and Social Management Systems. 2.4 Responsible Sourcing. 2.5 Impact Assessments. 2.6 Emergency Response Plan. 2.7 Mergers and Acquisitions 2.8 Closure, Decommissioning and Divestment.
COMMISSION DECISION (EU) 2019/63					the whole document is	EMAS, Use of renewable energy



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
					related to EMAS, 3.1.9	
Directive 2000/53/EC on ELVs	Article 6 - 1.; Article 7 - 5.;	Requirement to store and treat ELV without prejudice to national regulations on health; Requirement on reuse of components;			Article 4 - 1.(a); Article 6 - 1./3.(a)/5.; Article 7 - 1./5.;	Requirement to: limit the use of hazardous substances; store and treat ELV without prejudice to national regulations on environment; strip ELV before treatment; encourage certified environmental management systems; reuse and recycle without prejudice to environmental requirements; on reuse of components;
Directive 2012/19/EC on WEEE	Article 5 (d), Article 6 (2), ANNEX II	Community health and safety standards, health and safety			Art. 6 (6)	Environmental management systems in accordance with Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001
Directive 2006/66/EC on Batteries					Article 4	Prohibition of mercury content by weight and cadmium content by weight (Article 4)
ECOGuard	Operating instructions should be in line with the	Providing reference documents			The subject involved should be in possession of a certificate	Requirement to be certificated ISO or EMAS



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
	Consortium policies, the subject should guarantee the regularity/legality of work contracts				ISO 14001(or EMAS)	
EN 50581:2012					1 Scope	Specifies technical documentation that the manufacturer needs to compile in order to declare compliance with the applicable substance restrictions. The documentation of the manufacturer's management system is outside the scope of this European Standard. The compliance requirements relate to the RoHS Directive
EN 50625-1:2014	Indirect link		Indirect link		Indirect link	
EN 50625-2-1:2014 Lamps	4.2.; 5.11;	Requirement to assess risks to occupational health; Requirement to determine the need of personal protective equipment; Requirement to control employees exposure to hazards;			4.2; 5.1; 5.3; 5.4; 5.5; 5.8;	Requirement of measures to prevent emissions into the environment; Requirement to remove mercury; Requirements on handling to avoid damage; Prohibition on mixing or



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
		Requirement on regular medical checks;				dilution of mercury; Requirements on the storage of fractions;
EN 50625-2-2:2015 Displays	5.1.2; 5.3.1; 5.11;	Requirement to control employees' exposure to mercury; Requirement to reduce risk of implosion of CRT; Requirement for operator to assess risk; Requirement on regular medical checks;			5.5.1; 5.5.2; 5.3.1; 5.5.2;	Requirement to prevent uncontrolled emissions; Prohibition on crushing equipment with CRT or backlights; Requirement on dedicated treatment of FPD;
EN 60086-4:2015	The standard itself is all about safety. Principal clauses concerning safety: 4); 6); 7); 8); Annex A;	Requirements for safety; Testing and requirements; Information for safety;  Instructions for use; Guidelines for the achievement of safety of lithium batteries;				
EN 60086-5:2016	The standard itself is all about safety. Principal clauses concerning safety: 4) 6) 7) 8)	Requirements for safety Information for safety Testing and requirements Instructions for use				



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
EN 61960-3:2017	5.3	cell manufacturers shall provide equipment manufacturers who design and produce lithium-ion secondary batteries with the requirements specified in IEC 62133-2:2017, Annex A.				
EN 62281:2012	7 Information for safety; 8 Instructions for packaging and handling during transport - Quarantine	The document focuses on requirements related to a safe transport of batteries. These requirements are indirectly linked with the safety of logistic operators				
EPSC Electronics Recycling Standard (ERS) 2015	Chapter 1.0 - Primary Recyclers, Chapter 2.0 - Downstream Recyclers of Focus Materials	1.3 Possess workers' compensation coverage and a minimum of \$2M general liability insurance. (Chapter 1.0) 1.4 Maintain a documented procedure to provide notice of reportable incidents within 5 business days including: changes in name or ownership; fines or regulatory orders; spills; fires; or reportable injuries or changes in R2 Certification status.				



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
		(Chapter 1.0) 2.3 Possess adequate workers' compensation coverage and a minimum of \$1M general liability insurance. (Chapter 2.0) 2.4 Maintain a documented procedure to provide notice of reportable incidents within 30 business days including: changes in name or ownership; fines or regulatory orders; spills; fires; or reportable injuries. (Chapter 2.0)				
e-Stewards Standard	Chapter 4	The scope of the EHSMS shall include: - The environment, health and safety, data security, and social accountability and other requirements specified in this Standard; - All Electronic Equipment that comes under Control of the organization, regardless of ownership of that EE; - All property and assets under the organization's ownership and/or Control;			Chapter 4	The scope of the EHSMS shall include: - The environment, health and safety, data security, and social accountability and other requirements specified in this Standard; - All Electronic Equipment that comes under Control of the organization, regardless of ownership of that EE; - All property and assets under the organization's ownership and/or Control;



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
		<ul style="list-style-type: none"> <li>- All Ancillary Sites associated with the facility; and</li> <li>- Workers, including temporary, part time, and contract workers, volunteers, and interns.</li> </ul>				<ul style="list-style-type: none"> <li>- All Ancillary Sites associated with the facility; and</li> <li>- Workers, including temporary, part time, and contract workers, volunteers, and interns.</li> </ul>
eWASA Technical Guidelines	D.4.1; F.1.1; F.2.1; Directive 2 - 1.3/2.1/2.2/3.2; Directive 3 - 3.2; Directive 4 - 2.2.4; Directive 5 - 3.1/3.2/3.3/3.4;	Requirement to adhere to relevant safety measures for asbestos treatment and handling; Requirement to assign responsible persons in the area of safety; Requirement on written instructions at work stations detailing risk of injury; Requirement on mercury emission thresholds; Requirement to ventilate CRTs; Requirement on the removal of luminescent coating; Requirements when handling toner cartridges; Requirement check emissions at critical work stations; Requirement to protect plants against explosions; Requirements on hygiene and			C.2.3; C.2.5; C.3.1; C.3.2; C.3.3; C.4.1; D.1.1; D.2.1; D.2.3; D.4.1; D.6.1; E.1.2;	Requirement on the removal and treatment of hazardous substances; Prohibition on mechanically processing WEEE with other wastes; Prohibition on mixing hazardous waste with other fractions; Requirement to concentrate hazardous components for the purpose of destruction; Prohibition on mixing equipment not completely rid of hazardous waste with other waste for treatment; Requirement on the disposal of unusable fractions; Requirement on the removal of batteries; Requirement on the removal of capacitors; Requirement on the storage of



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
		safety when handling dental appliances;			E.1.5; E.1.7; E.1.9; E.2; E.3.2; E.3.3; F.1.1; 6,1; Directive 2 - 1.1/1.2/1.3/2.2/3.1; Directive 3 - 2.1/2.3/3.1; Directive 4 - 2.2.4; Directive 5 - 1.1/4.1/4.2/4.3;	removed capacitors; Requirement to separate WEEE containing asbestos from other equipment; Requirement on the prevention of asbestos emissions; Requirement on the disposal of asbestos containing WEEE; Requirement on the disposal of mercury containing WEEE; Requirements for waste handling, storage and transportation of hazardous waste; Requirement to handle and transport WEEE without causing damage; Requirement to avoid spillage; Requirement to assign responsible persons in the area of environment; Restriction on hazardous substances content for recovery and disposal options ; Requirements on the treatment of LCDs; Requirement on mercury emission thresholds;



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
						Requirement on the treatment of luminescent coating; Requirement on the treatment of printers and copiers; Requirement to prevent emissions from fluorescent lamps; Requirement to constantly monitor air emissions; Requirement to remove mercury switches and PCB capacitors; Requirement on handling and treating unused dental appliance; Requirement on storage of dental appliances;
IEC 60086-6 ED1	There are requirements with respect to toxicity, ignitability, reactivity, corrosivity	5.7 Criteria for waste				
IEEE 1680.1-2018	4.10.1.1; 4.10.1.2;	Requirement on socially responsible suppliers concerning labour; Requirement on socially	4.1.5.1.(a); 4.1.8.1; 4.8.1.1; 4.8.1.2;	Requirement: To perform a hazard assessment for parts exceeding the specified	4.1.1.1; 4.1.2.1; 4.1.3.1; 4.1.4.1;	Requirement to comply with the European Union RoHS Directive substance restrictions;



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
		responsible suppliers concerning Occupational Health and Safety;	4.8.2.1; 4.8.2.2;	concentration of bromine and chlorine; on the chemical assessment of substances; to conduct a life cycle assessment on the product; to conduct an assessment of life cycle greenhouse gas emissions of the product; to annually conduct a corporate carbon footprint; to annually conduct an assessment of greenhouse gas emissions from the transport of the product;	4.1.5.1; 4.1.5.2; 4.1.6.1; 4.1.7.1; 4.1.10.1; 4.1.10.2; 4.4.1.2; 4.5.1.1; 4.5.1.2; 4.5.1.3; 4.5.1.4; 4.5.1.5; 4.7.1.1; 4.7.1.2; 4.7.3.2; 4.9.1.1; 4.9.3.1; 4.9.3.2; 4.9.4.1; 4.9.4.2;	Restriction on the use of cadmium; Elimination of intentionally added mercury in light sources; Restriction on the use of beryllium; Restriction on Br and Cl content in plastic parts; Elimination of substances on EU REACH Annex XIV/Candidate List of SVHCs; Requirement to comply with the EU Battery Directive; Requirement to reduce fluorinated greenhouse gas emissions; Requirement to use long life rechargeable batteries; Requirement to conform with U.S. Energy Star specifications; Requirement on lowest power mode; Requirement to meet 80 Plus efficiency levels for internal power supplies; Requirement on the efficiency of external power supplies; Requirement on lowering



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
						energy limit; Restrictions on heavy metals in packaging; Prohibition of elemental chlorine as bleaching agent in packaging; Requirement on packaging containing recycled, bio-based or sustainably forested content; Requirement to demonstrate third party certified environmental management system; Requirement on energy management system/improved energy performance (company/suppliers); Requirement to use renewable energy (company/suppliers);
IEEE 1680.2™ – 2012			4.5.2.1; 4.5.2.2; 4.7.3.1;	Requirement to conduct a life-cycle greenhouse gas emissions assessment; Requirement to conduct complete life-cycle assessment on any product;	4.1.1.1; 4.1.2.1; 4.1.3.2; 4.1.4.1; 4.1.5.1; 4.1.6.1; 4.1.6.2; 4.1.6.3;	Requirement to comply with the European union RoHS Directive; Restriction on the use of cadmium; Prohibition on intentionally added mercury in light sources;



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
					4.2.2.2; 4.5.1.1; 4.5.3.1; 4.5.3.2; 4.7.1.1; 4.7.1.2; 4.8.1.1; 4.8.1.2; 4.9.1.1; 4.9.3.;	Restriction on substances on the EU REACH Candidate List of SVHCs; Requirement to comply with the EU Battery Directive; Restriction on BFR/CFR/PVC content; Requirement to use bio based plastic material; Requirement to comply with criteria of the ENERGY STAR program; Requirement on standby power level; Requirement to have auto standby capability; Requirement to have an certified operational management system; Elimination of intentionally added heavy metals in packaging; Elimination of elemental chlorine as bleaching agent in packaging; Requirement for the product to allow the use of sustainable office paper; Restriction on landfill and



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
						incineration of toner and ink cartridges;
IEEE 1680.3-2012			4.7.3.1	Requirement to conduct complete life-cycle assessment on any product	4.1.1.1; 4.1.2.1; 4.1.3.2; 4.1.4.1; 4.1.5.1; 4.1.6.1; 4.1.7.1; 4.1.7.2; 4.1.7.3; 4.2.2.2; 4.5.1.1; 4.5.1.2; 4.5.2.1; 4.5.2.2; 4.5.2.3; 4.7.1.1; 4.8.1.1; 4.8.1.2;	Requirement to comply with the European Union RoHS Directive; Restriction on the use of cadmium; Prohibition on intentionally added mercury in light sources; Restriction on the use of lead; Restriction on substance on the EU REACH Candidate List of SVHCs; Requirement to comply with the EU Battery Directive; Restriction on BFR/CFR/PVC content; Requirement to use bio based plastic material; Requirement to comply with criteria of the ENERGY STAR program; Restriction on the On Mode power consumption; Restriction on the Sleep Mode power consumption; Requirement on a automatic switch to sleep mode;



