Activating Circular Services in the Electric and Electronic Sector

GA NUMBER: 776714

Deliverable D6.3. Proposal for standardization of circular economy in the E&E sector

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Executive Summary

The present document constitutes the Deliverable 6.3 “Proposal for standardization of circular economy in the E&E sector” in the framework of the C-SERVEES project. The deliverable reports the outcomes of Task 6.3 “Measures towards the future standardization”.

The aim of this Deliverable is to explore standardization topics of Circular Economy (CE) in the EEE sector in order to evaluate the availability and appropriateness of the state-of-art standardization framework and collect information deriving from the experience of C-SERVEES Project and that can be useful for future standardization initiatives.

The standardization framework analysis collected a list of about 70 technical normative documents, including harmonized European standards, Technical Reports and Specifications, Guidelines, Standard proposals and other types of technical normative documents, covering all geographical areas (World relevance, European and national relevance standards, incl. IT, DE, CA, AU, NZ,…). The documents cover all the steps of the value chain, from the design phase to the use/reuse phases, collection and logistics, monitoring, Waste of Electronic and Electric Equipment (WEEE) pre-treatment and downstream treatment. A restricted list of these documents has been selected for a detailed investigation on its contents while an overview has been given if product specific regulations and/or standardization initiatives can be identified for the C-SERVEES products.

The analysis conducted on the WEEE Directive standardization deliverables (including the TR 50625-6 “Collection, logistics & treatment requirements for WEEE - Part 6: Report on the alignment between Directive 2012/19/EU and EN 50625 series standards and EN 50614” and relevant literature) showed that all relevant requirements of the WEEE Directive related to collection, transport, storage and depollution are largely covered in the CENELEC standardisation deliverables with the following Articles and Annexes covered in depth:

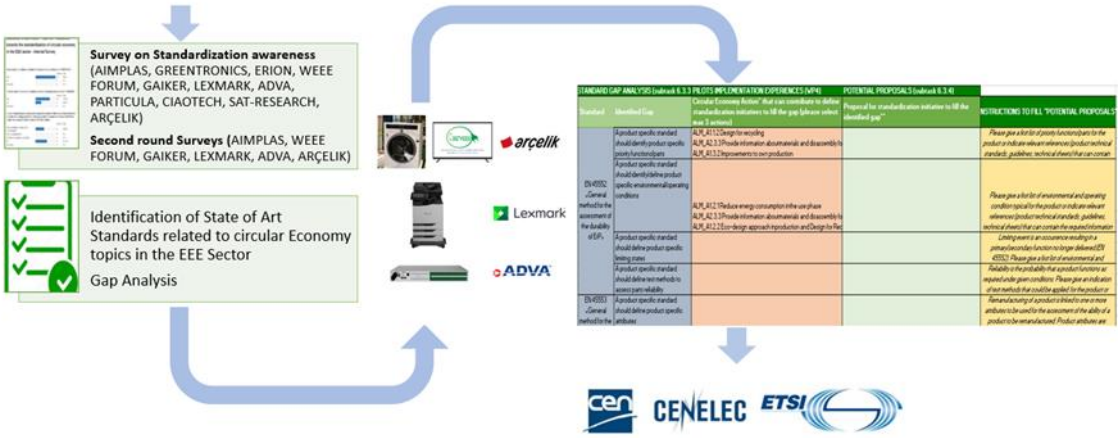
- Article 6 (Disposal and transport of collected WEEE)
- Article 8 (Proper treatment)
- Article 11 (Recovery targets)
- Annex VII (Selective treatment for materials and components of WEEE referred to in Article 8(2))
- Annex VIII (Technical requirements referred to in article 8 (3))

Specific issues that were highlighted in the M/518 Mandate are all covered: coverage of the collection of WEEE where it is crucial for subsequent proper treatment (TS 50265-4), areas for which detailed process management requirements are specified (EN 50625-1, EN 50625-2-4, 50625-2-3), Handling of batteries contained in WEEE (EN 50625-1, EN

50625-4), Data protection (EN 50625-1). Moreover, several requirements inserted as normative text in the standard are not derived from the WEEE Directive or other EU relevant legislation. Another important outcome of the study underlines that there is not a distinction between requirements deriving from the text of WEEE Directive or other relevant EU law and requirements that go beyond those depicted in the WEEE Directive (separating them between normative and informative parts of the standardization deliverable). Actually, several requirements inserted as normative text in the standard are not derived from the WEEE Directive or other EU relevant legislation.

The detailed analysis of EN 4555x series standards has also been conducted. The standards are horizontal and thought to be applied to any ErP, providing an agreed upon methodology to assess the following topics: durability, reuse, repair, upgrade, remanufacture, refurbish, recover, recycle, critical raw materials, marking and documentation. What is emerged from the standardization scenario analysis is the importance in the future to develop product group specific standards that will adapt the general assessment methodologies to the specificities of a product. Material efficiency aspects are indeed strictly related and prioritized in accordance with the product use profile (operating and environmental conditions, health and security issues, functional analysis, operating and limiting states, ...).

Consequently, the contribution deriving from the experience of Pilot implementation Partners during C-SERVEES Project has been exploited to derive a series of useful information that can be funnelled in future product specific standardization initiatives regarding TV, washing machines, printers, ICT equipment in general.



The overall activity of Task 6.3 can be so schematized as a roadmap that started in the framework of C-SERVEES Project and ended in the identification of stakeholders as potential recipients of the results.

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Acronyms and abbreviations

AFNOR	Association française de normalisation
ALM	Advanced Link Monitoring
ALM	Application Lifecycle Management
B2B	Business to Business
BSI	British Standards Institution
CA	Circularity Action
CEBMs	Circular Economy Business Models
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
DIN	Deutsches Institut für Normung
DT	Digital Twin
ECD	Environmentally Conscious Design
E&E	Electrical & Electronic
EEE	Electrical and electronic equipment
EoL	End of Life
ErP	Energy-related Products
ESOs	European Standards Organizations
EU	European Union
ICT	Information and Communication Technology
IoT	Internet of Things
ISO	International Organization for Standardization
IT	Information Technology
LCA	Life Cycle Assessment
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
NGO	Non-Government Organisations
NWI	New Work Item
SFS	Finnish Standards Association
CEN	European Committee of Normalization

TC	Technical Committee
TS	Technical Specification
UNE	Asociación Española de Normalización y Certificación
UNI	Ente Nazionale Italiano di Unificazione
WEEE	Waste of Electrical and Electronic Equipment (WEEE)
WG	Working Group

Introduction

The present document constitutes the Deliverable 6.3 “Proposal for standardization of circular economy in the E&E sector” in the framework of the C-SERVEES project. The deliverable reports the outcomes of Task 6.3 “Measures towards the future standardization”.

1.1 C-SERVEES Project

C-SERVEES projects aims to boost a resource-efficient circular economy in the electrical and electronic (E&E) sector through the development, testing, validation, and transfer of new Circular Economic Business Models (CEBMs) based on systemic eco-innovative services, such as: eco-leasing of EEE, product customisation, improved WEEE management, and ICT services to support the other eco-services (Figure 0.1).

ICT tools relying on QR codes are being developed as the driver of the proposed eco-innovative services to take full advantage of the potential and the synergies between circular economy and Industry 4.0.

The techno-economic, environmental, and social viability of the new CEBMs is validated through demonstrations dealing with four target products each belonging to a different EEE category: washing machines (large household appliances), printers and laser toner cartridges (IT equipment), ALM products (telecommunication equipment) and TV sets and displays (consumer electronics equipment).

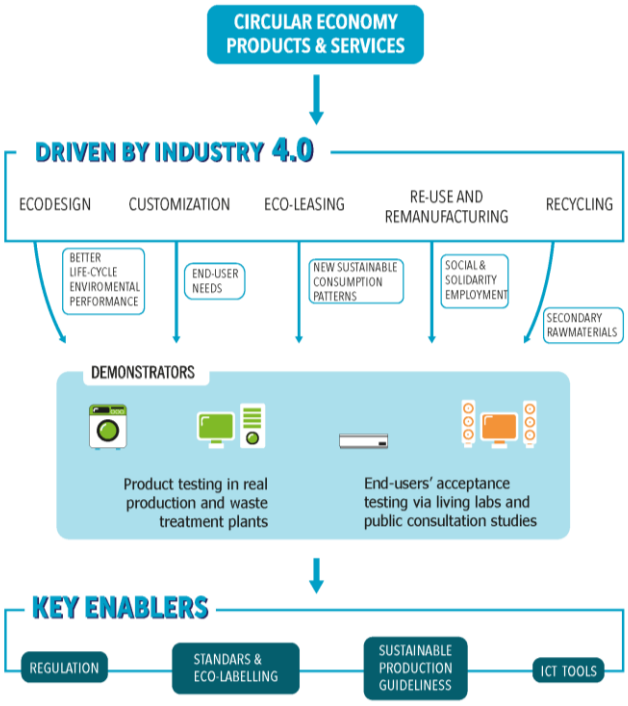

Figure 0.1 – Overview of C-SERVEES Project

In the framework of C-SERVEES, WP6 aims to provide key enabling tools for boosting the replicability and transferability of circular economy products and services across EU, developing ecodesign guidelines for EEE and recommendations on policies to overcome current legislative barriers, as well as a framework for standardizing the circular economy.

The latter is particularly important for overcoming the numerous uncertainties that producers and consumers are facing, which may limit the industrial use and market acceptability of new materials and products, such as recycled materials and products prepared for reuse or remanufactured. Standardization can simplify the communication of the technical and quality characteristics of materials and products, generating a greater confidence among end users and contributing to increase the market entry of materials and products obtained from WEEE.

In this regard, Task 6.3 aims to explore these issues and to evaluate the gaps in standards of circular economy in the E&E sector, identifying and collecting useful information to contribute future standardization initiatives.

1.2 Structure of the deliverable

The document is organised in the following chapters:

- Chapter 1 gives an introduction to the deliverable as well as an overview of the C-SERVEES project, main objectives and aim of the task.
- Chapter 2 describes the methodological approach.
- Chapter 3 reports an overview of standards and the results of the standardization framework analysis relating Circular Economy in the EEE sector.
- Chapter 4 reports an overview of main results deriving from the implementation of CEBMs in each of the C-SERVEES pilots.
- Chapter 5 reports the results of the analysis carried on the most relevant identified standard with the identification of gaps or availability for future standardization initiatives.
- Chapter 6 summarizes through a roadmap the main conclusions and considerations of the deliverable.

2 Methodology

The proposed methodology has been defined by RINA-C and shared for review and optimization with other partners involved in T6.3 (WEEE, LEXMARK, ADVA, ARCELIK, AIMPLAS, GAIKER). The below reported steps (1 to 4) have all been developed during Task 6.3 activities.

The overall approach can be summarized in the graph reported in the following Figure 2.1:

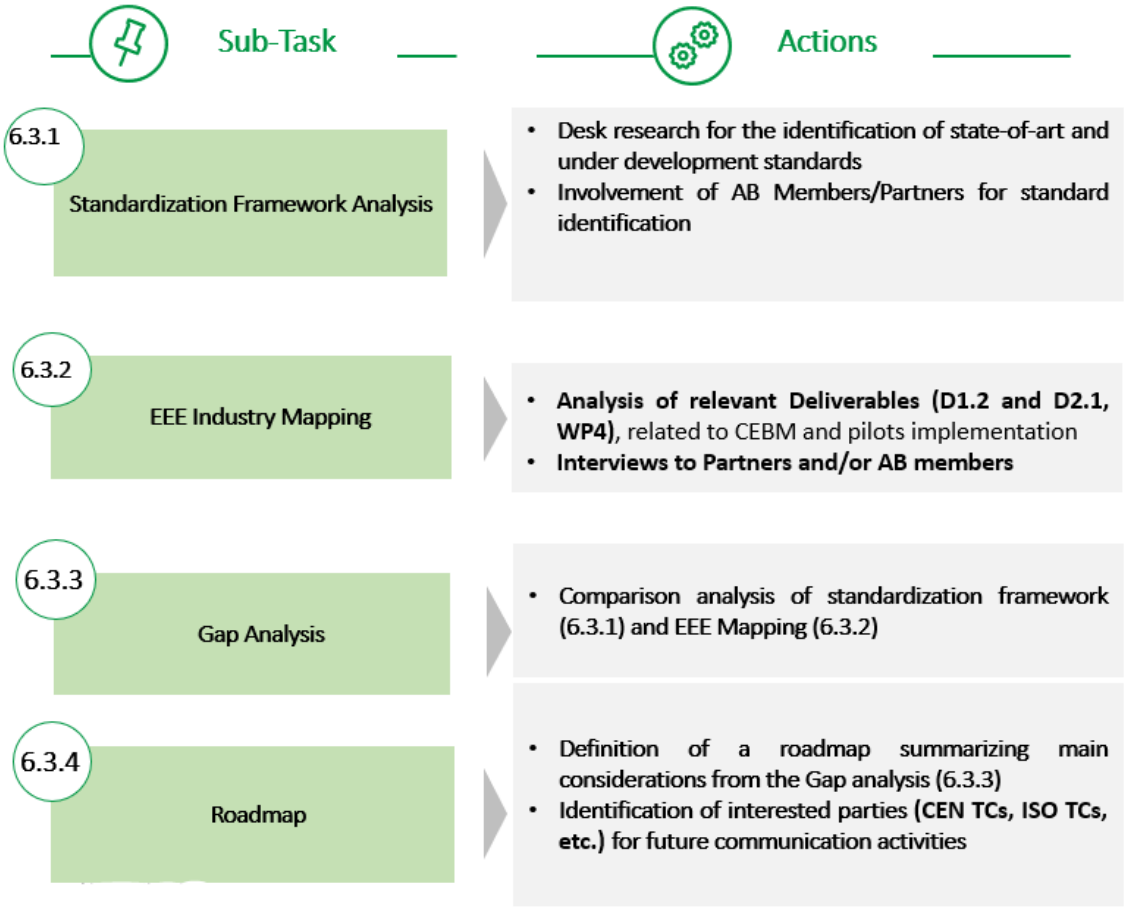

Figure 2.1 – Proposed Methodological Approach

The four steps were not necessarily conducted in strict subsequent time intervals, but continuous feedbacks were present between them during the entire duration of the Task.

Step 1 – Standardization Framework Analysis

First of all, a review on normative documents, their typologies and relations with legislative documents and typical development paths was performed, aiming to provide partners some training and basic knowledge on standardization, raise awareness on the importance of standards and the participation in standardization technical bodies.

A thorough research of relevant normative documents has been activated. The research covered mainly European standards developed by the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC), considering the objectives and main geographical areas of intervention of C-SERVEES. Also, international standards, developed by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) and/or other non-EU standardization organizations, have been considered, if relevant for C-SERVEES results.

Step 2 – Electric & Electronic Equipment Industry Mapping

The activities carried out included the analysis of relevant Deliverables (D1.2, D2.1, D4.2, D4.3 and D4.4), related to CEBM and pilot's implementation. Interviews to Partners and/or AB members have been conducted to collect feedback, suggestions and proposals on needs and requirements that could emerge from the implementation of the results of C-SERVEES. This is used to give an industry perspective on issues that can be covered or implemented by standardization related measures.

Step 3 – Gap Analysis - Study on quality of identified high priority standards

Objective of the analysis was the evaluation of the availability and appropriateness of the identified standardization framework and the identification of potential contributions to future standardization initiatives that can derive from the experience of C-SERVEES Project.

The activity is based on the outcomes of the standardization framework analysis and the EEE mapping.

The information has been gathered through a desk research and interviews with Partners that helped to collect feedback on standardization related issues emerged from project pilot's implementation and to depict the level of "standardization awareness" (knowledge of relevant standards, participation to TC/WGs, round tables, etc.) of the Consortium and to collect information that can be useful for future standardization initiatives.

Step 4 – Roadmap

The results and information collected during the previous subtasks has been synthesized and a panel of potential interested parties have been identified among Standardization Organizations Technical Committees, Working Groups, Environmental topics related Associations, etc. The list has been defined also based on the participation of C-SERVEES partners to some of the identified Organizations.

3 Standardization framework analysis

3.1 Standards and Technical normative documents [1], [2], [3]

In this Chapter, a brief overview on standards and standardization is reported.

A standard is a normative document that sets out requirements for a specific item, material, component, system or service, or describes in detail a particular method or procedure. A normative document is a "document that provides rules, guidelines or characteristics for activities or their results". It is used as a general term encompassing several documents such as standards, technical specifications, codes of practice and regulations. The formal definition of a standard (a specific normative document) is a "document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context".

According to [3], consensus is defined as a "general agreement, characterized by the absence of sustained opposition to substantial issues by any important part of the concerned interests and by a process that involves seeking to take into account the views of all parties concerned and to reconcile any conflicting arguments".

In terms of geographical coverage, a publicly available standard document can be classified as:

Table 3.1 – Publicly available standards: Geographical coverage

Publicly available standards – Geographical coverage	
International Standard	Standard that is adopted by an international standardizing/standards organization and made available to the public
Regional Standard	Standard that is adopted by a regional standardizing/standards organization and made available to the public
National Standard	Standard that is adopted by a national standards body and made available to the public
Provincial Standard	Standard that is adopted at the level of a territorial division of a country and made available to the public

The recognized body in the formal definition of standard is a "*standardizing body recognized at national, regional or international level, that has as a principal function, by virtue of its statutes, the preparation, approval or adoption of standards that are made available to the public*". Standard bodies can have different geographical coverage:

Table 3.2 – Bodies responsible for standards: Geographical coverage

Bodies responsible for standards Geographical coverage		Examples
National Standards Body	Standards body recognized at the national level, that is eligible to be the national member of the corresponding international and regional standards organizations.	UNI (Ente Nazionale Italiano di Unificazione), UNE (Asociación Española de Normalización y Certificación), BSI (British Standards Institution), DIN (Deutsches Institut für Normung), AFNOR (Association française de normalisation), SFS (Finnish Standards Association), *et al*
Regional Standards Organization	Standards organization whose membership is open to the relevant national body from each country within one geographical, political or economic area only.	CEN (European Committee for Standardization), CENELEC (European Committee for Electrotechnical Standardization), ETSI (European Telecommunications Standards Institute) for Europe, that is the region of interest for C-SERVEES Project
International Standards Organization	Standards organization whose membership is open to the relevant national body from every country.	ISO, IEC, ITU, IEEE, ASTM, ASME, *et al*

The main area of interest for the objectives of T6.3 are the **European Standards (ENs**[1]). These normative documents have been ratified by one of the three European Standardization Organizations (CEN, CENELEC, and ETSI), which are recognized as competent in the area of voluntary technical standardization as for the EU Regulation 1025/2012 [4]. Although they deal with different fields of activity, CEN, CENELEC, and ETSI cooperate in a number of areas of common interest, such as the machinery sector or information and communication technologies (ICTs). They also share common policies on issues where there is mutual agreement. An EN (European Standard) "*carries with it the obligation to be implemented at national level by being given the status of a national standard and by withdrawal of any conflicting national standard*" [5]. Therefore, a European Standard (EN) automatically becomes a national standard in each of the 34 CEN-CENELEC member countries. Standards are voluntary, which means that there is no automatic legal obligation to apply them. However, laws and regulations may refer to standards and even make compliance with them compulsory.

[1] EN, from the German name Europäische Norm ("European Norm")

European and International Standardization Organizations have signed formal agreements in order to avoid duplication of efforts and promote global relevance of standards.

