Guidelines for the definition of a legal framework on electronic waste from Information and Communication Technologies – ICT

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Summary

For the International Telecommunication Union - ITU, the environmentally sound management of e-waste from ICT has become a major issue, concerning which certain actions have been implemented in order to improve the situation of the countries in this regard, namely: reports, toolkits and educational material; direct assistance in planning and implementation of e-waste management techniques; promotion of innovative ICT solutions in the domain of e-waste and develops green ICT standards to reduce their negative impact; the ITU Global Portal on e-Waste; and so on (International Telecommunication Union - ITU, 2016.)

The ITU is aware of the existence of multiple instructional documents referring to the proper techniques for managing e-waste. Despite the foregoing, it has decided to prepare this document to provide guidance to countries on issues that should be taken into account in any regulation to be issued pertaining to e-waste.

The document states the undeniable social and economic benefits of ICT, as well as the problems caused by e-waste and how to tackle them accordingly, based on the application of Sustainable Development and Green ICT concepts, considering the organization as a management system and its implementation, along with the application of the best practices in each of the WEEE lifecycle assessment (cradle to grave).

This document provides organized information on the administrative, technical, social and economic aspects to be included in a legal framework, as well as the minimum standards required for specific regulations, as part of the first steps towards the environmentally sound management of e-waste.
0. Introduction

In today’s globalized world, in which Information and Communications Technology – ICT have become essential to everyday life and promote economic development and social mobility, ICT electric and electronic devices have become a problem, because they are mostly discarded prematurely and inadequately in the frenzy to acquire the latest update, without considering their content, which includes hazardous substances and precious and rare metals, which make them potentially harmful to the environment and the health of the people, while being attractive for recycling.

In least developed and developing countries the problem is ever-increasing, since they receive significant amounts of used electronic and electronic equipment – UEEE, either illegally or with the purpose of closing digital divides (in certain cases with short lifecycles), but they do not have the technology and infrastructure needed for the environmentally sound management of e-waste.

The lack of regulations, technology, infrastructure, as well as awareness and knowledge concerning the negative impact of the inadequate management of e-waste on the environment and human health, have allowed this type of waste to be disposed of along with ordinary waste, discarded in public areas or collected by informal recyclers, who do not implement the practices best suited for the environment, their health and that of their families (who are also involved in these activities), such as burning cables or using chemicals for recovering metals, without any knowledge and without applying any technical criteria.

Throughout our history, mankind has used natural resources, mostly indiscriminately, for the production of goods and services, generating high levels of contamination which in turn have pushed the planet to unfathomable limits. It is clear that development cannot be halted, but at the same time it must be reached without affecting the environment. This is the origin of the concept of Sustainable Development, which, according to the “Our Common Future” report (1987) means “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. The concept “Green ICT” then stemmed from Sustainable Development, which, in accordance with the Council of European Professional Informatics Societies – CEPIS (2016) “Green ICT benefits the environment by improving energy efficiency, lowering greenhouse gas emissions, using less harmful materials, and encouraging reuse and recycling”.

This is how it became necessary, based on the application of the concepts of Sustainable Development and Green ICT, to properly manage e-waste that has been used and discarded by their initial owners in order to generate economic, environmental and social benefits additional to those already generated by the used of ICT. Therefore, the first step to be taken must entail defining a legal framework and specific regulations that will permit organizing and implementing an e-waste management system. This is also why ITU has decided to prepare this document to provide guidance, so that the countries may design and apply laws relating to ICT e-waste, considering each nation’s individual conditions and needs.
1. Preliminary Aspects

1.1. Purpose

The purpose of this document is to define the aspects to be considered in the definition of a legal framework for the Environmentally Sound Management – ESM of Used Electric and Electronic Equipment - UEEE and electronic waste from the Information and Communication Technologies - ICT. The document is intended to guide all countries, regardless of their conditions and their advancements in this area, to the benefit of the general population and the environment.

1.2. Scope

This document presents, within the framework of the concepts of “Sustainability” and “Management System” and from the review and analysis of selected secondary sources, the aspects that should be considered by the countries in the design, organization and issue of a legal framework that allows for the proper management of the UEEE both, in the stages of direct or indirect reuse (repair and refurbishment) – Figure 5 - and in the recycling stages (ICT/WEEE pre-processing and processing) – Figure 6.

The legislation that the countries issue shall cover the organization of the used ICT/EEE management system, and its enforcement through minimum standards or best practices (specific regulations). The design of the system, as well as its implementation, are shown in this document.
2. Identification of the negative effects that result from the use of the telecom/ICT generated e-waste and best options to deal with them

2.1. The role of ICTs in economic and social development

The World Bank in 2009 and in 2012 (update) conducted a historical study, through which it demonstrated the increasing impact of different ICT on economic growth. It found that a 10% increase in fixed broadband penetration translates into a 1.35% increase in GDP growth in developing countries and 1.19% in developed economies. Subsequently, an analysis associated mobile broadband and usage intensity with economic growth, proving that doubling the use of mobile broadband data results in a 0.5% increase in GDP per capita growth rates (Pepper, 2015).

With ICT contributing to global economic growth, developing regions have experienced a steady decline in absolute poverty. According to the World Bank, the global extreme poverty rate (people who survive on less than $1.25 per day) dropped by more than 50% to 21% in 2010, driven by aspects such as: Economic growth in China and India (in the long term), growth in Africa and the impact of social programs in Latin America. Macroeconomic analyzes have demonstrated the significant impact of ICT on lower income groups, especially mobile telephony and the Internet (Pepper, 2015).

In addition, following the formulation of the 17 Sustainable Development Goals (SDG) and their 169 targets (2016-2030), initiatives to achieve them require the use of Information and Communication Technologies - ICT (Brecha Cero, 2016). ITU Fact and Figures 2016 reports the following results (ITU, 2016):

- Seven billion people (95% of the global population) live in an area that is covered by a mobile-cellular network. Mobile-broadband networks (3G or above) reach 84% of the global population but only 67% of the rural population.
- LTE networks have spread quickly over the last three years and reach almost 4 billion people today (53% of the global population), enhancing the quality of Internet use. By end 2016, 3.9 billion people - 53% of the world’s population – is not using the Internet.
- Close to one out of two people (47%) in the world are using the Internet but only one out of seven people in the LDC. Developed regions are home to one billion Internet users, compared to 2.5 billion users in the developing world.
- In developing countries, the number of mobile-broadband subscriptions continues to grow at double digit rates, reaching a penetration rate of close to 41%. The total number of mobile-broadband subscriptions is expected to reach 3.6 billion by end 2016.
- Fixed-broadband penetration remains at below 1% in Africa and the LDC. Strong growth in China is driving fixed broadband in Asia and the Pacific, where fixed-broadband penetration is expected to surpass 10% by end 2016.

Finally, ICT generate another series of positive impacts, such as: Reduction in costs and time involved in traveling; Reduction of product launch time to market; Greater use of funding opportunities; Remote networking, Access to global markets; Access to specialized information; Access to Price and demand information; Advertising Improvement (Crespo, 2008).

2.2. Information and Communication Technologies - ICT and Electrical and Electronic Equipment - EEE

To understand the issue related to the generation of electronic waste from ICT, it is necessary to know the following aspects:
2.2.1. EEE Classification

In accordance with EU Directive 2012/19/EU, the EEE are divided into the following categories for the transition period from 13 August 2012 to 14 August 2018. ICT equipment is in the third category.

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment and photovoltaic panels
5. Lighting equipment
6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
7. Toys, leisure and sports equipment
8. Medical devices (with the exception of all implanted and infected products)
9. Monitoring and control instruments
10. Automatic dispensers

As of August 15, 2018, the following classification applies. ICT equipment is found in categories 4 and 6.

1. Temperature exchange equipment
2. Screens, monitors, and equipment containing screens having a surface greater than 100 cm
3. Lamps
4. Large equipment (any external dimension more than 50 cm) including, but not limited to:

Household appliances; IT and telecommunication equipment; consumer equipment; luminaires; equipment reproducing sound or images, musical equipment; electrical and electronic tools; toys, leisure and sports equipment; medical devices; monitoring and control instruments; automatic dispensers; equipment for the generation of electric currents. This category does not include equipment included in categories 1 to 3.

5. Small equipment (no external dimension more than 50 cm) including, but not limited to:

Household appliances; consumer equipment; luminaires; equipment reproducing sound or images, musical equipment; electrical and electronic tools; toys, leisure and sports equipment; medical devices; monitoring and control instruments; automatic dispensers; equipment for the generation of electric currents. This category does not include equipment included in categories 1 to 3 and 6.

6. Small IT and telecommunication equipment (no external dimension more than 50 cm)

2.2.2. Generation of ICT/WE EE

To provide their services, ICT require an infrastructure (equipment). Unfortunately, the electrical and electronic equipment (EEE) life span is becoming shorter, due to the persistent desire of users to acquire the latest technologies and upgrades, which are constantly emerging. This situation has led to the generation of large amounts of electronic waste considered the dark side of ICT (Figure 1).
2.2.3. Metals in ICT/WEEE

Electronic waste from the ICT sector has materials that are considered clean and can be recovered with the appropriate techniques for commercialization and re-entry into production processes (copper - Cu, aluminum - Al, clean glass, plastic, rubber, ferrous metals, among others). However, e-waste also contains hazardous substances (cadmium - Cd, Lithium - Li, mercury - Hg, bromine - Br, beryllium - Be, lead - Pb, selenium - Se, chromium - Cr, nickel - Ni, among others) which, if released into the environment without proper controls, can cause serious pollution problems and affect the health of animals and people. The following table presents a summary of the hazardous substances that form part of ICT/WEEE:

<table>
<thead>
<tr>
<th>N°</th>
<th>Materials and Components</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Batteries</td>
<td>Heavy metals such as lead, mercury and cadmium are present in batteries</td>
</tr>
<tr>
<td>2</td>
<td>Cathode ray tubes (CTRs)</td>
<td>Lead in the cone glass and fluorescent coating cover the inside of panel glass</td>
</tr>
<tr>
<td>3</td>
<td>Mercury containing components such as switches</td>
<td>Mercury is used in thermostats, sensors, relays and switches (e.g., on PCBs and in measuring equipment and discharge lamps). It is also used in medical equipment, data transmission, telecommunication, and mobile phones</td>
</tr>
<tr>
<td>4</td>
<td>Toner cartridges, liquid and pasty, as well as color toner</td>
<td>Toner and toner cartridges have to be removed from any separately collected WEEE</td>
</tr>
<tr>
<td>5</td>
<td>PCBs</td>
<td>In PCBs, cadmium occurs in certain components, such as SMD chip resistors, infrared detectors and semiconductors</td>
</tr>
<tr>
<td>6</td>
<td>Polychlorinated biphenyl (PCB) containing capacitors</td>
<td>PCB-containing capacitors have to be removed for safe destruction 8 Liquid crystal displays (LCDs) LCDs of a surface greater than 100 cm2 have to be removed from WEEE</td>
</tr>
</tbody>
</table>
During incineration/combustion of the plastics, halogenated flame retardants can produce toxic components.

During incineration/combustion of the plastics, halogenated flame retardants can produce toxic components.

<table>
<thead>
<tr>
<th>7</th>
<th>Plastics containing halogenated flame retardants</th>
<th>During incineration/combustion of the plastics, halogenated flame retardants can produce toxic components</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Gas discharge lamps</td>
<td>Mercury has to be removed</td>
</tr>
</tbody>
</table>


The ICT/WEEE also contains precious metals (PM) (gold - Au, silver - Ag, platinum - Pt, gallium - Ga, palladium - Pd, tantalum - Ta, tellurium - Te, germanium - Ge and selenium - Se), rare earths (yttrium - Y, europium - Eu, coltan), which make WEEE attractive for recycling (Khaliq, 2014).