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
						Requirement to have an certified operational management system; Elimination of intentionally added heavy metals in packaging; Elimination of elemental chlorine as bleaching agent in packaging;
ISO/IWA 19: 2017	Section 6.2 (Principle 1, Objectives 1.1, 1.2, 1.3, 1.4, 1.5)	<ul style="list-style-type: none"> <li>• Objective 1.1 – Enable safe and healthy workplaces.</li> <li>• Objective 1.2 – Establish working terms and conditions that are decent and equitable.</li> <li>• Objective 1.3 – Eliminate child labour, forced labour, harassment and all forms of discrimination.</li> <li>• Objective 1.4 – Ensure freedom of association and the right to collective bargaining.</li> <li>• Objective 1.5 – Provide clear channels for communication, transparency and dialogue with workers.</li> </ul>	Section 6.3 (Principle 2, Objectives 2.1, 2.2, 2.3)	<ul style="list-style-type: none"> <li>• Objective 2.1 – Respect and foster local communities’ rights.</li> <li>• Objective 2.2 – Enable the social inclusion of workers in the community.</li> <li>• Objective 2.3 – Establish clear channels for communication, transparency and dialogue with local communities and affected stakeholders.</li> </ul>	Section 6.4 (Principle 3, Objectives 3.1, 3.2, 3.3)	<ul style="list-style-type: none"> <li>• Objective 3.1 – Conserve and protect water, air and soil resources.</li> <li>• Objective 3.2 – Restore severely damaged areas from metals recovery operations.</li> <li>• Objective 3.3 – Conserve and protect biodiversity, ecosystems and ecosystem services.</li> </ul>
NSF/ANSI 426-2017	12.4.1; 12.4.2;	Requirement to comply with occupational health and safety performance;	6.2.5; 12.5.1;	Requirement to perform a hazard assessment on lists substances;	5.1.1; 5.2.1; 5.2.2;	Requirement to conform with current version of Energy Star Computer Servers program;



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
	12.4.3;	Requirement for suppliers to comply with occupational health and safety performance; Requirement on certification to social responsibility of suppliers;	12.5.3;	Requirement on product life cycle assessment; Requirement on conducting an assessment of greenhouse gas emissions from transports;	5.3.1; 5.4.1; 5.4.2; 5.4.3; 5.5.2; 6.1.1; 6.1.2; 6.1.3; 6.1.6; 8.1.1; 8.1.2; 8.1.3; 8.4.1; 12.1.1; 12.1.2;	Requirement on operating range; Requirement on cooling capability; Requirement to conform with 80 Plus program Titanium level; Requirement on the active state power management; Requirement on inactive power state; Requirement on operating voltage; Requirement to meet the European Union RoHS Directive; Requirement to meet the European Union Battery Directive; Requirement on bromide and chlorine content; Requirement on REACH substance content; Requirement on heavy metals of packaging; Restriction on the use of chlorine; Requirement on elimination of individual packaging;



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
						Implement and certify a Environmental Management System;
PAS 62545:2008					Clause 4 and 5	requirement for environmental management systems that are in place, life cycle environmental assessment, environmental impacts of the product, description of the environmental policy at the manufacturing site, Special actions to reduce environmental impact, Environmental impacts
prEN 45553	5.1.3-197	Indication of the need for special care / handling during the testing in view of e.g. safety of the testing expert, of others, or of the equipment itself			6.1, 6.2	The users of this standard shall ensure that their standards include requirements for reporting material efficiency. The user of the standards shall ensure that their standard(s) sufficiently cover that when reporting material efficiency aspects results, data, methods, assumptions, limitations and conclusions shall be completely and accurately reported.



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
prEN 50614	see separate document	see separate document			see separate document	see separate document
R2:2013	1.(b); 4.(a); 4.(d); 4.(f);	Requirement to be certified to one or more environmental, health and safety management system standards; Requirement to process equipment in a protective manner to worker safety; Requirement to minimize environmental, health and safety hazards;	4.(c)	Requirement to conduct a hazards identification and assessment	1.(b); 2.(a).(3); 4.(a); 4.(b); 4.(d); 4.(g); 9.(a).(1); 12.(a);	Be certified to one or more environmental, health and safety management system standards; avoid material incineration, energy recover and landfill; process equipment in a protective manner to the environment; Requirement to adhere to good housekeeping standards; Minimize environmental, health and safety hazards; Designate qualified employees to promote health and safety and environmental protection; Protect storage areas; Ensure materials are packaged appropriately for transport;
Regulation (EC) No. 1013/2006					Article 11 - 3.; Article 19; Article 49 – 1./2./3.;	Shipment of small quantities of hazardous waste; Prohibition on the mixing of wastes; Ensuring the management of shipped wastes in a environmental sound manner; Restriction on imports and



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
						exports based on environmental management;
TS 50625-2-4: 2017 PVs	Subclause 5.1	During handling and storage attention should be given but not limited to prevent injury from broken glass and electrocution caused through contact with hazardous voltage generated when PV panels are exposed to light.				
TS 50625-3-3 Displays	4.101.2	Requirement to include measure to avoid loss of fluorescent powder			8.4.102	Requirement to monitor ambient air and water used in the treatment
TS 50625-4:2017 Collection					General requirement to have a management system in place for activities in the field of EHS	
TS 50625-5:2017 end processing	Clause 4.3 Environment, Health and Safety - EHS requirements	To ensure a safe working environment there shall be a number of different exposure limits depending on the substance or conditions. The exposure limits for inhalable inorganic dust and lead are given in Annex C, as well as guidance values for other	Annex B - Normative	Limit value for noise  For continuous noise generated by the final treatment facility, the maximum exposure level for 8 h between 23.00 and 07.00 hrs (night time) shall be < 60 dB(A).	Chapter 4 Administrative and organisational requirements	4.2 Management principles The final treatment operator shall ensure that a documented management system is in place for all activities in the fields of environment, health, safety and quality. NOTE ISO 9001, ISO 14001,



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
		<p>substances. If competent or governing authorities impose more stringent limit values, then this latter value shall apply. Appropriate personal protection equipment shall be used in case the limits are exceeded in certain working areas.</p> <p>The final treatment operator shall possess infrastructure, in terms of size, technologies installed, and characteristics of the operations, that is suitable for the activities performed at the facility. Suitability of the site shall be assessed by a risk management process for all tasks performed on site and include the identification of hazards, the assessment of risk and, where appropriate, the elimination or reduction of the risk, and documentation of the process.</p> <p>The final treatment operator shall have the following</p>		<p>This shall be measured at the closest private dwelling of the final facility or calculated by certified noise modelling. If processes at the final facility change a new measurement is required.</p> <p>NOTE 3 More stringent requirements can be applicable depending upon local requirements.</p>		<p>EMAS and OHSAS 18001 are examples of management systems, but other management systems may exist.</p> <p>The final treatment operator shall demonstrate continuous improvement of their activities by a review and management process. This management process shall be updated or revised as changes occur to the activities of the treatment operator and evaluated in order to monitor its effectiveness.</p> <p>The management system shall include the following documented points:</p> <ul style="list-style-type: none"> <li>— Legal compliance report</li> <li>— Organisational plan</li> <li>— Work instructions</li> <li>— Fire and explosion prevention plan and emergency plan</li> <li>— A process description and a process flowchart;</li> <li>— Data register</li> <li>— Sub-contractors and sub-</li> </ul>



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
		<p>Environment, Health and Safety (EHS) measures in place:</p> <ul style="list-style-type: none"> <li>— EHS programmes;</li> <li>— EHS reports</li> <li>— EHS awareness program: evidence of the implementation of an on-going and interactive EHS awareness program;</li> <li>— Employees (regular, temporary and/or contractors) shall be provided with and be required to wear adequate personal protective equipment (PPE) as identified in risk assessments. The PPE provided shall be suitable and adequate for the expected type of potential risk and exposure for the area in which the employee works;</li> <li>— All materials and material types intended for processing on site shall be evaluated by means of an EHS risk analysis prior to processing. Written evidence of this evaluation process shall be available on</li> </ul>				<p>processors report:</p> <ul style="list-style-type: none"> <li>— Insurance: Document in which the actual insurance coverage is stated.</li> </ul>



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
		<p>site;</p> <ul style="list-style-type: none"> <li>— Employees and contractors shall undergo regular EHS training and related information sessions, including emergency response plans and work related processes. Details on training/information provided and the broad objectives of the training shall be documented. A program for monitoring workplace conditions shall also be in place;</li> <li>— Employees and contractors who are at potential risk of exposure to deleterious elements and/or compounds above minimum exposure limit levels given in Annex C, shall undergo at least annual health and hygiene-related checks. Records of each check shall be made; and</li> <li>— Environmental monitoring shall be carried out on a regular basis covering process effluents, emissions and the</li> </ul>				



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
		like. If limit values have been exceeded there shall be a report on improvement actions and data shall be reported that also indicate any effects of such corrective measures will have.				
Überblick AG 1 –5 der UBA-Empfehlungen zu Behandlungsanforderungen an EAG		Prevention of dust emissions in pre-treatment of flat panel displays and PV modules				
UL 110 Edition 2 – 2017			7.3.1; 9.2.1; 14.1.1;	Requirement to perform a chemical hazard assessment of alternatives; Requirement to test and restrict the release of nickel from exterior surfaces; Requirement to develop a Life Cycle Assessment on the product;	7.1.1; 7.2.1; 9.1.1; 9.2.2.; 9.2.3; 9.2.4; 9.2.5; 10.1.1;	Requirement to comply with the European Union REACH Regulation; Restriction on use of European Union REACH Candidate SVHC substances; Requirement to comply with the European Union RoHS Directive; Restriction on the use of phthalates; Restriction on the use of bromine and chlorine; Restriction on the use of cadmium and mercury in



Name of document	Clauses on safe, healthy and equitable working condition	Topics in focus	Clauses on local community impacts and resilience	Topics in focus	Clauses on environmental management and sustainable natural resources	Topics in focus
					10.1.2; 10.1.3; 10.1.4; 12.4.1; 12.6.1; 12.6.2; 12.7.1; 12.8.1; 12.9.1; 15.2.1; 15.4.1;	battery cells; Restriction on the use of listed substances in textile and leather; Meet requirement of the Federal Energy Conservation Standards for Battery Chargers; Requirement to reduce energy consumption of battery charging systems; Meet efficiency requirements of the U.S. Department of Energy Efficiency Regulations for External Power Supplies; Requirement to exceed the external power supply efficiency requirement; Prohibition on the use of EPS packaging; Requirement on the use of preferable virgin fiber-based POS packaging; Requirement on preferable fiber-based printed materials; Prohibition on the use of chlorine as bleaching agent in packaging; Restriction on the use of heavy



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						metals in packaging; Requirement to improve packaging efficiency; Requirement to be third-party certified to either ISO 14001 or the EMAS; Requirement to reduce fluorinated gas emissions resulting from FDP manufacturing;
VDI 2343 Blatt 4	Chapter 2 - 3rd paragraph;  Chapter 4 - Point 1;  Chapter 4 - Point 3;	Requirement for to comply with occupational safety regulation; Requirement for staff protection measures in crushing plants; Requirement for spark-proofing to avoid dust explosions and fires;				