CEN/ISO and CENELEC/IEC cooperation agreements [6]

CEN has an agreement for technical co-operation with the International Organization for Standardization (ISO). The **Vienna Agreement**, signed in 1991, was drawn up with the aim of preventing duplication of effort and reducing time when preparing standards. As a result, new standards projects are jointly planned between CEN and ISO. Wherever appropriate priority is given to ISO standard development, provided those international standards meet European legislative and market requirements and that non-European global players also implement these standards. The Vienna Agreement is completed by jointly developed Guidelines supporting the practical implementation of the Vienna Agreement.

CENELEC and IEC formalized the framework of their cooperation through the signature, in 1996, of an 'agreement on common planning of new work and parallel voting', known as the **Dresden Agreement**. The main purpose of the CENELEC-IEC cooperation is to avoid the duplication of work and to reduce time when preparing standards. As a result, new electrical standards projects are jointly planned between CENELEC and IEC, and, when possible, most are carried out at international level (IEC). This means that CENELEC will first offer a New Work Item (NWI) to its international counterpart. If accepted, CENELEC will cease working on the NWI. If IEC refuses, CENELEC will work on the standards content development, keeping IEC closely informed and giving IEC the opportunity to comment at the public enquiry stage. CENELEC and IEC vote in parallel (both organizations are voting at the same time) during the standardization process. If the outcome of the parallel voting is positive, CENELEC will ratify the European standard and the IEC will publish the international standard. CENELEC and IEC have reconfirmed their longstanding cooperation on October 17, 2016, by signing the **Frankfurt Agreement**.

Standards can be classified according to their typology (Table 3.1), even if the classification it is not intended to be rigid; standards related to products can be also classified as testing method standards if the normative document describes the testing procedures to verify the compliance to the specified minimum requirements.

Table 3.3 – Types of Standards and their description

Types of Standards	
Basic Standard	Standard that has a wide-ranging coverage or contains general provisions for one field

Terminology Standard	Standard that is concerned with terms, usually accompanied by their definitions, and sometimes by explanatory notes, illustrations, examples, *et al.*
Testing Standard	Standard that is concerned with test methods, sometimes supplemented with other provisions related to testing, such as sampling, use of statistical methods, sequence of tests
Product Standard	Standard that specifies requirements to be fulfilled by a product, or a group of products, to establish its fitness for purpose
Process Standard	Standard that specifies requirements to be fulfilled by a process, to establish its fitness for purpose
Service Standard	Standard that specifies requirements to be fulfilled by a service, to establish its fitness for purpose
Interface Standard	Standard that specifies requirements concerned with the compatibility of products or systems at their points of interconnection
Standard on data to be provided	Standard that contains a list of characteristics for which values or other data are to be stated for specifying the product, process or service

The key benefits that standards introduce are:

- Increase confidence: manufacturers, service providers and consumers can feel confident that the products, services or components they develop and/or use are safe, reliable and fit-for-purpose.
- Enhance innovation: new standards are often developed to reflect the latest technologies and innovations. Scientific literature already exists that relate the development of new standards and emerging technologies.
- Increase product competitiveness: a product/service that is compliable with a standard has more appeal towards the customers.
- Reduce barriers to international trade: setting out a common framework of minimum requirements and performances gives assurance that a specific product or service can be fit-for-purpose independently of where it has been developed.

Summarizing, their implementation helps both consumers and businesses by reducing costs, improving safety and enhancing performances. Moreover, they facilitate the international trade, ensuring that products, services and components are comparable in terms of compatibility and interoperability.

The interrelation between standards and the regulatory environment is particularly strong in the EU, where it can take place according to two main modalities. Standards can be directly cited by a Directive, as a reference document for evaluation of requirements. In this case, standards are called “Harmonized Standards” (hEN) and fulfilling them

guarantees compliance with the essential requirements defined by the Directive. The most relevant Directives and Regulations for C-SERVEES Project are briefly summarized in the following Chapter (starting from the analysis of results of T6.2).

Another way to link standard document development with legislation in EU is “Mandates”, also called “standardization requests”, a mechanism by which the European Commission (EC) and the EFTA Secretariat request the European Standards Organizations (ESOs) to develop and adopt European standards in support of European policies and legislation. Together with already published hEN, Mandates have been used as a search field in order to identify other relevant standards (developed and in progress) for C-SERVEES Project.

3.2 Standardization scenario analysis – environmental topics in the E&E sector

In this Paragraph the results of the standardization scenario analysis related to environmental and circular economy topics in EEE sector are reported.

The list of technical normative documents has been retrieved through the collaboration of all the Partners involved in T6.3 together with the consultancy of Advisory Board Members (ERION). The geographical coverage included all international relevant standards in order to track all potential contributions and standardization initiatives that can be relevant for the purposes of C-SERVEES Project. The list is reported in the following Table 3.4 together with the following information:

- Standard and version,
- Publisher,
- Geographical scope,
- Title,
- Scope.

Table 3.4 – Standardization scenario analysis – List of identified standards

Standard	Publisher	Geographical Scope	Title	Scope
EN 45552: 2020	CENELEC	EU	General method for the assessment of the durability of energy-related products	EN 45552 defines a framework comprising of parameters and methods for assessing the reliability and durability of ErPs. It is intended to be used in the preparation of product or product-group standardization deliverables.
EN 45553: 2020	CENELEC	EU	General method for the assessment of the ability to remanufacture energy-related products	NEN-EN 45553 contains a general method to assess the ability of energy-related products to be remanufactured. It is intended to be used by technical committees when producing horizontal, generic, and product, or product-group, standards. Assessing the ability of a part that is not considered to be an energy-related product to be remanufactured is not considered in this document. A scoring system to quantify the ability of an energy-related product to be remanufactured is not covered in this document. Only the criteria for the ability of an energy-related product to be remanufactured are presented in this document.
EN 45554: 2020	CENELEC	EU	General methods for the assessment of the ability to repair, reuse and upgrade energy-related products	EN 45554 provides generic methods to assess the following aspects: 1. the ability of products to be repaired 2. the ability of products, or parts thereof, to be reused 3. the ability of products to be upgraded For the purposes of this document, "product" refers to "Energy-related Product (ErP)". This document includes generic criteria and methods relevant for assessing the ability of certain parts to be removed from products for the purpose of repair, reuse or upgrade. The methods in this document include product-related and support-related criteria when the product is placed on the market, taking into account knowledge of parts that are likely to fail, need replacing, or have reuse potential. The decision whether a product should be repaired, reused or upgraded, is dependent on a range of factors such as health and safety, as well as economic, legal and environmental aspects. However, the question of whether it is reasonable to repair, reuse or upgrade products is outside of the scope of this document.
EN 45555: 2019	CENELEC	EU	General methods for assessing the recyclability and	EN 45555 establishes general principles for: - Assessing the recyclability of energy-related products; - Assessing the recoverability of energy-related products. This document also considers: - The ability to access or remove certain components, assemblies, materials or substances from products to facilitate their extraction at

Standard	Publisher	Geographical Scope	Title	Scope
			recoverability of energy-related products	the end-of-life for ease of treatment, recycling and other recovery operations; - The recyclability of critical raw materials (CRMs). This document defines parameters which are applicable for the development of product or product-group standards in order to calculate recyclability/recoverability rates. This document serves as a method for writing product or product-group standards, rather than being directly applied. Additional information and requirements not provided in this document will be necessary for product or product-group standards. This document is not applicable to generate publicly available product information and compare products in absence of product standards based on this document. Although this document can be used for a product or product-group, for the sake of a better readability only "product" is used throughout the rest of the document.
EN 45556: 2019	CENELEC	EU	General method for assessing the proportion of reused components in energy-related products	EN 45556 deals with the assessment of the proportion of reused components in energy-related products on a generic level, which can be applied at any point in the life of the product. This document is intended to be used by product technical committees when producing product, or product-group, standards. This document can be applied where no product-specific standard exists. Aspects like performance, validation, verification and suitability of reused components are not in the scope of this document.
EN 45557: 2020	CENELEC	EU	General method for assessing the proportion of recycled material content in energy-related products	EN 45557 specifies a general method for assessing the proportion of recycled material in an energy-related product. This document is applicable as the framework to be used for defining the assessment of recycled materials content in specific product groups. It is not intended to generate publicly available product information and compare products in the absence of a product standard based on this document. This document does not cover aspects such as quality and physical properties of recycled materials. This document does not apply to the assessment of reused components.
EN 45558: 2019	CENELEC	EU	General method to declare the use of critical raw materials in energy-related products	The main intended use of EN 45558 is to provide a means for information on the use of CRMs to be exchanged up and down the supply chain and with other relevant stakeholders. Potential users of this document are any public, private or social enterprises involved in the production of ErP, such as manufacturers of energy-related products (including SMEs) and other organisations in the product

Standard	Publisher	Geographical Scope	Title	Scope
				supply chain. It is also relevant to European market surveillance and trade authorities as well as European policy makers. This document is horizontal in nature and can be applied directly to any type of energy-related product. This document proposes a standardized format for reporting use of CRMs in energy-related products by applying the EN IEC 62474 materials declaration standard. However, this document does not provide or determine any specific method or tool to collect CRM data. Process chemicals, emissions during product manufacturing and packaging are not in scope of this document.
EN 45559: 2019	CENELEC	EU	Methods for providing information relating to material efficiency aspects of energy-related products	EN 45559 establishes a common method for the provision of information related to the material efficiency (ME) aspects of ErP. It has two key intentions: • it requires generic or horizontal ME topic publications to include a clause with an overview of the specific topic-related content to be reported; and • it includes a generic method on how to create a communication strategy which will be used when preparing product-specific, or product-group, publications.
EN 15343: 2008	CENELEC	EU	Plastics - Recycled Plastics - Plastics recycling traceability and assessment of conformity and recycled content	EN 15343 is the European standard that specifies the procedures needed for the traceability of recycled plastics. This gives the basis for the calculation procedure for the recycled content of a product.
EN 15347:2007	CENELEC	EU	Plastics - Recycled Plastics - Characterisation of plastics wastes (confirmed 2017; under review 2021)	This standard provides a scheme for the characterisation of plastics wastes, laying out those properties for which the supplier of the waste shall make information available to the purchaser, and identifying test methods where applicable. The s.cheme provides for a division of information between "Required Data", where a statement is required, even if it is "unclassified", and additional "Optional Data" which the supplier may choose to provide if it adds value to the waste
CEN/TR 15353:2007	CENELEC	EU	Plastics - Recycled plastics - Guidelines for the development of standards for recycled plastics	This Technical Report provides a format for the drafting of standards for recycled plastics. It is intended for use by all those who are preparing drafts for consideration by the Technical Committee. The guide provides information for the development of standards (guides, practices, test methods, and specifications) relating to the proper use of recycled plastics.

Standard	Publisher	Geographical Scope	Title	Scope
CEN/TS 16010:2021	CENELEC	EU	Plastics - Recycled plastics - Sampling procedures for testing plastics waste and recyclates (in revision CEN/TC 249 N2473)	This Technical Specification specifies a system for sampling procedures for testing plastics waste and recyclates which take into account the specifics of the plastics waste and recyclates. It is intended to cover all stages of the plastic recycling process. The sampling procedures include the statistical specifics of the plastic waste and the behaviour of recyclates. The sampling method should produce a representative testing sample. Differences can arise due to: - the mixture of plastics; - the origin (e.g. green dot in Germany, or electronic/automotive industry); - the previous use of the plastic material; - the residual contents (e.g. of containers); - inert, residual or moisture content on or in the material. This Technical Specification is without prejudice to any existing legislation.
CEN/TS 16011:2015	CENELEC	EU	Plastics - Recycled plastics - Sample preparation (confirmed 2019)	This Technical Specification specifies the preparation of samples of recycled plastics prior to testing and takes account of the specifics of the material. Sample preparation should avoid any process that causes 'de-mixing' of the sample. Following preparation, the sample should remain representative. The behaviour of contaminants should be carefully analysed and observed to ensure this is homogeneous. This Technical Specification does not address any legal or product safety issues.
CEN/TS 17627:2021	CENELEC	EU	Plastics - Recycled plastics - Determination of solid contaminants content	This document specifies a method for determination by melt filtration of solid contaminants content in a sample of recycled thermoplastic material, evaluating their number and, optionally, their size and substance (material).
ISO 17422:2020	ISO	World	Plastics — Environmental aspects — General guidelines for their inclusion in standards	This document provides a structure for inclusion of environmental aspects in standards for plastics products. It proposes an approach which is directed at minimizing any adverse environmental impact without detracting from the primary purpose of ensuring adequate fitness for use of the products under consideration. The guidance provided by this document is intended primarily for use by standards writers. Over and above its primary purpose, however, this document provides guidance of value to those involved in design work and other activities where environmental aspects of plastics are being considered.

Standard	Publisher	Geographical Scope	Title	Scope
EN 50419:2022	CENELEC	EU	Marking of electrical and electronic equipment in accordance with Article 11(2) of Directive 2002/96/EC (WEEE)	BS EN 50419 contains the marking requirements needed to ensure compliance with WEEE Directive. These marking requirements are applicable to all manufacturers and producers of electrical and electronic equipment distributed within the EU. BS EN 50419 contains additional information relating to the marking requirements, including positioning, visibility, dimensions, location and referenced documents. This standard will also be of interest to distributors, importers and exporters of electrical and electronic equipment on a professional basis into EU Member States. The marking serves to clearly identify the producer of the equipment and that the equipment has been put on the market after 13 August 2005.
IEC 63000:2021+AMD1:2022 CSV	IEC	EU	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances	This document specifies the technical documentation that the manufacturer compiles in order to declare compliance with the applicable substance restrictions. The documentation of the manufacturer's management system is outside the scope of this document.
EN 50614: 2020	CENELEC	EU	Requirements for the preparing for re-use of waste electrical and electronic equipment	This Technical Specification applies to the following operations: collection, handling, sorting, storage, preparation for transport and transport of WEEE. It is applicable to all WEEE prior to arriving at the treatment facility or arriving at a preparation for re-use facility. This Technical Specification addresses all operators that perform collection and logistics operations. This technical specification does not cover treatment of WEEE. In case of treatment activities undertaken at collection or logistics facilities the Standard EN 50625-1 applies.
EN 50625-1:2014	CENELEC	EU	Collection, logistics & treatment requirements for WEEE - Part 1: General treatment requirements	This European Standard is applicable to the treatment of waste electrical and electronic equipment (WEEE). This standard will be supplemented, for example by standards covering specific equipment. NOTE This European Standard is intended to cover WEEE arising from electrical and electronic equipment as listed in Annex I and Annex III of Directive 2012/19/EU. This standard applies to the treatment of WEEE until end-of-waste status is fulfilled, or until the WEEE is prepared for re-use, recycled, recovered, or disposed of. This standard addresses all operators involved in the treatment including related handling, sorting, and storage of WEEE.

Standard	Publisher	Geographical Scope	Title	Scope
EN 50625-2-2:2015	CENELEC	EU	Collection, logistics & treatment requirements for WEEE - Part 2-2: Treatment requirements for WEEE containing CRTs and flat panel displays	This clause of Part 1 is replaced by the following: This European standard is applicable to the treatments of WEEE containing CRTs and flat panel displays. This European standard applies to the treatment of WEEE containing CRTs and flat panel displays until end-of-waste status is fulfilled, or fractions are recycled, recovered, or disposed of. This European standard addresses all operators involved in the treatment including related handling, sorting, and storage.
EN 50625-2-3: 2017	CENELEC	EU	Treatment requirements for temperature exchange equipment and other WEEE containing VFC and/or VHC	This European Standard is applicable to the treatment of waste temperature exchange equipment and other WEEE containing VFC or VHC in refrigerants or blowing agents. This European Standard applies to the treatment of temperature exchange equipment until end-of-waste status is fulfilled, or temperature exchange equipment fractions are recycled, recovered, or disposed of. This European Standard addresses all operators involved in the treatment including related handling, sorting and storage of temperature exchange equipment.
TS 50625-3-1: 2015	CENELEC	EU	Collection, logistics & treatment requirements for WEEE - Part 3-1: Specification for de-pollution - General	This Technical Specification is intended to be used in conjunction with the WEEE Treatment Standard EN 50625-1 for most types of WEEE (other documents will be developed to define requirements for specific WEEE requiring more specialised treatment).
TS 50625-3-3: 2017	CENELEC	EU	Collection, logistics & treatment requirements for WEEE – Part 3-3: Specification for de-pollution – WEEE containing CRTs and flat panel displays	Clause 1 of CLC/TS 50625-3-1:2015 is replaced with the following: This European Technical Specification is intended to be used in conjunction with CLC/TS 50625-3-1 Collection, logistics and treatment requirements for WEEE - Part 1: General treatment requirements, EN 50625 1, Collection, logistics and Treatment requirements for WEEE - Part 2-2: Treatment requirements for WEEE containing CRTs and flat panel displays, EN 50625-2-2 and Collection, logistics and treatment requirements for WEEE - Part 3-1: Specification for de-pollution - General, CLC/TS 50625-3-1.
TS 50625-3-4: 2017	CENELEC	EU	Collection, logistics & treatment requirements for WEEE - Part 3-4: Specification for de-pollution - temperature	This Technical Specification is intended to be used in conjunction with the WEEE Treatment Standard for temperature exchange equipment, EN 50625-2-3, and the Technical Specification for de-pollution, CLC/TS 50625 3-1.

Standard	Publisher	Geographical Scope	Title	Scope
			exchange equipment	
TS 50625-4:2017	CENELEC	EU	Collection, logistics & treatment requirements for WEEE - Part 4: Specification for the collection and logistics associated with WEEE	This Technical Specification applies to the following operations: collection, handling, sorting, storage, preparation for transport and transport of WEEE. It is applicable to all WEEE prior to arriving at the treatment facility or arriving at a preparation for re-use facility. This Technical Specification addresses all operators that perform collection and logistics operations. This technical specification does not cover treatment of WEEE. In case of treatment activities undertaken at collection or logistics facilities the Standard EN 50625-1 applies.
TS 50625-5:2017	CENELEC	EU	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. NOTE 1 For the treatment of WEEE EN 50625-1 applies. This Technical Specification 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 (see Annex A). All chemical and metallurgical processes are included up and until the output materials will be used for their original purpose or for other purposes or will be finally disposed of. NOTE 2 The main precious metals concerned are gold, silver, and palladium. NOTE 3 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). NOTE 4 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, pressure leaching. They differ from mechanical / physical processes such as sorting and separation based on physical properties (e.g. density, magnetism, colour) and size reduction processes such as shredding and grinding. NOTE 5 In general, these final treatment facilities are covered by the IED 2010/75/EU, e.g. copper smelters or refiners.
UNE CLC/TR 50625-6: 2018	CENELEC	EU	Collection, logistics & treatment requirements for	This Technical Report provides information on the alignment between Directive 2012/19/EU and EN 50625 series standards and EN 50614.