Both, the recovery of hazardous metals and rare metals is necessary for economic and other issues related to environmental preservation, energy efficiency and resources conservation. It is proven that the extraction of virgin metals consumes more energy and generates greater amounts of CO₂ than urban mining (recovery of metals from WEEE); in fact, the amount of gold recovered from one tonne of electronic waste from computers is more than that recovered from 17 tonnes of gold ore (Khaliq, 2014).

### 2.2.4. Classification of WEEE with hazardous content

In addition, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, electronic waste is classified in Annex VIII, entries A1180, A1190, A1150 and A2010, as well as Annex IX, At the B1110 entrance (UNEP, 1992).

### 2.2.5. Problems caused by ICT / WEEE

**Graph 1** shows the total and per capita quantities of WEEE produced worldwide from 2010 to 2014, and a projection from 2015 to 2018. The worldwide generation of WEEE in 2014 was 41.8 million tonnes and is expected to increase to 49.8 million tonnes by 2018, with an annual growth rate of 4% to 5%. Of this volume, only 6.5 million tonnes of WEEE (16% of the total generated) were reported as being formally managed by a WEEE collection and management system (UNU, 2014).

The causes of high generation of electronic waste from ICT and their negative impacts on the environment and the health of the population can be summarized as follows:

- Accelerated technology growth.
- Shorter life cycles of EEE because of permanent demand for technology with new and varied improvements.
- Lack of legislation related to the environmentally sound management of ICT/WEEE and in cases where it exists, it is not adequate and/or is not enforced.
- Illegal export of e-waste from developed countries to developing countries, to reduce the costs of management and without ensuring the proper management of WEEE in the recipient country. Despite the Basel Convention, it is estimated that between 50% and 80% of the electronic waste from the USA, Japan and the European Union is transferred to landfills located in China, India, Nigeria, Pakistan and Gahna (Urbina, 2014)
- Export of ICT equipment from developed countries to developing countries with the purpose of closing the digital divide, but in some cases, the equipment has already become electronic waste or is very close to become it.
- Proliferation of the informal sector, which means women, youngsters, and children are involved in the inadequate recovery of valuable metals from WEEE due to ignorance concerning the presence of hazardous substances and the appropriate management techniques.
Improper management of WEEE for lack of: legislation, knowledge, Inclusion of the informal sector, figures and basic information, installed capacity, and all kind of resources to complete the required processes in each stage of management.

Graph 1. E-waste generated globally 2010-2018


In accordance with the above, the consequences for the environment and human health due to the inadequate management of ICT/WEEE have shown unexpected results, such as:

- Long term exposure to the hazardous components that are present in the e-waste can affect the nervous system, kidneys, bones, and reproductive and endocrine systems (Kumar, 2014).
- Health hazards arising from improper handling of WEEE may be caused by direct contact with harmful materials from the inhalation of toxic fumes as well as the accumulation of chemicals in soil, water, and food. Mismanagement causes toxic by-products such as dioxins and furans (highly toxic and carcinogenic compounds) by burning cables and plastics with flame retardants, without regard to technical criteria (WHO, 2016).
- Hazardous substances contained in WEEE are released in uncontrolled recycling processes as a mixture. In the recycling workshops environment and nearby neighborhoods, Persistent Organic Pollutants (POP) and heavy metals can coexist. E-Waste toxicant exposure is variable because of the type of e-Waste, length of recycling history, volume of recycling, specialization in recycling processes, locations of workshops, parental involvement in recycling, and the daily activities of the child. Cumulative exposure in the local environment is typically high in many of the recycling sites because of more than a decade of operations (Kumar, 2014).

Considering the above, the negative impacts on the environment resulting from mismanagement of ICT / WEEE can be summarized as follows:

- **Atmosphere:** pollution by:
  - Substandard incineration processes.
  - Cable burning to recover copper.
  - Improper chemical processes to recover metals.

- **Soil/Surface Water and Groundwater:** contamination by:
  - Uncontrolled recycling processes carried out at different places, particularly by the informal sector.
• Pollution due to the disposal of e-waste in public areas (forests, rivers, streets, parks, etc.)
• Pollution by sending electronic waste to landfills (not to secure cells).

2.3. **Sustainable Development and Green ICT**

It is worth asking, *Is technological and economic development feasible per se?* The answer lies in Sustainable Development and Green ICT.

### 2.3.1. Sustainable development

Development and environment that were two concepts that were handled separately until 1972, when the concept of Sustainable Development was formally incorporated and analyzed at the Stockholm Conference - Sweden (UN, 1972) and subsequently in 1992 at the Earth Summit of the United Nations (Rio de Janeiro - Brazil). It was recognized that the deterioration of the environment has social, political, and economic implications (Sánchez, 2002).

Development can not be stopped, countries should continue their progress, but seeking a balance with the environment, in what has been called “Sustainable Development”, within which it is possible to apply methods that, in addition to preventing and mitigating negative environmental impacts, can generate employment and economic benefits for the countries. **Figure 2** shows “Sustainable Development” as a differentiating factor, in its three dimensions (environmental, economic and social).

![Figure 2. Sustainable Development](image)

**Source:** document author

### 2.3.2. Green ICT

ICT generate electronic waste containing hazardous substances. It has also been estimated that they account for 2 to 2.5% of global greenhouse gas (GHG) emissions (ITU, 2015). However, in addition to the already described undeniable economic and social benefits generated by ICT, they can also contribute to energy efficiency, global warming mitigation and cost optimization through the application of the Green ICT concept, which shall bring about a positive impact on the sector itself and other sectors of the economy, with actions such as:

Prevention in the generation of hazardous electronic waste (from eco-design).
- Environmentally Sound Management – ESM of used ICT / EEE by extending its useful life and recovering various materials and metals from e-waste (lower CO₂ generation and higher energy efficiency).

- Fundamental support to develop:
  - Intelligent power supply networks.
  - Smart buildings.
  - Efficient industrial processes.
  - Smart logistics
  - Everything related to dematerialization (e-government, cloud computing, e-commerce, telework, telepresence, e-mail, videoconference, e-books, among others).

The foregoing shows the importance of addressing the concepts of Environmental Sustainability by the ICT sector (Green ICT), without further delay.
3. Legislation and ICT e-waste management system (organization and enforcement)

Legislation represents a big step towards solving the problems caused by e-waste from ICT. The legislation on electronic waste covers two major components, as follows:

**Figure 3. Components of legislation on ICT/WEEE**

1. Organization of ICT/WEEE management system (Figure 4).
2. Implementation of ICT/WEEE management system.

Source: document author

Legislation requires a component related to the design and organization of a management system and another to its implementation. Once the e-waste management system has been defined, its enforcement requires specific regulations (minimum standards) that allow for the Environmentally Sound Management of used ICT/EEE and ICT/WEEE; effective surveillance and control actions by the Government are required in order to monitor compliance with standards, progress, as well as to identify the need for adjustments.

**Figure 4** shows the electronic waste management system, which is framed within the cycle P-D-C-A (Planning, Doing, Checking, Acting), and becomes tangible with the issue and implementation of the legal framework and specific regulations.

**Figure 4. ICT/WEEE Management System**

Source: document author with information from Q8/2 ITU Study Groups

**Figures 5 and 6** summarize the macro-stages of used ICT/EEE and ICT/WEEE management. In these figures recycling appears after the second life cycle, although it can also be presented after the first cycle, if in sorting, the used ICT/EEE is found not to be suitable for reuse and as a result of repair and refurbishment of equipment. Minimum standards (best practices) shall be defined for each of the management stages, through the issue of specific regulations.
Figure 5. ICT/EEE reuse stages

Source: document author with information from Q8/2 ITU Study Groups

Figure 6. ICT/WEEE recycling stages

Source: document author with information from Q8/2 ITU Study Groups
4. Review currently existing policy/legislative/regulatory frameworks that countries/regions across the world have developed relating to the status of the telecom/ICT generated e-waste

This chapter provides information relating to the legal framework in some countries in the field of ICT/WEEE; rather than comparing them, the idea is to establish the relevant aspects that can be considered by any country in the definition of its WEEE framework laws.

4.1. Selected Countries

The following criteria were applied to select five countries:

- Developed and least developed or developing countries with legislation on electronic waste and different levels of progress.
- Countries located in different regions of the world.

So, the selected countries are: Canada (North America), France (Europe), Bhutan (Asia), Colombia (South America) and South Africa (Africa).

4.2. Structure of the review

As noted at the beginning of this document, the review is framed within a “Management System” (Planning, Doing, Checking, Acting) and within the concept of Sustainability and its three dimensions (Economic, Social, and Environmental), defining four (4) basic aspects: Administrative, Technical, Economic, Supervision and Control. The detailed review of existing WEEE legislation in each country is presented in the Annexes - Table 13.

4.3. Results of review

The results of the review that was carried out are presented in Table 2.

<table>
<thead>
<tr>
<th>PDCA / General Aspects</th>
<th>Specific Aspects</th>
<th>Results of Review</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planning and Doing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administrative Aspects</td>
<td>Public and private entities related to the topic / Stakeholders responsibilities</td>
<td>The subject of electronic waste is managed in a multidisciplinary way, by private and public entities, led by the environmental, ICT, health, and energy sectors, among others.</td>
</tr>
<tr>
<td></td>
<td>General principles</td>
<td>In the cases analyzed the principles are similar, for example: safe and healthy environment; precautionary principle; polluter pays; Extended Producer Responsibility - EPR; 3R (reduce, reuse and recycle); waste minimization hierarchy; sustainable production and consumption; among others.</td>
</tr>
<tr>
<td></td>
<td>Extended Producer Responsibility – EPR</td>
<td>It is applied in all case studies (Canada at a provincial level, not at a federal level; In South Africa EPR should be applied considering product or kind of products). Producers can organize themselves into individual or collective systems to manage EEE placed in the market at the end of their life cycle.</td>
</tr>
<tr>
<td></td>
<td>Import / Export</td>
<td>All countries have ratified the Basel Convention.</td>
</tr>
</tbody>
</table>
| Information Systems and Records | Canada: a great deal of WEEE are exported to developing countries.  
Bhutan: for low quantities generated, it has the option of importing WEEE for handling into the country or for legally exporting them to other countries.  
Colombia: It carries out control over illicit imports of EEE or those that do not comply with regulations and over the import of refurbished, repaired, reconstructed electrical and electronic equipment for donation. |
| Permission and Licenses | Government: It establishes a national and local system on waste management to be fed by producers, as well as generate reports with a specific periodicity about existing producers and marketers, equipment placed in the market, consumption statistics, WEEE generated and auctioned.  
Producers: They shall submit a periodic report on the development of the E-Waste Management System and feed the national WEEE system.  
Managers: They shall register and report data of WEEE managed in their different stages to the Government as well as maintain records that allow for the traceability of WEEE. |
| Targets | WEEE shall be managed only by companies that have the respective environmental license, permit or authorization. Companies or Managers have to be audited. Certain activities are “listed” and require a special waste management license. Small-scale WEEE collection and transportation activities may not require a license. |
| Technical Aspects | **WEEE Category**: WEEE is classified as differentiated management waste of (Colombia). WEEE is a specific category of waste, not classified as hazardous waste (Bhutan). E-waste is included within the definition of hazardous waste (South Africa).  
**Collection**: channelised to the designated collection centres/drop-off sites or e-waste management entity (Bhutan). Individuals deliver e-waste to collection points inside cities: more than 22,900 collection points. Producers or individuals using out-of-town recovery centres: more than 4500 centres (France). Several national and provincial organizations dealing with the collection and recycling of electronic waste by province (Canada).  
**Information for management**: importers and producers shall provide information about hazardous nature of e-waste and potential damage to human health and environment (Bhutan).  
**RoHS**: six prohibited substances in EEE (lead, mercury, cadmium, hexavalent chrome, polybromobiphenyls and polybromodiphenylethers) (Bhutan, France).  
**Depollution**: PRO will take direct charge of certain hazardous components through stricter traceability regulations. Reuse: through a principle whereby social and solidarity economy structures will be granted access to household WEEE landfills, |
and PRO will cover the costs of transporting the equipment to reuse facilities (France).