## Management and re-use requirements

Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
AS/NZS 5377:2013	1.5.; 1.6.2; 1.6.4.; 1.6.6.; 1.8.; 1.9.; 2.1; 2.5.; 4.1.; 4.3.(a)/(b)/(c);	Requirement to comply with legal, regulatory and international requirements; Requirement to be authorized; Requirement to implement an emergency response plan; Requirement to remove private and confidential data; Requirement to dispose of waste in licensed facilities; Requirement to manage broken or dumped material; Requirement to train transportation staff (staff training, appropriate equipment);	1.10;  3.2;  3.3.(a)/(g);	Requirement to treat equipment for re-use separately; Requirement to maintain physical integrity during handling and storage; Requirement to have written procedures; Requirement to provide secure testing of parts for re-use;
ASI Chain of Custody (CoC) Standard V1 2017	1. Management System and Responsibilities, 1.1 , 1.2 , 1.3, 1.4 , 1.5 , 1.6, 1.7	1. Management System and Responsibilities Section 1 outlines the general elements of management systems an Entity needs to effectively implement the ASI CoC Standard. An Entity may consist of a single Facility or multiple Facilities, but must be under the Control of an ASI Member to link to the ASI's membership obligations and the ASI. Complaints Mechanism. The criteria in this section can usually be integrated into existing management systems relevant to managing sales, sourcing and inventory. 1.1 The Entity seeking CoC Certification		



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
		<p>shall be an ASI Member in good standing in the Production and Transformation or Industrial Users membership classes, or under the Control of such an ASI Member, thereby committing to comply with ASI's membership obligations and the ASI Complaints Mechanism.</p> <p>1.2 The Entity shall have a Management System that addresses all applicable requirements of the CoC Standard, in all Facilities under the Control of the Entity that have Custody of CoC Material.</p> <p>1.3 The Entity shall ensure that the Management System for criteria 1.2 are periodically reviewed and updated in light of implementation experience and to address potential areas of non-conformance.</p> <p>1.4 The Entity shall nominate at least one Management Representative as having overall responsibility and authority for the Entity's conformance with all applicable requirements of the CoC Standard.</p> <p>1.5 The Entity shall establish and implement communications and training measures that make relevant personnel aware of and competent in their responsibilities under the CoC Standard.</p> <p>1.6 The Entity shall maintain up to date records covering all applicable requirements of the CoC Standard and</p>		



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
		<p>shall retain them for a minimum of five (5) years.</p> <p>1.7 The Entity shall report the following information to the ASI Secretariat within 3 months after the end of each calendar year, as applicable:</p> <p>a. All Entities: Input and Output Quantities of CoC Material/s over the calendar year.</p> <p>b. All Entities: Input Percentage/s calculated for the calendar year.</p> <p>c. All Entities: the maximum Positive Balance in the calendar year carried over to the subsequent Material Accounting Period, if any.</p> <p>d. All Entities: the maximum Internal Overdraw within the calendar year, if any, and the percentage of Input Quantity of CoC Material this represents.</p> <p>e. Entities engaged in Aluminium Re-melting/Refining to produce Recycled Aluminium: total Input Quantity of Eligible Scrap, with a breakdown by Post-Consumer Scrap and Pre-Consumer Scrap that is designated as CoC Material supplied directly from a CoC Certified Entity, in the calendar year.</p> <p>f. Entities engaged in producing Casthouse Products: quantity of ASI Aluminium allocated to ASI Credits in the calendar year.</p>		



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
		g. Post-Casthouse Entities using ASI Credits: quantity of ASI Credits purchased in the calendar year.		
ASI Performance Standard V2 - 2017	2. Policy and Management Principle. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8	2. Policy and Management Principle: The Entity is committed to sound management of its environmental, social and governance processes. 2.1 Environmental, Social, and Governance Policy. The Entity shall: a. Implement and maintain integrated or stand-alone Policies consistent with the environmental, social, and governance practices included in this Standard. b. Have senior management endorse, support through provision of resources and regularly review the Policies. c. Communicate the Policies internally, and externally as appropriate. 2.2 Leadership. The Entity shall nominate at least one senior Management Representative as having overall responsibility and authority for ensuring conformance with the requirements of this Standard. 2.3 Environmental and Social Management Systems. The Entity shall document and implement integrated or stand-alone: a. Environmental Management Systems. b. Social Management Systems. 2.4 Responsible Sourcing. The Entity shall		



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		<p>implement a responsible sourcing Policy covering environmental, social and governance issues.</p> <p>2.5 Impact Assessments. The Entity shall conduct environmental, social, cultural and Human Rights Impact Assessments, including a gender analysis, for new projects or major changes to existing facilities.</p> <p>2.6 Emergency Response Plan. The Entity shall have site specific emergency response plans developed in collaboration with potentially affected stakeholders groups such as Communities, Workers and their representatives, and relevant agencies.</p> <p>2.7 Mergers and Acquisitions. The Entity shall review environmental, social and governance issues in the Due Diligence process for mergers and acquisitions.</p> <p>2.8 Closure, Decommissioning and Divestment. The Entity shall review environmental, social and governance issues in the planning process for closure, decommissioning and divestment.</p>		
COMMISSION DECISION (EU) 2019/63			3.3.3	remanufacturing, refurbishment of used products,
Directive 2000/53/EC on ELVs	<p>Article 4 - 2.;</p> <p>Article 5 - 1./2./3./4./5.;</p>	<p>Restrictions on materials and components;</p> <p>Requirement to implement systems for collection;</p>	<p>Article 4 - 1.(b);</p> <p>Article 6 - 3.(c);</p>	<p>Requirement on design to facilitate dismantling;</p> <p>Requirement on stripping and storage operations;</p>



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	<p>Article 6 - 1./2./4.;</p> <p>Article 7 - 2./3./4.;</p> <p>Article 8 - 2.;</p> <p>Article 10 - 1./3.;</p>	<p>Requirement on the transfer of ELV to treatment facilities;</p> <p>Requirement to implement a system for deregistration of ELV;</p> <p>Requirement on the cost of delivery of ELV;</p> <p>Requirements on the certificate of destruction;</p> <p>Requirement to store and treat in accordance to Directive 75/442/EEC;</p> <p>Requirement on permits to treatment establishments;</p> <p>Requirement to achieve reuse and recycling targets;</p> <p>Requirement to establish targets for reuse and recovery;</p> <p>Requirement to promote the preparation of European standards for treatment;</p> <p>Requirement on establishing coding standards;</p> <p>Requirement to implement laws and regulations;</p> <p>Requirement on achieving the objectives of the Directive;</p>	<p>Article 7 - 1.;</p> <p>Article 8 - 1./4.;</p>	<p>Requirement to encourage reuse of components;</p> <p>Requirement on material coding standards;</p> <p>Requirement for producers to disclose information on components which can be reused;</p>
Directive 2012/19/EC on WEEE	(3), (4), Art. 2 (2), Art. 8 (2, 3),	Management of WEEE, Community strategy for waste management	3, 4, 12, 18, 24, Art. 4, Art. 6 (5), Art 7 (1,2)	recovery, reuse and/or recycling, recovery rate
Directive 2006/66/EC on batteries	Article 22 and Annex I	Member States shall send the Commission a report on the implementation of this Directive every three years (Article 22). National governments must report regularly to the		



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
		European Commission every three years (Annex I)		
EN 50625-2-1:2014 Lamps	4.2; 5.4;	Requirement to implement a risk management process; Requirement on the organization of storage areas; Restriction on the maximum amount of stored lamps;	5,8	Requirement to clean containers for reuse
EN 50625-2-2:2015 Displays	4,3; 5,4; 5.5.1;	Requirement to train employees to identify equipment; Requirement on maximum amount of stored equipment; Requirement on handling hazardous waste according to national legislation;	-	-
e-Stewards Standard	5.3 Organizational roles, responsibilities & authorities	Top management shall assign the responsibility and authority for: a) ensuring that the environmental health & safety management system conforms to the requirements of this International Standard; b) reporting on the performance of the environmental management system, including environmental and stewardship performance, nonconformity, and continual improvement to top management; c) Evaluating performance of managers and supervisors in ensuring the effectiveness and continual improvement of the EHSMS in their areas of responsibility;	8.6 Reuse and Refurbishment of Electronic Equipment	8.6.1 Test EE and ensure Full Functionality & data sanitization 8.6.2 Label or list identifying records for each item of EE 8.6.3 Provide protective packaging 8.6.4 Verify Direct Reuse markets 8.6.5 Ensure responsible management of resulting HEWs and PCMs 8.6.6 Control outsourced reuse activities



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
		d) Providing workers with the authority and responsibility to identify system failures, safety concerns, hazardous situations, risks, controls, and opportunities for improvement; and e) Establishing an EHSMS team(s) responsible for driving implementation and continual improvement of the EHSMS,		
eWASA Technical Guidelines	B.; B.7; C.1; D.1.2; D.2.2; E.1.1; E.1.2; E.1.6; E.3.1; F.1.3; F.2.1;	Requirement to comply with legal regulations; Requirement to proof compliance with legal regulations; Requirement to destroy data; Requirement to comply with the regulations on transportation of dangerous goods during collection and transport; Requirement on unauthorized access to stored WEEE; Requirement on maximum stock of stored WEEE; Requirement to comply with effluent limit values set in local municipality by-laws; Requirement to implement a documented management system; Requirement on instructions on pre-treatment processes by equipment type; Restriction on content of Copper, Cadmium and PCB after	-	-



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	F.5.2; F.5.3; Directive 3 -2.2/3.3; Directive 4 - 5.1/5.2;	decontamination; Requirement of suitable backup system to constantly verify functional efficiency;  Requirement on calibration of emissions measurement equipment; Requirement on eWASA on-site assessment;		
IEEE 1680.1-2018	-	-	4.4.2.1; 4.4.2.2; 4.4.2.3; 4.4.2.5; 4.4.2.6;	Requirement to remove external closures without damage; Requirement to provide service and repair information; Requirement to declare the availability of spare parts for use in repair; Requirement on product upgrade and repair features; Requirement for easily removable Lithium ion batteries;
IEEE 1680.2™ – 2012	4.3.4.2; 4.5.4.1; 4.8.3.1; 4.9.2.1;	Meet requirement of EU WEEE Directive; Requirement to default to automatic duplex printing; Requirement on the total recovered fibber content; Requirement to allow non-manufacturer cartridges and containers;	4.3.1.1; 4.3.1.2; 4.3.2.2; 4.3.4.3; 4.9.4.1;	Requirement to design to provide ease of disassembly; Restriction on materials not compatible with reuse; Requirement on the weight of reusable material; Requirement to not inhibit the reuse of cartridges;
IEEE 1680.3-2012	4.3.4.1; 4.8.3.1;	Meet requirement of EU WEEE Directive; Requirement on the total recovered fibber content;	4.3.1.1; 4.3.2.5;	Requirement to design to provide ease of disassembly; Restriction on materials not compatible with reuse;



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			4.3.4.2;	Requirement on the weight of reusable material;
ISO/IWA 19: 2017	Section 6.6 (Principle 5, Objectives 5.1, 5.2, 5.3, 5.4, 5.5)	<ul style="list-style-type: none"> <li>• Objective 5.1 – Document and evaluate the existing baseline conditions of secondary metals operations in the areas addressed by the Principles and Objectives.</li> <li>• Objective 5.2 – Mitigate negative impacts and strengthen positive impacts of secondary metal operations through the development, implementation and continuous improvement of a Management Plan.</li> <li>• Objective 5.3 – Strengthen the organisational capacity of Economic Operators involved in secondary metals operations.</li> <li>• Objective 5.4 – Ensure compliance with local and/or national laws and regulations.</li> <li>• Objective 5.5 – Eliminate bribery, money laundering and corruption.</li> </ul>		
NSF/ANSI 426-2017	5.5.3; 11.2.1;	Requirement on the capability to log metrics; Requirements on the collected end-of-life servers;	9.1.1	Requirement on design for repair, preparation for reuse
prEN 45553			5, 6	Reporting the assessment of the ability of an ErP to be remanufactured Input data and approach for the assessment of the ability of a product to be re-manufactured



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
				Evaluating the ability of an ErP to be re-manufactured Facilitate re-manufacturing
prEN 50614	see separate document		see separate document	
R2:2013	1.(c); 3.(a).1; 3.(a).2; 3.(a).3; 4.(a); 4.(e); 4.(h); 5.(a); 5.(f); 6.(a); 6.(c).(1).(B); 6.(c).(1).(D); 6.(c).(1).(E); 6.(c).(2).(B); 6.(c).(2).(E); 6.(c).(3).(A); 6.(c).(3).(C); 8.(a); 8.(b); 8.(c); 8.(e); 8.(f); 9.(a).(2); 9.(a).(3); 10.; 11.(a); 11.(b); 13.;	Requirement to annually review the environmental, health and safety management system; Identify legal requirements that cover operation; Requirement to identify and document the legality of exporting, transit and importing; Periodically audit compliance with legal requirements; Requirement to demonstrate expertise to process equipment; Requirement to use monitoring and sampling protocols for risks; Requirement to implement emergency plans; Requirement to implement a Focus Material Management Plan; Requirement to audit downstream facilities; Requirement of authorization from owners to reuse; Requirement to implement a Quality Assurance Plan of test methods;	2.(a).1	Requirement to take all practical steps to direct for reuse