Standard	Publisher	Geographical Scope	Title	Scope
			WEEE - Part 6: Report on the alignment between Directive 2012/19/EU and EN 50625 series standards and EN 50614	
PNW 111-610: 2021	IEC	World	Sustainable management of waste electrical and electronic equipment (e-waste).	This document specifies the requirements for the sustainable management of waste electrical and electronic equipment (e-waste). The document is intended for use by an organization seeking to manage its responsibilities in a systematic manner that contributes to the environmental and social pillars of sustainability. Organizations can use this document to enhance the sustainability of e-waste management. The requirements set by this international standard will help an organization to achieve sustainability outcomes, which provide value for the environment, the organization itself and interested parties. Consistent with the organization's own policy, the intended outcomes of a sustainable e-waste management approach include: • enhancement of sustainability performance; • fulfilment of compliance obligations; • achievement of sustainability objectives. The document is applicable to any organization, regardless of size, type and nature. The document applies to the environmental and social aspects of the e-waste management activities, products and services that the organization determines, it can either control or influence considering a lifecycle perspective.
IEC 62321-1:2013	IEC	World	Determination of substances in metals, plastics and electronics (for instances PBDE)	IEC 62321-1:2013 refers to the sample as the object to be processed and measured. The nature of the sample and the manner in which it is acquired is defined by the entity carrying out the tests and not by this standard. It provides guidance on the disassembly procedure employed for obtaining a sample. This first edition of IEC 62321-1 is a partial replacement of IEC 62321, forming a structural revision and replacing Clauses 1 to 4.

Standard	Publisher	Geographical Scope	Title	Scope
EN-IEC 62430:2019	IEC	World	Environmentally conscious design (ECD) - Principles, requirements and guidance	EN-IEC 62430 describes principles, specifies requirements and provides guidance for organizations intending to integrate environmental aspects into the design and development in order to minimize the adverse environmental impacts of their products. This document applies to processes on how ECD (environmentally conscious design) are integrated into the design and development. This document applies to any organization, regardless of its size, type or sector. This document does not provide requirements for assessing the conformity of individual products. This horizontal standard is primarily intended for use by technical committees in the preparation of standards in accordance with the principles laid down in IEC Guide 108. One of the responsibilities of a technical committee is, wherever applicable, to make use of horizontal standards in the preparation of its publications. The contents of this horizontal standard will not apply unless specifically referred to or included in the relevant publications.
IEC 62474:2019	IEC	World	Material declaration for products of and for the electrotechnical industry	IEC 62474:2018 is available as IEC 62474:2018 RLV which contains the International Standard and its Redline version, showing all changes of the technical content compared to the previous edition.IEC 62474:2018 specifies the procedure, content, and form relating to material declarations for products of companies operating in and supplying the electrotechnical industry. Process chemicals and emissions during product use are not in the scope of this International Standard.
IEC TR 62476:2010	IEC	World	Guidance for evaluation of product with respect to substance-use restrictions in electrical and electronic products	IEC 62474:2018 is available as IEC 62474:2018 RLV which contains the International Standard and its Redline version, showing all changes of the technical content compared to the previous edition.IEC 62474:2018 specifies the procedure, content, and form relating to material declarations for products of companies operating in and supplying the electrotechnical industry. Process chemicals and emissions during product use are not in the scope of this International Standard.
IEC 62542:2013	IEC	World	Environmental standardization for electrical and electronic products and systems - Glossary of terms	IEC 62542:2013 specifies generic terms and definitions that are related to environmental standardization within the IEC. It serves as a glossary of terminology to be considered for environmental aspects of relevant work in IEC. The terms cover environmental issues that are relevant for electrotechnical products across all product life cycle stages. It has the status of a horizontal standard in accordance with IEC Guide 108.

Standard	Publisher	Geographical Scope	Title	Scope
PAS 62545:2008	IEC	World	Environmental information on Electrical and Electronic Equipment (EIEEE)	This PAS provides 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 who needs or requests it. As a result, generic requirements to be followed by upstream suppliers to deliver necessary information to downstream producers are also specified. This PAS is stand-alone and only applicable if relevant requirements on environmental aspects and impacts information does not exist in relevant product standard.
PAS-62596: 2009	IEC	World	Electrotechnical products. Determination of restricted substances. Sampling procedure. Guidelines	IEC/PAS 62596:2009(E) is a Publicly Available Specification which provides general sampling guidelines and strategies of sampling for electrotechnical products, electronic assemblies, electronic components. In order to obtain samples that can be used for analytical testing to determine the levels of restricted substances as described in the test methods of IEC 62321. Restrictions for substances will vary between geographic regions and from time to time. This document describes a generic process for the sampling of any substance which could be restricted.
TR 62635:2012	IEC	World	Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment	IEC/TR 62635:2012(E) provides a methodology for information exchange involving EEE manufacturers and recyclers, and for calculating the recyclability and recoverability rates to provide information to recyclers to enable appropriate and optimized EoL treatment operations, provide sufficient information to characterize activities at EoL treatment facilities in order to enable manufacturers to implement effective ECD, evaluate the recyclability and recoverability rates based on product attributes and reflecting real end-of-life practices.
PAS-62596: 2009* *Withdrawn. Note: this publication has been partially replaced by IEC 62321-	IEC	World	Electrotechnical products. Determination of restricted substances. Sampling procedure. Guidelines	IEC/PAS 62596:2009(E) is a Publicly Available Specification which provides general sampling guidelines and strategies of sampling for electrotechnical products, electronic assemblies, electronic components. In order to obtain samples that can be used for analytical testing to determine the levels of restricted substances as described in the test methods of IEC 62321. Restrictions for substances will vary between geographic regions and from time to time. This document describes a generic process for the sampling of any substance which could be restricted.

Standard	Publisher	Geographical Scope	Title	Scope
2:2013 IEC 62321-3-1:2013				
IEC TR 62824:2016	IEC	World	Guidance on material efficiency considerations in environmentally conscious design of electrical and electronic products	IEC 62824:2016(E) which is a Technical Report provides information on selection and efficient use of materials in electrical and electronic products. Environmentally conscious design (ECD) can then proceed in such a way that aspects, including material type, material quantity, material substitutability, renewable material, material recyclability, material recoverability, and durability of product are taken into account during the design phase.
IEC TR 62936: 2016	IEC	World	Test method development - Guidelines for substance selection	IEC/TR 62936 provides guidelines for the selection of substances for the development of test method standards. The substances and substance groups listed in the IEC 62474 database are the primary source of candidate substances. Other substances that are under regulatory roadmap and market requirements can also be considered for this filtering and selection process.
EN-IEC 63333	IEC	World	General method for assessing the proportion of reused components in products	This document deals with the assessment of the proportion of reused components in products on a generic level, which can be applied at any point in the life of the product. It applies primarily to electrical and electronic products and systems, but could be also applied to other product types and systems. This document is intended to be used in the assessment of the proportion of reused components in products. It can be also used by technical committees when developing assessment methods dedicated to their product or product-group publications. Aspects like performance, validation, verification and suitability of reused components are not in the scope of this document.
EN-IEC 63366: 2021	IEC	World	Product category rules for life cycle assessment of electrical and electronic products and systems.	This document establishes product category rules (PCR) for life cycle assessment of electrical and electronic products and systems. It specifies the process and requirements on how to conduct life cycle assessment in the context of Type Ⅲ environmental declarations. PCR is complemented by additional product-specific rules (PSR), which further define e.g. functional units and default scenarios in the product-specific context. Therefore, it also gives guidance on how to develop PSR in corresponding product (group) committees (TCs/SCs/SyCs). This document provides common rules for: a) life cycle assessment (LCA), including the

Standard	Publisher	Geographical Scope	Title	Scope
				requirements for developing default scenarios; b) the LCA report; c) the development of product specific rules.
EN-ISO/IEC 82474-1: 2021	IEC	World	Material declaration – Part 1: General requirements	The existing IEC 62474 Ed. 2 covers material declaration for products of and for the Electrotechnical industry. The new ISO-IEC Dual Logo International Standard will cover material declaration of and for products of any industry sector. More specifically, it specifies the procedure, content, and form relating to material declarations for products and accessories of organizations operating in and supplying to any industry sector. The main intended use of this document is to provide data up and down the supply chain that: • allows organizations to assess products against substance and material compliance requirements, • allows organizations to use this information in their environmentally conscious design process and across all product life cycle phases. This new International Standard is intended to allow reporting based on engineering judgement, supplier material declarations, and/or sampling and testing. It does not suggest any specific method or process to obtain material declaration data in the supply chain. However, it provides a data format used to transfer information within the supply chain. This new IS will also specify formats and rules to manage sector specific requirements. However, it will not include the creation or maintenance of sector specific requirements such as the content of lists (e.g. declarable substances lists), and other sector specific declaration requirements which are the responsibility of each sector itself. Last, it is the objective that all generic requirements and guidance existing in the IEC 62474 Ed. 2.0 will be transferred to the new IEC 82474-1 standard. All the Electrotechnical-specific content (such as the declarable substances list), however, will remain in the IEC 62474, but under a new edition (IEC 62474 Ed.3).
IEEE 1680.1-2020	IEEE	World	IEEE Standard for Environmental and Social Responsibility Assessment of Computers and Displays	A clear and consistent set of environmental and social responsibility performance criteria for the design of computers (including notebook computers, desktop computers, integrated desktop computers, portable all-in-one computers, slates/tablets, small-scale servers, thin clients and workstations) and displays (including monitors and signage displays) is established, providing an opportunity

Standard	Publisher	Geographical Scope	Title	Scope
				for manufacturers to secure market recognition for their efforts. This standard is also intended to provide a tool for government, institutional, corporate, and consumer purchasers to identify products that demonstrate environmental and social responsibility leadership. This standard is intended to be updated and revised on a periodic basis to continue to set a higher performance standard for leadership products.
IEEE 1680.2™ – 2012	IEEE	World	Standard for Environmental Assessment of Imaging Equipment	This standard defines environmental performance standards for imaging equipment (as defined by the U.S. ENERGY STAR® Imaging Equipment Specification1) including copiers, digital duplicators, facsimile machines, multifunction devices, printers, mailing machines, and scanners, relating to reduction or elimination of environmentally sensitive materials, materials selection, design for end of life, life-cycle extension, energy conservation, end-of-life management, corporate performance, packaging, consumables, and indoor air quality.
IEEE 1680.3-2012	IEEE	World	IEEE Standard for Environmental Assessment of Televisions	This standard defines environmental performance for televisions, television combination units, and component television units, relating to reduction or elimination of environmentally sensitive materials, materials selection, design for end of life, life-cycle extension, energy conservation, end-of-life management, corporate performance, and packaging. This standard applies to products that are primarily marketed as televisions, and does not cover computer displays as defined by IEEE 1680.1
ISO/IWA 19:2017	ISO	World	Guidance principles for the sustainable management of secondary metals	IWA 19:2017 provides a global framework for the sustainable management of secondary metals. The framework includes sustainability and traceability requirements for metals recovered. IWA 19:2017 guides economic operators of secondary metals value chains, including those engaged in the informal sector, in the efficient and credible implementation of improved recycling practices, in particular in emerging and developing economies.
ISO/TC 323: 2018	ISO	World	Standardization in the field of Circular Economy to develop frameworks, guidance,	Standardization in the field of Circular Economy to develop frameworks, guidance, supporting tools and requirements for the implementation of activities of all

Standard	Publisher	Geographical Scope	Title	Scope
			supporting tools and requirements for the implementation of activities of all involved organizations, to maximize the contribution to Sustainable Development.	involved organizations, to maximize the contribution to Sustainable Development. Excluded: Aspects of Circular Economy already covered by existing committees. Note: In parallel, the ISO TC 323 works in cooperation with existing committees on subjects that may support Circular Economy.
Standard in progress: ISO/WD 59004	ISO	World	Circular economy — Framework and principles for implementation	
Standard in progress: ISO/WD 59010	ISO	World	Circular economy — Guidelines on business models and value chains	
Standard in progress: ISO/WD 59020	ISO	World	Circular economy — Measuring circularity framework	
Standard in progress: ISO/CD TR 59031	ISO	World	Circular economy – Performance-based approach – Analysis of cases studies	
Proposed standard, under development: ISO 59014	ISO	World	Secondary materials - Principles, sustainability and traceability requirements	
Proposed standard: ISO/NP 6572: 2021	ISO	World	Circular Economy - Product Circularity Data Sheet	

Standard	Publisher	Geographical Scope	Title	Scope
Proposed standard: ISO NP/XXX	ISO	World	Italian proposal for "Efficient use and management of resources in the circular economy"	
e-Stewards Standards: 2012	Basel Action Network	World	e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment	The e-Stewards Initiative is an electronics waste recycling standard created by the Basel Action Network. The program and the organization that created it grew out of the concern that electronic waste generated in wealthy countries was being dismantled in poor countries, often by underage workers. The young workers were being exposed to toxic metals and working in unsafe conditions.
NSF/ANSI 426-2019	NSF	World	Environmental Leadership and Corporate Social Responsibility Assessment of Servers	This Standard defines environmental and corporate social responsibility performance criteria for computer servers as defined in the ENERGY STAR Server specification. This Standard establishes criteria for multiple levels of environmental leadership and corporate social responsibility performance throughout the product life cycle, relating to energy efficiency; management of substances; preferable materials use; product packaging; design for repair, reuse and recycling; product longevity; responsible end-of-life management; and corporate responsibility.
UL 110 Edition 2 – 2017	UL Environmental Standard	World	Standard for Sustainability for Mobile Phones	This Standard establishes multiple attribute sustainability criteria for mobile phones, covering the mobile phone, accessories shipped in the box with the mobile phone, and packaging. The criteria in this Standard were developed based on the life cycle stages of mobile phones and corporate sustainability performance factors. Sustainability factors considered in this Standard are: a) Materials; b) Energy use; c) End of life management and extension of useful life; d) Packaging; e) Corporate practices; f) Manufacturing and operations. Credit for innovations in these, or other factors not listed, is also addressed in this Standard. This standard includes two types of criteria: Product criteria: Applies to the product declared to conform to the standard. Corporate criteria: Applies to the manufacturer that declares products to conform to this standard for at least the applicable operations. Unless designated as corporate, criteria in this standard are product criteria.

Standard	Publisher	Geographical Scope	Title	Scope
R2:2013	SERI	World	The Responsible Recycling ("R2") Standard for Electronics Recyclers	The R2:2013 Standard is the most recent version of the Standard. The R2 Standard is a way to identify, aggregate, distribute, and monitor best-practices in electronics repair and recycling. The (R2) Standard "Responsible Recycling practices for Use in Accredited Certifications Programs" emerged from a multi-stakeholder process convened by the US Environmental Protection Agency to create a voluntary, market-based mechanism for ensuring best practices in electronics recycling. The development of the standard addressed the operational and environmental challenges in electronics recycling and repair. The R2 Standard creates market incentives for recycling facilities to implement environmental, health, and safety procedures that directly benefit their workers, the communities in which they operate, and the environment. The R2 Standard helps facilities avoid "reinventing the wheel" by providing consistent knowledge and guidance for electronics repair and recycling that can be applied to any facility, anywhere.
EPSC Electronics Recycling Standard (ERS) 2015	EPSC	Canada	Standard for the downstream treatment of all WEEE	As the problems posed by waste electronics has grown, governments around the world have enacted various rules and regulations around how they are handled. These regulations often take the form of a stewardship scheme where the manufacturers are responsible for setting up and paying for the collection, transportation and recycling of e-waste. The products covered under the various provincial stewardship programs have expanded over the years in phases. All programs started with phase 1, which included standard office and home electronics like computers, printers, monitors and TVs. Phase 2 included home audio and telecommunications equipment such as stereos and phones. In Canada, stewardship programs are implemented at the provincial level and overseen by the respective Ministry of the Environment.
Überblick AG 1 –5 der UBA-Empfehlungen zu Behandlungsa	Federal Environment Agency	Germany		

Standard	Publisher	Geographical Scope	Title	Scope
nforderungen an EAG: 2020				
VDI 2343 Blatt 4: 2012	VDI – The Association of German Engineers	Germany	Recycling of electrical and electronic equipment - Preparation techniques	The guideline provides precise instructions and recommendations for reconditioning of electrical and electronic equipment and considers specifications and influence of legal frames, manufacturer specifications, sales markets for recovered material flow as well as type and stage of disassembly. The reconditioning essentially comprises crushing, classification and sorting in appropriate plants. The aim is the separation of harming and disturbing substances following the technical and regulatory requirements as well as the production of material flow for the utilization and harmless disposal.
UNI/CT 057 Economia circolare: 2019	UNI	Italia	Circular economy	The standardization system, which "has always been sensitive to environmental issues," intends to contribute to promoting the circular economy. This is the reason why the Italian Organization for Standardization (UNI) has established a new technical commission UNI/CT 057 "Circular Economy". UNI/CT 057 will have the task to develop requirements, reference frameworks, guidelines and support regulatory instruments for the circular economy projects.
Standard in progress: UNI/TS (UNI1608856)	UNI	Italia	Circularity measurement	
Standard in progress: UNI/TR (UNI1608977)	UNI	Italia	Case study analysis	
AS/NZS 5377: 2013	Standards Australia	Australia, New Zealand	Collection, storage, transport and treatment of end-of-life electrical and electronic equipment	This Standard sets out principles and minimum requirements for the safe and environmentally sound collection, storage, transport and treatment of end-of-life electrical and electronic equipment in order to maximize re-use and material recovery, reduce or eliminate the amount of waste from this equipment going to final point of disposal operations such as landfill, safeguard worker health, and minimize harm to the environment. This Standard covers electrical and electronic

Standard	Publisher	Geographical Scope	Title	Scope
				equipment designed for a supply voltage not exceeding 1000 volts for alternating current and 1500 volts for direct current.
eWASA Technical Guidelines	eWASA	South Africa	Recycling of Electrical and Electronic Equipment, Technical Guidelines	The aim of these technical Guidelines is to put measures needed in place to protect the environment and human health by preventing or reducing the adverse effects of the recycling of waste electrical and electronic appliances. These technical regulations will contribute towards closing material cycles, thereby reducing the consumption of natural resources.These technical regulations are an integral part of the recycling contract on environmentally- friendly treatment of waste electrical and electronic appliances concluded between eWASA and the recycling company. These technical Guidelines stipulate the processing requirements and special obligations of the recycling companies, and observance of these is assessed by eWASA Technical Control Committee (TCC) via a bi-annual auditing process.
XP X 30-901:2018	AFNOR		"Circular economy - Circular economy project management system - Requirements and guidelines"	Management. The standard defines the guidelines, consistently with ISO 9001, for the certification of an organization in relation to the circular economy, that according to the standard is considered as "an economic system of exchange and production that, at all stages of the product life cycle (goods and services) aims to use resources more efficiently and decrease environmental impact, while promoting the welfare of the individual, and in which the value of products, materials and resources is maintained in the economy as long as possible and the production of waste is minimized". Organisations that want to distinguish themselves as leaders in the field of circular economy management can adopt a circular economy management system and, pending the release of the ISO standard on circular economy management, developed by the ISO Committee ISO/TC 323 - Circular economy, can refer to the standard 'XP X30 -901 Circular Economy - Circular economy project management system - Requirements and guideline' developed by AFNOR. The management system according to the AFNOR XP X30-901 standard can be integrated with other ISO 14001/9001/45001 systems already implemented in the company.
BS 8001:2017 (under review)	BSI	UK	Framework for implementing the principles of the circular	Management. BS 8001 on the circular economy provides guidance and recommendations that will help an organization turn the circular economy concept and theory into practical action.

Standard	Publisher	Geographical Scope	Title	Scope
			economy in organizations. Guide	BS 8001 will help provide environmental benefits through improved resource use in addition to delivering financial and social benefits, through economic, employment, and innovation opportunities.