**Pre-processing and processing stages:** recyclers have a smaller dismantling unit in most of the provinces before the e-waste is sent to specific processing centers.

**Disposal:** e-waste disposal is to put it in the garbage, return it to the supplier, drop it off at a depot, or donate it (Canada).

<table>
<thead>
<tr>
<th>Economical Aspects</th>
<th>Various Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Creation of a fund</strong> with contributions from: Government, producers and importers, fines for non-compliance with electronic waste regulations, etc. <strong>Resources</strong> from the public, private and international cooperation sectors will be considered as sources of financing <strong>Producers pay a fee</strong> for each product they place in the market to their nominated E-waste. The fees vary according to the products and e-waste. <strong>Financing by consumers</strong> through an eco-fee applied during the purchase.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Checking and Acting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supervision and Control Aspects</strong></td>
</tr>
<tr>
<td>Violations to the proper management of waste and the penalties depending on the crime are established (administrative sanctions; fines; imprisonment; responsibility for the costs of avoidance, containment, abatement, medical compensation, mitigation, remediation, and restoration; etc.).</td>
</tr>
</tbody>
</table>

**Source:** document author with information related to regulations of Canada, Bhutan, Colombia and France.
5. Environmental standards and procedures for the recycling and disposal of ICTs generated e-waste

This chapter presents information related to best practices, to which end a review of WEEELABEX and R2 The Responsible Recycling (“R2”) standards, as well as of PACE (Partnership for Action on Computing Equipment) and MPPI (Mobile Phone Partnership Initiative) guidelines was performed. The purpose of the review is not to compare standards and guidelines, but to determine the relevant and possibly common aspects among documents, which could be useful to the countries in the definition of specific regulations conducive to the implementation of an e-waste management system and to the development of best practices or minimum standards.

5.1. Standards and guidelines reviewed

<table>
<thead>
<tr>
<th>Region / Country</th>
<th>Standard / Guidelines and original denomination</th>
<th>Responsible organization</th>
<th>Last Version</th>
<th>Revised Version</th>
<th>Language</th>
<th>Type of Standard</th>
<th>Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>WEEELabex</td>
<td>Weeeforum Association</td>
<td>10.0</td>
<td>10.0</td>
<td>English</td>
<td>Standard</td>
<td>No Certification, there is “Conformity Verification”</td>
</tr>
<tr>
<td>United States</td>
<td>R2 The Responsible Recycling (“R2”) Standard for Electronics Recyclers</td>
<td>R2 Solutions</td>
<td>2013</td>
<td>2013</td>
<td>English</td>
<td>Standard</td>
<td>Yes</td>
</tr>
<tr>
<td>International</td>
<td>MPPI (Mobile Phone Partnership Initiative) Guidelines</td>
<td>Basel Convention</td>
<td>2009</td>
<td>2009</td>
<td>English</td>
<td>Guidelines</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 3. Standards and guidelines reviewed

Source: document author

- Europe

WEEELABEX (WEEE Label of Excellence). European standard, which emerged between 2009 and 2012 as part of a project co-financed by LIFE + (European Union - EU environmental program). The organization responsible for implementing this standard is the “Weee Forum Association”. It is made up of three (3) documents: collection, logistics and treatment and is available in seven (7) languages.

- United States

The Responsible Recycling (“R2”) Standard for Electronics Recyclers. It was designed by the EPA (Environmental Protection Agency) of the United States. It is a voluntary standard and Managers or electronics recyclers from anywhere in the world can be certified. It is available in English and Spanish.

- International
- **PACE (Partnership for Action on Computing Equipment) Guidelines.** PACE was launched in 2008 by the ninth meeting of the Conference of the Parties to the Basel Convention, which agreed with the mission, scope, working principles and activities of PACE. A Working Group was established as the operating mechanism for the Partnership which operates under the guidance of the Basel Convention Open-ended Working Group (Basel Convention, 2016).

The following guidelines and documents are available: Environmentally sound management of used and end-of-life computing equipment; Environmentally sound testing, refurbishment, and repair of used computing equipment; Environmentally sound material recovery and recycling of end-of-life computing equipment; Transboundary movement of used and end-of-life computing equipment; PACE glossary of terms. These are available in English.

- **MPPI (Mobile Phone Partnership Initiative) guidelines.** The sixth meeting of the Conference of the Parties established a working group consisting of experts from Parties and/or Signatories interested in a sustainable partnership on the ESM of end-of-life mobile telephones plus representatives of the mobile phone manufacturers and the Secretariat of the Basel Convention (Basel Convention, 2016).

The following guidelines and documents have been developed: Environmentally sound management of used and end-of-life mobile telephones; Refurbishment of used mobile phones; Material recovery and recycling of end-of-life mobile phones; Awareness raising-design considerations; MPPI glossary of terms. These are available in English.

**5.1.1. Structure of the review**

The review is carried out taking into account the electronic waste management system, the macro-stages of used ICT / EEE management and specific aspects related to: Infrastructure; Human Talent; Documentary Support (Processes and Procedures); Equipment, Tools and Machinery; Records; Information and Communication Systems. The structure is summarized in **Figure 7**.

**Figure 7. Structure for standards and guidelines review**

*Source: document author*

*Note: The aspects noted in the base of Figure 7 may apply to some particular stages or to all management stages.*

The results of the detailed review, aimed at defining best practices or minimum standards that can be comply by any used ICT/EEE Manager, are presented in **Annexes - Table 14**.
5.1.2. Results of the review

As a summary of this review, it is possible to present the following Table:

Table 4. Conclusions and summary requirements of Table 14 (Annexes)

<table>
<thead>
<tr>
<th>General Aspects / Management Stages / Specific Aspects</th>
<th>Conclusions / Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generalities</strong></td>
<td></td>
</tr>
<tr>
<td>Scope</td>
<td>While R2 and WEEELABEX establish requirements (technical and management) to be complied with by organizations within the recycling chain, MPPI and PACE focus on requirements for the reuse and recycling of cell phones and computers, respectively.</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>WEEELABEX: the operator shall ensure that there is a health, safety, environment, and quality system; does not require certification. R2: electronics recycler shall be certified with one or more comprehensive systems (certified and mandatory). PACE encourages facilities to use a certified comprehensive system (voluntary). MPPI promotes the use of an environmental management system (voluntary and non-integrated). WEEELABEX: only contracts can be entered into with operators that comply with these requirements or other equivalent.</td>
</tr>
<tr>
<td>Principles</td>
<td>All standards and guidelines share principles such as: protection of the health and safety of workers and the public; waste hierarchy; Environmentally Sound Management - ESM of UEEE; precautionary principle. WEEELABEX: “polluter pays” principle. MPPI: EPR principle as well as prevention and minimization of waste in production processes.</td>
</tr>
<tr>
<td>Licenses and authorizations</td>
<td>All documents: licenses and authorizations for facilities handling UEEE and e-waste. PACE: facilitate licensing of companies that are in charge of the pre-processing stages, without compromising the environmentally sound management.</td>
</tr>
<tr>
<td><strong>Planning</strong></td>
<td></td>
</tr>
<tr>
<td>Policy, purposes and goals</td>
<td>WEEELABEX: environmental, health and safety policy. R2: policy on management of used and end-of-life electronics equipment and policy on used equipment that can be accepted depending on technical capacity of the facility.</td>
</tr>
<tr>
<td>Legal and Administrative Aspects</td>
<td>In all cases, compliance with legal obligations (including those relating to transboundary movement of UEEE and e-waste), and the requirements of the standards and guidelines are requested. WEEELABEX: if legal obligations and requirements are in conflict, the most restrictive prevails, whereas R2 establishes that the legal obligation prevails. All documents explicitly and / or implicitly determine the need to apply “due diligence” to each facility and to the other actors in the downstream chain. WEEELABEX and R2: facilities shall obtain the insurance policies needed to cover the potential risks and liabilities.</td>
</tr>
<tr>
<td><strong>Doing</strong></td>
<td></td>
</tr>
<tr>
<td>All stages</td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>All documents: appropriate infrastructure according to the operations that are intended to be carried out in it, which must have adequate security conditions.</td>
</tr>
</tbody>
</table>
MPP and PACE refer to possible sources of financing to have a good installed capacity.

**Human Talent**

In *all cases*, employees shall be familiar with the environmental, health and safety risks of the facility, controls shall be established for hazards and risks. Employees shall have personal protective equipment and shall be instructed and trained to perform their tasks correctly.

**WEEELABEX:** employee training materials and information shall be available at the workplace and the effectiveness and suitability of training shall be checked; there shall be programs for controlling accidents and incidents.

**PACE:** training and integrating the informal sector.

**R2:** training for new hires and refresher courses for all employees.

**Documentary support (processes and procedures)**

<table>
<thead>
<tr>
<th>All documents: procedures or plans to identify legal requirements and emergency plans.</th>
<th><strong>WEEELABEX</strong> and <strong>PACE:</strong> procedures for monitoring hazards and risk as well as documenting the downstream logistic chain of WEEE.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R2</strong> and <strong>MPPI:</strong> procedures or plans that assure proper closure of the facility.</td>
<td><strong>R2:</strong> recyclers shall document data destruction procedures.</td>
</tr>
</tbody>
</table>

**Tools, equipment, and machinery**

**WEEELABEX:** all handling of UEEE and WEEE including the loading, unloading and transport shall be carried out with appropriate tools, containers and repairs/maintenance to avoid damage.

**Records**

**PACE** and **MPPI:** records of the inspections, testing and assessment of facilities and development of adequate records programmes.

**R2:** records of commercial transfers of equipment, components, and material; adequate data destruction.

**WEEELABEX:** records related to: amount of WEEE collected and forwarded; the operator’s activities; compliance with legal and regulatory obligations; mass balance; measures taken as a result of an accident or incident; accidents or dangerous occurrences; among others. Logistics and collection records shall be kept for at least three years and treatment records shall be available for at least five years.

**Pre-processing stages**

**Collection and Transport**

**R2** does not release specific standards for this stage.

**WEEELABEX:** do not mix WEEE with other waste; prepare and transport lamps, CRT and flat screens so that they are not damaged.

**PACE:** find ways to subsidize collection systems.

**MPPI:** recommendations for the collection of cell phones: establish collection points conveniently located for users; separate collection; collection with battery chargers and accessories as well as with batteries in place in the phones; any loose batteries shall be identified and properly managed.

**Reception, sorting and weighing**

**WEEELABEX:** WEEE shall be sorted into the WEEE collection categories.

**PACE:** computing equipment that is to be refurbished or repaired shall be identified and sorted.

**Storage**

**WEEELABEX** and **R2:** infrastructure requirements for storage areas: impermeable surfaces; spillage collection facilities; weatherproof covering and labeled containers.

**MPPI:** used mobile phones shall be properly packaged to protect their integrity; batteries shall be packaged in a proper manner to avoid contact with their terminals; mobile phones for refurbishment shall be adequately handled to protect them and avoid release of hazardous substances.