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
		Requirement for the certified destruction of data on storage devices; Requirement to document data destruction procedures; Requirement to train employees involved in data destruction; Requirement on security and quality control of data destruction; Requirements on secure and legal storage of equipment; Requirement to implement a security program; Requirement to demonstrate adequate insurance to cover liabilities; Requirement to develop a closure plan of the facilities; Requirement to demonstrate conformity with this standard;		
Regulation (EC) No. 1013/2006	Article 4 - 4./5.; Article 5 - 1./2./3./5.; Article 6 - 1./2./3./4./5./6./7./8.; ; Article 9 - 1./4./5./6./7./8.; Article 10 - 1./2./3.;	Requirement to conclude a contract between notifier and consignee for the recovery or disposal of notified waste; Requirement to establish a financial guarantee or equivalent insurance; Requirement on consents from competent authorities of destination; Requirement on planned shipment fulfilment;  Requirement on recovery and disposal of waste fulfilment; Requirement on the withdrawal of	-	-



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
	Article 11 - 1./2./5.; Article 12 - 1./2./4.; Article 13 - 1./2./3.; Article 14 - 1./2./3./5.; Article 15 - (b); Article 15 - (e)/(f); Article 17 - 2./3.; Article 18 - 2.; Article 28 - 1.; Article 29; Article 30 - 1./2./3.; Article 33 - 1.; Article 34 - 1./2./3./4.; Article 35 - 1./2./3./4./5./6.; Article 36 - 1./2./3./4./5.; Article 37 - 1./2./3./4./5.;	consent; Requirement on placing conditions for shipment by competent authorities ; Requirements on objections to shipments by competent authorities of destination; Requirements on general notification that cover several shipments; Requirements on pre-consents from competent authorities of destination; Requirement on consents to wastes destined to interim recovery and disposal; Requirement on facilities after interim recovery or disposal; Requirements for changes in shipment after consent; Requirement on contracts for shipment of wastes referred in Article 3(2) and (4); Requirement on disagreement on classification of wastes; Requirement on administrative costs of implementing notification and supervision procedures; Requirement on agreements for the notification of cross-border shipments;  Requirement to implement system for the control of shipments within Member States; Restriction on exports of waste for disposal; Requirements on exports to EFTA		



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
	<p>Article 38 - 1./1./3./4./5./6./7.;</p> <p>Article 39;</p> <p>Article 40 - 1./2./3.;</p> <p>Article 41 - 1./2./3./4.;</p> <p>Article 42 - 1./2./3./4./5.;</p> <p>Article 43 - 1./2./3.;</p> <p>Article 44 - 1./2./3./4./5.;</p> <p>Article 45; Article 46 - 1./2./3.;</p> <p>Article 47;</p> <p>Article 48 - 1./2./3.;</p> <p>Article 50 - 1./2./3./4./5./6./7.;</p> <p>Article 53;</p> <p>Article 55;</p>	<p>countries of wastes for disposal;</p> <p>Restrictions on exports to non-OECD Decision countries of wastes for recovery;</p> <p>Requirements on exports of wastes in Annex III or IIIA to non-OECD Decision countries;</p> <p>Requirement on exports of wastes in Annexes III, IIIA, IIIB, IV, IVA to OECD-Decision countries;</p> <p>Prohibition of exports to Antarctic;</p> <p>Restriction on exports to overseas countries and territories;</p> <p>Restrictions on imports of wastes for disposal from third countries;</p> <p>Requirements on imports of wastes for disposal from countries party to the Base Convention;</p> <p>Restrictions on imports of wastes for recovery;</p> <p>Requirements on imports of wastes for recovery from OECD Decision countries;</p> <p>Requirements on imports of wastes for recovery from countries party to the Basel Convention;</p> <p>Requirements on imports from overseas countries or territories;</p> <p>Requirements on transit of wastes for disposal;</p> <p>Requirements on transit of wastes for recovery;</p> <p>Requirement to apply penalties for infringement of the Regulation;</p>		



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
		Requirement on inspections of shipments; Requirement on designating competent authorities; Requirement on designating custom offices for entry and exit of shipments;		
TR 62635:2012			5.4.2. Condition for part reuse	n.a.
TS 50625-3-2:2015 Lamps	9,2	Established limit value for mercury in treatment fractions	-	-
TS 50625-4:2017 Collection			general requirements about collection and logistics	
TS 50625-5:2017 end processing	4.2 Management principles	<p>The final treatment operator shall ensure that a documented management system is in place for all activities in the fields of environment, health, safety and quality. NOTE ISO 9001, ISO 14001, EMAS and OHSAS 18001 are examples of management systems, but other management systems may exist. The final treatment operator shall demonstrate continuous improvement of their activities by a review and management process. This management process shall be updated or revised as changes occur to the activities of the treatment operator and evaluated in order to monitor its effectiveness.</p> <p>The management system shall include</p>		



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		<p>the following documented points:</p> <ul style="list-style-type: none"> <li>— Legal compliance report: a list of relevant legislation and associated requirements, which applies to the final treatment operator and their facility and evidence of compliance to this legislation and associated requirements;</li> <li>— Organisational plan: an up to date organisation chart that shall include all management and production personnel levels, including those positions regarding acceptance and treatment of WEEE and/or fractions thereof, waste management, the transport and the handling of materials that exhibit hazardous properties;</li> <li>— Work instructions: work procedures shall be in place regarding all processes performed, including the handling of any off-spec materials and/or waste materials produced from the final treatment of WEEE and/or fractions of WEEE containing copper and/or precious metals;</li> <li>— Fire and explosion prevention plan and emergency plan: fire and explosion-prevention systems as well as related emergency plans and emergency testing procedures and records of tests performed and any corrective actions or amendments to the plans;</li> <li>— A process description and a process</li> </ul>		



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
		<p>flowchart;</p> <p>— Data register: a record of data including input and output description, weight, origin and destination. This shall be kept for a minimum period of three years; and</p> <p>— Sub-contractors and sub-processors report: information such as company name, address, legal registration, permits of contractors and operators that handle the wastes from the final treatment operator (if used), along with work procedures and proof of the monitoring procedures.</p> <p>— Insurance: Document in which the actual insurance coverage is stated.</p>		
UL 110 Edition 2 – 2017	<p>13.3.1;</p> <p>14.2.1;</p> <p>15.1.1;</p>	<p>Requirement for third party assurance of the Corporate Sustainability reporting;</p> <p>Requirement for third party verification of the results of the LCA;</p> <p>Requirement on an evaluation of risks of the suppliers;</p>	<p>11.3.1;11.3.3; 11.4.1;</p> <p>11.4.2; 11.6.1; 11.6.2;</p>	<p>Requirement for batteries to be replaceable without the use of tools;</p> <p>Requirement on ease of disassembling;</p> <p>Requirement on repair and refurbishment;</p>
VDI 2343 Blatt 4	<p>Chapter 4 - Point 5;</p> <p>Chapter 6 - 6.2.1 - Point 2;</p> <p>Chapter 6 - 6.2.1 - Point 3;</p> <p>Chapter 6 - 6.2.2 - Point 4;</p> <p>Chapter 6 - 6.2.2 -</p>	<p>Requirement on a permission under the German Federal Emission Control Act;</p> <p>Requirement for authorized to check the reliability of refrigerant drainage;</p> <p>Requirement on annual test of leakproofness;</p> <p>Requirement on a continuous measurement of CFC/ODS emissions;</p>	<p>Chapter 6 - 6.3.4 - Disassembly/decomposition of cathode ray tubes -1st paragraph</p>	<p>Requirement to separate black-and-white CRT glass from fraction for reuse</p>



Short name of standard	List the clauses about management approach and government	Topics dealt in the requirements	Clauses on requirements stimulating preparation of reuse	Topics dealt in the requirements
	Point 5; Chapter 6 - 6.2.2 - Point 9; Chapter 6 - 6.2.2 - Page 43 - 2nd paragraph;	Requirement on the amount of blowing agents recovered; Requirement to comply with the German Ordinance on Chemical depleting the Ozone Layer;		



## 10 ANNEX IV TRACEABILITY REQUIREMENTS

Requirements on material traceability and procurement service procedures

Short name of standard	Clauses about management systems and responsibilities on materials traceability	Please list the topics dealt in the requirements	Clauses about procurement of services procedures	Topics dealt in the requirements
AS/NZS 5377:2013	3.3.(f); 5.1; 1.7 Records management	Requirement on labelling parts for re-use; Requirement to contain and monitor identifiable streams at the end of treatment; Traceability of EEE, assemblies, parts, commodities and waste	-	-
ASI Chain of Custody (CoC) Standard V1 2017	4.4.1; 4.2; 4.3;	4. Recycled Aluminium: Criteria for Eligible Scrap and ASI Liquid Metal Recycled Aluminium is the second potential starting point for Chain of Custody for ASI Aluminium. The CoC Standard anticipates that the first Entity in the Chain of Custody of recycled CoC Material will be an aluminium re-melter and/or refiner (aluminium refining includes recovery and refining of aluminium from Dross and Dross residues such as slag). Section 4 requires that 'know your customer' principles apply to suppliers of Recyclable Scrap Material (and the due diligence requirements of section 7 also apply). This section sets the ASI CoC Standard's requirements for Entities producing recycled scrap material and recycled aluminium.	2.; 2.1; 2.2; 2.3; 2.4; 2.5.	2. Outsourcing Contractors Outsourcing Contractors are encouraged to become CoC Certified in their own right. However it is recognised there are often challenges in uptake of CoC Certification in long or flexible supply chains, or by smaller businesses. Section 2 provides Entities seeking CoC Certification with the ability to outsource processing, treatment or manufacturing of CoC Material that they own or control to non- CoC Certified Outsourcing Contractors, by including them in their own CoC Certification Scope. 2.1 Any Outsourcing Contractor without CoC Certification that takes Custody of an Entity's CoC Material for the purposes of further processing, treatment or manufacturing, shall be identified in the Entity's CoC Certification Scope.