The list includes harmonized European standards, Technical Reports and Specifications, Guidelines, Standard proposals and other types of technical normative documents, covering all geographical areas (World relevance, European and national relevance standards, incl. IT, DE, CA, AU, NZ,…). The identified documents cover all the steps of the value chain, from the design phase to the use/reuse phases, collection and logistics, monitoring, Waste of Electronic and Electric Equipment (WEEE) pre-treatment and downstream treatment. As can be seen from the following Figure 3.1, the main Standardization Body involved in the publication or initiatives (Technical Committees designations, Technical Reports drafting, etc.) on the implementation of Circular Economy principles for the EEE sector is the European Standard Organization CENELEC followed by the IEC and ISO. It is interesting to note that the first national standard body is the Italian UNI with the Technical Committee UNI/CT 057 "Circular Economy" and two standards in progress related to the horizontal implementation of Circular Economy measurement and principles.

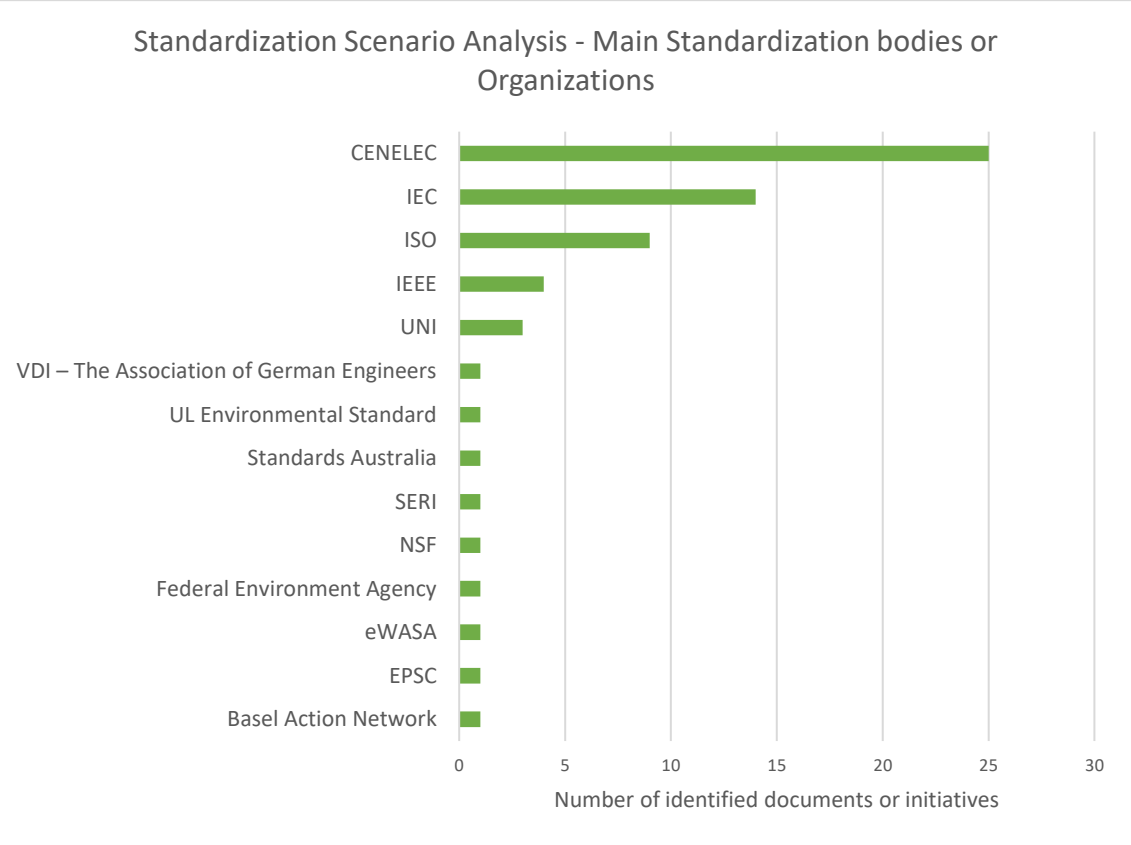

Figure 3.1 – Standardization Framework Analysis – Main Standardization Bodies and Organizations

In the following Table 3.5 main topics covered by the normative documents published by the first four Standardization Organizations (CENELEC, IEC, ISO and IEEE) are reported:

Table 3.5 – Main topics covered by published standards on Circular Economy – Main Standardization Organizations

Organizations	Topics covered by the standards
CENELEC	Durability – Remanufacturing – Repair/Recyclability/Recycling/Reuse Information and Traceability Analysis and Sampling WEEE containing CRTs and flat panel displays Temperature exchange equipment and other WEEE containing VFC and/or VHC WEEE containing and flat panel displays CRT monitors and TVs, Fluorescent lamps, Large household appliances like washing machines, dishwasher and dryers, Mobile phones, Laptops, Tablets, Desktop computers All WEEE – sub-stream containing copper and precious metals and CRMs general
IEC	All WEEE Determination of substances in metals, plastics and electronics (for instances PBDE) Electrical and Electronic Equipment
ISO	CRT monitors and TVs, Fluorescent lamps, Large household appliances like washing machines, dishwasher and dryers, Mobile phones, Laptops, Tablets, Desktop computers Standardization in the field of Circular Economy
IEEE	Computers and displays - Imaging Equipment - Televisions

According to the standardization scenario analysis, the geographical area of interest of C-SERVEES Project together with the feedbacks collected from the Partners on the first survey on "Standardization awareness", the detailed analysis of technical standards and the subsequent gap analysis (Paragraph 5) is dedicated to the following standards:

- EN 50614:202 - Requirements for the preparing for re-use of waste electrical and electronic equipment
- EN 50625-1: 2014 - Collection, logistics & treatment requirements for WEEE - Part 1: General treatment requirements
- EN 50625-2-1: 2014 - Collection, logistics & treatment requirements for WEEE – Part 2-1: Treatment requirements for lamps
- EN 50625-2-2: 2015 - Collection, logistics & treatment requirements for WEEE – Part 2-2: Treatment requirements for WEEE containing CRTs and flat panel displays

- EN 50625-2-3: 2017 - Collection, logistics & Treatment requirements for WEEE – Part 2-3: Treatment requirements for temperature exchange equipment and other WEEE containing VFC and/or VHC
- EN 50625-2-4: 2017 - Collection, logistics & treatment requirements for WEEE – Part 2-4: Treatment requirements for photovoltaic panels
- EN 50614: 2020 - Requirements for the preparing for re-use of WEEE
- TS 50625-3-1: 2015 - Collection, logistics & treatment requirements for WEEE – Part 3-1: Specification for de-pollution – General
- TS 50625-3-2: 2016 - Collection, logistics & treatment requirements for WEEE – Part 3-2: Technical specification for depollution – Lamps
- TS 50625-3-3: 2017 - Collection, logistics & treatment requirements for WEEE – Part 3-3: Specification for de-pollution - WEEE containing CRTs and flat panel displays
- TS 50625-3-4: 2017 - Collection, logistics & treatment requirements for WEEE – Part 3-4: Specification for de-pollution – temperature exchange equipment
- TS 50625-3-5: 2017 Collection, logistics & treatment requirements for WEEE – Part 3-5: Technical specification for depollution - photovoltaic panels
- TS 50625 – 4: 2017 - Collection, logistics & treatment requirements for WEEE – Part 4: Specification for the collection and logistics associated with WEEE
- EN 45552:2020 'General method for the assessment of the durability of energy-related products'
- EN 45553:2020 'General method for the assessment of the ability to remanufacture energy-related products'
- EN 45554:2020 'General methods for the assessment of the ability to repair, reuse and upgrade energy-related products'
- EN 45555:2019 'General methods for assessing the recyclability and recoverability of energy-related products'
- EN 45556:2019 'General method for assessing the proportion of reused components in energy-related products'
- EN 45557:2020 'General method for assessing the proportion of recycled material content in energy-related products'
- EN 45558:2019 'General method to declare the use of critical raw materials in energy-related products'
- EN 45559:2019 'Methods for providing information relating to material efficiency aspects of energy-related products'

Before analysing the standards in detail, an overview is given if product specific regulations and/or standardization initiatives can be identified for the C-SERVEES products.

Washing Machine

Table 3.6 – Product specific regulations and standardization initiatives for washing machine

WASHING MACHINE
Commission Implementing Decision (EU) 2021/936 of 3 June 2021 on the harmonised standards for household washing machines and household washer-dryers drafted in support of Regulation (EU) 2019/2023 and Delegated Regulation (EU) 2019/2014
*«…(3) By Implementing Decision C(2020)4329 (6), the **Commission made a request to the European Committee for Standardization (CEN), … to revise existing harmonized standards** on household dishwashers, household washing machines …**in support of Regulations** (EU) 2019/2022 and (**EU) 2019/2023** and…»*
***Article 1.** The references to harmonized standards on household washing machines and household washer-dryers drafted in support of Regulation (EU) 2019/2023 and listed in **Annex II** to this Decision are hereby published in the Official Journal of the European Union with restriction*
ANNEX II EN 60456:2016 - Clothes washing machines for household use – Methods for measuring the performance EN 60456:2016/A11:2020 EN IEC 62512:2020 - Electric clothes washer-dryers for household use – Methods for measuring the performance

Printer and laser cartridges

Table 3.7 – Product specific regulations and standardization initiatives for imaging equipment

PRINTERS AND CARTRIDGES
Imaging equipment are covered by a voluntary agreement. The voluntary agreement for imaging equipment (proposed by industry sectors) covers energy efficiency, resource efficiency and information for end-users. The European Commission monitors and assesses the agreement as they need to fulfil some criteria of the Ecodesign Directive (2009/125/EC). Useful references for the voluntary agreement for imaging equipment are the following: • Report from the Commission to the European Parliament and the Council ì on the voluntary ecodesign scheme for imaging equipment [7]. • The Voluntary Agreement for Imaging Equipment: assessment of admissibility criteria for self-regulation (policy report by the Joint Research Centre (JRC) [8]. • Industry voluntary agreement to improve the environmental performance of imaging equipment placed on the European market [9].
Relevant initiatives: The European Toner and Inkjet Remanufacturers Association ETIRA is working on a formal position paper to address progress on draft regulation for the imaging equipment sector [10].

TV

Table 3.8 – Product specific regulations and standardization initiatives for electronic display and televisions

TV
Commission Regulation (EU) 2019/2021 of 1 October 2019 laying down ecodesign requirements for electronic displays pursuant to Directive 2009/125/EC of the European Parliament and of the Council, amending Commission Regulation (EC) No 1275/2008 and repealing Commission Regulation (EC) No 642/2009.
(2010/C 114/05) - Commission communication in the framework of the implementation of Commission Regulation (EC) No 642/2009 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for televisions

ALM PRODUCTS

Table 3.9 – Product specific regulations and standardization initiatives for ALM product

ALM PRODUCT
Relevant initiatives: The standardization body ITU-T have developed dedicated recommendations for ICT; the more relevant on the Project are following reported: • L.1410 (12/2014) "Methodology for environmental life cycle assessments of information and communication technology goods, networks and services " which provides best practices to carry through life cycle assessment" [11]. • L.1024 (01/2021) "The potential impact of selling services instead of equipment on waste creation and the environment – Effects on global information and communication technology" [12] • L.1023 (09/2020) "Assessment method for circular scoring" [13]. Regarding this specific recommendation, C-SERVEES results are currently under considerations through the activity carried out by ADVA (member of TIA – SWG [14]) and a draft proposal on the utilization of the UPR_{10} (Use phase/Production phase ratio) as a more apt parameter than the LCA when considering environmental impact evaluations of ICT equipment's where use stage dominates (such as the ALM or other infrastructure communication equipment). The UPR_{10} parameter and its utilization in comparison with LCA evaluations are reported in detail in the publication "Energy Efficiency Limits to ICT Equipment Lifetime" Photonic Networks; 23th ITG-Symposium, 2022, pp. 1-8 [15].

Moreover, NGMN Alliance recommended the integration of circular economy principles and life-cycle assessment methods into the procurement process of all mobile network operators and equipment manufacturers. Underlining that Standards developed through global consultation at the International Telecommunication Union (ITU) provide valuable models for the industry to follow and citing the L.1023 (Assessment method for circular scoring) and L.1410 (Methodology for environmental life cycle assessments of information and communication technology goods, networks and service).

4 EEE industry mapping

This chapter focuses on the C-SERVEES demonstrations of CEBMs and eco-services in the target products in order to map the EEE industry under the perspective of CE implementation, helping to identify the needs and requirements in the E&E sector on which standardization activities should focus on.

Several circularity actions identified in CEBMs were implemented in the four products: washing machines (large household appliances), printers and laser toner cartridges (IT equipment), ALM products (telecommunication equipment) and TV sets and displays (consumer electronics equipment).

Washing machines

Table 4.1 – Circularity actions implemented in C-SERVEES washing machine demo

C-SERVEES WASHING MACHINE DEMO	
Design & production	Increase recycled plastic content in washing machine parts
	Reduction of PP use by using blowing agent in detergent box group and inner cover enhancing the integration of circular strategies into the production process. These circularity action leads to: • Less plastic usage and lower CO_2 emissions. • 10% weight reduction. • Increased productivity by reducing process cycle times by ~25%, which entails the reduction of energy consumption in the use phase.
	Use of ICT tool for tracing the recycled content and enhance product circularity and sustainability
Distribution & use phase	Exploration of a new renting/leasing business model for corporate washing machine customers (B2B) and testing their feasibility. For this purpose, eco-designed washing machines were installed in different demo sites to test the model in real site and collect customer feedback and assess their acceptance.
	Optimisation of maintenance and repair service during the leasing period and preparation for reuse operations to give the used products a second life through the following actions: • Analysis of the washing machine's most often replaced spare part and refurbishment operations • Development of repair and refurbishment protocols to standardize the operations.
	Use of reverse logistic platform to optimize the transportation of materials/products/WEEE from the collection points to the

C-SERVEES WASHING MACHINE DEMO	
	manufacturing/use/treatment/recycling sites in sustainable and cost-effective way. It defines the order of the nodes among the different stakeholders (i.e. suppliers already existing or new ones) where to collect products or materials useful to create the final product and identify the number of trucks needed to minimize the total travel distance as well as suggests the best route connecting all the nodes of the supply chain to save CO_2 emissions, time and costs.
EoL phase	Development of a new business line to recover, refurbish and give a second life to used washing machines. Different CE actions were carried out to improve and expand repair and refurbishment operations: • Develop dismantling and repair training programmes • Expansion of partnership, creating a new business opportunity and generating a collaboration that contributes to developing circular economy strategy. • Collect end of life products from B2B customers, refurbish them and provide refurbished products to B2B customers as a new business line • Initiatives for increase the consumers' education and awareness on circular economy.
	Testing 3D printing technology to facilitate the refurbishment operations.
	Collection of customer feedback related to the eco-designed and refurbished products and testing their acceptance and at the same time creating awareness among B2B consumers thanks to the QR codes inserted in products.
	Develop circular end-of-life recovery strategies for end of use WMs, through the exploration of the potential to use plastics from EoL device outside Turkey.
	Testing of ICT tool to support EoL operations. The following documents were shared with the different actors in the CEBM value chain: user manuals, cleaning procedure, exploded views of some parts, circuit diagram, replacement/dismantling documents for some parts (i.e., belt, door lock, detergent box group, drain pump, front door, gasket, heater, motor, shock absorber).

Printer and laser cartridges

Table 4.2 – Circularity actions implemented in C-SERVEES printer and cartridges demo

C-SERVEES PRINTER AND CARTRIDGES DEMO	
Design & production	Exploration of potential improvements based on the collaboration with recyclers to increase durability and circularity and to improve the effectiveness of the refurbishment operations through the investigation of the following aspects: – Ease of disassembly – Recovery of components – Value of recovered materials – Hazardous or toxic materials – Material compatibility for recycling Through feedbacks from recyclers, useful information was collected on the barriers to printer disassembly, the ease of recycling materials, as well as the time and resources required to recover critical components. These allow to identify ecodesign measures to be implemented (e.g., use of materials that recyclers can easily and profitably recycle, improve recyclable materials in printers, improve printer durability, and optimize the disassembly process, enhance the recover and reuse of some components from EoL printers and toner cartridges.
	Use of ICT tool to improve circularity of the printer and toner cartridges by improving tracking of printers' current location and status and the sharing of information across the supply chain. Scan the QR code, the user can access to the following information: – The % of the changed parts in the printer – All product and process certifications (like Energy Star, Blue Angel, EPEAT, ISO, etc.) – Hazardous material and chemical of concern information (RoHS, REACH) – The warranty information for the printer – Technical specifications – Life Cycle Assessment data – Other data based upon the feedback obtained from authorities, NGO's, customers, recyclers.
Distribution & use phase	Improve the circularity of the current PSS by examining the main issues, namely the cost of reconditioning a printer and customer acceptance. In this regard, the following actions were carried out: • Investigation of dismantling printers for part recovery (improvement of the dismantling manual, evaluation of economic viability for the recovery from end-of-life printers, investigation of the significant issues from recyclers and remanufactured perspective)

C-SERVEES PRINTER AND CARTRIDGES DEMO	
	• Investigation of competitiveness of using 3D printing for repair and refurbishment • Investigation of Printer refurbishment efficiency • Investigation of customer acceptance and collection of feedbacks from representative parties to whom refurbished products were sent.
	Enhancing and assessment of the potential to increase material circularity by: • Testing and evaluating the potential and feasibility of incorporating recycled ABS from EoL printers and toner cartridges in new products. • Use of ICT tool to certificate the recycled content, supporting transparency and sharing information across the supply chain.
	Improving the reverse logistics efficiency by the extension of the current LCCP platform to printers to facilitate buy back and take back operations and by testing the new ICT platform developed within C-SERVEES project for the optimization of logistic operations. This allows to identify the best route solutions, reducing the number of unnecessary and incorrect shipments as well as support information sharing across the supply chain. This latter allows to calculate air pollutant emissions, determine truck capacity needed, compare the possible transportation routes and display the maps of the sections of the best route solutions.
	Promote the remanufacturing of cartridges and the refurbishment of printers by: • Active lobbying at EU and/or national level for wider acceptance and promotion of circular business models • Active media/PR campaign on refurbished printers • Gathering feedback from key customers to understand their needs and requirements related to refurbished products
EoL phase	Assessment of opportunities to enhance circularity of the current PSS run by Lexmark, looking at the recovery of printer parts and components, use of 3D printed parts and analysis of the economic viability of the options studied.
	Assessment of potential to increase material circularity in printers and the use of ICT functionalities to support these measures.
	Improving the reverse logistics to optimize the circularity of the PSS, increasing the flow of returned EoL printers by reducing the associated time and costs.
	Testing the customer acceptance of refurbishment products at and gathering their feedback
	Promotion of the refurbishment business and customer engagement

ALM Product

Table 4.3 – Circularity actions implemented in C-SERVEES ALM demo

C-SERVEES ALM DEMO	
Design & production	Investigation of potential improvements of ALM unit to implement design for easy disassembly and design for recycling through the following actions: • Development of a manual disassembly of ALM units • XFR analysis of plastic parts derived from disassembly
	New fibre-optic sensors were eco-designed specifically to reduce energy consumption in the use phase and increase longevity and reliability.
	Optimising packaging by developing new plastic-free packaging and tape, reducing plastic waste.
	Exploration of ICT functionalities to foster circular economy
Distribution & use phase	Exploration and testing of new PSS models for ALM system (PSS with optimized operational efficiency, PSS aiming to improve longevity, PSS where the manufacturer retains product ownership).
	Update of ADVA's Ecodesign guide, which supports the main product features to be considered in order to attain efficient product-service systems (requirements regarding longevity, parts reuse, recycling with focus on disassembly, material efficiency, use of recycled/recyclable materials, plastic parts).
	Extensive lifetime optimisation analysis for ICT products and its validation in order to extend the analysis to other EEE
	Testing of the ICT functionalities, i.e., blockchain to exchange information and facilitate recycling operations.
EoL phase	Development of reuse guidelines for ICT B2B products, following the findings according to an optimum-lifetime analysis
	Development of disassembly guidelines for ICT and electronics equipment to support and facilitate WEEE recycling.
	Assessment of potential for ICT tool as support to the EoL phase though the testing of the integrated C-SERVEES ICT platform, where information related to repair, refurbishment, disassembly, and recycling can be shared and requested by the involved actors.