**Processing stages**

**Direct or Indirect reuse (repair / refurbishment)**

**WEEELABEX** and **R2:** it shall be contracted only with third parties that are authorized and have the capacity to repair or refurbish used equipment; fractions that are not used shall be returned to the collection facility.
**WEEELABEX and MPPI:** the Party that put refurbished equipment on the market shall place its name on the equipment, shall protect the original manufacturer from any claim related to the equipment and shall deliver the corresponding legal waranties.

**R2:** ensure traceability of downstream equipment; prior to shipping used electronics and components containing FMs (domestically or internationally), insure and identify each shipment; and together with PACE request to ensure that all data is sanitized.

**R2:** quality controls to ensure effectiveness of data sanitization, purging, and destruction techniques.

**PACE and MPPI:** documentation and labelling shall certify the equipment is working and that it is fit for its intended end use; remarketed of used equipment shall ensure that it continues to meet all applicable standards and requirements; ensure compliance with all applicable laws for product and used product in the case of export / import of refurbished equipment.

**MPPI:** evaluation and/or testing and labelling to decide if used mobile phones can be directly reused, or if they need repairs, refurbishment or upgrading prior to reuse, or are to be sent for environmentally sound material recovery and recycling.

**R2:** quality controls to ensure effectiveness of data sanitization, purging, and destruction techniques.

---

| Manual / Mechanical dismantling | **WEEELABEX:** crushing or compacting of WEEE prior to the treatment is not permitted; destroy personal data stored on the memory of the ICT equipment; ban on dilution; if it is uncertain which hazardous substances are present in WEEE, they shall be treated as if they contain the substances; and together with **R2** determine to remove all liquids, substances, preparations, and components from WEEE prior treatment.  
**R2 and PACE:** FMs should be sent to treatment facilities that meet regulations and can receive FMs having proper capabilities; and together with PACE permit the use of manual or mechanical dismantling in case of equipment that will not be reused.  
**MPPI:** manual removal of batteries to minimize contamination of other materials and to maximize recovery of the substances. |
|---|---|
| Sorting according to kind of WEEE and storage according to type of material | **PACE:** Identifying and labelling of substances, preparations, and components to be removed from ICT equipment.  
**WEEELABEX:** CRT display appliances, flat panel displays, and lamps shall be placed in containers or stacked in a stable manner; WEEE shall respect legal and regulatory requirements and storage with due care in order to avoid release of hazardous substances.  
**MPPI and PACE** tackle the eco-design concept (implement improvements in the environmental design; reuse and recycling information into product marking; labelling of internal software; replacing all toxic substance with benign substitutes). |
| Treatment (including recovery) and disposal | In the reviewed documents, some guidelines are given for the treatment of CRT display appliances, flat panel displays, lamps and batteries as well as for recovery of metals. |
| Checking | **WEEELABEX:** policy shall be evaluated in order to monitor its effectiveness; monitoring for shipments.  
**R2:** audit recyclers compliance with legal requirements, and take corrective actions; annual audits on downstream facilities.  
**PACE:** third party audits |

---

**Manual / Mechanical dismantling**

**WEEELABEX:** crushing or compacting of WEEE prior to the treatment is not permitted; destroy personal data stored on the memory of the ICT equipment; ban on dilution; if it is uncertain which hazardous substances are present in WEEE, they shall be treated as if they contain the substances; and together with **R2** determine to remove all liquids, substances, preparations, and components from WEEE prior treatment.

**R2 and PACE:** FMs should be sent to treatment facilities that meet regulations and can receive FMs having proper capabilities; and together with PACE permit the use of manual or mechanical dismantling in case of equipment that will not be reused.

**MPPI:** manual removal of batteries to minimize contamination of other materials and to maximize recovery of the substances.

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**Sorting according to kind of WEEE and storage according to type of material**

**PACE:** Identifying and labelling of substances, preparations, and components to be removed from ICT equipment.

**WEEELABEX:** CRT display appliances, flat panel displays, and lamps shall be placed in containers or stacked in a stable manner; WEEE shall respect legal and regulatory requirements and storage with due care in order to avoid release of hazardous substances.

**MPPI and PACE** tackle the eco-design concept (implement improvements in the environmental design; reuse and recycling information into product marking; labelling of internal software; replacing all toxic substance with benign substitutes).

---

**Treatment (including recovery) and disposal**

In the reviewed documents, some guidelines are given for the treatment of CRT display appliances, flat panel displays, lamps and batteries as well as for recovery of metals.

---

**Checking**

**WEEELABEX:** policy shall be evaluated in order to monitor its effectiveness; monitoring for shipments.

**R2:** audit recyclers compliance with legal requirements, and take corrective actions; annual audits on downstream facilities.

**PACE:** third party audits
<table>
<thead>
<tr>
<th>Acting</th>
<th>MPPI: supervision carried out by competent authorities.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvement</td>
<td><strong>WEELABEX:</strong> The operator shall prove continuous improvement of their activities by a review and management process</td>
</tr>
</tbody>
</table>

**Source:** author of document with information from the standards and guidelines analyzed.
6. Recommendations for a model policy/legislative/regulatory framework to facilitate the management of ICTs generated e-waste

Taking into account the foregoing chapters, the following model of regulations (framework and specific) to facilitate management of ICT generated e-waste is proposed.

6.1. Framework regulations

The basic content for the legal framework concerning WEEE is provided below. These guidelines are useful to the countries in the design and organization of an ICT e-waste management system.

6.1.1. Basic content of used ICT/EEE and ICT/WEEE legal framework

Tables 5 and 6 show the proposed basic aspects that may be included in a legal framework for ICT/WEEE.

Table 5. Basic content of used ICT/EEE and ICT/WEEE legal framework

<table>
<thead>
<tr>
<th>PDCA / General Aspects</th>
<th>Specific Aspects</th>
<th>Basic Content of ICT/WEEE Legal Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning and Doing</td>
<td>Diagnosis</td>
<td>It is important to know the reality of the country in terms of ICT / WEEE management before designing and issuing a legal framework, so that a diagnosis of the country’s situation with respect to the organization and management of ICT/WEEE, including figures, will be useful. The diagnosis shall consider figures such as: existence of policies or regulations relating to WEEE; import / export of EEE (new and used) and WEEE from ICT; market share of manufacturers, importers, assemblers, distributors; sales figures of ICT equipment; Trends in sales and consumption of EEE; capacity building for appropriate management of used ICT/EEE; ICT/WEEE generation rates; ICT e-waste Managers present in the country; analysis of used ICT/EEE management at each stage; among others.</td>
</tr>
<tr>
<td>Starting Points</td>
<td>Classification of ICT/WEEE</td>
<td>Classification of ICT/WEEE as a special category and not as hazardous waste to facilitate pre-processing stages and the recovery of resources and critical metals.</td>
</tr>
<tr>
<td>Administrative Aspects</td>
<td>Other aspects</td>
<td>The e-waste management system shall be defined taking into account aspects such as: the reality of each country in terms of the e-waste management; infrastructure required for the management of WEEE; possible funding mechanisms, among others.</td>
</tr>
<tr>
<td></td>
<td>Policy</td>
<td>A public policy on the Environmentally Sound Management - ESM of used ICT/EEE and ICT/WEEE shall be issued at the State level, from which the electronic waste management system shall be designed and organized for its implementation through compliance with best management practices.</td>
</tr>
</tbody>
</table>
## Principles

The following principles shall be considered in the definition of a legal framework on management of used ICT/EEE and ICT/WEEE.
- Protection of the environment and human health
- Environmentally Sound Management - ESM of used ICT/EEE
- Precautionary principle
- **3R**s (reduce, reuse and recycle)
- Waste hierarchy
- Polluter pays principle
- EPR principle
- Sustainable production and consumption

## Permissions and Licenses

ICT /WEEE shall be managed only with companies that have an environmental license, permission, or authorization.

**Pre-processing stages** do not require licensing, but the companies that carry them out shall register themselves with the Government and can be supervised.

**Processing stages** require licensing and shall be supervised by the Government-delegated entities.

## Targets

Realistic targets related to collection, reuse, recycling and recovery shall be defined, reviewed and adjusted gradually.

## Import / Export used ICT/EEE and ICT/WEEE

Guidelines for this topic are disclosed in Table 6.

## Stakeholders Responsibilities

Shared but clearly differentiated responsibilities shall be established for stakeholders within the supply chain:
- Producers (manufacturers, importers, assemblers, distributors and marketers); consumers; ICT/EEE and ICT/WEEE Managers.
- **Government**: responsibilities shall include: assign clear responsibilities to Government entities and other stakeholders; establish, monitor and gradually adjust realistic targets related to collection, reuse, recycling and recovery; design, manage and monitor an information system; define strategies for training and inclusion of the informal sector; carry out oversight and control actions; create and operate technical committees with the participation of all stakeholders.
- **Producers**: comply with regulations; feed and periodically update the information system; meet established targets and report results; work on eco-design and cleaner production; provide technical and relevant information to used ICT/EEE and ICT/WEEE Managers and ICT/EEE consumers; comply with the model established for the financing of the electronic waste management system; allowing Government supervision actions; participate in technical committees; develop information and awareness campaigns to facilitate
| Extended Producer Responsibility – EPR | The responsibility of the manufacturer or producer in relation to its ICT equipment extends throughout the different stages of its life cycle; the manufacturers internalize the cost of the management of these devices at the end of their useful life, through EPR.

EPR involves the sustainable design of the product (reduction and elimination of toxic substances, use of recycled and recyclable materials, upgradeability and ease of dismantling of equipment for repair and recycling), participation in take-back and recycling programmes and liability in the management of e-waste until its disposal. Producers can organize themselves into individual or collective systems, the latter also being known as “Producer Responsibility Organizations” (PRO).

Used ICT/EEE collection, individually and by brand, makes it difficult to achieve targets, thus increasing related costs. Collective systems facilitate achieving the targets and reduces costs; allows for the inclusion of historical and orphan equipment, since there is no brand discrimination; facilitates the identification of “freeriders”, which are those producers that are not registered, and therefore do not contribute to the system financing; it is possible to establish public-private partnerships to implement a network of collection points (door-to-door collection involves significant costs) and facilitate negotiation with used EEE Managers.

The Government shall promote the formation of several PRO. The PRO shall be monitored and controlled by the Government, which may request its financial statements. |
<p>| Information System | The Government shall design an information system and designate a public entity to be responsible for the system’s administration. Stakeholders shall be responsible for feeding the system and timely upgrading the data (ICT/EEE put on the market, information on generation and management used ICT/EEE and ICT/WEEE). |</p>
<table>
<thead>
<tr>
<th>Social Aspects</th>
<th>Employment and Training (Informal Sector)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The Government shall use the information for planning purposes, to adjust regulations and to exercise supervision and control actions.</td>
</tr>
<tr>
<td></td>
<td>The environmentally sound management of used ICT/EEE (both reuse and recycling) encourages the creation of jobs (direct and indirect), for unskilled, semi-skilled and qualified labor (depending on the management stage).</td>
</tr>
<tr>
<td></td>
<td>In some countries (particularly in the least developed and developing countries), the existence of informal recyclers is a reality and their lack of knowledge about the composition and correct management of used ICT/EEE and ICT/WEEE is causing important health problems among themselves and their families (there are now a large number of women and children in the informal sector), to the population in general and to the environment.</td>
</tr>
<tr>
<td></td>
<td>This problem makes it a priority to have programmes, led by the Government, to raise awareness, train and include the informal sector in the process of used ICT/EEE and ICT/WEEE management.</td>
</tr>
<tr>
<td></td>
<td>In countries such as India, China and some African countries, there is a high dependence on the informal sector for the collection and management of e-waste, whose strength lies in the large numbers and economy of its labor force, which reaches an important coverage. Governments shall take advantage of these strengths and create programmes conducive to its formalization.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical Aspects</th>
<th>Infrastructure, Technology, and Technical Guidelines (Standards)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Awareness and responsible consumption of technology shall be promoted. The media, along with Government and other stakeholders (financial support), shall contribute to creation of environmental awareness among consumers to ensure, inter alia, the delivery of ICT equipment at collection points and the responsible consumption of technology. The education sector shall promote environmental awareness among children and young people as permanent users of ICT.</td>
</tr>
<tr>
<td></td>
<td>Proper/adequate and sufficient installed capacity must be available in order to manage reused and ICT e-waste (pre-processing and processing stages).</td>
</tr>
<tr>
<td></td>
<td>Particularly for developing countries, mechanisms shall be established to provide financial support (public, private and international sectors’ cooperation).</td>
</tr>
<tr>
<td></td>
<td>It shall be necessary to incorporate technology to facilitate the recovery, use, treatment, and disposal of ICT/WEEE in an environmentally sound manner in the country where the waste originates, respecting the proximity principle and allowing for the creation and retention of wealth in each nation (recovery of precious and rare metals).</td>
</tr>
</tbody>
</table>
Minimum standards shall be applied to ensure best practices in the management of ICT waste throughout their life cycle (See Tables 7 - 10).