Short name of standard	Clauses about management systems and responsibilities on materials traceability	Please list the topics dealt in the requirements	Clauses about procurement of services procedures	Topics dealt in the requirements
		<p>4.1 An Entity engaged in Aluminium Re-melting/Refining to produce Recycled Aluminium shall have systems in place to ensure that ASI Liquid Metal is produced only from Facilities that are:</p> <p>a. Within the Entity's CoC Certification Scope, and/or in which the Entity holds a legal interest and are within the CoC Certification Scope of another CoC Certified Entity;</p> <p>b. Certified against the ASI Performance Standard.</p> <p>4.2 An Entity engaged in Aluminium Re-melting/Refining shall account for Eligible Scrap in their Material Accounting System as only:</p> <p>a. Pre-Consumer Scrap that is designated as CoC Material supplied directly from a CoC Certified Entity or Aluminium recovered from Dross and treated Dross residues that is subject to supplier due diligence as per section 7; and/or</p> <p>b. Post-Consumer Scrap that is subject to supplier due diligence as per section 7 and is assessed by the Entity to be post-consumer in origin.</p> <p>4.3 An Entity engaged in Aluminium Re-Melting/Refining to produce Recycled Aluminium shall have systems in place to record:</p> <p>a. The identity, principals and place/s of</p>		<p>2.2 Entities which wish to include Outsourcing Contractors within their CoC Certification Scope shall ensure the following:</p> <p>a. The Entity has legal ownership or control of all CoC Material used by these Outsourcing Contractors.</p> <p>b. Any Outsourcing Contractor included in an Entity's Certification Scope shall not outsource any processing, treatment or manufacturing of CoC Material to any other contractor.</p> <p>c. The Entity has assessed the risk of potential non-conformance with the CoC Standard resulting from the engagement of each Outsourcing Contractor, and determined, based on the risk assessment, that the risk is acceptable.</p> <p>2.3 The Entity shall ensure that the Outsourcing Contractor provides information on Output Quantity of CoC Material to the Entity at the conclusion of the Entity's Material Accounting Period (or more frequently as required by the Entity).</p> <p>2.4 The Entity shall have systems in place to verify that the Output Quantity of CoC Material is consistent with the Input Quantity of CoC Material provided to the Outsourcing Contractor, and record it in its Material Accounting System.</p> <p>2.5 If an error is discovered after CoC Material has been shipped, the Entity and the Outsourcing Contractor shall document the error and the</p>



Short name of standard	Clauses about management systems and responsibilities on materials traceability	Please list the topics dealt in the requirements	Clauses about procurement of services procedures	Topics dealt in the requirements
		operation of all direct suppliers of Recyclable Scrap Material. b. All financial transactions with direct suppliers of Recyclable Scrap Material, ensuring that cash payments are within the lower of the relevant defined financial threshold under Applicable Law or US\$10,000 (or equivalent), where the transaction is carried out in a single operation or in several operations that appear to be linked.		agreed steps taken to correct it, and implement actions to avoid a recurrence.
COMMISSION DECISION (EU) 2019/63	3.2.1	material declaration		
Directive 2000/53/EC on ELVs	Article 8 - 1.	Producers implement material coding standards	-	-
ECOGuard		Requirement to check the transport documentation (FIR) and requirement to produce report to track the quantities treated and secondary materials obtained and their final destination (REPTOOL). The subject involved should ensure the traceability between the incoming FIR and the outgoing FIR. The subject involved should identify quantities, composition and destinations exiting from the process and use the software REPTOOL for the mass balance.	/	/
EN 50419:2006	section 4.1 of the standard	Requirements to identify the producer and the equipment: identification of the producer, date	/	/



Short name of standard	Clauses about management systems and responsibilities on materials traceability	Please list the topics dealt in the requirements	Clauses about procurement of services procedures	Topics dealt in the requirements
		of the manufacture/put on the market, marking the equipment with a symbol		
EN 50581:2012	Introduction			
EN 50625-2-1:2014 Lamps	5,2	Requirement to record the mass of deliveries	-	-
EN 50625-2-2:2015 Displays	5,6	Requirement to monitor de-pollution	-	-
e-Stewards Standard	8.9 Downstream Accountability			
eWASA Technical Guidelines	C.2.4; D.5.1; F.4.1; Directive 4 - 2.3.1;	Requirement to maintain proof of disposal; Requirement to identify potentially radioactive WEEE; Responsibility for the entire treatment chain; Requirement to record number of appliances based on size categories;	D.5.2; F.3.1; 2.2.1; Directive 4 - 2.2.1;	Requirement to send back to suppliers potential radioactive WEEE for disposal; Requirement to account all material flows; Requirement to supply compressors with harmful substances undamaged;
IEC 62474:2018	4.5.2 and 4.5.3	Product parts and Materials		
IEEE 1680.1-2018	4.1.9.1; 4.1.9.3.; 4.1.10.2. (a); 4.7.2.1; 4.7.2.2;	Requirement to maintain data on substances from the IEC 62474 declarable substances; Requirement to maintain an inventory of the substances; Requirement to develop a fluorinated greenhouse gas emissions inventory; Requirement on separable packaging made of dissimilar materials; Requirement to implement a protocol for resin identification;	4.1.9.2; 4.6.3.1; 4.9.1.2;	Requirement to request from suppliers the inventory of substances in the parts; Requirements for service providers to be certified; Requirement to demonstrate suppliers third party certified environmental management system;



Short name of standard	Clauses about management systems and responsibilities on materials traceability	Please list the topics dealt in the requirements	Clauses about procurement of services procedures	Topics dealt in the requirements
IEEE 1680.2™ – 2012	4.1.8.1; 4.3.2.3; 4.8.2.3;	Requirement to document the presence of Joint Industry Guide 101/IEC 62474 declarable substances; Requirement to mark plastic parts with a material code; Requirement to mark plastic packaging with a material code;	4.1.7.1; 4.6.2.1; 4.6.2.2;	Requirement for suppliers to control and reduce fluorinated gas emissions; Requirement for service providers to be certified;
IEEE 1680.3-2012	4.1.9.1; 4.3.2.2; 4.3.2.2; 4.8.2.3;	Requirement to document the presence of Joint Industry Guide 101/IEC 62474 declarable substances; Requirement to mark plastic parts with a material code; Requirement to label materials with special handling needs; Requirement to mark plastic packaging with a material code;	4.1.8.1; 4.6.2.1; 4.6.2.2;	Requirement for suppliers to control and reduce fluorinated gas emissions; Requirement for service providers to be certified;
ISO/IWA 19: 2017	Section 7	7.2 7.3	7.2.2 7.2.3 7.2.4 7.2.4	7.2.2 Policy and procedures 7.2.3 Responsibilities 7.2.4 Product documentation and records 7.2.4 Compliant claims
NSF/ANSI 426-2017	6.1.5; 6.2.1; 9.2.3; 9.2.4; 11.2.2;	Requirement to disclose substances on REACH candidate list; Requirement to record IEC 6247 declarable substances; Requirement to identify materials and components requiring selective treatment; Requirement to evaluate compliance of materials transported across national borders;	5.5.1; 6.2.3; 6.3.1;	Requirement on certification of suppliers of listed components; Requirement to request and record the inventory of substances from suppliers; Requirement for suppliers to develop a process F-GHG emissions inventory with emission reduction goal;



Short name of standard	Clauses about management systems and responsibilities on materials traceability	Please list the topics dealt in the requirements	Clauses about procurement of services procedures	Topics dealt in the requirements
R2:2013	6.(b); 9.(a).(4);	Requirement to track components shipped downstream; Requirement to label storage equipment;	5.(c); 5.(e);  5.(h); 6.(c).(3).(B); 8.(d); 8.(f); 12.(b);	Requirement for facilities that treat Focus Materials to meet regulatory requirements; Requirements on selecting downstream vendors; Requirement to confirm appropriate contractual agreements of shipped Focus Materials; Requirement for a independent party to validate the data destruction process; Requirements on data destruction handled by downstream vendors; Requirement to verify transporters have regulatory authorizations;
Regulation (EC) No. 1013/2006	Article 10 - 5.	Requirement on record of inputs, outputs and/or balances for wastes by facilities	-	-
TR 62476:2010	4. 5. 6.	Framework of evaluation of product, Restricted substance control (RSC) considerations, Documentation of evaluation results	5.2.2 Supplier information	
TS 50625-3-2:2015 Lamps	-	-	4,4	Requirement for laboratories to comply with EN ISO/IEC 17025
TS 50625-3-3 Displays	4.101.1; 8.3.103; 8.4.102; 8.4.103; 8,5; AA.4;	Requirement to monitor de-pollution activities; Requirement to monitor information from downstream operators; Restriction on the amount of lead oxide in panel glass; Requirement to measure the efficiency of the air filtration system; Requirement on the amount lamps not broken during treatment; Requirement to perform one analysis per year on the de-polluted smallest shredded mixed	8,1	Requirement to ensure de-pollution activities in downstream operators follows this TS



Short name of standard	Clauses about management systems and responsibilities on materials traceability	Please list the topics dealt in the requirements	Clauses about procurement of services procedures	Topics dealt in the requirements
		fraction; Requirement to label sample containers; Requirements on the storage and transportation of mercury;		
TS 50625-4:2017 Collection		general requirement to trace and document downstream chain		
TS 50625-5:2017 end processing	Chapter 6 Monitoring and reporting and chapter 7 Documentation	For documentation (normative requirements): Legal compliance report. - A record documenting compliance with legal and regulatory obligations applying to final treatment activities undertaken on the site. - Organisational plan A documented organisational chart of the final treatment facility showing key management and production staff positions, with special emphasis on those areas related to the steps for material treatment, transport and handling of material - Work instructions Document with work instructions for the key treatment steps, including handling of Waste and any products. - Emergency plan Document in which measures in case of emergency are described, communicated and if applicable approved by the relevant authorities. - Fire and explosion prevention plan Document in which measures to prevent fire and explosions are described.	4.2 Management principles	— Sub-contractors and sub-processors report: information such as company name, address, legal registration, permits of contractors and operators that handle the wastes from the final treatment operator (if used), along with work procedures and proof of the monitoring procedures.



Short name of standard	Clauses about management systems and responsibilities on materials traceability	Please list the topics dealt in the requirements	Clauses about procurement of services procedures	Topics dealt in the requirements
		<ul style="list-style-type: none"> <li>- Final treatment flow diagram or chart Flow chart showing the process including main steps and output fractions achieved; see example in annex I</li> <li>- Data register A document or electronic system listing the in/output streams (type, volume, origin and destination).</li> <li>- Document for off spec materials A procedure for the handling of off spec materials.</li> <li>- Sub-contractors and sub-processors report Document with information of all companies (name, address, legal registration, permits) that are used as sub-contractors or sub-processors relevant to the end processing.</li> <li>- Insurance Document in which the actual insurance coverage is stated.</li> <li>- EHS programmes Documents in which the environment, health and safety procedures are included .</li> <li>- EHS reports Documents in which the up to date data on environmental performance and incidents (LTI frequencies, IWA frequencies, near misses) are available to employees and for sub-contractors and in which data on measured occupational health values are included . If limit values have</li> </ul>		



Short name of standard	Clauses about management systems and responsibilities on materials traceability	Please list the topics dealt in the requirements	Clauses about procurement of services procedures	Topics dealt in the requirements
		<p>been exceeded there shall be a report on improvement actions and data shall be reported that also indicate any effects of such corrective measures will have .</p> <ul style="list-style-type: none"> <li>- EHS awareness program Document in which the on-going, interactive and training activities in the field of environment, health and safety are described.</li> <li>- Contract Describing the contractual arrangements of deliveries of WEEE and/or fractions thereof to a final treatment operator.</li> <li>- Sampling and validation procedure Document in which the procedure on sampling and validation of WEEE and/or fractions thereof are described.</li> <li>- Assaying report Report on elements used in the calculation of mass balance and/or for determining the recycling rate and recovery rate and metal yield according to chapter 6.</li> <li>- Protocol and report on emissions Document in which the protocol on measurements of emissions is given and reports on the measured emissions.</li> <li>- Report on process conditions Data base or document in which measured data are given that show that limit values which are required for this standard are not</li> </ul>		



Short name of standard	Clauses about management systems and responsibilities on materials traceability	Please list the topics dealt in the requirements	Clauses about procurement of services procedures	Topics dealt in the requirements
		exceeded. If exceeded there shall be a report on corrective actions and data shall be reported that indicate what the effect of these actions are.		
UL 110 Edition 2 – 2017	7.4.1; 12.2.1;	Requirement to have an information management system to address the inventory of substances; Requirement to label plastics in packaging;	7.4.1; 11.2.1; 15.2.2;	Requirement to request an inventory of substances from suppliers; Requirement for third party recyclers to be certified; Requirement for suppliers to be third-party certified to either ISO 14001 or EMAS;
VDI 2343 Blatt 4	Chapter 6 - 6.2.1 - Point 4; Chapter 6 - 6.2.1 - Point 5; Chapter 6 - 6.2.2 - Point 8; Chapter 6 - 6.2.2 - Point 11; Chapter 6 - 6.2.2 - Point 12;	Requirement to compare annually the recovered refrigerants with number of treated devices; Requirement for a detailed registration of the devices; Requirement to compare input and output flows of blowing agents;	-	-