TV sets and displays

Table 4.4 – Circularity actions implemented in C-SERVEES TV set demo

C-SERVEES TV SET DEMO	
Design & production	Increase recycled plastic materials in TV back cover, using 30% PC/ABS halogen free.
	Decrease of packaging waste by introducing reusable packaging: multi-use plastic boxes instead of individual carboard packaging in forward and reverse logistics
	Tracing of recycled content via ICT (ICT-based certification) to enhance the circularity of the product and materials. Information on product sustainability is available on the app, including product user manual, parts made from recycled materials and their proportions, hazardous substance information in product raw material content, instruction for recycling.
Distribution & use phase	Exploration and testing of new renting/ecoleasing model for the TV set. The C-SERVEES TV set demos were installed in demo sites (Spain and Turkey) to evaluate the feasibility and acceptance of this strategy, gathering B2B customer feedback.
	Implementation of standardized repair and refurbishment operations for maintenance during the renting period and for the preparation for reuse operations to grant the used products a second life by: • Analysis of TV most replaced spare parts • Development of replacement instructions and manuals.
	Enhancing the logistic efficiency by Reverse logistics ICT tool (definition of the order of the nodes among the different stakeholders and identification of the number of trucks needed to minimize the total travel distance and best route connecting all the nodes of the supply chain).
EoL phase	Development of a new business line to recover, refurbish and give a second life to used TVs.
	Gathering of customer feedback related to refurbished products.
	Testing the 3D printing technology to facilitate and improve the refurbishment operations.
	Improving dismantling operations and recycling, identifying eco-design measures to be implemented.
	Testing of ICT tool to support EoL operations

In order to complete the description of the EEE industry from the point of view of the C-SERVEES Partners, a Survey has been launched with the following objectives:

- Objective 1: collect data on the level of awareness on standards and standardization among the C-SERVEES Partners.
- Objective 2: collect useful data emerging from the pilot implementation activities and that can be associated to standardization topics.

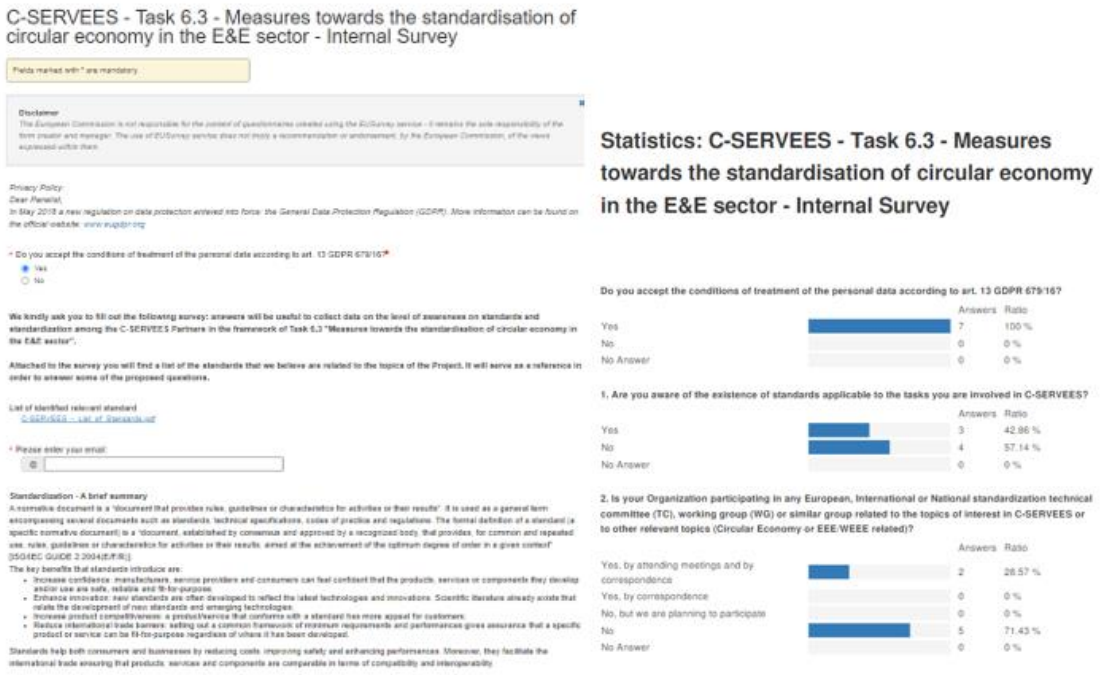

Figure 4.1 – Screenshot of the internal Survey

Table 4.5 – Feedback and Considerations emerged from the Survey on Standardization awareness

Feedback and Considerations emerged from the Survey - Standardization awareness	
Partners and/or AB Members contributing	AIMPLAS, GREENTRONICS, ERION, WEEE FORUM, GAIKER, LEXMARK, ADVA, PARTICULA, PNO, SAT-RESEARCH, ARÇELIK
Most Cited Standards and/or TC	All the main standards as identified in Subtask 6.3.1 «Standardization Framework» and reported in Table Survey highlighted other normative documents or Organization of interest (ISO 14040/ISO 14044; BS 8001; ITU-T, ETSI standards for the ICT sector) together with under development standards from the ISO/TC 323: ISO/CD 59004 "Circular Economy – Terminology, Principles and Guidance for Implementation"; ISO/CD 59010 "Circular Economy — Guidance on the transition of business models and value networks"; ISO/CD 59020 "Circular Economy — Measuring and assessing circularity"; ISO/CD TR 59031 "Circular economy – Performance-based approach – Analysis of cases studies"; ISO/CD TR 59032.2 "Circular economy - Review of business model implementation"; ISO/WD 59040 "Circular Economy — Product Circularity Data Sheet"
Participation in standardization activities	Good partecipation level on standardization processes (Arçelik, ADVA, WEEE Forum, Aimplas, Erion) among C-Servees Partners, with some of the mentioned activities/participations/associations here recalled: Sustainability Working Group (SWG) of the Telecommunications Industry Association (TIA) ISO TC 261: Additive manufacturing ISO TC 61: Plastics / SC 14: environmental aspects / WG5: mechanical and chemical recycling CEN TC 438: Additive manufacturing CEN TC 249: Plastics / WG11: Plastics recycling ISO TC 323 - Circular economy

Which Standards are mainly used?	ErP Standards (EN 4555x series), EN 50614, EN 50625 series. Particular attention is paid to standards coming from ISO TC/323. Main drivers outlined for standards utilizations are legislative requirements and quality levels assurance
Suggestions on usefulness and on potential changes on Standards	Standards should be as short as possible; good examples can be derived from sector specific standards such as the ones developed in the ICT sector from ITU-T and ETSI. Use of parameters such as ratio of 10-years use-phase emissions over production emissions, to discriminate among use-phase impacted products.
C-SERVEES results that could contribute to standardization topics	Standards concerning refurbishment/preparation for reuse activities (e.g., refurbishment activities performed on printers); Eco-design standards (e.g., use of recycled materials in washing machines);Eco-leasing standards (e.g., definition of the conditions for implementing B2B renting models as it has been done for washing machines and TVs);Standards concerning collection of information on the entire product life-cycle (e.g., Circularise platform).

The Survey registered a good level of participation. The details gathered by the answers were a starting point for the specified objective 2 of the survey; consequently, a second activity has been launched, involving the industrial Partners responsible for the Pilot's implementation (ADVA, LEXMARK, ARCELIK) and more focused on the drafting of potential contributions for future standardization initiatives on the basis of the gap analysis conducted on the identified high priority standards (Paragraph 5).

5 Gap analysis - Study on quality of identified high priority standards [16] [17] [18]

Objective of the analysis is the evaluation of the identified standardization framework and the identification of potential contributions to future standardization initiatives that can derive from the experience of C-SERVEES Project.

The activity is based on the outcome of the standardization framework analysis (Chapter 3) and the EEE mapping (Chapter 4).

The information has been gathered through a desk research and interviews with Partners that helped to collect feedback on standardization related issues emerged from project pilot's implementation, to depict the level of "standardization awareness" (knowledge of relevant standards, participation to TC/WGs, round tables, etc.) of the Consortium and to collect information that can be useful for future standardization initiatives.

The deployment of nine horizontal standards (EN 4555x series) under the requirements defined by the European Ecodesign Directive and the European Commission standardization request (Mandate M/543 [19]) supports the integration of Circular Economy through the optimization of material efficiency aspects consistent with the following objectives:

- Extending product lifetime (durability and reliability)
- Increase the ability to reuse components or recycle materials from end-of-life products
- Increase the ability to utilize reused components or recycled materials in products.

The material efficiency topics that the involved European Standardization Bodies (CEN, CENELEC and ETSI) have considered can be resumed as:

- Definition of parameters and methods for assessing durability, upgradability, and ability to repair, re-use, and re-manufacture products
- Provision of guidance on how standardization deliverables covering the first topic can be applied to product-specific standards
- Ability to access or remove certain components or assemblies from products to facilitate repair, remanufacture, or reuse
- Reusability/recyclability/recoverability (RRR) indexes or criteria
- Ability to access or remove certain components or assemblies from products to facilitate their extraction at the end-of-life for ease of treatment, recycling, and recovering
- Method to assess the proportion of re-used components and/or recycled materials in products
- Use and recyclability of critical raw materials (CRM)
- Documentation and/or marking regarding information relating to material efficiency of the product, taking into account the intended audience

All the listed topics contribute to the achievement of the three main pillars of Circular Economy, as defined by the Ellen MacArthur Foundation [20]:

- Eliminate waste and pollution (through design and manufacturing processes optimization)
- Circulate products and materials (at their highest value), i.e. keep materials, products and systems in use (durability and reliability)
- Regenerate nature

The EN 4555x Series standards that have been analysed are horizontal and thought to be applied to any ErP [21], providing an agreed upon methodology to assess all the topics listed before and here resumed: durability, reuse, repair, upgrade, remanufacture, refurbish recover, recycle, critical raw materials, marking and documentation. It will be important in the future to develop product specific standards that will adapt the general assessment methodologies to the specificities of a product such as the one considered for the CEBM pilot implementation in C-SERVEES: TV, washing machines, printers, ICT

equipment in general. Indeed, material efficiency aspects are strictly related and prioritized in accordance with the product use profile (operating and environmental conditions, health and security issues, functional analysis, operating and limiting states,...).

For the end-of-life phase of EEE, the EC mandated the European Standardisation Organisation (CEN, CENELEC and ETSI) to develop a series of standards for the treatment, including recycling, recovery and preparation for re-use of WEEE [22] (M/518 Mandate to the European standardisation organisations for standardisation in the field of Waste Electrical and Electronic Equipment (Directive 2012/19/EU (WEEE)).

The published Standards and Technical Specifications have been reported in Paragraph 3.2 and are here recalled:

- EN 50614:202 - Requirements for the preparing for re-use of waste electrical and electronic equipment
- EN 50625-1: 2014 - Collection, logistics & treatment requirements for WEEE - Part 1: General treatment requirements
- EN 50625-2-1: 2014 - Collection, logistics & treatment requirements for WEEE – Part 2-1: Treatment requirements for lamps
- EN 50625-2-2: 2015 - Collection, logistics & treatment requirements for WEEE – Part 2-2: Treatment requirements for WEEE containing CRTs and flat panel displays
- EN 50625-2-3: 2017 - Collection, logistics & Treatment requirements for WEEE – Part 2-3: Treatment requirements for temperature exchange equipment and other WEEE containing VFC and/or VHC
- EN 50625-2-4: 2017 - Collection, logistics & treatment requirements for WEEE – Part 2-4: Treatment requirements for photovoltaic panels
- EN 50614: 2020 - Requirements for the preparing for re-use of WEEE
- TS 50625-3-1: 2015 - Collection, logistics & treatment requirements for WEEE – Part 3-1: Specification for de-pollution – General
- TS 50625-3-2: 2016 - Collection, logistics & treatment requirements for WEEE – Part 3-2: Technical specification for depollution – Lamps
- TS 50625-3-3: 2017 - Collection, logistics & treatment requirements for WEEE – Part 3-3: Specification for de-pollution - WEEE containing CRTs and flat panel displays
- TS 50625-3-4: 2017 - Collection, logistics & treatment requirements for WEEE – Part 3-4: Specification for de-pollution – temperature exchange equipment
- TS 50625-3-5: 2017 Collection, logistics & treatment requirements for WEEE – Part 3-5: Technical specification for depollution - photovoltaic panels
- TS 50625 – 4: 2017 - Collection, logistics & treatment requirements for WEEE – Part 4: Specification for the collection and logistics associated with WEEE.

The detailed analysis of these standards, together with the investigation of all relevant requirements defined in the WEEE Directive, have been conducted by the EC and the results published in an important report [18] which main results are reported in the following Table 5.1. Other information can be retrieved by the TR 50625-6 “Collection,

logistics & treatment requirements for WEEE - Part 6: Report on the alignment between Directive 2012/19/EU and EN 50625 series standards and EN 50614". This study showed that **all relevant requirements of the WEEE Directive related to collection, transport, storage and depollution are largely covered in the CENELEC standardisation deliverables**, and the following Articles and Annexes are covered in depth:

- Article 6 (Disposal and transport of collected WEEE)
- Article 8 (Proper treatment)
- Article 11 (Recovery targets)
- Annex VII (Selective treatment for materials and components of WEEE referred to in Article 8(2))
- Annex VIII (Technical requirements referred to in article 8 (3))

Another important outcome of the study underlines that there is not a distinction between requirements deriving from the text of WEEE Directive or other relevant EU law and requirements that go beyond those depicted in the WEEE Directive (separating them between normative and informative parts of the standardization deliverable). Actually, several requirements inserted as normative text in the standard are not derived from the WEEE Directive or other EU relevant legislation.

The excellent level of completeness of these WEEE standardization deliverables is also outlined by the fact that specific issues that were highlighted in the M/518 Mandate are all covered: coverage of the collection of WEEE where it is crucial for subsequent proper treatment (TS 50265-4), areas for which detailed process management requirements are specified (EN 50625-1, EN 50625-2-4, 50625-2-3), Handling of batteries contained in WEEE (EN 50625-1, EN 50625-4), Data protection (EN 50625-1).

Table 5.1 – Study on the implementation of WEEE Directive requirements in 50625 Series Standards [18]

WEEE Directive reference		Reference Standard
Article 5 Separate collection 1.Member States shall adopt appropriate measures to minimise 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.	✓	TS 50625-4, Chapter 5.1.1 Technical requirements, Collection Operators and Logistics Operators, Principles
Article 6 Disposal and transport of collected WEEE 1. Member States shall prohibit the disposal of separately collected WEEE which has not yet undergone the treatment specified in Article 8.	✓	EN 50625-1 Chapter 5.5 De-pollution EN 50625-1 Annex A De-pollution A.1 Introduction EN 50625-1 Annex F
Article 6 Disposal and transport of collected WEEE 2. 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.	✓	EN 50625-1, chapter 5.1 EN 50625-1, chapter 4.2 Technical and infrastructural preconditions EN 50625-1, chapter 5.3 Handling of WEEE EN 50625-2-1, Chapter 5.3 Handling of WEEE EN 50625-2-2, Chapter 5.3 Handling of WEEE EN 50625-2-3, Chapter 5.1 Technical requirement, General TS 50625-3-3, Chapter 4.101.2 CRT equipment TS 50625-4, Chapter 5.1.2 Technical requirements, Acceptance, TS 50625-4, Chapter 5.1.3, Technical requirements, Preparing for re-use TS 50625-4, Chapter 5.1.4 Technical requirements, Handling TS 50625-4 Chapter 5.1.7 Technical requirements, Transport TS 50625-4 Chapter 5.2 Collection points
Article 6 Disposal and transport of collected WEEE In order to maximise preparing for re-use, Member States shall promote	✓	TS 50625-4, Chapter 4.1.5 Preparing for re-use

WEEE Directive reference		Reference Standard
that, prior to any further transfer, collection schemes or facilities provide, where appropriate, for the separation at the collection points of WEEE that is to be prepared for re-use from other separately collected WEEE, in particular by granting access for personnel from re-use centres.		TS 50625-4, Chapter 5.1.2 Acceptance TS 50625-4, Chapter 5.1.3 Preparing for re-use
Article 7 Collection rate 2. In order to establish whether the minimum collection rate has been achieved, Member States shall ensure that information concerning the WEEE that is separately collected in accordance with Article 5 is transmitted to the Member States free of charge, including at least information on WEEE that has been: (a) received by collection and treatment facilities; (b) received by distributors; (c) separately collected by producers or third parties acting on their behalf	✓	TS 50625-4, Chapter 6 Documentation
Article 8 Proper treatment 1. Member States shall ensure that all separately collected WEEE undergo proper treatment.	✓	All
Article 8 Proper treatment 2. Proper treatment, other than preparing for re-use, and recovery or recycling operations shall, as a minimum, include the removal of all fluids and a selective treatment in accordance with Annex VII.	✓	EN 50625-1 Chapter 5.5 Depollution EN 50625-1 Annex A De-pollution A.1 Introduction EN 50625-1 Annex F EN50625-1, A.2 Capacitors EN50625-1, A.4 Gas discharge lamps and components containing mercury EN50625-1, A.5 Batteries and accumulators EN50625-1, A.3 Printed circuit boards EN50625-1, A.6 Plastics EN50625-1, A.8 Asbestos EN 50625-2-2, Chapter 5.5.1 Depollution CRT equipment EN50625-1, A.7 Volatile fluorocarbons and volatile hydrocarbons EN50625-2-3, Chapter 5.5.101 Depollution General