The application of the EPR principle encourages eco-design, since the ICT/WEEE management costs will be lower if the content of hazardous substances in the equipment is less.

Eco-design is the manufacturers’ responsibility. Manufacturers shall permanently implement environmental improvements in their design; must work constantly researching ways and means of extending the life cycle of ICT equipment; also, they must include reuse and recycling information into product marking and label the internal software and work to replace all toxic substances with benign and environmentally-friendly substitutes.

Examples: low power ICT/EEE that could reduce or eliminate the use of flame retardants; recharge batteries using renewable energy sources (solar cells, muscle power); consistency in plastic material selection during the design stage, which would facilitate plastics recyclers to eliminate sorting steps necessary to achieve compatibility of plastic types; substitutes for lead, beryllium, brominated flame retardants; eliminate unnecessary technical incompatibilities between ICT/EEE; eliminate the use of hazardous substances prohibited by European Directive 2002/9/EC; design and manufacture of universal current adapters and charger solutions (ITU-T L.1000); among others.

Manufacturers shall periodically share information with e-waste Managers regarding to components and materials used in the manufacturing process to facilitate ICT/WEEE management.

ICT/EEE manufacturers shall inform consumers that WEEE must not be sorted as ordinary waste, thus exhibiting the defined symbol to this end/purpose; they will also comply with the labeling requirements to disclose the data related to: content of hazardous materials; potential risks for health and environment, as well as the location of collection points.

Economic aspects shall be considered to ensure the feasibility and financial sustainability of the used ICT/EEE and ICT/WEEE management system.

The used ICT/EEE and ICT/WEEE management is a business opportunity, ensuring a balance between the environmental, social and economic dimensions.

In order to achieve the reuse of the used ICT/EEE, it shall be re-entered into the system in the shortest possible time (reducing storage time in homes and companies), which translates into lower costs, higher incomes, longer useful life and higher sales prices.
The largest expenditures can be caused by: initial investment in infrastructure; take-back of used ICT/EEE (depending on the method applied); treatment of CRT, batteries and capacitors; recovery of precious and rare metals. The most important revenues can come from: sale of reused equipment; valuation of ferrous and non-ferrus metals, rare and precious metals. It is crucial for developing countries to have the necessary infrastructure to allow for the local recovery of valuable materials (precious and rare metals), in order to avoid their export.

Economic Models

To achieve the financing of the used ICT/EEE and ICT/WEEE management system, different models have been applied: producers financing (EPR); consumers financing (polluter pays); financing by public and private sector, and international organizations. The sustainability of the system can be achieved, especially in developing countries, by a combination of the three alternatives.

Producers Financing: Producers (manufacturers, importers, assemblers, marketers and distributors) are responsible for financing the management system on the basis of their market share, type of EEE introduced into the market and the environmental impact of their products at the end of their lifecycle.

Consumers Financing: it corresponds to the payment of an advance recycling fee - ARF, which is charged to the consumer at the time of purchase and corresponds to the cost of managing a new equipment once it reaches the end of its useful life, and depends on the type of EEE and the environmental impact of these products at the end of their lifecycle. The fee may be invisible or visible to the consumer, but it is recommended that it be visible in order to create awareness.

Financing by public (Government) and private sectors and international organizations: Additional funding sources could be considered from the public, private, and international cooperation sectors.

Fund creation: A fund shall be created with contributions from: Government, producers, consumers, fines from non-compliance with electronic waste regulations, among others. The fund shall be monitored by an entity designated for that purpose by the Government.

Checking and Acting

Supervision and control Aspects

Supervision and Control

Government shall delegate to public entities the supervision and control functions over the stakeholders of the used ICT/EEE management system, ensuring compliance with framework laws and specific regulations. The audits shall be carried out periodically and with transparency, impartiality, and efficiency criteria.

Violations and Penalties

Different kind of sanctions shall be applied: administrative, criminal or disciplinary. The sanctions applied shall be
effective, proportionate and dissuasive. Violations to the proper management of e-waste from ICT and penalties shall be applied depending on the crime.

**Source:** document author with information from analyzed standards and guidelines and Q24/1 report (ITU Study Groups)

### Table 6. Import and Export of used ICT/EEE and ICT/WEEE

<table>
<thead>
<tr>
<th>Cases</th>
<th>Information</th>
</tr>
</thead>
</table>
| **Generalities / Basel Convention** | • E-waste is classified in Annex VIII under entries A1180, A1190, A1150 and A2010, and in Annex IX under entry B1110.  
• Convention only applies to hazardous wastes and other waste.  
• Training for customs officials shall be considered for carrying out supervision and control actions on imports and exports of used and fuctional or non-fuctional ICT/EEE, in a precise manner, as well as to carry out the work of ICT e-waste identification.  
• According to Basel Convention: “…Parties exercising their right to prohibit the import of hazardous or other wastes for disposal shall inform the other Parties of their decision…”; “…Parties shall prohibit or shall not permit the export of hazardous or other wastes to the parties which have prohibited the import of such wastes when notified…”; “…Any transboundary movement of hazardous and other wastes is subject to prior written notification from the exporting country and prior written consent from the importing country and, if appropriate, transit countries.”.  
• Export of hazardous wastes and other wastes to Parties (particularly developing countries) is prohibited, for they have prohibited all imports in their legislation or if there is reason to believe the waste will not be subject to ESM.  
• When Parties (particularly developing countries) have prohibited in their legislation all imports of hazardous or other waste, or when there is reason to believe the waste will not be subject to ESM, exports are not allowed.  
• Hazardous waste shall be handled and disposed of in the country of origin and in an environmentally sound manner. |
| **Import / Export of ICT/WEEE (Basel Convention is applicable)** | • It shall be established that only imports / exports can be accepted if there is the installed capacity for ESM, in the recipient country, depending on the type of ICT/WEEE.  
• Mechanisms shall be defined and Government entities shall be entrusted to ensure ICT/WEEE traceability and to establish the maximum quantities that can enter the country.  
• Illegal exports and imports of ICT/WEEE shall be combatted by the entities delegated by the Government.  
• The principles of transparency and respect will be observed by the parties involved. |
| **Import / Export of used and functional EEE (The Basel Convention does not apply)** | • Before starting the import process, proof-of-fuunctioating tests of ICT/EEE shall be carried out taking into account the technical proof-of-fuunctioating guides for the different categories of ICT equipment proposed by international organizations, to ensure that they are not actually ICT/WEEE. Documents and records shall accompany the shipment.  
• The entry of ICT/EEE “near the end of the life cycle” shall be evaluated, since although they still work and can be used directly, they will become waste in short time. |
- An instrument (control and supervision of used and refurbished, repaired, reconstructed EEE enter the country) shall be applied by a Government-delegated entity in order to ensure the EPR Principle and the differentiated environmental management of the equipment at the end of the useful life.
- Used equipment is waste in a country if it is defined or considered as waste in accordance with the provisions of the national legislation of that country.
- Evidence (documents and records) shall be presented to prove that the used and functional equipment is not waste.

<table>
<thead>
<tr>
<th>Import / Export of used and non-functional ICT/EEE (The Basel Convention does not apply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• If the import of non-functional ICT/EEE is accepted without considering it e-waste (for those whose operation has been tested and can subsequently be directly reused; for failure analysis or reused after repair or refurbishment; for repair hardware/software; for repair and refurbishment only; for return under warantee; for leasing, among others), controls shall be established particularly at customs, in a homogenized and harmonized way, since there are no uniform criteria at a worldwide level on the procedures to be applied.</td>
</tr>
<tr>
<td>• Evidence (documents and records) shall be presented to prove that the used and non-functional equipment is not waste.</td>
</tr>
<tr>
<td>• Used equipment is waste in a country if it is defined or considered as waste in accordance with the provisions of the national legislation of that country.</td>
</tr>
<tr>
<td>• If a Party does not wish to enable the import or export of used and non-functional EEE, it is fully entitled to do so if it complies with applicable international, regional, and national legal instruments.</td>
</tr>
</tbody>
</table>

6.2. Minimum standards or best practices

The minimum standards or best practices to be included in a specific regulation aimed at implementing the designed WEEE management system (framework regulation), are set out in the following tables.

The minimum standards below shall be applied by the used ICT/WEEE and ICT/WEEE Managers.

6.2.1. General Aspects (apply to all stages)

<table>
<thead>
<tr>
<th>General Aspects</th>
<th>Standards (Best Practices)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>This document sets out the minimum standards for the ESM of ICT/WEEE, as guidelines for Governments and Managers of all types and sizes, and also seeks to foster compliance with these requirements, within the framework of the concepts of “Sustainability” and “Management System”.</td>
</tr>
<tr>
<td>Scope</td>
<td>This document presents the minimum standards that can be applied to UEEE, from the moment they are discarded by the first user and sent to collection centers, through reuse (direct / indirect) and until the ESM of electronic devices waste.</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Managers shall only be able to establish contractual relations with other Managers of the recycling chain who comply with these requirements. The producers (manufacturers, sellers, importers, or assemblers), according to the EPR principle (individually or organized in collective systems), shall be responsible for verifying compliance with these requirements by Managers and Logistics Operators of the recycling chain, without prejudice to the actions that shall be carried out by the supervision and control entities of the State. Producers shall provide Managers with information on the hazardous substances contained in the EEE and their location.</td>
</tr>
<tr>
<td>Principles</td>
<td>The following principles govern this document:</td>
</tr>
<tr>
<td></td>
<td>• Protection of the environment and human health</td>
</tr>
<tr>
<td></td>
<td>• Environmentally Sound Management - ESM of UEEE</td>
</tr>
<tr>
<td></td>
<td>• Precautionary principle</td>
</tr>
<tr>
<td></td>
<td>• 3R (reduce, reuse and recycle)</td>
</tr>
<tr>
<td></td>
<td>• Waste hierarchy: prevention; minimization; direct reuse; indirect reuse (repair and refurbishment), recycling or recovery of materials for use in new products and applications; recovery of metals; disposal.</td>
</tr>
<tr>
<td></td>
<td>• Polluter pays principle</td>
</tr>
<tr>
<td></td>
<td>• Extended Producer Responsibility - EPR principle</td>
</tr>
<tr>
<td></td>
<td>• Operations shall use Best Available Techniques (BAT) and be in line with Best Environmental Practices (BEP)</td>
</tr>
<tr>
<td></td>
<td>• Prevention and minimization of e-waste in production processes</td>
</tr>
<tr>
<td>Licenses and authorizations</td>
<td>All Managers and Logistics Operators shall have licenses and authorizations, in accordance with the procedures defined in each country, to ensure compliance with the legislation and these requirements.</td>
</tr>
<tr>
<td></td>
<td>Managers and Logistics Operators may submit a statement of compliance with the applicable legal framework and with these standards, based on which the competent authorities grant them licenses and permits, which will be withdrawn if during the oversight and control activities of the State, their non-compliance is confirmed.</td>
</tr>
</tbody>
</table>
These standards do not exempt Managers from complying with existing standards applicable in each country regarding management of ICT/WEEE, nor from compliance with national laws regarding the environment, hygiene, industrial safety and quality. If legal obligations and requirements are in conflict, the former prevails.