## Requirements on chain custody and eligible input materials

Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
AS/NZS 5377:2013	3.3.(e); 5.2.; 5.4.; Appendix B;	Requirement to implement a mass balance tracking system; Requirement to separate substances of concern from ink and toner cartridges; Requirement on providing mass balance, recycling and recovery rates; Requirement on the removal and separation of hazardous substances;	1.7; 3.3.(d); 4.4.; 5.3;	Requirement on the management of records to allow traceability; Requirement on records of parts that enter and exit the facility; Requirement to document materials classified as traceable, controlled, hazardous or prescribed industrial; Requirement to document flow of materials from receipt at facility to final disposition; Requirement on Waste Storage Licences and Waste Transport Licences; Requirement to evidence import/export permits;
AS/NZS 5377-2013	See TR 2	Manifests, bills of loading, chain of custody documents, transport records	See TR 2 and TR 9	See TR 2 and 9
ASI Chain of Custody (CoC) Standard V1 2017	8; 8.2; 8.3; 8.4 8.5; 8.6 ; 8.7 ; 8.8; 8.9; 8.10; 8.11	8. Mass Balance System: CoC Material and ASI Aluminium The Mass Balance System requires each successive Entity handling CoC Material to be CoC Certified to create an unbroken chain of custody. It	9; 9.1; 9.2; 9.3 ; 9.4; 9.5; 9.6;	9. Issuing CoC Documents The Mass Balance System is supported by accurate CoC information accompanying shipments of CoC Material. In the CoC Standard, the set of required CoC information is

lead-acid Batteries, retrievable from [HYPERLINK "http://www.basel.int/Porta"](http://www.basel.int/Porta)



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
		<p>allows for CoC Materials to be mixed with Non-CoC Material over a defined period, at any stage in the value chain. The Entity's Material Accounting System is used to record and calculate the percentage-based input and output of CoC Materials. Note that the CoC Standard stipulates that the output of CoC Material cannot be allocated as 'partially CoC' – so if 20 % of output is 'CoC', that 20 % is 100 % CoC (and not all output is "20 % CoC").</p> <p>8.1 The Entity's Management System shall include a Material Accounting System that records Input Quantity and Output Quantity of CoC Material and Non-CoC Material, by mass.</p> <p>8.2 An Entity engaged in Aluminium Re-Melting/Refining to produce Recycled Aluminium shall also record the following breakdown of Recyclable Scrap Material in their Material Accounting System:</p> <ul style="list-style-type: none"> <li>a. Input Quantity of Post-Consumer Scrap.</li> <li>b. Input Quantity of Pre-Consumer Scrap (total).</li> <li>c. Input Quantity of Pre-Consumer Scrap that is Eligible Scrap, where it is supplied directly from a CoC Certified Entity (where applicable).</li> </ul> <p>8.3 The Entity's Material Accounting System shall specify a Material Accounting Period, which shall not be longer than 12 months.</p>		<p>referred to as CoC Documents (a template is in Appendix 1). Entities often integrate CoC information into their usual shipment processes, such as sales invoices or shipping documentation. Additional data and information may also be included in CoC Documents at the business' discretion, but must be accurate and verifiable.</p> <p>9.1 The Entity shall ensure that a CoC Document accompanies each shipment or transfer of CoC Material dispatched to other CoC Certified Entities or Outsourcing Contractors.</p> <p>9.2 The Entity shall ensure that CoC Documents include at least the following information:</p> <ul style="list-style-type: none"> <li>a. Date of issue of the CoC Document.</li> <li>b. Reference number for the CoC Document, which is linked to the Entity's Material Accounting System for verification purposes.</li> <li>c. The identity, address and CoC Certification number of the Entity issuing the CoC Document.</li> <li>d. The identity and address of the customer receiving the CoC Material, and if it is another CoC Certified Entity, their CoC Certification number.</li> <li>e. The responsible employee of the Entity who can verify information in the CoC Document.</li> <li>f. A statement confirming that "The information provided in the CoC Document is in conformance with</li> </ul>



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
		<p>8.4 The Entity shall calculate and record the Input Percentage for a given Material Accounting Period using the following formula (except where 8.5 is applicable):</p> $\text{Input Percentage} = (\text{Input Quantity of CoC Material}) \times 100 / (\text{Input Quantity of CoC Material}) + (\text{Input Quantity of Non-CoC Material})$ <p>The units used in the numerator and the denominator must be the same.</p> <p>8.5 An Entity engaged in Aluminium Re-Melting/Refining shall calculate and record the Input Percentage for a given Material Accounting Period using the following formula:</p> $\text{Input Percentage} = (\text{Input Quantity of Eligible Scrap}) \times 100 / (\text{Input Quantity of Recyclable Scrap Material})$ <p>The units used in the numerator and the denominator must be the same. The Input Quantity of Eligible Scrap and Recyclable Scrap Material shall be based on an assessment of aluminium content.</p> <p>8.6 The Entity shall use the Input Percentage for the given Material Accounting Period to determine the Output Quantity of CoC Material, by mass.</p> <p>8.7 The Output Quantity of CoC Material, which may be a subset of total production, shall be</p>		<p>the ASI CoC Standard.”</p> <p>g. Type of CoC Material in the shipment.</p> <p>h. Mass of CoC Material in the shipment.</p> <p>i. Mass of total Material in the shipment.</p> <p>9.3 Where the Entity is engaged in one or more of the following activities, it may also include the applicable Sustainability Data in the CoC Document for that CoC Material:</p> <p>a. Entities engaged in Aluminium Smelting, and/or Aluminium Re-Melting/Refining, and/or operating a Casthouse: the average intensity of GHG emissions (scope 1 and scope 2) in tonnes CO<sub>2</sub> –eq per metric tonne ASI Aluminium, from the production of ASI Aluminium, which includes emissions from the Casthouse, produced in the Material Accounting Period.</p> <p>b. Post-Casthouse Entities: where available, the average intensity of GHG emissions (scope 1 and 2) in tonnes CO<sub>2</sub> –eq per metric tonne ASI Aluminium, based on the information provided in 9.3a in received CoC Document/s.</p> <p>c. Post-Casthouse Entities: ASI Certification status for the ASI Performance Standard for the Entity and/or Facility issuing the CoC Document.</p> <p>9.4 If the CoC Document includes Supplementary Information about the Entity or CoC Material, the Entity shall ensure that the Supplementary Information can be supported by objective evidence.</p>



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
		<p>designated as 100 % CoC Material.</p> <p>8.8 If the Entity produces Pre-Consumer Scrap from its processing and wishes to designate the relevant proportion as Eligible Scrap, the Entity shall use the Input Percentage for the given Material Accounting Period to determine the Output Quantity of Eligible Scrap.</p> <p>8.9 The Entity's Material Accounting System shall ensure that the total output of CoC Material and/or Eligible Scrap does not proportionally exceed the Input Percentage as applied to total input of CoC Material and/or Eligible Scrap over the Material Accounting Period.</p> <p>8.10 Where CoC Material is under contract for delivery to an Entity within a given Material Accounting Period, but is subject to a force majeure situation, the Entity's Material Accounting System may carry over an Internal Overdraw to the subsequent Material Accounting Period.</p> <p>a. The Internal Overdraw shall not exceed 20 % of total Input Quantity of CoC Material for the Material Accounting Period.</p> <p>b. The Internal Overdraw shall not exceed the amount of CoC Material affected by the force majeure situation.</p> <p>c. The Internal Overdraw shall be made up within the subsequent Material Accounting Period.</p>		<p>9.5 The Entity shall have systems in place to enable it to respond to reasonable requests for verification of information in CoC Documents issued by the Entity.</p> <p>9.6 If an error is discovered after CoC Material has been shipped, the Entity and the receiving party shall document the error and the agreed steps taken to correct it, and implement actions to avoid a recurrence.</p>



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
		8.11 Where an Entity has a Positive Balance of output CoC Material at the end of a Material Accounting Period, this may be carried over to the subsequent Material Accounting Period. a. The Entity's Material Accounting System must clearly identify any carry over of a Positive Balance. b. A Positive Balance generated in one Material Accounting Period and carried over to the subsequent Material Accounting Period shall expire at the end of that Period if not drawn down.		
COMMISSION DECISION (EU) 2019/63			3.2.1	material declaration
Directive 2000/53/EC on ELVs	Article 6 - 3.(b)	Requirements to segregate hazardous materials	Art. 7 (3)	Member States shall ensure that, for the purpose of calculating these targets, producers or third parties acting on their behalf keep records on the mass of WEEE, their components, materials or substances when entering (input) and leaving (output) the treatment facility and/or when entering (input) the recovery or recycling facility.
Directive 2006/66/EC on batteries			Article 10, Article 12, Article 22, Annex I	Reports for collection targets (Article 10), Reports for level of recycling achieved (Article 12), Reports on the implementation of the Directive (Article 22), Reporting requirements (Annex I)
EN 50625-2-1:2014 Lamps	-	-	5,2	Requirement to verify compliance of deliveries with relevant documentation



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
EN 50625-2-2:2015 Displays	5.5.1	Requirement to separate CRT, CRT glass and fluorescent coatings from other fractions	-	-
EN 60086-4:2015	-	-	9)	Marking
EN 60086-5:2016	-	-	9)	Marking
EN 62281:2012	6.3.5 Leakage; 6.6 Packaging test	Evaluation of leakage during test procedures: it is evaluated through a mass loss comparing mass before the test with mass after the test.	7.3 Transport; 9.2 Marking of the packaging and shipping documents	Regulations for transport are highlighted: Air Transport (Regulations concerning air transport of lithium batteries are specified in the Technical Instructions for the Safe Transport of Dangerous Goods by Air published by the International Civil Aviation Organization (ICAO) and in the Dangerous Goods Regulations published by the International Air Transport Association (IATA)), Sea Transport (Regulations concerning sea transport of lithium batteries are specified in the International Maritime Dangerous Goods (IMDG) Code published by the International Maritime Organization (IMO)), Land Transport (country-specific transport regulations be consulted before shipping)
EPSC Electronics Recycling Standard (ERS) 2015				There is an indirect link with shipment and export documents. In fact, the R2 Standard (prerequisite for ERS 2015) does not forbid the export of e-waste to developing countries. R2 does not contain any reference to the Basel Convention and does not utilize Basel Convention



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
				definitions or apply the Basel Convention obligations.
e-Stewards Standard			7.5 Documented information	<ul style="list-style-type: none"> <li>- General/EHSMS documentation</li> <li>- Creating &amp; updating EHSMS documentation</li> <li>- Control of documented information</li> <li>- Retention of records</li> </ul>
eWASA Technical Guidelines	F.5.1; 7.5; Directive 3 - 3.4; Directive 4; 3.1/3.2/3.3/3.4/8.1/8.2/8.3/9.1/9.2/9.3; Directive 5 - 2.1/2.2/2.3/2.4/2.5/2.6/2.7/2.8/2.9/2.10;	Requirement to check the quality of decontamination; Methodology for the manual dismantling of fractions; Requirement on chemical analyses of fraction with residual mercury content; Requirement on removal of substances from refrigeration appliances; Methodology for determining the effectiveness of plants; Processing guidelines of dental appliances;	F.1.2; F.2.2; F.3.2; F.4.2; Directive 2 - 3.1; Directive 4 - 4.1/4.2/7.1/7.2/7.3/7.4/7.5;	Requirement to document training of staff; Requirement to document disposal of WEEE; Requirement to record all incoming and outgoing deliveries; Requirement on proof of material flow; Requirement to issue certificates of safe destruction of hard drives; Requirement on monthly records of incoming refrigeration appliances; Requirement on material flow dossier for refrigeration appliances;
IEC 62474:2018			Clause 4 and 5	reporting threshold level, declaration hierarchy of the material, Material class declaration
IEEE 1680.1-2018	4.1.9.3; 4.1.10.1; 4.1.10.2; 4.4.1.2;	Requirement to calculate the percentage mass level of inventory; Requirement to calculate the reduction on fluorine greenhouse gas emissions;	4.6.3.1	Requirement to document compliance with importing, exporting and transit regulations