WEEE Directive reference		Reference Standard
		TS50625-3-4, Chapters 4-7, 12 EN50625-1, A.9 Components containing radioactive substances EN 50625-1, Chapter 5.10 Recovery and disposal of fractions EN50625-2-3, Chapter 5.5.101 Depollution General EN50625-2-3 Chapter 5.5.104 Step 3 treatment EN 50625-2-2, Chapter 5.5.1 Depollution CRT equipment TS 50625-3-3:2017 Chapter 4.101.2 CRT equipment EN 50625-2-1 Chapter 5.5 Depollution EN 50625-2-1 Chapter 5.1 General
Article 8 Proper treatment 3. Member States shall ensure that producers or third parties acting on their behalf set up systems to provide for the recovery of WEEE using best available techniques. The systems may be set up by producers individually or collectively. Member States shall ensure that any establishment or undertaking carrying out collection or treatment operations stores and treats WEEE in compliance with the technical requirements set out in Annex VIII.	✓	EN 50625-1, Chapter 5.4 EN 50625-2-1, Chapter 5.4 Storage of WEEE prior to treatment EN 50625-2-2, Chapter 5.4 Storage of WEEE prior to treatment EN 50625-2-3, Chapter 5.4 Storage of WEEE prior to treatment EN 50625-5, Chapter 5.2 Acceptance TS 50625-4, Chapters 5.1.5 Technical requirements, Storage EN 50625-1, Chapter 4.2 Technical and infrastructural preconditions EN 50625-2-1, Chapter 4.2 Technical and infrastructural preconditions EN 50625-1, Chapter 5.2 Receiving WEEE at treatment facility EN 50625-1, Chapter 4.1 Monitoring

WEEE Directive reference		Reference Standard
		EN 50625-2-1, Chapter 5.2 Receiving WEEE at treatment facility EN 50625-2-3, Chapter 5.2 Receiving WEEE at treatment facility EN 50625-2-4, Chapter 4.1 Technical and infrastructural preconditions EN 50625-1, Chapter 5.8 Storage of fractions EN 50625-2-1, Chapter 5.8 Storage of fractions EN 50625-2-2, Chapter 5.1.1
Article 9 Permits 1. Member States shall ensure that any establishment or undertaking carrying out treatment operations obtains a permit from the competent authorities in compliance with Article 23 of Directive 2008/98/EC	✓	TS 50625-4, Chapter 5.2 Collection points
Article 10 Shipments of WEEE 1. The treatment operation may also be undertaken outside the respective Member State or the Union provided that the shipment of WEEE is in compliance with Regulation (EC) No 1013/2006 and Commission Regulation (EC) No 1418/2007 of 29 November 2007 concerning the export for recovery of certain waste listed in Annex III or IIIA to Regulation (EC) No 1013/2006 of the European Parliament and of the Council to certain countries to which the OECD Decision on the control of transboundary movements of wastes does not apply	✓	EN 50625-1, Chapter 4.5 Shipment TS 50625-4, Chapter 4.1.6 Transportation and shipments
Article 10 Shipments of WEEE 2. WEEE exported out of the Union shall only count towards the fulfilment of obligations and targets set out in Article 11 of this Directive if, in compliance with Regulations (EC) No 1013/2006 and (EC) No 1418/2007, the exporter can prove that the treatment took place in conditions that are equivalent to the requirements of this Directive.	✓	EN 50625-1, Chapter 4.5 Shipment TS 50625-4, Chapter 4.1.6 Transportation and shipments
Article 11 Recovery targets 1. Regarding all WEEE separately collected in accordance with Article 5 and sent for treatment in accordance with Articles 8, 9 and 10, Member States shall ensure that producers meet the minimum targets set out in Annex V	✓	EN 50625-1, Chapter 4.1
Article 11 Recovery targets 2. The achievement of the targets shall be calculated, for each category, by dividing the weight of the WEEE that enters the recovery or recycling/preparing for re-use facility, after proper treatment in accordance with Article 8(2) with regard to recovery or recycling, by the weight of all separately collected WEEE for each category, expressed as a percentage. Preliminary activities including sorting and storage prior to recovery shall not count towards the achievement of these targets.	✓	EN 50625-1, 5.9 Recycling and recovery targets EN 50625-1, Annex C.2 Principles EN 50625-1, Annex C.3 Calculation EN 50625-5, Chapters 6.2, 6.3, 6.4, 6.5 TS 50625-4, Chapter 4.1.4 Monitoring

WEEE Directive reference		Reference Standard
		TS 50625-4 Chapter 6, Documentation
Article 11 Recovery targets 4. Member States shall ensure that, for the purpose of calculating these targets, producers or third parties acting on their behalf keep records on the weight of WEEE, its components, materials or substances when leaving (output) the collection facility, entering (input) and leaving (output) the treatment facilities and when entering (input) the recovery or recycling/preparing for re-use facility. Member States shall also ensure that, for the purposes of paragraph 6, records on the weight of products and materials when leaving (output) the recovery or recycling/preparing for re-use facility are kept.	✓	EN 50625-1, Chapter 6 Documentation EN 50625-1, Annex C.4 Documentation EN 50625-1, Annex G.1 Information requirements EN 50625-5, Chapter 6.1 Monitoring and reporting, General TS 50625-4, Chapter 4.1.4 Monitoring TS 50625-4 Chapter 6, Documentation
Article 16 Registration, information and reporting 4. Member States shall collect information, including substantiated estimates, on an annual basis, on the quantities and categories of EEE placed on their markets, collected through all routes, prepared for reuse, recycled and recovered within the Member State, and on separately collected WEEE exported, by Weight.	✓	EN 50625-1, Chapter 4.1 Monitoring EN 50625-1, Chapter 6 Documentation TS 50625-4, Chapter 4.1.4 Monitoring TS 50625-4, Chapter 6 Documentation
Article 23 Inspection and monitoring 1. Member States shall carry out appropriate inspections and monitoring to verify the proper implementation of this Directive. Those inspections shall at least cover: (a) information reported in the framework of the register of producers; (b) shipments, in particular exports of WEEE outside the Union in compliance with Regulation (EC) No 1013/2006 and Regulation (EC) No 1418/2007; and (c) the operations at treatment facilities in accordance with Directive 2008/98/EC and Annex VII of this Directive.	✓	EN 50625-1 Chapter 4.1, Note EN 50625-1 Chapter 4.4, Note
ANNEX III Categories of EEE covered by this directive 1. Temperature exchange equipment 2. Screens, monitors, and equipment containing screens having a surface greater than 100 cm2 3. Lamps 4. Large equipment (any external dimension more than 50 cm) 5. Small equipment (no external dimension more than 50 cm) 6. Small IT and telecommunication equipment (no external dimension more than 50 cm)	✓	EN 50625-1 Chapter 3.5 Note EN 50625-1 Chapter 5.9 EN 50625-1 Annex D.2
ANNEX IV Non-exhaustive list of EEE which falls within the categories listed in Annex III 1. Temperature exchange equipment (…) 2 Screens, Televisions, LCD photo frames, Monitors, Laptops, Notebooks. 3. Lamps Straight fluorescent lamps, Compact fluorescent lamps, Fluorescent lamps, High intensity discharge lamps – including pressure sodium lamps and metal halide lamps, Low pressure sodium lamps, LED. 4. Large equipment Washing machines, Clothes dryers, Dish washing machines, Cookers, Electric stoves, Electric hot plates, Luminaires, Equipment reproducing sound or images, Musical equipment (excluding pipe organs installed in churches), Appliances for knitting and weaving, Large computer mainframes, Large printing machines, Copying equipment, Large coin slot machines, Large medical devices, Large monitoring and control instruments, Large appliances which automatically deliver products and money, Photovoltaic panels. 5. Small equipment Vacuum	✗	

WEEE Directive reference		Reference Standard
cleaners, Carpet sweepers, Appliances for sewing, Luminaires, Microwaves, ventilation equipment, Irons, Toasters, Electric knives, Electric kettles, Clocks and Watches, electric shavers, Scales, Appliances for hair and body care, Calculators, Radio sets, Video cameras, Video recorders, Hi-fi equipment, Musical instruments, Equipment reproducing sound or images, Electrical and electronic toys, Sports equipment, Computers for biking, diving, running, rowing, etc., Smoke detectors, Heating regulators, Thermostats, Small Electrical and electronic tools, Small medical devices, Small Monitoring and control instruments, Small Appliances which automatically deliver products, Small equipment with integrated photovoltaic panels. 6. Small IT and telecommunication equipment (no external dimension more than 50 cm) Mobile phones, GPS, Pocket calculators, Routers, Personal computers, Printers, Telephones.		
ANNEX V Minimum recovery targets referred to in article 11 Part 3: Minimum targets applicable by category from 15 August 2018 with reference to the categories listed in Annex III: (a) for WEEE falling within category 1 or 4 of Annex III, — 85 % shall be recovered, and — 80 % shall be prepared for re-use and recycled; (b) for WEEE falling within category 2 of Annex III, — 80 % shall be recovered, and — 70 % shall be prepared for re-use and recycled; (c) for WEEE falling within category 5 or 6 of Annex III — 75 % shall be recovered, and — 55 % shall be prepared for re-use and recycled; (d) for WEEE falling within category 3 of Annex III, 80 % shall be recycled	✓	EN 50625-1, Chapter 4.1
ANNEX VI Minimum requirements for shipments 1. In order to distinguish between EEE and WEEE, where the holder of the object claims that he intends to ship or is shipping used EEE and not WEEE, Member States shall require the holder to have available the following to substantiate this claim: (a) a copy of the invoice and contract relating to the sale and/or transfer of ownership of the EEE which states that the equipment is destined for direct re-use and that it is fully functional; (b) evidence of evaluation or testing in the form of a copy of the records (certificate of testing, proof of functionality) on every item within the consignment and a protocol containing all record information according to point 3; (c) a declaration made by the holder who arranges the transport of the EEE that none of the material or equipment within the consignment is waste as defined by Article 3(1) of Directive 2008/98/EC; and (d) appropriate protection against damage during transportation, loading and unloading in particular through sufficient packaging and appropriate stacking of the load.	✓	EN 50614, chapter 6.4 EN 50614, chapter 6.5
ANNEX VI Minimum requirements for shipments 2. By way of derogation, point 1(a) and (b) and point 3 do not apply where it is documented by conclusive proof that the shipment is taking place in the framework of a business-to-business transfer agreement and that: (a) the EEE is sent back to the producer or a third party acting on his behalf as defective for repair under warranty with the intention of reuse; or (b) the used EEE for professional use is sent to the producer or a third party acting on his behalf or a third-party facility in countries to which Decision C(2001)107/Final of the OECD Council concerning	✓	EN 50614, chapter 6.5

WEEE Directive reference		Reference Standard
the revision of Decision C(92)39/Final on control of transboundary movements of wastes destined for recovery operations applies, for refurbishment or repair under a valid contract with the intention of re-use; or (c) the defective used EEE for professional use, such as medical devices or their parts, is sent to the producer or a third party acting on his behalf for root cause analysis under a valid contract, in cases where such an analysis can only be conducted by the producer or third parties acting on his behalf.		
ANNEX VI Minimum requirements for shipments 3. In order to demonstrate that the items being shipped constitute used EEE rather than WEEE, Member States shall require the following steps for testing and record keeping for used EEE to be carried out: Step 1: Testing (a) Functionality shall be tested and the presence of hazardous substances shall be evaluated. The tests to be conducted depend on the kind of EEE. For most of the used EEE a functionality test of the key functions is sufficient. (b) Results of evaluation and testing shall be recorded. Step 2: Record (a) The record shall be fixed securely but not permanently on either the EEE itself (if not packed) or on the packaging so it can be read without unpacking the equipment. (b) The record shall contain the following information: — name of item (name of the equipment if listed in Annex II or Annex IV, as appropriate, and category set out in Annex I or Annex III, as appropriate), — identification number of the item (type No) where applicable, — year of production (if available), — name and address of the company responsible for evidence of functionality, — result of tests as described in step 1 (including date of the functionality test), — kind of tests performed	✓	EN 50614, chapter 6.5
ANNEX VI Minimum requirements for shipments 4. In addition to the documentation requested in points 1, 2 and 3, every load (e.g. shipping container, lorry) of used EEE shall be accompanied by: (a) a relevant transport document, e.g. CMR or waybill; (b) a declaration by the liable person on its responsibility	✓	EN 50614, chapter 6.5
ANNEX VI Minimum requirements for shipments 5. In the absence of proof that an object is used EEE and not WEEE through the appropriate documentation required in points 1, 2, 3 and 4 and of appropriate protection against damage during transportation, loading and unloading in particular through sufficient packaging and appropriate stacking of the load, which are the obligations of the holder who arranges the transport, Member State authorities shall consider that an item is WEEE and presume that the load comprises an illegal shipment. In these circumstances the load will be dealt with in accordance with Articles 24 and 25 of Regulation (EC) No 1013/2006	✗	
ANNEX VII Selective treatment for materials and components of WEEE referred to in Article 8(2) 1. As a minimum the following substances, mixtures and components have to be removed from any separately collected WEEE: […]	✓	EN 50625-1 Chapter 5.5 Depollution EN 50625-1, Annex A De-pollution A.1 Introduction EN 50625-1 Annex F
ANNEX VII	✓	EN 50625-2-1 Chapter 5.1 General

WEEE Directive reference		Reference Standard
3. Taking into account environmental considerations and the desirability of preparation for re-use and recycling, points 1 and 2 shall be applied in such a way that environmentally-sound preparation for re-use and recycling of components or whole appliances is not hindered.		
ANNEX VIII Technical requirements referred to in article 8(3) 1. Sites for storage (including temporary storage) of WEEE prior to its treatment (without prejudice to the requirements of Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste (1)): — impermeable surfaces for appropriate areas with the provision of spillage collection facilities and, where appropriate, decanters and cleanser-degreasers, — weatherproof covering for appropriate areas.	✓	EN 50625-2-1, Chapter 5.4 Storage of WEEE prior to treatment, EN 50625-2-2, Chapter 5.4 Storage of WEEE prior to treatment, EN 50625-2-3, Chapter 5.4 Storage of WEEE prior to treatment EN 50625-5, Chapter 5.2 Acceptance TS 50625-4, Chapters 5.1.5 Technical requirements, Storage EN 50625-1, Chapter 4.2 Technical and infrastructural preconditions EN 50625-2-1, Chapter 4.2 Technical and infrastructural preconditions TS 50625-4, Chapters 5.1.5 Technical requirements, Storage
ANNEX VIII Technical requirements referred to in article 8(3) 2. Sites for treatment of WEEE: — scales to measure the weight 170ft he treated waste, — impermeable surfaces and waterproof covering for appropriate areas with the provision of spillage collection facilities and, where appropriate, decanters and cleanser-degreasers, — appropriate containers for storage of batteries, PCBs/PCTs containing capacitors and other hazardous waste such as radioactive waste, — equipment for the treatment of water in compliance with health and environmental regulations.	✓	EN 50625-1, Chapter 5.2 Receiving WEEE at treatment facility EN 50625-1, Chapter 4.1 Monitoring EN 50625-2-1, Chapter 5.2 Receiving WEEE at treatment facility EN 50625-2-3, Chapter 5.2 Receiving WEEE at treatment facility EN 50625-5, Chapter 5.2 Acceptance EN 50625-2-4 4.1 Technical and infrastructural preconditions EN50625-2-1, Chapter 4.2 Technical and infrastructural preconditions EN 50614 4.2.1 EN 50614 5.11.1 EN 50614 5.11.3 EN 50625-1, Chapter 5.4

WEEE Directive reference		Reference Standard
		EN 50625-1, Chapter 5.8 Storage of fractions EN 50625-2-1, Chapter 5.8 Storage of fractions EN 50625-2-2, Chapter 5.1.1
ANNEX X B. Information for registration and reporting referred to in article 16 Information to be submitted for reporting: 1. National identification code of the producer. 2. Reporting period. 3. Category of EEE set out in Annex I or III, as appropriate. 4. Quantity of EEE placed on the national market, by weight. 5. Quantity, by weight, of waste of EEE separately collected, recycled (including prepared for re-use), recovered and disposed of within the Member State or shipped within or outside the Union. Note: information set out in points 4 and 5 must be given by category.	✓	EN 50625-1, Chapter 4.1 Monitoring EN 50625-1, Chapter 6 Documentation TS 50625-4, Chapter 4.1.4 Monitoring TS 50625-4, Chapter 6 Documentation

The detailed analysis of EN 4555x series standards has also been conducted and the results are reported in the following Table 5.2. For each standard key concepts, functions, parameters and outputs contributing to material efficiency assessment methodology are explained, while in the last column potential recommendations or suggestions for the potential adoption toward a specific ErP are defined. The results of this first step of analysis have been then submitted to the Pilot implementation Partners (ARCELIK, ADVA and LEXMARK) and a series of round tables have been organized with the aim to provide answers to some of the previously identified recommendations. The results of this work are summarized in Table 5.3 where the Circular Economy Action that can contribute to future standardization initiatives are identified and associated to each suggestion/recommendation and in Table 5.4 where the results of the collection of useful information for future product specific standardization initiatives is reported, targeting the main Pilot products.

Table 5.2 – Ecodesign Horizontal Standards – Detailed analysis and recommendations for future product specific initiatives

EN 4555x Standard	Key Concepts	Key Functions, Parameters and Outputs	Potential Recommendations
EN 45552:2020 «General method for the assessment of the durability of ErP»	**Durability** • **Serviceability** (marginal condition approached, maintenance and repair) • **Limiting state** (perform required function under conditions of use and maintenance)	• Definition of **environmental and operating conditions** (T, humidity, use-profile, maintenance, repair, refurbishment) • **Priority functions/parts** identification • **Durability** calculation • **Reliability** calculation	Development of **product specific standards**: • Identification of product specific **priority functions/parts** • Identification of product specific **environmental/operating conditions** • Definition of product specific **limiting states** • **Test methods** to assess parts reliability
EN 45553:2020 «General method for the assessment of the ability to remanufacture ErP»	• **Remanufacturing** • **Part**: hardware, firmware or software component of a product • **Disassembly** • **Reprocessing**	**Attributes**: • Ability to be **identified** • Ability to locate **access points and fasteners** • **Accessibility** of parts • Ability to be **disassembled/assembled** • **Wear/damage** resistance during remanufacturing	Development of **product specific standards**, that should target the following aspects: • Definition of **product/product group specific EoL scenario**
EN 45554:2020 «General method for the ability to repair, reuse and upgrade ErP»	**Repair** **Reuse** **Upgrade** • Assessment of the **relevance of parts** • **Ranking** parts in a **priority parts list**	**Product related criteria** • Repair (disassembly depth, tools, …) • Reuse (user data transfer,…) • Upgrade **Support related criteria** • Repair (availability of spare parts,..) • Reuse Upgrade (type and availability of information..)	Development of **product specific standards**: • Identification of product specific **priority parts that will be considered for the assessment** • Selection of **relevant criteria according to the product** (**applicability, appropriateness** and relevance) Integration of the **functional analysis, together with predictive, corrective, preventive or maintenance methodologies**

EN 4555x Standard	Key Concepts	Key Functions, Parameters and Outputs	Potential Recommendations
EN 45555:2019 «General method for assessing the recyclability and recoverability of ErP»	• **Recyclability** • **Recoverability** • **End of life**/treatment scenario • Disposal Backfilling	• **Reference EoL treatment scenario and its representativeness** (product/part ; applicable regulations, industry practices and standards…) • Product related criteria (CRM,…) • **Detailed assessment** of recyclability/recoverability factor **Simplified assessment** of recyclability/recoverability factor	Development of **product specific standards,** that should target the following aspects: Definition of **product/product group specific EoL scenario**
EN 45556:2019 «General method for assessing the proportion of reused components in ErP»	• **Component** • **Mass** of reused components **Number** of reused components	• Proportion of reused components by mass at product level • • Proportion of reused components by number at product level • Proportion of reused components by mass balance at product level • Proportion of reused components by number balance at product level	Development of **product specific standards** that should target the following aspects: • Calculation methods Criteria to be associated in terms of **relevance for each reused component** according to its **utilization scope** (active and passive components)
EN 45557:2020 «General method for assessing the proportion of recycled material content in ErP»	• **Primary material** • **Recycled material** • **Pre-consumer material** **Post-consumer material**	• **Materials composition** for a single product • Management system **for traceability** of input for primary and recycled materials (Chain of Custody)	Development of **product specific standards** that should target the following aspects: • **Traceability** system (CoC) and management