Managers and Logistics Operators shall conduct periodic evaluations to ensure compliance with the legislation and these requirements. Managers shall apply the principle of “due diligence” for themselves and to select downstream Logistics Operators and Managers.

Managers and Logistics Operators shall have insurance according to the size and nature of their operations and shall have legal and financial assurances in place for the adequate closure of the facilities.

No Manager shall initiate, permit, or contribute to UEEE and ICT/WEEE shipments that would lead to treatments that do not comply with the legal requirements and those established in this document (See Table 6).

**Source:** document author with information from analyzed standards and guidelines and Q8/2 report (ITU Study Groups)

### 6.2.2. Cross-cutting Requirements (apply to all stages)

#### Table 8. Minimum standards - Cross-cutting Requirements (apply to all stages)

<table>
<thead>
<tr>
<th>Cross-Cutting Requirements</th>
<th>Standards (Best Practices)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrastructure</strong></td>
<td>The facilities shall comply with the current standards of each country in terms of earthquake resistance. The infrastructure shall be appropriate, in terms of size and technology, depending on the stages developed by each Manager. Facilities shall have: signaling (emergency, fire, obligation, prohibition, warning); Maps and evacuation routes; Safe and marked access and exit; Natural and artificial lighting and ventilation to prevent and control the accumulation of particulate matter, dust and fumes; Security systems and alarms (security cameras, smoke detectors, motion sensors, among others), to prevent theft and reduce risks. Efforts shall be made to develop an adequate infrastructure for the ESM of UEEE with the support of producers, other stakeholders, multilateral and regional development banks and bilateral donors. The facilities and their areas shall have appropriate security conditions and access to authorized personnel.</td>
</tr>
<tr>
<td><strong>Human Talent</strong></td>
<td>Personnel (not university professionals) involved in the ICT/WEEE management stages shall be certified by an entity of the State concerning their theoretical and practical training in all matters relating to the ESM of ICT/WEEE. Vulnerable population and the informal sector shall be included in the management processes; for this staff, the Government shall establish the obligation to take refresher courses and take exams every two (2) years. There should be periodic training for all personnel (WEEE management from ICT, ICT/WEEE content, health and environmental risks, actions to be taken in case of used EEE breaking, processes and procedures of the center, use of Personal Protective Equipment - PPE; tool handling; among others).</td>
</tr>
</tbody>
</table>
The personnel shall have permits for handling machinery and working at heights, which shall be renewed periodically. Strict measures of occupational health and industrial safety shall be applied in plants specialized in the treatment of mercury lamps. Medical tests shall be performed, both periodically and upon leaving, including blood and urine tests to control lead and mercury levels, due to accidental breaks in CRT, LCD, and fluorescent lamps. The facilities and work areas shall remain clean. Personnel shall use Personal Protective Equipment – PPE depending on the activity to be performed. Information and training materials for employees shall always be available at the workplace or an easily accessible place.

<table>
<thead>
<tr>
<th>Documentary support (processes and procedures)</th>
<th>The following shall be documented and kept as records: technical processes, procedures and instructions (depending on the stages carried out by the Manager); results from batches; identification, access, and compliance with applicable legal requirements; hazards and risks (identification and assessment); environmental aspects and impacts; controls (elimination, substitution, engineering controls, administrative controls); Programme on safety and health at work; training and induction and re-induction plans (effectiveness shall be assessed); emergency plans including evacuation drills; procedures for measuring lead and mercury in and outside working areas to verify if these are found within the professional exposure threshold; care provided in accidents and incidents; site maintenance and servicing of machinery; management review and improvement process; application of corrective and preventive actions and disseminating lessons learned; results and documents of downstream monitoring; plan for closure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment, Tools and Machinery</td>
<td>Facilities shall have: multipurpose extinguishers, Solkaflam (types 1 2 3) and D, according to the type of UEEE and ICT/WEEE stored and fireproof shelves; shelves and extinguishers shall be located at suitable and easily accessible sites. Facilities shall have the necessary tools and machinery, depending on the management stages that are carried out. There shall be logging sheets for equipment and machinery and maintenance and calibration certificates for the same.</td>
</tr>
<tr>
<td>Records</td>
<td>Records shall enable tracking of UEEE from their collection until their disposal (origin-destination), including their processing through the different stages and stakeholders of the recycling chain. In addition to the records described in “Documentary Support”, Managers shall calculate the mass balance by batch or annually and keep records related to: processes and procedures implementation; compliance with legal and regulatory obligations; recycling and recovery rates. The retention time of records generated from the ICT/WEEE management shall be of five (5) years or more depending on legislation of each country, and these might be in magnetic or physical means. Record keeping allows the Manager to measure performance and make informed decisions to achieve the goals and, if necessary, implement corrective actions.</td>
</tr>
<tr>
<td>Information systems</td>
<td>Producers of ICT/EEE shall feed and update a database with information on Managers and Logistics Operators involved in the recycling chain and about management stages (quantity and weight of used EEE or ICT/WEEE received, quantity processed, type kind of applied operation, results of operations, and so on).</td>
</tr>
</tbody>
</table>
Producers are required to periodically inform the relevant authorities about their management results (individually or collectively) and about achievement of goals.

Communications

The Managers shall have access to communications (Internet, land lines and cell phones), as well as having at hand the list of entities that cover occupational risks, health entities, entities for emergency care, among others.

Source: document author with information from analyzed standards and guidelines and Q8/2 report (ITU Study Groups).

6.2.3. Requirements by management stages

<table>
<thead>
<tr>
<th>Management Stages / Specific Aspects</th>
<th>Standards (Best Practices)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy, purposes and goals</strong></td>
<td>Managers shall have an environmental, health and safety policy which shall include the commitment to control the risks arising from UEEE and WEEE management. The policy shall be deployed through purposes, goals and indicators designed to measure the performance of the management system. The policy shall be published and brought to the attention of the Manager’s in-house and external customers. A policy on used equipment that can be accepted depending on technical capacity of the facility shall be designed and implemented.</td>
</tr>
<tr>
<td><strong>Doing</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Pre-processing stages</strong></td>
<td></td>
</tr>
<tr>
<td>Collection and Transport</td>
<td>It is a critical stage and finding ways to subsidize collection systems is essential. In the collection site, it is important that WEEE is not combined with other waste and ICT/WEEE with other WEEE. <strong>Containers, labelling, and identification:</strong> UEEE shall be placed in suitable and resistant containers of adequate size, allowing them to be moved mechanically without rupture. Each package shall be duly covered and labeled and identified with information on its contents, as follows: type of ICT/EEE, date of packaging, weight (kilograms), quantity (units), batch number, official responsible, etc. <strong>Transport companies and vehicles:</strong> the transport companies shall have the required authorizations, depending on the regulations in force in each nation, according to the type of waste and the means of transport used. Vehicles that transport UEEE by land shall meet certain general requirements (if complete equipment is not considered hazardous waste) or comply with the rules for the transport of hazardous goods (if complete equipment or some components are classified as hazardous waste). Each container shall be secured to the vehicle by the necessary devices, which shall be located in each of the four corners of the container; the load shall be covered with impermeable materials and vehicle shall have certificates of technical-mechanical reviews and of compliance with emission standards, as well as having multipurpose extinguishers, road equipment and toolbox. <strong>Records:</strong> records of the collection and subsequent delivery of used EEE shall be generated through a “transport document”, with data relating to: type of ICT/waste, provenance, batch number, weight (kilograms), quantities (units),</td>
</tr>
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<td></td>
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</tbody>
</table>
destination and data on vehicle (number plate and type), signature of official responsible, etc.

**Standards for cell phones collection:** establish collection points conveniently located for users; separate collection; collection with battery chargers and accessories as well as with batteries in place in the phones; any loose batteries shall be identified and properly managed. Selective collection of used mobile phones shall be applied to preserve the working characteristics and resale value of collected devices.

### Reception, sorting and weighing

**Generalities:** UEEE shall be unloaded with mechanical aid. It shall be verified that the amounts and / or weight that arrive at the Manager correspond to what is expected, according to the information as recorded in the “transport document”. If it is necessary to repackage the used ICT/EEE, uncontrolled tipping-over of equipment with CRT, LCD, plasma, fluorescent lamps, among others, shall be avoided.

If necessary, used ICT/EEE shall be resorted (UEEE from ICT sector shall be sorted into used ICT/EEE collection categories or any other groups based on legislation) and re-weighed, labeled and identified (used ICT/EEE that is to be refurbished or repaired shall be identified and sorted) with the following data: type of used ICT/EEE, weight (kilograms), quantity (units), batch number, container number, assigned shelf place, date, official responsible, etc.

The handling of WEEE (packaging, loading and unloading, storage, movements inside the Manager’s facilities, etc.) shall be carried out with care to avoid equipment damage and possible leak of hazardous substances.

**Equipment, Tools and Machinery:** Managers shall have the necessary equipment (scales and forklifts). Minimum maintenance and calibration of equipment shall be performed every six (6) months.

**Records:** The following records shall be generated and maintained: transport document; certificates of maintenance and calibration of equipment.

### Storage

**Infrastructure.** Requirements for storage areas: impermeable surfaces and spillage collection facilities, and where necessary, decanters and cleanser-degreasers; spillage collection facilities; weatherproof covering and labeled containers.

The maximum amounts of used ICT/EEE storage shall comply with legal and regulatory requirements or failing that, it cannot exceed the amount of used equipment that can be processed in six (6) months.

**Documentary Support (processes and procedures):** safety sheets and emergency cards shall be available for the most representative substances that may contain used ICT/EEE, which shall be applied in case of equipment breakdown.

Used mobile phones shall be properly packaged to protect their integrity; batteries shall be packaged in a proper manner to avoid contact with their terminals; mobile phones for refurbishment shall be adequately handled to protect them and avoid release of hazardous substances.

**Equipment, Tools and Machinery:** The necessary equipment for the activities carried out at this stage shall be available. The heavy-duty shelving is required for the optimal use and organization of space in the facilities.
**Information Systems**: an information systems or at least a database with relevant information shall be designed and fed periodically.