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
		Requirement to test the performance of rechargeable batteries;		
IEEE 1680.2™ – 2012	4.10.1.1	Requirement to test for indoor air quality emissions	4.5.3.1; 4.6.2.1; 4.9.4.1;	Requirement to provide documentation on how the standby power level was achieved; Requirement to document compliance with importing, exporting and transit regulations; Requirement to document that cartridges are not designed to prevent reuse and recycling;
IEEE 1680.3-2012	-	-	4.6.2.1	Requirement to document compliance with importing, exporting and transit regulations
ISO/IWA 19: 2017	7.2.2 Policy and procedures (incl. accounting methods such as mass balance, book and claim and physical segregation methods) 7.2.3 Responsibilities 7.2.4 Product documentation and records 7.2.5 Compliant claims	7.2.2 Policy and procedures (incl. accounting methods such as mass balance, book and claim and physical segregation methods) Economic operators seeking compliance should develop, implement, and publish CoC procedures in line with at least one of the following three material accounting models: a) Physical segregation. This model allows the direct measurement of amounts of secondary metals produced and the physical tracking of the materials concerned up to their origin. To ensure this, consignments of waste and end-of-waste that contain metals, or secondary metals with demonstrated origin and compliance with the guidance principles, are kept physically separated from other waste, end-of-waste and secondary metals consignments of unknown origin and from	7.2.4 Product documentation and records	Any economic operator acquiring, processing or delivering batches of compliant waste, end-of-waste, materials or fractions that contain metals or secondary metals, and seeking compliance with the guidance principles, should document and record important characteristics, including but not limited to: 7.2.4 Product documentation and records a) name and address of supplier; b) unique reference number; c) date of receipt of goods and date of release/shipment of goods; d) origin (address) of batch; e) shipment address; f) metal(s) recovered; NOTE A colour code can be used to differentiate among metal types. g) nature or state (i.e. concentration of metal(s) in an alloy, part of waste, etc.) of metal; h) materials



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
		<p>primary metals.</p> <p>b) Mass balance. A mass balance ensures that the amount of outgoing secondary metals compliant with the guidance principles does not exceed the amount of incoming material compliant with the guidance principles by taking conversion factors or other calculation methodologies into consideration. This material accounting model can be used when consignments of waste and end-of-waste that contain metals, or secondary metals with demonstrated origin and compliance with the guidance principles, are physically mixed with other waste, end-of-waste and secondary metals consignments of unknown origin and primary metals.</p> <p>c) Book and claim. Economic operators in compliance with the guidance principles may create certificates up to a volume corresponding to the actual production of compliant material and trade them on a dedicated platform. Product manufacturers using secondary metals may buy such certificates and the compliant sustainability claims with the guidance principles associated with them.</p>		<p>accounting model used;</p> <p>i) weight;</p> <p>j) proof of compliance with the guidance principles, with details of how the verification was conducted (e.g. based on third-party audits to issue on-product claims or second-party audits to issue off-product claims);</p> <p>k) name and details of the assurance provider or second-party organization concerned with issuing the proof of compliance;</p> <p>l) name and address of all supplier(s), contractor(s) and subcontractor(s) involved in the acquisition, processing and delivery of the batch or products.</p> <p>If the concerned compliant batches include waste that contains metals, local laws and regulations for waste management need to be fully adhered to. If an international transboundary shipment of waste is planned, according to the Basel Convention Guidelines (2004),[12] it first needs to be determined whether the batch is hazardous waste or non-hazardous waste. IWA 19:2017(E)</p> <p>Correspondingly, specific documentation should be attached to the shipment according to the Basel Convention Guidelines (2004)[12].</p> <p>Recorded material without appropriate documentation should be considered</p>



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
NSF/ANSI 426-2017	6.2.4; 9.1.4; 11.2.3;	Requirement to implement a system to validate supplier information; Requirement on product recyclability rate; Methodology for calculating the reuse and recycling achievements;	-	-
prEN 45553	6.2 c	Description of data and other information used/needed for the assessment (e.g. manual, bill of material, drawings)		
prEN 45557:2018	Section 6.3 Chain of custody	The traceability of information may be achieved through the implementation of different chain of custody models: mass balance, physical segregation, identity preservation	/	/
prEN 50614	see separate document		see separate document	
R2:2013	5.(b); 6.(c).(2).(A); 6.(c).(1).(A);	Requirements to remove Focus Materials; Requirement to test equipment for reuse;	7.(a); 8.(g);	Requirement to maintain documentation for all transfers of material; Requirement to document data destruction;
Regulation (EC) No. 1013/2006	-	-	Article 4 - 1./2./3./6.; Article 5 - 4.; Article 9 -3.; Article 14 - 3.; Article 15 - (a)/(d);	Requirement on notification and movement documents; Requirement on certificates of interim recovery or disposal; Requirement on written consents from competent authorities; Requirement on information of issued pre-consents; Requirement on notification documents for waste destined to interim recovery or disposal; Requirement to certify interim recovery or disposal of



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
			Article 16 - (a)/(b)/(c)/(d)/(e); Article 18 - 1./4.; Article 20 - 1./2.;	wastes; Requirement on movement documents after consent; Requirement on documents of shipment of waste referred in Article 3(2) and (4); Requirement on the keeping of documents;
TR 62476:2010			4. 5. 6.	Framework for evaluation of product, restricted substance control considerations, documentation of evaluation of results.
TR 62635:2012			5.2	5.2 Product identification should contain manufacturers identification and contact details; name, model, type; total mass; date of information release; product characteristics. Identification of potential hazards. Parts identification for dismantling. Provision for end-of-life treatment information
TS 50625-3-1			4.2	Requirement to record the amount of components removed to evaluate the fulfillment of the targets
TS 50625-3-2:2015 Lamps	4,4	Requirements on the sampling of output fractions; Requirements on the evaluation of analysis results; Requirement to perform analysis on residual amount of mercury; Requirement for the chemical analysis to follow standards;	-	-
TS 50625-3-3 Displays	4,4; 4.101.2; 4.101.3;	Requirement to follow the described procedures for sample preparation and analytical methods; Requirement to document the CRT removal	-	-



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
	8.3.101; 8.3.102; 8.4.102; AA.2; BB.2; CC.2; CC.3; DD; EE; FF;	procedure; Requirement to document the removal of mercury or lamps from FPD; Requirement to perform one analysis per month on residual CRT glass in the listed fractions; Requirement on the number of samples for analysis per year of Cleaned CRT glass; Requirement to perform on analysis per year to test de-pollution of mercury from FPD; Requirement on the number and size of samples; Requirement to perform a visual inspection on cleaned CRT glass; Protocol for the extraction of residual fluorescent coatings from CRT glass; Protocol for the analysis of lead oxide in panel glass; Protocol for mass balance of FPD manually treated; Protocol for the analysis of the de-polluted smallest shredded mix;		
TS 50625-3-4 Fridges	/	/	Annex II	/
TS 50625-4:2017 Collection	general requirement to separate WEEE that can be prepared for reuse			



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
TS 50625-5:2017 end processing	6.2 Recycling rate and recovery rate	The determination of the recycling rate and recovery rate shall be completed and updated at least once every year, but also after relevant changes within the processing chain, influencing the recycling rate and recovery results. The documents and records relating to this process shall be stored for three years.	4.4 Agreement for acceptance of materials	Deliveries of WEEE and/or fractions of WEEE containing copper and/or precious metal to a final treatment facility shall only occur once the operator supplying and the final treatment operator have completed a written agreement. The minimum components of such a written document (contract) shall include information: <ul style="list-style-type: none"> <li>— Description of material i.e. estimated composition and physical characteristics;</li> <li>— Mutually agreed specification of materials. This specification shall as a minimum include the following conditions as regards details on the following possible contaminants: <ul style="list-style-type: none"> <li>— Agreed acceptance levels of polychlorinated biphenyls – PCBs;</li> <li>— Agreed acceptance levels of mercury (Hg);</li> <li>— Declaration of check of radioactive materials;</li> <li>— Agreed acceptance levels of beryllium (Be);</li> </ul> </li> </ul> NOTE 1 <ul style="list-style-type: none"> <li>— Typical PCB acceptance level &lt; 50 ppm</li> <li>— Typical Hg acceptance level &lt; 10 ppm.</li> <li>— In case of detection of any radioactivity, in which there should be generally a low tolerance level, while the evaluation of radioactivity and maximum content's threshold should be in accordance with 2003/122/Euratom or those of the equivalent competent authority whichever is the most stringent.</li> <li>— Typical Beryllium acceptance level &lt; 200 ppm.</li> </ul>



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
				<ul style="list-style-type: none"> <li>— The delivery mode e.g. transport by road, ship or rail;</li> <li>— Duration of the agreement;</li> <li>— Agreed quantities;</li> <li>— Transport provisions and terms;</li> </ul> <p>NOTE 2 For example: Incoterms are internationally recognised terms for transport, details of which are regularly amended and published by the International Chamber of Commerce (ICC). Incoterms is a registered trademark of the ICC.</p> <ul style="list-style-type: none"> <li>— Specification of authorized transport and logistics related requirements;</li> </ul> <p>NOTE 3 Compliance with Waste Shipment Regulation - (EC) No 1013/2006 and European List of Waste - 2000/532/EC if required and compliance with the ADR (European Agreement concerning the International Carriage of Dangerous Goods by Road) provisions if applicable.</p> <ul style="list-style-type: none"> <li>— Packaging requirements;</li> <li>— Arrangements for handling of 'off-spec material'; and</li> <li>— Arrangements for sampling as set out in 5.3.</li> </ul>
UL 110 Edition 2 – 2017	7.4.2	Requirement to calculate the percentage mass of substances inventoried	-	-
VDI 2343 Blatt 4	Chapter 2 - 2nd paragraph; Chapter 3 - Table 2; Chapter 4 - 4.1 -	Requirement for the hazard potential of devices after preparation to be easily assessed; Requirement on preparation techniques; Requirement to separate the mixture from crushing according to sorting and sizing procedures (DIN	-	-



Short name of standard	Clauses about chain of custody and procedures in line with mass balance, physical segregation etc.	Topics dealt in the requirements	Clauses on product documentation and records <sup>60</sup>	Topics dealt in the requirements
	page 11; Chapter 4.3 - Table 7; Chapter 6 - 6.2.1 - Point 1; Chapter 6 - 6.2.2 - 1st paragraph; Chapter 6 - 6.2.2 - 2nd paragraph; Chapter 6 - 6.2.2 - Page 43 - 1st paragraph; Chapter 6 - 6.3.4 - Separation of coating and screen glass - 1st paragraph;	8588); Area of application of sorting procedures; Requirement to separate refrigerants and refrigerator oil; Requirement for enclosed shredding of refrigerators; Requirement on mechanical procedures to release blowing agents; Requirement on the treatment of drained refrigerators (stage II); Requirement to remove coating from glass;		



Requirements about compliant claims (on-product or off-product claims) and communication

Short name of standard	Clauses about compliant claims (on-product or off-product claims) and communication	Topics dealt in the requirements (e.g. communication policies etc.)
AS/NZS 5377:2013	1.5; 1.6.6; 3.3.(c);	Requirement to communicate legal and other obligations; Requirement on information available at the facility; Requirement to remove distinguishing marks that trace to the disposer;
ASI Chain of Custody (CoC) Standard V1 2017	12. Claims and Communications 12.1	12. Claims and Communications CoC Certified Entities are encouraged to communicate with their customers and consumers about their support for responsible supply chains. All marketing and communications claims, beyond what is contained in CoC Documents or ASI Credits Certificates, are to be consistent with the assurance provided by the relevant ASI Standards and with the ASI Claims Guide. 12.1 Where the Entity makes claims and/or representations about CoC Material outside of CoC Documents, or about ASI Credits outside of ASI Credits Certificates, the Entity shall have systems in place to ensure that: a. These are made in a manner and form consistent with the ASI Claims Guide. b. There is verifiable evidence to support the claims and/or representations made. c. Appropriate training is provided for relevant employees to properly understand and communicate the claims and/or representations.
Directive 2000/53/EC on ELVs	Article 8 - 3.; Article 9 -1./2.; Article 10 -2.;	Producers must provide dismantling information; Requirement to report the implementation of the Directive; Requirement on published information by economic operators; Requirement to communicate the provisions of domestic law;
Directive 2006/66/EC on batteries	Article 21 and Annex II	Member States shall ensure that all batteries, accumulators and battery packs are appropriately marked with a specific symbol
EN 60086-4:2015	9); Annex D;	Marking; Safety pictograms;
EN 60086-5:2016	9); Annex C	Marking, Safety pictograms
e-Stewards Standard	7.4 Communication	- General/Process for communication - Internal communication - External communication
eWASA Technical Guidelines	D.5.3; E.1.3; Directive 4 - 2.2.2;	Inform companies treating potentially radioactive WEEE of risks; Requirement to report temporarily higher storage stock; Inform suppliers that sorting of different appliance types is not permitted;