EN 4555x Standard	Key Concepts	Key Functions, Parameters and Outputs	Potential Recommendations
		Mass balance calculation: recycled materials content/total materials content	• Definition of **pre-consumer materials** according to product specific technological processes Definition of **main materials clusters** or **unspecified materials**
EN 45558:2019 «General method to declare the use of CRM in ErP»	Critical Raw Materials (CRM) Materials Declaration Regulated/Non-regulated CRMs Substance/Substance Group Declarable Substance/Substance Group	EN IEC 62474 reference EN 45559 reference Amount of substance/substance group Threshold amounts	• **No gaps identified** Product specific standards/regulations could provide thresholds for CRM
EN 45559 «Methods for providing information relating to material efficiency aspects of energy-related products»	• Method to provide information on Material Efficiency • Communication strategy (target audience, data sensitivity, …) • Provision of information on Material Efficiency	Material Efficiency Topic (durability, recyclability,…) Topic related content Target audience Data sensitivity Communication method Material Efficiency communication Matrix	**Development of product specific standards** that should target the following aspects: Definition of a **product specific communication strategy** Introduction of **input for "reliability" (as per EN 45552 assessment method)** - Definition of a **product specific list of precautions for the users to extend lifespan of parts and products** (for example under normal special and harsh service conditions) **LCA (environmental footprint)** information to be implemented

Table 5.3 – Pilot Implementation Experiences - Circular Economy Action that can contribute to future standardization initiatives

PILOTS IMPLEMENTATION EXPERIENCES (WP4) - Circular Economy Action that can contribute to future standardization initiatives					
Standard	Identified Gap	WASH	PRINT	ALM	TV
EN 45552 «General method for the assessment of the durability of ErP»	A product specific standard should identify product specific priority functions/parts	WASH_A1.2.1 Improve durability and reparability WASH_A1.3.1 Enhance the integration of circular strategies into the production process	PRINT_A7.3.1 Explore the potential of eco-design to enhance printers' durability	ALM_A1.2.1 Reduce energy consumption in the use phase" ALM_A1.1.2 Design for recycling	TV_A1.2.1 Improve durability and reparability TV_A1.3.1 Enhance the integration of circular strategies into the production process
	A product specific standard should identify/define product specific environmental/operating conditions	WASH_A1.1.1 Increase recycled plastic content in WM parts WASH_A1.2.1 Improve durability and reparability WASH_A1.3.1 Enhance the integration of circular strategies into the production process	PRINT_A7.3.1 Explore the potential of eco-design to enhance printers' durability	ALM_A1.2.1 Reduce energy consumption in the use phase" ALM_A1.1.2 Design for recycling	TV_A1.1.1 Increase recycled plastic content in TV parts TV_A1.2.1 Improve durability and reparability TV_A1.3.1 Enhance the integration of circular strategies into the production process
	A product specific standard should define product specific limiting states	WASH_A1.3.1 Enhance the integration of circular strategies	PRINT_A7.3.1 Explore the potential of eco-	ALM_A1.1.1 Design for longevity	TV_A1.3.1 Enhance the integration of circular strategies

PILOTS IMPLEMENTATION EXPERIENCES (WP4) - Circular Economy Action that can contribute to future standardization initiatives					
Standard	Identified Gap	WASH	PRINT	ALM	TV
		into the production process WASH_A1.1.1 Increase recycled plastic content in WM parts	design to enhance printers' durability PRINT_A7.3.2 Leverage the use of WP3 ICT tool to improve printers' circularity	ALM_A1.2.1 Reduce energy consumption in the use phase"	into the production process TV_A1.1.1 Increase recycled plastic content in TV parts
	A product specific standard should define test methods to assess parts reliability	WASH_A1.3.1 Enhance the integration of circular strategies into the production process WASH_A1.1.1 Increase recycled plastic content in WM parts	PRINT_A7.3.1 Explore the potential of eco-design to enhance printers' durability	ALM_A1.1.1 Design for longevity ALM_A1.1.2 Design for recycling	TV_A1.3.1 Enhance the integration of circular strategies into the production process TV_A1.1.1 Increase recycled plastic content in TV parts
EN 45553 «General method for the assessment of the ability to remanufacture ErP»	A product specific standard should define product specific attributes	WASH_A1.1.1 Increase recycled plastic content in WM parts WASH_A2.3.2 Use ICT to enhance washing machines' circularity during the production and end-of-life phases	PRINT_A7.3.1 Explore the potential of eco-design to enhance printers' durability PRINT_A2.3.1 Use ICT to improve information sharing across the supply chain	ALM_A1.1.1 Design for longevity "ALM_A1.2.1 Reduce energy consumption in the use phase"	TV_A1.1.1 Increase recycled plastic content in TV parts TV_A1.1.2 Decrease packaging waste TV_A2.3.1: Use ICT to enhance TV circularity during the production and end-of-life phases
	A product specific standard should define product specific assessment	WASH_A1.1.1 Increase recycled	PRINT_A7.3.1 Explore the potential of eco-	ALM_A1.1.1 Design for longevity	TV_A1.1.1 Increase recycled plastic content in TV parts

PILOTS IMPLEMENTATION EXPERIENCES (WP4) - Circular Economy Action that can contribute to future standardization initiatives					
Standard	Identified Gap	WASH	PRINT	ALM	TV
		plastic content in WM parts	design to enhance printers' durability		TV_A1.1.2 Decrease packaging waste
EN 45554 «General method for the ability to repair, reuse and upgrade ErP»	A product specific standard should define product specific priority parts that will be considered for the assessment	WASH_A1.1.1 Increase recycled plastic content in WM parts	PRINT_A9.2.1 Explore the potential of eco-design measures costs related to the refurbishment process of printers PRINT_A1.1.3 Provide information about printers to LEXMARK recycling partners	ALM_A1.1.1 Design for longevity	TV_A1.1.2 Decrease packaging waste TV_A1.1.1 Increase recycled plastic content in TV parts
	A product specific standard should select relevant criteria according to the product (in terms of applicability, appropriateness and relevance)	WASH_A1.1.1 Increase recycled plastic content in WM parts WASH_A1.2.1 Improve durability and reparability	PRINT_A1.1.2 Improve the refurbishment and/or dismantling processes PRINT_A7.3.2 Leverage the use of WP3 ICT tool to improve printers' circularity	ALM_A1.1.1 Design for longevity	TV_A1.1.1 Increase recycled plastic content in TV parts TV_A1.1.2 Decrease packaging waste TV_A1.2.1 Improve durability and reparability
	A product specific standard should integrate considerations based on functional analysis, together with predictive, corrective, preventive or maintenance methodologies	WASH_A1.1.1 Increase recycled plastic content in WM parts	PRINT_A9.2.1 Explore the potential of eco-design measures costs related to the	ALM_A1.1.1 Design for longevity	TV_A1.1.1 Increase recycled plastic content in TV parts TV_A1.1.2 Decrease packaging waste

PILOTS IMPLEMENTATION EXPERIENCES (WP4) - Circular Economy Action that can contribute to future standardization initiatives					
Standard	Identified Gap	WASH	PRINT	ALM	TV
			refurbishment process of printers PRINT_A2.3.1 Use ICT to improve information sharing across the supply chain PRINT_A7.3.1 Explore the potential of eco-design to enhance printers' durability		
EN 45555 «General method for assessing the recyclability and recoverability of ErP»	A product specific standard should diefine a product/product group specific EoL scenario	WASH_A1.2.1 Improve durability and reparability	PRINT_A1.1.2 Improve the refurbishment and/or dismantling processes PRINT_A2.1.1 Further improve recyclable materials in printers	ALM_A1.1.2 Design for recycling	TV_A1.2.1 Improve durability and reparability
EN 45556 «General method for assessing the proportion of reused components in ErP»	A product specific standard should indicate a calculation method	WASH_A1.2.1 Improve durability and reparability	PRINT_A1.1.2 Improve the refurbishment and/or dismantling processes PRINT_A1.2.3 Use materials that recyclers can easily and profitably recycle	ALM_A1.1.1 Design for longevity	TV_A1.2.1 Improve durability and reparability

PILOTS IMPLEMENTATION EXPERIENCES (WP4) - Circular Economy Action that can contribute to future standardization initiatives					
Standard	Identified Gap	WASH	PRINT	ALM	TV
	A product specific standard should indicate the relevance for each reused component according to its utilization scope in the product	WASH_A1.3.1 Enhance the integration of circular strategies into the production process	PRINT_A1.1.2 Improve the refurbishment and/or dismantling processes PRINT_A1.2.3 Use materials that recyclers can easily and profitably recycle	ALM_A1.1.1 Design for longevity	TV_A1.3.1 Enhance the integration of circular strategies into the production process
EN 45557 «General method for assessing the proportion of recycled material content in ErP»	A product specific standard should provide indications for a traceability system (CoC) and management of the product	WASH_A1.2.1 Improve durability and reparability	PRINT_A2.3.1 Use ICT to improve information sharing across the supply chain PRINT_A2.3.2 Use ICT to improve tracking of printers' current location and status	"ALM_A1.2.2 Eco-design approach in production and Design for Recycling"	TV_A1.2.1 Improve durability and reparability
	A product specific standard should provide an indication of pre-consumer materials according to product specific technological processes	WASH_A1.2.1 Improve durability and reparability	PRINT_A7.3.1 Explore the potential of eco-design to enhance printers' durability		TV_A1.2.1 Improve durability and reparability
	A product specific standard should provide indications or references to indicate main materials clusters or unspecified materials	WASH_A1.3.1 Enhance the integration of circular strategies into the production process	PRINT_A2.1.1 Further improve recyclable materials in printers PRINT_A7.3.1 Explore the potential of eco-	"ALM_A1.2.2 Eco-design approach in production and Design for Recycling"	TV_A1.3.1 Enhance the integration of circular strategies into the production process

PILOTS IMPLEMENTATION EXPERIENCES (WP4) - Circular Economy Action that can contribute to future standardization initiatives					
Standard	Identified Gap	WASH	PRINT	ALM	TV
			design to enhance printers' durability		
EN 45558 «General method to declare the use of CRM in ErP»	Product specific standards could provide thresholds for CRM in the product	WASH_A2.3.2 Use ICT to enhance washing machines' circularity during the production and end-of-life phases TV_A1.3.1 Enhance the integration of circular strategies into the production process	PRINT_A1.1.2 Improve the refurbishment and/or dismantling processes	"ALM_A1.2.2 Eco-design approach in production and Design for Recycling"	TV_A2.3.1: Use ICT to enhance TV circularity during the production and end-of-life phases TV_A1.3.1 Enhance the integration of circular strategies into the production process
EN 45559 «Methods for providing information relating to material efficiency aspects of energy-related products»	Definition of a product specific communication strategy		PRINT_A1.1.3 Provide information about printers to LEXMARK recycling partners PRINT_A2.3.1 Use ICT to improve information sharing across the supply chain	"ALM_A1.2.2 Eco-design approach in production and Design for Recycling"	
	Some information should be integrated related to "reliability" for the product (as per EN 45552 assessment method)	WASH_A1.2.1 Improve durability and reparability	PRINT_A7.3.1 Explore the potential of eco-design to enhance printers' durability	"ALM_A1.2.2 Eco-design approach in production and Design for Recycling"	TV_A1.2.1 Improve durability and reparability
	Definition of a product specific list of precautions for the users to extend lifespan of parts and products (for example under normal special and harsh service conditions)	WASH_A1.1.1 Increase recycled plastic content in WM parts	PRINT_A7.3.1 Explore the potential of eco-	"ALM_A1.2.2 Eco-design approach in	TV_A1.1.1 Increase recycled plastic content in TV parts

PILOTS IMPLEMENTATION EXPERIENCES (WP4) - Circular Economy Action that can contribute to future standardization initiatives					
Standard	Identified Gap	WASH	PRINT	ALM	TV
			design to enhance printers' durability	production and Design for Recycling"	TV_A1.1.2 Decrease packaging waste
	LCA (environmental footprint) information to be implemented			"ALM_A1.2.2 Eco-design approach in production and Design for Recycling"	

Table 5.4 – Pilot Implementation Experiences – Collected information as potential contribution for future product group specific standardization initiatives

Collected information as potential contribution for future product group specific standardization initiatives			
Standard	Identified Gap	Collected information	Guidelines to fill out the required information
EN 45552 «General method for the assessment of the durability of ErP»	A product group specific standard should identify product group specific priority functions/parts	Spare Part list and Bill of materials can give such informatio; a non-exhaustive list for the TV case for example is: Power cable, Back Cover, Plastic Stand Bracket, Wall MountBracket, Cable, T-con Board, Main Board, PSU Power Supply Unit, Loundspeaker, Wi-fi/Bluetooth Board, Front Plastic Cover, Display, Display Plastic Frame, Reflective plastic film, Led bar, Remote control	*Please give a first list of priority functions/parts for the product or indicate relevant references (product technical standards, guidelines, technical sheets) that can contain the required information*
	A product group specific standard should identify/define product group specific environmental/operating conditions	Sources of information can be retrieved from specific tests such as Tests in Humidity and Temperature Controlled Rooms or basic safety directives (LVD: Low Voltage Directives). Air-conditioning and Voltage Performance tests can be applied to verify the operability of the designed products under these conditions Usually this category of products can operate in the 220-240V AC voltage range in an environment with 0°C-40°C/45°C temperature and 0%-90% humidity. Other product group specifications can be applied (for example full military specs (-40…+85)	*Please give a first list of environmental and operating condition typical for the product or indicate relevant references (product technical standards, guidelines, technical sheets) that can contain the required information*
	A product group specific standard should define product group specific limiting states	Main tests that can be used as a source of information or contribute to define the specific point are EMC Test, LVD Test, Climatic Tests, Packaging Tests, Accelerated Life Test, Derating Analysis Test, Thermal Analysis Test, Voltage Performance Tests, Software Approval Tests, Picture & Sound Perf. Tests (TV), RF- Tuner Perf. Tests, Wifi-Bluetooth Perf. Tests, Energy performance tests, Broadcast-Country Approval Tests (TV), specific third-party tests (TUV, VDE, …) Field Tests.	*Limiting event is an occurrence resulting in a primary/secondary function no longer delivered (EN 45552). Please give a first list of environmental and operating condition typical for the product or indicate relevant references (product technical standards, guidelines, technical sheets) that can contain the required information*
	A product group specific standard should define test methods to assess parts reliability	Main tests that can be used as a source of information or contribute to define the specific point are EMC Test, LVD Test, Climatic Tests, Packaging Tests, Life Test, Derating Analysis Test, Thermal Analysis Test, Voltage Performance Tests, Software Approval Tests, Picture & Sound Perf. Tests, RF- Tuner Perf. Tests, Wifi-Bluetooth Perf. Tests, Technology Certification Tests, Broadcast-Country Approval Tests, Field Tests. For the ALM case,	*Reliability is the probability that a product functions as required under given conditions. Please give an indication of test methods that could be applied for the product or indicate relevant references (product technical*

Collected information as potential contribution for future product group specific standardization initiatives			
Standard	Identified Gap	Collected information	Guidelines to fill out the required information
		information on MTBF derives from product group specification, on module level	*standards, guidelines, technical sheets) that can contain the required information*
EN 45553 «General method for the assessment of the ability to remanufacture ErP»	A product group specific standard should define product group specific attributes A product group specific standard should define product group specific assessment	Useful information can be collected if referring to the product group specific Eco Design Directives (TV and WASH) and specifically in the following points from Annex II, point D: 1. Design for dismantling, recycling and recovery 2. Marking of plastic components The following points emerged as of relevance for remanufacturing evaluation: Avoidance of fixed joints, Number of screws, Necessity of specialty tools, Accessibility to battery, Modularity degree	*Remanufacturing of a product is linked to one or more attributes to be used for the assessment of the ability of a product to be remanufactured. Product attributes are: ability to be identified, ability to locate access points and fasteners, accessibility of parts, ability to be disassembled/assembled, wear and damage resistance during the remanufacturing process steps. Please give an indication on which "product attributes" could be more relevant for remanufacturing evaluation of the product and which remanufacturing step impact the most among inspection, disassembly, cleaning, reprocessing, assembly, testing, storage. In alternative you could also provide relevant references (product technical standards, guidelines, technical datasheets) that can contain useful information*
EN 45554 «General method for the ability to repair, reuse and upgrade ErP»	A product group specific standard should define product group specific priority parts that will be considered for the assessment	Bill of material as a source of information for every product group. For ezample for the TV case: main Board, PSU Power Supply Unit, T-con Board,Display, Front Plastic Cover Back Cover, Reflective plastic film, Led bar, Power cable, Plastic Stand Bracket, Wall, MountBracket, , Loundspeaker, Wi-fi/Bluetooth Board, , Display Plastic Frame,Remote control For ICT equipment (as ALM) more than a list of priority function/parts a contribution can be derived from the assessment of properties such as modularity, resilience (e.g. by duplication) in terms of capability for "hot" plug/unplug.	*Please give a first list of priority functions/parts for the product or indicate relevant references (product technical standards, guidelines, technical sheets) that can contain the required information*

Collected information as potential contribution for future product group specific standardization initiatives			
Standard	Identified Gap	Collected information	Guidelines to fill out the required information
	A product group specific standard should select relevant criteria according to the product (in terms of applicability, appropriateness and relevance)	Reference has been made to dismantling criteria and as an example a dismantling procedure (detailing tools, parts involved, etc) has been detailed as follows for the TV case: • Remote control batteries are easily removed. • The TV is laid on the table • The rear cover is removed from the screws using a PH1 Phillips head manual or automatic screwdriver. • The rear cover is removed and placed in the free position. • All motherboard cables are easily removed and released by pressing their sockets. • The sideAV plastics on the motherboard are taken out by removing their tabs. • Main board screws are removed with the help of PH1 Phillips head screwdriver. All cables are released. • All PSU cables are easily removed and released by pressing their sockets. • PSU screws are removed with the help of a PH1 Phillips head screwdriver. All cables are released. • PSU screws are removed with the help of a PH1 Phillips head screwdriver. All cables are released. • All sockets connected to the T-conboard are easily removed and released by hand. • T-conboard screws are removed with the help of a PH1 screwdriver. All cables are released. • The metal foot connection part screws are removed using a Phillips head PH1 Phillips head manual or automatic screwdriver. • The speaker plastic boxes are pulled out of their sockets and released. • Wi-fi module is pulled out of its socket. • Wi-fimodule holder screws are removed with the help of a PH1 Phillips head screwdriver. The plastic holder remains free. • The remote-control receiver lens is removed by manually pulling it out. • The remote-control receiver module is pulled out by hand.	*Please give a first list of product group specific criteria that could influence the ability of the product to be repaired, reused or upgraded (example disassembly depth, fasteners and connectors, tools, working environment, skill level) providing some examples. Alternatively you can indicate relevant references (product technical standards, guidelines, technical sheets) that can contain the required information*