**Records**: There should be records of periodic maintenance of the heavy shelf (minimum every 12 months).

<table>
<thead>
<tr>
<th>Processing stages</th>
<th>Generalities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct or Indirect reuse (repair / refurbishment)</td>
<td>• It shall be contracted only with third parties that are authorized and have capacity to repair or refurbish used equipment; fractions that are not used, shall be managed in a proper manner.</td>
</tr>
<tr>
<td></td>
<td>• The Party that put refurbished equipment on the market shall place its name on the equipment, protect the original manufacturer from any claim related to the equipment and shall deliver the corresponding legal warantees.</td>
</tr>
<tr>
<td></td>
<td>• Documentation and labelling shall certify the equipment is working and that it is fit for its intended end use.</td>
</tr>
<tr>
<td></td>
<td>• Remarketing of used equipment shall ensure that it continues to meet all applicable standards and requirements.</td>
</tr>
<tr>
<td></td>
<td>• Refurbisher shall ensure compliance with all applicable laws for product and used product in the case of export / import of refurbished equipment.</td>
</tr>
<tr>
<td></td>
<td>• Evaluation and/or testing and labelling is required to decide if ICT/EEE can be directly reused, or requires repairs, refurbishment or upgrading prior to reuse, or must be sent for environmentally sound material recovery and recycling.</td>
</tr>
<tr>
<td></td>
<td>• The parts used in the refurbishment of electrical equipment from ICT, cases and covers shall be of a type and design that permit the devices to comply with the rated operational characteristics specified by the original equipment manufacturer.</td>
</tr>
<tr>
<td></td>
<td>• Refurbishers shall not add or update software for refurbished ICT equipment that change the rated operational characteristics specified by the original equipment manufacturer.</td>
</tr>
<tr>
<td></td>
<td>• Refurbisher or Manager shall ensure that all data is sanitized (data destruction by electronic means). Quality controls to ensure effectiveness of data sanitization, purging, and destruction techniques shall be carried out.</td>
</tr>
<tr>
<td></td>
<td>• Any party refurbishing or remarketing ICT/EEE shall inform the subsequent purchaser that the product is used and / or refurbished and shall provide contact information.</td>
</tr>
<tr>
<td></td>
<td>• Refurbishers shall ensure the labeling is carried out and documentation of the refurbished equipment is available in order to cover, as far as possible, the type of equipment, the model and the serial numbers, the year of manufacture, the date of refurbishment / repair, the possible evaluation and tests that were performed, a general confirmation that the refurbished / repaired equipment is suitable for reuse.</td>
</tr>
<tr>
<td></td>
<td>• Refurbisher or Manager shall ensure traceability of downstream equipment.</td>
</tr>
<tr>
<td></td>
<td>• Prior to shipping used electronics and components (domestically or internationally), Manager shall assure and identify each shipment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manual / Mechanical dismantling</th>
<th>Generalities:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Equipment that is not intended for direct reuse shall be dismantled and separated by manual and/or mechanical processing.</td>
</tr>
<tr>
<td></td>
<td>• Manual dismantling generates employment and produces a high degree of quality in the separated components.</td>
</tr>
</tbody>
</table>
- Mechanical separation may be used, including grinding, shredding, and size reduction followed by various separation techniques.
- Managers shall remove all liquids, substances, preparations, and components from WEEE prior treatment.
- Manual removal of batteries and lamps may be applied to minimize contamination of other materials and to maximize recovery of the substances.
- Crushing or compacting of WEEE prior to the treatment is not permitted.
- Personal data stored on the memory of the ICT equipment shall be destroyed.

**Documentary support (processes and procedures):** procedures and instructions related to the manual / mechanical dismantling of used ICT/EEE shall be documented.

**Information systems:** a system or database shall be used to record ICT/WEEE movement from the shelves (warehouse) to the dismantling area.

### Sorting according to type of WEEE and storage according to type of material

<table>
<thead>
<tr>
<th>Sorting</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>- After manual / mechanical dismantling, clean materials (ferrous and non-ferrous metals) can be valued and the remainder shall be sent to properly equipped material recovery facilities.</td>
<td>- Items containing lithium shall be stored separately and in a restricted area, avoiding exposure to heat, sunlight, humidity and water, as they may ignite or explode if exposed to high temperatures. Batteries shall be stored in places protected from humidity, rain and with waterproof covers.</td>
</tr>
<tr>
<td>- If there is doubt about the presence of hazardous substances in the components of electronic waste (separated and classified), they should be treated as hazardous (e.g. when it is not known if the capacitors contain polychlorinated biphenyls (PCBs) or if the content of brominated flame retardants in plastic fractions is lower than the thresholds established in each country).</td>
<td>- Mercury lamps and CRT, LCD or plasma screens that are broken by accident shall be stored in closed and identified containers. The areas in which the lamps are stored shall be ventilated, easily accessible to authorized personnel, but should be disturbed as little as possible.</td>
</tr>
<tr>
<td>- No materials (either waste or not) shall be added to fractions or substances classified as dangerous to bring the total volume of waste below the threshold that classifies it as hazardous (dilution prohibition).</td>
<td>- ICT/WEEE shall storage with due care in order to avoid release of hazardous substances.</td>
</tr>
<tr>
<td>- Substances, preparations, and components removed from ICT equipment shall be Identified and labeled.</td>
<td>- CCFL backlights that break during manual disassembly will be stored and transported in closed containers to prevent mercury emissions. These containers will remain stored in places that are not exposed to heat.</td>
</tr>
<tr>
<td>- Eco-design is important in sorting process (implement improvements in the environmental design; reuse and recycling information into product marking; labelling of internal software; replacing all toxic substance with benign substitutes).</td>
<td>- Eco-design is important in sorting process (implement improvements in the environmental design; reuse and recycling information into product marking; labelling of internal software; replacing all toxic substance with benign substitutes).</td>
</tr>
</tbody>
</table>
The mercury and lead concentrations in the air shall be regularly monitored in all working areas, including storage areas.

**Containers, Labeling and Identification:**
CRT display appliances, flat panel displays, and lamps shall be placed in containers or stacked in a stable manner. The containers shall be labeled and identified with the following data: type of material or component, weight (kilograms), container number, shelf place, official responsible, date, among others, which shall be reflected in the information system with the destination assigned to the material or components in each container.
For the storage of lamps, it shall be necessary to have: lockable containers for the storage output fractions, designed to avoid the emission of mercury, and an industrial vacuum cleaner with activated carbon filters.

### Recovery of materials and components

**Generalities:** recovery refers to the sale of clean materials and other fractions from the dismantling process for re-incorporation in production processes and the application of other processing methods for the recovery of metals, respectively. The recovery of clean materials is possible when there is a market and their use has no negative impacts. Fractions for the recovery of heavy, rare, and precious metals shall be sent to specialized treatment facilities.

### Treatment (including recovery) and disposal

**Generalities:** hazardous waste for which appropriate treatment technology in the country of origin does not exist shall be exported, so the Basel Convention shall be applied (in the case of the countries that have ratified it), or other treaties and agreements subscribed between countries. Export records shall be kept.

**Infrastructure:** water used in wet treatment processes of CRT or CRT display appliances shall be kept in a closed loop, and shall not be released to the sewage system. The dry treatment processes applied to CRT or CRT display appliances shall have an effective dust extraction system, connected to a filtering system, which shall ensure compliance at all times with the established emission thresholds. Treatment Managers shall periodically monitor the air filtration system outputs in an accredited laboratory, and the quantities of dust and heavy metal emissions (especially lead and cadmium) shall be determined. The facilities in which the treatment of the ICT/WEEE is carried out will have systems to control air, water, and soil contamination, complying with the discharge limits established in the legislation of each country. Treatment processes shall be carried out in controlled environments to protect workers and the environment.

**Equipment, Tools and Machinery:** shall be required according to the physical-chemical processes that are applied for the treatment and recovery of metals.

**Records:** Records regarding treatment and disposal methods applied to hazardous e-waste; quantities processed; kinds of materials/metals obtained and quantities; methods of disposal (in the Manager facilities or other Managers downstream); among others, which shall be supported by the mass balance and certificates of treatment and disposal. Also, records related to transboundary movements of hazardous ICT/waste shall be kept.

**Treatment options:** Treatment options for some fractions are presented in Table 10.
Checking

| Audits and supervision | Environmental, health and safety policy shall be adjusted when changes occur and its effectiveness shall be evaluated. Audits may be conducted by first, second or third parties. **First-party audits**: Managers shall have in-house auditors who act with of objectivity and impartial criteria. **Second-party audits** shall be carried out by interested parties (e.g. producers organized into collective systems or acting individually), on the Managers and Logistics Operators that are part of the recycling chain. **Third-party audits** shall be carried out by external, independent organizations offering certification of compliance. On the other hand, competent authorities of each country shall carry out supervision actions and impose sanctions in the event of non-compliance. At this stage, the defined indicators shall be applied to verify proper operation of the system, as well as corrective and preventive actions and reviews by management. |

| Acting | Improvement | Managers shall prove the continuous improvement of their activities in a review and management process. |

Source: document author with information from analyzed standards and guidelines and Q8/2 report (ITU Study Groups)

6.2.3.1. Treatment options

**Table 10. Minimum standards – Treatment options**

<table>
<thead>
<tr>
<th>Kind of hazardous ICT/WEEE</th>
<th>Treatment Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generalities</td>
<td>After developing the first steps for the separation of metallic and non-metallic fractions from WEEE, these fractions can be processed as follows: Metallic fractions: through metallurgical processes (hydrometallurgical, pyrometallurgical, electrometallurgical, biometallurgical, and their combinations). Nonmetallic fractions: recycling methods are based on chemical processes (gasification, pyrolysis, supercritical de-polymerization and hydrogenolytic degradation) for the production of chemicals and fuels (non-metallic fractions can be used in pyrometallurgical processes such as fuels and reducing agent). Hydrometallurgical and pyrometallurgical processes are the most common and can be followed by electrometallurgical / electrochemical processes (e.g. electro-refining or electrolytic extraction) for the separation and recovery of the selected metal. Biometallurgical processes, for example, the bioleaching of metals from electronic waste, are only limited to laboratory studies, but it is an alternative worth exploring given its great potential (Khaliq, 2014). Hydrometallurgical processes, compared to pyrometallurgical processes, are more reliable and controllable. In addition, the latter are highly polluting, emitting SO₂ and CO₂.</td>
</tr>
</tbody>
</table>
The treatment processes shall be adequate and monitored to avoid the generation of by-products of ICT/WEEE management from contaminating as much or more than mismanagement.

<table>
<thead>
<tr>
<th>Aliminium, Steel and Copper</th>
<th>Scrap steel can be used in electric arc furnaces to produce new steel. Scrap aluminum can be used in secondary aluminum furnaces to produce new aluminum. Scrap copper, scrap precious metals, and some other non-ferrous (special) metals are commonly recovered from computer circuit boards and other components/fractions in pyrometallurgical processing and/or by metal-specific hydrometallurgical refining.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRT screens</td>
<td>Clean and sorted CRT glass may be used to produce new leaded glass (e.g. for x-rays) or can be used in lead smelters to produce lead. Cone glass and CRT glass mixtures shall, as far as possible, be recovered or recycled in products or processes where the lead content has a technical function to avoid the dispersion of lead to other products and to the environment. Otherwise, such glass shall be used in such a way that the lead content of the final product does not exceed the limits specified in national legislation.</td>
</tr>
<tr>
<td>Mercury lamps</td>
<td>The mercury lamps shall be properly packaged and sent to specialized mercury recovery facilities. All CCFL backlights from manual dismantling, whether broken or not, will be managed in treatment plants (Annexes – Table 11).</td>
</tr>
<tr>
<td>Mobile Phones</td>
<td>Processing and recycling of mobile phones include recovery of copper and precious metals such as gold, silver, and palladium (they are extremely valuable). In addition, some material recovery and recycling processes result in the recovery of materials such as steel, aluminium and magnesium, tin, cobalt, lead, and plastics. Direct smelting of mobile phones at the end of life permits recovery of metals such as copper, precious metals, and most other metals (except iron, magnesium, and aluminium); plastics can be used as a source of heat and as reducing agents. Smelting of used mobile phones requires specialized equipment with pollution control systems. Electronic waste, including mobile phones, contains plastics and halogens (chlorine and bromine) which, when burned, can lead to the formation of dioxins and furans, which are highly toxic and carcinogenic.</td>
</tr>
<tr>
<td>Batteries</td>
<td>Batteries can be safely recycled to recover iron, aluminium, copper, nickel, cobalt and cadmium, depending upon the battery type and also on the specific recovery process (Annexes -Table 12).</td>
</tr>
<tr>
<td>Flat screens</td>
<td>For the treatment of flat-screen devices, different screen types, fractions, components, and requirements for the ESM shall be taken into account: mercury, fluorescent coatings, and indium tin oxide (ITO). On a flat screen it is possible to find the following components: backlight lamps, fluorescent coatings and/or lithium containing batteries. Liquid crystal display panels or their fractions shall be sent to treatment plants to concentrate indium tin oxide (ITO). Fluorescent coatings and their fractions shall be disposed of in landfills (security cells) or treated with appropriate thermal processes which have been designed and authorized for hazardous substances. Processing of flat panel displays shall be carried out in a controlled atmosphere. Suitable ventilation equipment and filters shall be used to ensure that the occupational exposure limits and the emission limit values</td>
</tr>
</tbody>
</table>
for particulates and heavy metals are not exceeded at any time. The accumulation of heavy metals in dust shall also be measured periodically.