Short name of standard	Clauses about compliant claims (on-product or off-product claims) and communication	Topics dealt in the requirements (e.g. communication policies etc.)
IEEE 1680.1-2018	4.1.10.2.(b); 4.3.1.1; 4.4.1.1; 4.4.2.3; 4.4.2.4; 4.6.1.1; 4.6.2.1; 4.7.4.1; 4.8.1.1; 4.9.2.1; 4.9.2.2;	Publicly available annual reports with results of fluorinated greenhouse gas emissions; Make available information on the presence of components that require selective treatment to reuse and recycling facilities; inform the purchaser about repair and replacement services; Information regarding spare parts; Requirement to provide primary power replacements; Requirement to provide nationwide product take-back services; Requirements on the take-back program of removable rechargeable battery; Requirement to offer bulk packaging option to institutional customers; Requirement to publish a full life cycle assessment; Make annual public disclosures of environmental performance (company/suppliers);
IEEE 1680.2™ – 2012	4.1.3.1; 4.2.2.1; 4.2.3.1; 4.3.3.1; 4.3.4.1; 4.4.1.1; 4.4.2.1; 4.4.3.1; 4.6.1.1; 4.6.1.2; 4.7.2.1; 4.7.2.2; 4.7.3.1; 4.8.4.1; 4.9.3.1;	Requirement to report the mercury content of light sources; Requirement to declare bio based plastic materials content; Requirement to declare product weight; Requirement to make available information on the location of hazardous components; Requirement to offer guidance for the effective processing of materials in EU WEEE Directive 2002/96/EC; Requirement to make available procedures to solve product fails; Requirement to offer upgradeability to institutional products; Requirement to declare available spare parts; Requirement to provide nationwide take-back services; Publicly disclose environmental aspects; Publicly disclose toxics release data of chemicals listed on the United Nations; Protocol on Pollutant Release; Publicly disclose the result of the life-cycle assessment; Requirement to provide take-back services for packaging materials; Requirement to provide take-back services for toner and ink cartridges; Requirement to annually publish results of the take-system for cartridges;
IEEE 1680.3-2012	4.1.3.1; 4.2.2.1; 4.2.3.1; 4.3.3.1; 4.3.4.3; 4.4.1.1; 4.4.2.1; 4.4.3.1; 4.6.1.1; 4.6.1.2; 4.7.2.1; 4.7.2.2; 4.7.3.1; 4.8.4.1;	Requirement to report the amount of mercury in light sources; Requirement to declare bio based plastic materials content; Requirement to declare product weight; Requirement to make available information on the location of hazardous components; Requirement to make available end-of-life characterization report for products;



Short name of standard	Clauses about compliant claims (on-product or off-product claims) and communication	Topics dealt in the requirements (e.g. communication policies etc.)
		<p>Requirement to have the capability for firmware to be upgradeable;  Requirement to provide service information;  Requirement to make available procedures to solve product fails;  Requirement to provide nationwide take-back services;  Publicly disclose environmental aspects;</p> <p>Publicly disclose toxics release data of chemicals listed on the United Nations; Protocol on Pollutant Release;  Publicly disclose the result of the life-cycle assessment;  Requirement to provide take-back services for packaging materials;</p>
ISO/IWA 19: 2017	7.2.5 Compliant claims	<p>Claims of compliance with the guidance principles can be used for internal or external communication purposes. The latter could include audiences such as consumers or local and national government authorities. For this purpose, a communication and claim policy should be developed by the economic operators wishing to ensure the credible traceability of metals recovered.</p> <p>7.2.5 Compliant claims</p> <p>Only economic operators sourcing compliant material and having been verified against traceability requirements through a third-party-based assurance system (see 8.4.3) are allowed to issue and use on-product claims.</p> <p>In case the concerned batches of recovered metals have been verified through second-party-based verification mechanisms, the use of claims is limited to off-product ones (see 8.3.4).</p> <p>Examples of compliance claims include the following.</p> <ul style="list-style-type: none"> <li>— On-product claim: A brief text such as “This batch of secondary/recycled [metal name] was produced in compliance with the guidance principles for the Sustainable Management of Secondary Metals.”</li> <li>— Off-product claim: “Enterprise X supports the implementation of the guidance principles on Sustainable Management of Secondary Metals and is sourcing up to X % of compliant secondary metals as of [date].”</li> </ul>
NSF/ANSI 426-2017	6.2.2; 6.2.6; 7.1.1; 7.2.1; 8.4.2; 9.2.1; 9.2.2; 9.2.5; 10.1.1; 11.2.3; 12.2.1; 12.2.2; 12.2.3; 12.5.2;	<p>Public disclosure of IEC 62474 declarable substance;  Public disclosure of the hazard assessment;  Public disclosure of recycled plastic content;  Option for purchasers to "opt out" of receiving the listed parts;  Option of bulk packaging to institutional costumers;</p>



Short name of standard	Clauses about compliant claims (on-product or off-product claims) and communication	Topics dealt in the requirements (e.g. communication policies etc.)
		<p>Publishing of information for use by reuse and recycling organizations;</p> <p>Provide necessary hardware functionality testing software;</p> <p>Option to purchase product replacement components;</p> <p>Publish reuse and recycling achievement;</p> <p>Publicly disclose environmental and social responsibility performance;</p> <p>Publicly disclose environmental and social responsibility performance of suppliers;</p> <p>Publicly report toxics release data;</p> <p>Publicly disclose LCA results;</p>
R2:2013	4.(g); 4.(h); 6.(c).(1).(C); 6.(c).(2).(C); 6.(c).(2).(D); 7.(b);	<p>Requirement on internal communication regarding potential hazards;</p> <p>Requirement to report emergency events;</p> <p>Requirement to implement a Product Return Plan;</p> <p>Requirement to disclose functions in equipment for resale not working properly;</p> <p>Requirement to provide information on downstream vendors;</p>
Regulation (EC) No. 1013/2006	<p>Article 6 - 9.; Article 7 - 1./2./3./4.;</p> <p>Article 8 - 1./2./3.; Article 9 - 2.; Article 9 - 9.; Article 10 - 4.; Article 11 - 4./5.;</p> <p>Article 12 - 3./5./6.;</p> <p>Article 15 - (c); Article 17 - 1.; Article 18 - 3.;</p> <p>Article 21; Article 22 - 1./2./3./4./5./6./7./8./9.;</p> <p>Article 23 - 1.; Article 24 - 1./2./3./4./5./6./7./8./9./10.;</p> <p>Article 25 - 1./2./3./4./5.; Article 26 - 1./2./3./4.; Article 27 - 1./2.; Article 30 - 4.;</p> <p>Article 31 - (a)/(b); Article 32 - 1./2.;</p> <p>Article 33 - 2.; Article 50 - 1.; Article 51 - 1./2./3./4.; Article 52; Article 54;</p> <p>Article 56 - 1./2./3./4./5.; Article 57;</p>	<p>Requirement to inform about provisions of national law adopted pursuant to Article 6;</p> <p>Requirement on transmission of the notification by the competent authority;</p> <p>Requirement on request of information by competent authorities;</p> <p>Requirement on transmission of consents by competent authorities of destination;</p> <p>Requirement on transmission of the withdrawal of consent;</p> <p>Requirement on transmission of the conditions of shipment by the competent authorities ;</p> <p>Requirement on the communication of objections;</p> <p>Requirement to notify restrictions on shipment of wastes for disposal and recovery by Member States;</p> <p>Requirement on confirmation of receipt of waste for interim recovery or disposal;</p> <p>Requirement to notify changes in shipment after consent;</p> <p>Requirement on the request of information by Member States on shipments referred by Article 18;</p> <p>Requirement on public access to notifications;</p> <p>Requirement on take-back of shipments by competent authorities;</p> <p>Requirement on costs of take-back of shipments;</p> <p>Requirement on take-back of illegal shipments by competent authorities;</p> <p>Requirement on costs of take-back of illegal shipments;</p> <p>Requirement on formats of communications;</p> <p>Requirement on documentation language;</p>



Short name of standard	Clauses about compliant claims (on-product or off-product claims) and communication	Topics dealt in the requirements (e.g. communication policies etc.)
		<p>Requirement on communication of cross-border agreements;  Requirement on communication with third countries about transit;  Requirement to communicate their control system for shipments within Member States;  Requirement for Member States to notify legislation relating to prevention and penalties for illegal shipments;</p> <p>Requirement to report the previous calendar year by each Member State;  Requirement on International cooperation;  Requirement on designating correspondents;  Requirement on the notification of designations;  Requirement on meetings of the correspondents;</p>
TS 50625-5:2017 end processing	5.3 Sampling and assaying	<p>A documented procedure shall be in place for sampling and assaying of the WEEE (fractions) input. The procedure as regards sampling and assaying shall include the following:</p> <ul style="list-style-type: none"> <li>— The process to be used to shred/reduce the WEEE and/or fractions of WEEE containing copper and/or precious metals for sample preparation (if done at the final treatment facility);</li> <li>— The weight or percentage of weight of input consignment for each sample;</li> <li>— The name and contact details of any external laboratory (if applicable);</li> </ul> <p>The specific techniques for sampling and assaying and the way the process is to be conducted and the techniques used;</p> <ul style="list-style-type: none"> <li>— The operator or their nominated agent shall be entitled to be present during the sampling and assaying and shall be provided with a sealed bag containing the sample of the material tested; and</li> <li>— The records of each sampling and assaying test performed, including the final results and laboratory reports where required, are to be kept by the final treatment operator for a minimum of three years.</li> </ul>
UL 110 Edition 2 – 2017	8.1.1; 11.1.1; 11.3.2; 11.5.1; 11.7.1; 11.8.1;	<p>Requirement to declare recycled and bio based plastics content;  Requirement to provide a take-back program;  Requirement to provide instructions on battery removal;  Requirement to include software function to erase data;  Publicly document the availability of replacement parts/services;  Requirement to inform on the location of materials for selective treatment;</p>



Short name of standard	Clauses about compliant claims (on-product or off-product claims) and communication	Topics dealt in the requirements (e.g. communication policies etc.)
	13.1.1; 13.2.1;	Requirement to publish a Corporate Sustainability report; Publish disclosures for the supplier operations;



## 11 ANNEX V – ADDITIONAL INFORMATION ON VERIFICATION SYSTEMS

Verification scheme	Organisation managing the scheme	Country in which is based the organisation managing the scheme	Existing since (indicate year)	last review of the scheme	Geographical scope (applicability)	Please precise your answer if you replied “national” or other territories in the previous question	Who is financing the audits?
WEEELABEX	WEEELABEX Organisation	Czech Republic (CZ)	2011	N.A.	EU		The recycler or the compliance scheme
R2:2013 Checklist	SERI	USA	2014		World		The recycler or the client
e-Stewards	BAN - Basel Action Network	USA	2010	Version 3.0 was published in March of 2017. In August of 2018, was published a Sanctioned Interpretations (SI), for Version 3.0 of the e-Stewards Standard - e-Stewards Standard V3.1.	World	e-Stewards certification is currently available in almost every country in the world, with a few exceptions for those countries where accredited e-Stewards certification bodies are not allowed to do business.	Own funding. Recylers and Enterprises.
RECYCLER QUALIFICATION PROGRAM	EPRA	Canada	2009	March 31, 2016	National	Canada	The organizations that want to operate under an EPRA program must be audited and approved by the Recycler Qualification Office



Verification scheme	Organisation managing the scheme	Country in which is based the organisation managing the scheme	Existing since (indicate year)	last review of the scheme	Geographical scope (applicability)	Please precise your answer if you replied "national" or other territories in the previous question	Who is financing the audits?
EPEAT	Green Electronics Council	USA	2003	EPEAT is using a list of standards, EPEAT always requires the use of the latest update of these standards	World		Manufacturers
AS/NZS 5377-2013	Developed by the Australian Government Department of the Environment and the New Zealand Ministry of Environment, accreditation of CABs by The Joint Accreditation System of Australia and New Zealand (JAS-ANZ)	Australia and New Zealand	2013		National	Australia and New Zealand	Recyclers/transporters/Collectors , etc.