Collected information as potential contribution for future product group specific standardization initiatives			
Standard	Identified Gap	Collected information	Guidelines to fill out the required information
		• Wall hanger metals are removed using PH1 Phillips head manual or automatic screwdriver. • All tapes are removed by hand. • WIFI antenna is separated from its adhesive with a plastic spatula. • Capacitors larger than 25 mm are not included in the power supply board. • Plastic parts larger than 25 gr cannot contain bromlual flame retardants. For ICT equipment (ALM) modularity can represent one of the main criteria, together with resilience (duplication of key components, e.g., PSUs). Aspects that are already taken into consideration for B2B ICT equipment	
	A product group specific standard should integrate considerations based on functional analysis, together with predictive, corrective, preventive or maintenance methodologies	Some standard specified as the IEC 61850, ISO 5867 and the EN10327 (for metals), while other useful information can be retrieved through the Digital Europe (DE) Home Connectivity Alliance (HCA) initiatives and a further research of already published CEN-CENELEC standards. Further information can be retrieved from secondhand usage/repair/refurbishment acceptance criterias or ecodesign criteria. For ICT equipment in support of maintenance/condition monitoring, AI-based predictive maintenance is only recently being rolled out for B2B and it is not standardized. It might, e.g., include monitoring laser currents of laser diodes etc., plus AI algorithms.	*Please give an indication of product group specific technical standards or other technical references that can contribute to the definition of a functional analysis methodology. Please give also an indication of technical standards or other references that are being used to help evaluate maintenance, condition monitoring, failure analysis of the product*
EN 45555 «General method for assessing the recyclability and recoverability of ErP»	A product group specific standard should diefine a product/product group specific EoL scenario	Typical EoL scenario firstly starts with dismantling, then after the relevant tests are completed, it can be decided as if the product goes to recycling or scrubbing. No information has been retrieved on relevant tests but those should be considered in future activities For B2B ICT equipment (such as ALM), the 99% scenario after long usage is recycling.	*Please give an indication of a product/product group typical EoL scenario in terms of: - applicable regulations; - relevant industry practices and standards allowing efficient recycling and recovery; - main health, safety and environmental concerns; - main materials content*
EN 45556 «General method for	A product group specific standard should indicate a calculation method	Both mass based and number of components-based calculation methods can be considered within the scope of process. The number of	*EN 45556 describes two calculation methods to assess the proportion of reused components: "mass based" and "number of*

Collected information as potential contribution for future product group specific standardization initiatives			
Standard	Identified Gap	Collected information	Guidelines to fill out the required information
assessing the proportion of reused components in ErP»	A product group specific standard should indicate the relevance for each reused component according to its utilization scope in the product	components-based calculation can be prior, while for explanatory reasons the mass-based calculation can be added Also for ICT equipment the number of components should be preferred upon mass-based that can be corrupted by the weight of the chassis (ALM), which in turn is a minor contributor to LCA and environmental impact evaluations in general	*components based". Which one would you consider the best option for the product/product group? Moreover which calculation strategy would you adopt: at product level (calculation for a single product of proportion of reused components) or on a time interval (considering the number of reused components in the defined period for the assessed products)? Are there parts/components that you would consider more important than others when reused for the product?*
EN 45557 «General method for assessing the proportion of recycled material content in ErP»	A product group specific standard should provide indications for a traceability system (CoC) and management of the product	References can be found from the Digital Europe (DE), Home Connectivity Alliance (HCA) and AppliA initiatives. For ICT equipment the Digital Product Passport (DPP) represents an initiative that can contribute to this regard	*Are there indications (for example CIRCULARISE platform or other previous experiences) of tracebility of the content of recycled materials for the specified product?*
	A product group specific standard should provide an indication of pre-consumer materials according to product group specific technological processes	This information can be retrieved from the Bill of material, together with RoHS, Reach, PAH declarations for materials and components in MSDS and TDS	*Please provide main occurrences of pre-consumer materials for the considered product*
	A product group specific standard should provide indications or references to indicate main materials clusters or unspecified materials	Apart metal and plastic parts relevant references can be retrieved from the Bill of material, together with RoHS, Reach, PAH declarations for materials and components in MSDS and TDS In the case of the ALM for example we can list main and daughter PCBAs, Chassis, PSUs (they have slightly different material mix compared to main	*Please give an indication of main materials clusters for the product or indicate relevant references (material declaration standards, guidelines, technical sheets) that can contain the required information for the specific product.*

Collected information as potential contribution for future product group specific standardization initiatives			
Standard	Identified Gap	Collected information	Guidelines to fill out the required information
		PCBA). This evaluation can be part of the EPDs (Environmental Product Declarations)	
EN 45558 «General method to declare the use of CRM in ErP»	Product group specific standards could provide thresholds for CRM in the product	In EEE almost all the CRM need to be considered, including and not limiting to Rare Earth Elements, Platinum Group Metals, Germanium, Gallium.	*Please provide an indication of main CRM occurring in the product and (if possible) a list non CRM that you should consider of relevance*
EN 45559 «Methods for providing information relating to material efficiency aspects of energy-related products»	Definition of a product group specific communication strategy	A good strategy could be based on the communication of how the product has been designed, with reference to design for modularity and design for sustainability and decrease usage of virgin raw material. The information managed by a centralized, non-commercial cloud-based data base	*Which communication strategy would you envisage as more efficient to communicate material efficiency aspects for the considered product?*
	Some information should be integrated related to "reliability" for the product (as per EN 45552 assessment method)	In addition to what has already been written in EN 45552 section it can be added that together with the MTBF specification (based on artificial ageing) for the modules, another important factor to be taken into account for reliability is the MTTR (Mean Time to Repair) that is more user- (operator-) specific than product group-specific.	*Reliability is the probability that a product functions as required under given conditions. Please give an indication of test methods that could be applied for the product or indicate relevant references (product technical standards, guidelines, technical sheets) that can contain the required information*
	Definition of a product group specific list of precautions for the users to extend lifespan of parts and products (for example under normal special and harsh service conditions)	Not a specific list but, deriving from the experience in the B2B ICT equipment sector a remote performance monitoring and fault correlation should give contribution on this respect.	*Could you define of a product group specific list of precautions for the users to extend lifespan of parts and products (for example under normal special and harsh service conditions)? An approximate and not detailed list is sufficient for the objective of the analysis*

6 Roadmap and Conclusions

In the framework of C-SERVEES, WP6 aimed to provide key enabling tools for boosting the replicability and transferability of circular economy products and services across EU, developing eco-design guidelines for EEE and recommendations on policies to overcome current legislative barriers, as well as a framework for standardizing the circular economy.

The latter is particularly important for overcoming the numerous uncertainties that producers and consumers are facing, which may limit the industrial use and market acceptability of new materials and products, such as recycled materials and products prepared for reuse or remanufactured. Standardization can simplify the communication of the technical and quality characteristics of materials and products, generating a greater confidence among end users and contributing to increase the market entry of materials and products obtained from WEEE.

In this regard, Task 6.3 aimed to explore these issues and to evaluate the "gaps" in standards of circular economy in the E&E sector, subsequently identifying and collecting useful information to contribute future standardization initiatives. The overall activity of Task 6.3 can be so schematized as a roadmap (Figure 6.1) starting in the framework of C-SERVEES Project and ending with the identification of stakeholders as potential recipients of the results of Task 6.3 (CEN TCs, ISO TCs, etc.).

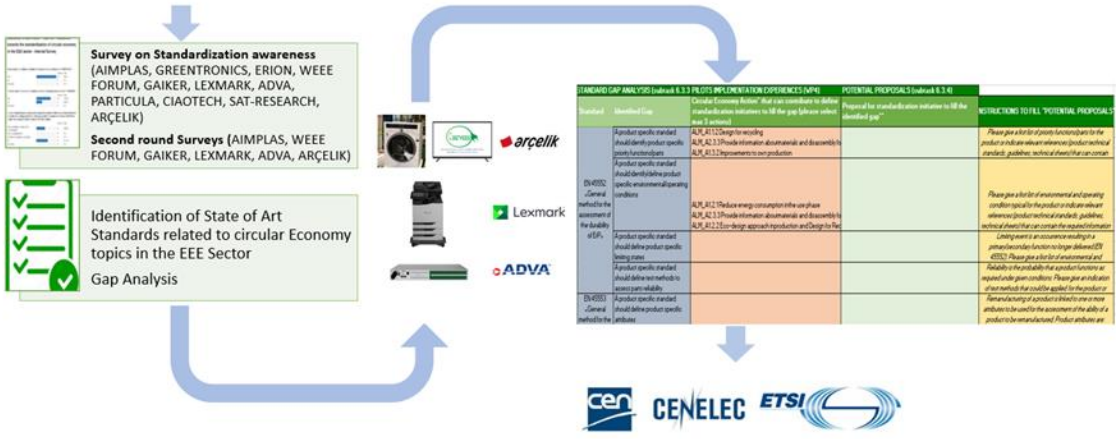

Figure 6.1 – Roadmap for proposal of standardization initiatives

In the first steps of the roadmap information has been gathered (desk research, interviews with Partners) regarding standardization related issues emerged from project pilot's implementation and the level of "standardization awareness" (knowledge of relevant standards, participation to TC/WGs, round tables, etc.) of the Consortium. The identification and analysis of high priority state-of-art standards relating to environmental topics in the EEE industry allowed to define the standardization scenario and perceive some room for future standardization initiatives contributing to implementation of CE in the industry.

The analysis conducted on the WEEE Directive standardization deliverables (including the TR 50625-6 "Collection, logistics & treatment requirements for WEEE - Part 6: Report on the alignment between Directive 2012/19/EU and EN 50625 series standards and EN 50614" and relevant literature [18]) showed that **all relevant requirements of the WEEE Directive related to collection, transport, storage and depollution are largely covered in the CENELEC standardisation deliverables** with the following Articles and Annexes covered in depth:

- Article 6 (Disposal and transport of collected WEEE)
- Article 8 (Proper treatment)
- Article 11 (Recovery targets)
- Annex VII (Selective treatment for materials and components of WEEE referred to in Article 8(2))
- Annex VIII (Technical requirements referred to in article 8 (3))

Specific issues that were highlighted in the M/518 Mandate are all covered: coverage of the collection of WEEE where it is crucial for subsequent proper treatment (TS 50265-4), areas for which detailed process management requirements are specified (EN 50625-1, EN 50625-2-4, 50625-2-3), Handling of batteries contained in WEEE (EN 50625-1, EN 50625-4), Data protection (EN 50625-1). Moreover, several requirements inserted as normative text in the standard are not derived from the WEEE Directive or other EU relevant legislation.

The analysed EN 4555x Series standards are horizontal and thought to be applied to any ErP, providing an agreed upon methodology to assess the following topics: durability, reuse, repair, upgrade, remanufacture, refurbish, recover, recycle, critical raw materials, marking and documentation. What is emerged from the standardization scenario analysis is the importance in the future to develop product group specific standards that will adapt the general assessment methodologies to the specificities of a product. Material efficiency aspects are indeed strictly related and prioritized in accordance with the product use profile (operating and environmental conditions, health and security issues, functional analysis, operating and limiting states, ...).

The contribution deriving from the experience of Pilot implementation Partners during C-SERVEES Project has been exploited to derive a series of useful information that can be funnelled in future product specific standardization initiatives regarding TV, washing machines, printers, ICT equipment in general. The results are presented in Table 5.2, Table 5.3 and Table 5.4 of this Deliverable in terms of:

- Potential recommendations (starting from relevant publications from CEN-CENELEC [17]) - Table 5.2
- Circularity Actions (CA) as developed in WP4 and linking the recommendation to the experience carried out in the framework of C-SERVEES - Table 5.3

- Collected information that can be used as potential contribution for future product specific standardization initiatives - Table 5.4.

Besides the necessity to develop product specific standards, it needs to be highlighted that the EN 4555x series does not provide requirements for Environmental Conscious Design (ECD) or global Circular Economy considerations that are being depicted in the IEC/ISO 62430 standard (EN-IEC 62430: 2019 "Environmentally conscious design (ECD) - Principles, requirements and guidance"; Table 3.4). Topics that are currently covered by the joint working group "JWG ECD" established between IEC/TC 111 Committee[2] (Environmental standardization for electrical and electronic products and systems) and ISO/TC 207 Committee[3] (Environmental Management) under the provisions from the IEC /Guide 109 "Environmental aspects - Inclusion in electrotechnical product standards" [23] and that consider of relevance other elements further than the ones related to material efficiency, such as:

- Mission profile
- Dependability
- Interoperability
- Digitization
- Energy saving and efficiency
- Environmental footprint

In a perspective aimed at sharing the results of this Task and the experiences done through the Pilot implementation of CEBM, main organizations that should be taken into consideration are listed in the following Table 6.1. Some of the listed Organizations have been suggested by the C-SERVEES Consortium during the Survey on Standardization Awareness (Paragraph 3.2).

[2] https://www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID,FSP_LANG_ID:1314,25
[3] https://www.iso.org/committee/54808.html

Table 6.1 – Potential recipients of the results of C-SERVEES Project from a standardization point of view

Organization (Standardization Organization/Body, other organizations)	Technical Committee, Working Group, Joint Technical Committee	Scope and activities (Business Plan documents)
CEN - CENELEC	CEN/CLC/JTC 10 WG 1-8 "Material efficiency aspects for products in scope of Ecodesign legislation"	Material efficiency aspects for products in scope of the Ecodesign Directive 2009/125/EC and its future revisions[4].
IEC	IEC/TC 111 "Environmental Standardization for Electrical and Electronic Products and Systems"	Standardization of environmental aspects […] - To liaise with **product committees in the elaboration of environmental requirements of product standards** in order to foster common technical approaches and solutions for similar problems and thus assure consistency in IEC standards[…][5]
ISO	ISO/TC 207 "Environmental management"	Standardization in the field of environmental management to address environmental and climate impacts, including related social and economic aspects, in support of sustainable development[6].
Telecommunications Industry Association (TIA)	Sustainability Working Group (SWG)	The TIA QuEST Forum Sustainability Working Group (SWG) is made up of companies that prioritize sustainability and corporate social responsibility[7]. ADVA appointed with the Sustainability Leadership role
ISO	ISO/TC 323 Circular economy	Standardization in the field of Circular Economy to develop frameworks, guidance, supporting tools and requirements for the implementation of activities of all involved organizations, to maximize the contribution to Sustainable Development. Excluded: Aspects of

[4] https://standards.cencenelec.eu/BPCEN/2240017.pdf
[5] https://assets.iec.ch/further_informations/1314/TC111%20SBP%202021-2022.pdf?0926T11
[6] https://isotc.iso.org/livelink/livelink/fetch/2000/2122/687806/ISO_TC_207_Environmental_management_.pdf?nodeid=999214&vernum=-2
[7] https://tiaonline.org/what-we-do/tia-quest-forum/working-groups/%E2%80%8Bsustainability-working-group/

Organization (Standardization Organization/Body, other organizations)	Technical Committee, Working Group, Joint Technical Committee	Scope and activities (Business Plan documents)
		Circular Economy already covered by existing committees[8].
CEN	CEN TC 249/WG 11 - Plastics Recycling	Standardization of terminology, test methods and specifications in the field of plastics and plastic-based materials,[…][9]
CEN	CEN TC 438: Additive manufacturing	Standardization in the field of Additive Manufacturing (AM)[10]
ISO	ISO/TC 61/SC 14 Environmental aspects WG 5 Mechanical and chemical recycling	All standardization activities in the field of plastics relating to environmental and sustainability aspects.[…]
CENELEC	CLC/TC 111X - ENVIRONMENT	To deal with environmental aspects for electrical and electronic products and systems.[…]

[8] https://isotc.iso.org/livelink/livelink/fetch/2000/2122/687806/ISO_TC_323__Circular_Economy_.pdf?nodeid=21218393&vernum=-2

[9] https://standards.cencenelec.eu/BPCEN/6230.pdf

[10] https://standards.cencenelec.eu/BPCEN/1961493.pdf

7 Bibliography

[1] "CEN-CENELEC," [Online]. Available: https://www.cencenelec.eu/ .

[2] "Standards Australia," [Online]. Available: https://www.standards.org.au/standards-development/what-is-standard.

[3] *ISO/IEC GUIDE 2:2004(E/F/R).*

[4] "EUR-Lex," [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02012R1025-20151007.

[5] CEN-CENELEC, "Internal Regulations Part 2 - Common Rules For Standardization Work," 2022.

[6] CEN-CENELEC, "European standardization - International Cooperation," [Online]. Available: https://www.cencenelec.eu/european-standardization/international-cooperation/.

[7] "REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the voluntary ecodesign scheme for imaging equipment," 2013.

[8] D. Bernad Beltran and F. Alfieri, "The Voluntary Agreement for Imaging Equipment: assessment of admissibility criteria for self-regulation. EUR 31093 EN.," Publications Office of the European Union, Luxembourg, 2022.

[9] "Industry voluntary agreement to improve the environmental performance of imaging equipment placed on the European market Draft FY20.v5," 2021. [Online]. Available: https://www.eurovaprint.eu/fileadmin/eurovaprint_files/Member_Only/VA_Revision/Joint_VA_2020/VA_Agreement_Imaging_Equipment_9_April_2021_FINAL_CLEAN.pdf.

[10] "ETIRA," [Online]. Available: https://www.etira.org/posts/tag/eu-voluntary-agreement/.

[11] ITU-T. L. 1410, "Methodology for environmental life cycle assessments of information," 2014. [Online]. Available: https://www.itu.int/rec/TREC-L.1410-201412-I/en.

[12] ITU-T. L.1024 , "The potential impact of selling services instead of equipment on waste creation and the environment - Effects on global information and communication technology," 2021. [Online]. Available: https://www.itu.int/rec/T-REC-L.1024-202101-I/en.

[13] ITU-T, "L.1023 : Assessment method for circular scoring," 2020. [Online]. Available: https://www.itu.int/rec/T-REC-L.1023-202009-I/en.

[14] "TIA - SWG," [Online]. Available: https://tiaonline.org/what-we-do/tia-quest-forum/working-groups/%E2%80%8Bsustainability-working-group/.

[15] K. Grobe, "Energy Efficiency Limits to ICT Equipment Lifetime," in *Photonic Networks; 23th ITG-Symposium*, 2022.

[16] T. Cormenier and M. Patra, "How Standardization for Ecodesign and Circular Economy Contributes to Sustainability," Schneider Electric, 2020.

[17] CEN-CENELEC, "Highlights in Circular Economy standardization in CEN and CENELEC," 2022.

[18] Directorate-General for Environment (European Commission), "STUDY ON QUALITY STANDARDS FOR THE TREATMENT OF WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE)," 2020.

[19] *M/543 COMMISSION IMPLEMENTING DECISION C(2015)9096 of 17.12.2015 on a standardisation request to the European standardisation organisations as regards ecodesign requirements on material efficiency aspects for energy-related products in support of the impl,* 2015.

[20] "Circular economy introduction," Ellen MacArthur Foundation , [Online]. Available: https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview.

[21] "List of energy efficient products Regulations: by product group," European Commission, [Online]. Available: https://energy.ec.europa.eu/topics/energy-efficiency/energy-label-and-ecodesign/list-energy-efficient-products-regulations-product-group_en.

[22] "Internal Market, Industry, Entrepreneurship and SMEs," European Commission, [Online]. Available: https://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=526.

[23] *IEC GUIDE 109:2012 Environmental aspects - Inclusion in electrotechnical product standards.*