| Printed circuit boards | Lead, tin, antimony, chromium oxide, beryllium, cadmium, gold, silver can be recovered. Brominated Flame Retardants and Bromine present in the plastic part require additional treatment. For the recovery of rare and precious metals advanced techniques can be applied combining hydrometallurgy and pyrometallurgy. The techniques must be controlled and will vary depending on the metal to be obtained (Cui & Zhang, 2008) |

**Source:** document author with information from analyzed standards and guidelines and Q8/2 report (ITU Study Groups)
Conclusions

The use of Information and Communication Technologies - ICT generates important social and economic benefits for the countries. In addition, ICT can contribute to energy efficiency and global warming mitigation, resulting in a positive impact not only in the sector itself, but also in other sectors of the economy. Despite this, the use of ICT produces electronic waste and contributes from 2% to 2.5% of global emissions of Greenhouse Gases - GHG, aspects that can be adequately addressed through the application of the concepts of Sustainable Development and Green ICT.

For all countries, it is of great importance to have a legal framework that allows for the Environmentally Sound Management- ESM of e-waste from ICT as one of the first and fundamental steps to achieve the improvement of the existing conditions in each nation, mitigating or eliminating the negative impacts on the environment and human health resulting from improper handling.

It is essential that the legislation that is issued covers both the design and organization of a WEEE management system and its enforcement, which requires the establishment of minimum standards that allow for the ESM of this type of waste.

It is not enough to legislate to achieve an appropriate management of electronic waste: it is necessary to ensure the implementation of regulations, in which the State plays a fundamental role through awareness-raising actions, as well as monitoring and control.

The legislation issued will depend on the type of country (least developed, developing or developed countries), size, customs, consumption habits of ICT/EEE, existing situation concerning the subject of electronic waste, amounts of WEEE generated, technologies available for waste management, among others. However, there are several aspects that should be considered in any WEEE legislation, which are discussed in Chapter 6 of this document.

The financial sustainability of the e-waste management system must be guaranteed, hence the importance of clearly establishing in the legislation the contributions that must be made by the stakeholders and their proportion. To ensure success in the case of least developed and developing countries, it is desirable to have a sum of financing sources (producers, consumers, government, international organizations, fines from sanctions, among others).

Small countries and/or with low WEEE generation rates can: a) legally export e-waste to nations that have the technology required for proper management. b) authorize legal imports, investing in the creation of the necessary infrastructure for the ESM of electronic waste as a business alternative, guaranteeing the volume required to achieve economic, environmental, and social benefits. Imports and exports of WEEE should consider principles of respect and transparency between the Parties.

For the least developed and developing countries it is beneficial, either individually or in alliance with other States in the region, to recover precious and rare metals from WEEE, for which they must have the appropriate technology.

The Extended Producer Responsibility - EPR principle is essential not only for the proper management of UEEE, but also to ensure the permanent work of manufacturers in eco-design, which will help reduce the environmental and financial costs of reuse and recycling.

The creation, feeding and administration of an information system on EEE from ICT placed on the market, as well as on the UEEE management (reuse and recycling), is important for supervising and making adjustments to the legislation concerning WEEE, as well as for the exercise of oversight and control actions by the State.
The integration of the informal sector, its training and taking advantage of the large numbers and economy of its workforce, which reaches important coverage, constitutes a fundamental tool to achieve an appropriate management of WEEE.
• **Best Available Techniques – BAT**: means the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste (OSPAR Commission, 2015).

• **Best Environmental Practices – BEP**: the application of the most appropriate combination of environmental control measures and strategies (OSPAR Commission, 2015).

• **Direct reuse**: continued use of EEE and components by a second user, without the need for repairs, refurbishment or hardware updating, provided that such use is for the purpose for which the item was originally manufactured.

• **Disposal**: any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy (WEEEABEX, 2013).

• **Due Diligence**: includes understanding of all obligations to which the company is subject and transparency with business partners (WEEEABEX, 2013).

• **Environmentally Sound Management – ESM**: management of electronic waste using best available techniques (BAT) in line with best environmental practices (BEP), eliminating or mitigating negative impacts on the environment and human health.

• **Focus Materials – FMs**: are materials in end-of-life electronic equipment that warrant greater care during recycling, refurbishing, materials recovery, energy recovery, incineration, and/or disposal due to their toxicity or other potential adverse worker health and safety, public health, or environmental effects that can arise if the materials are managed without appropriate safeguards (Responsible Recycling (R2) Certification Program, 2013).

• **Green ICT**: is the study and practice of designing, manufacturing, using and disposing of computers, servers and associated subsystems-such as monitors, printers, storage devices and networking and communications systems efficiently and effectively, with minimal or no impact on the environment. Green ICT includes the dimensions of environmental sustainability, the economics of energy efficiency and the total cost of ownership, which includes the cost of disposal and recycling. Green ICT benefits the environment by improving energy efficiency, lowering greenhouse gas emissions, using less harmful materials, and encouraging reuse and recycling. Green design, green manufacturing, green use, green disposal are complementary paths of green ICT. Only by focusing on these four fronts can we achieve total environmental sustainability from the IT side and make IT greener throughout its entire lifecycle (The Council of European Professional Informatics Societies - CEPIS, 2016).

• **Hazardous waste**: a residue or waste whose corrosive, reactive, explosive, toxic, inflammable, infectious or radioactive properties may represent a risk, or cause harm, to human health and the environment. Packages and packaging that have been in contact with such items is likewise considered a hazardous residue or waste (Ministry of Environment and Sustainable Development of Colombia, 2005). Waste which displays one or more hazardous properties (WEEEABEX, 2013).

• **Hydrometallurgy**: extraction of metal from ore by preparing an aqueous solution of a salt of the metal and recovering the metal from the solution. The operations usually involved are leaching, or dissolution of the metal or metal compound in water, commonly with additional agents; separation of the waste and purification of the leach solution; and the precipitation of the metal or one of its pure compounds from the leach solution by chemical or electrolytic means. The most common leaching agent is dilute sulfuric acid (Britannica, 1998).

• **Historical WEEE**: wastes from EEE which were put on the market before the entry into force of legal provisions governing WEEE (Ministry of Environment and Sustainable Development of Colombia - MADS, 2013).

• **Indirect reuse**: use of EEE and components by a second user following repairs, refurbishment or hardware updating, provided that such use is for the purpose for which the item was originally manufactured.

• **Life Cycle**: life cycle: estimated time span during which an object can be expected to perform correctly the function for which it was manufactured (Study Groups ITU).
• **Logistics Operators**: entities taking part in the recycling chain, in charge of actions such as: reverse logistics or recollection, transport, storage.

• **Management System**: the organization and coordination of the activities of a business or topic in order to achieve defined objectives. Management consists of the interlocking functions of creating corporate policy and organizing, planning, controlling, and directing an organization's resources in order to achieve the objectives of that policy (Business Dictionary, 2016). A management system describes the set of procedures an organization needs to follow in order to meet its objectives (International Standards Organization - ISO, 2016).

• **Managers**: entities part of the recycling chain, with environmental permits or licenses needed to undertake some or all environmentally sound management stages of the used ICT/EEE and WEEE/ICT.

• **Orphan WEEE**: wastes from EEE without any identifiable manufacturer or whose manufacturers have left the market (Ministry of Environment and Sustainable Development of Colombia - MADS, 2013)

• **Precautionary principle**: the precautionary principle enables decision-makers to adopt precautionary measures when scientific evidence about an environmental or human health hazard is uncertain and the stakes are high (European Parliament, 2015).

• **Pyrometallurgy**: is a process through which ores and metals are heated to produce a finished product of workable compounds, purer metals and alloys. The process may be any of the following: drying, roasting, smelting, refining, and alloying, among others. By using high temperatures, one can cause chemical and exothermic reactions in materials. Drying is a type of pyrometallurgy in which moisture is removed from the material; heat is applied to make the metal hotter than the boiling point of water, and then the moisture can be extracted from the material. Roasting occurs when metal sulfide is heated to a point that oxygen reacts to form solid metal oxide and sulfur dioxide gas. Smelting involves thermal reactions at a molten phase and typically takes place at a temperature higher than the metal's melting point, and removes carbon dioxide from the material, leaving a more refined metal. Refining is removes impurities by heating the metals (WiseGEEK, 2016).

• **Recovery**: any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy (WEEELABEX, 2013).

• **Recycling**: any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations (WEEELABEX, 2013).

• **Refurbishment**: a process for obtaining renovated or refurbished EEE by means of activities such as cleaning, data wiping and software updating. It may include repairs in cases of damaged equipment (Ministry of Environment and Sustainable Development of Colombia - MADS, 2013).

• **Repair**: the process of correcting a specific hardware fault or series of faults in EEE.

• **Sustainable Development**: according with Brundtland Report (1987) sustainable developement is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: a) the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and b) the idea of limitations imposed by the state of technology and social organization on the environment’s ability to meet present and future needs.” (International Institute for Sustainable Development - IISD, 2016).

• **Take-back or reverse logistics**: a procedure to take back and/or collect disused EEE and transport them to reuse centres or facilities authorized for the management of WEEE (Ministry of Environment and Sustainable Development of Colombia - MADS, 2013).

• **Treatment**: recovery or disposal operations, including any preparation prior to recovery or disposal (WEEELABEX, 2013).
• **UEEE (Used Electrical and Electronic Equipment):** is electrical and electronic equipment that has been put into service and used but has subsequently been taken out of service and not yet discarded as waste (WEEELABEX, 2013).

• **Waste Electrical and Electronic Equipment - WEEE:** electrical or electronic equipment which is waste, including all components, subassemblies and consumables which are part of the product at the time of discarding (WEEELABEX, 2013).

• **Waste:** any substance or object that the holder discards or intends or is required to discard (WEEELABEX, 2013).
Abbreviations

CCFL: Cold Cathode Fluorescent Lamp
CRT Cathode ray tube
EEE: Electrical and Electronic Equipment
EHSMS: Environmental, Health and Safety Management System Standards
EPR: Extended Producer Responsibility
ESM: Environmentally Sound Management
FMs: Focus Materials
GHG emissions: Greenhouse Gas emissions
ICT/EEE: Electrical and Electronic Equipment from ICT sector
ICT/WEEE: Waste Electrical and Electronic Equipment from ICT sector
ICT: Information and Communication Technologies
ITU International Telecommunication Union
LCD Liquid crystal display
LDC: Least Developed Countries
LTE networks: Long Term Evolution networks
MPPI: Mobile Phone Partnership Initiative
PACE: Partnership for Action on Computing Equipment
PCB: Polychlorinated biphenyl
PCB: Printed Circuit Board
PRO: Producer Responsibility Organizations
RoHS: Restriction of Hazardous Substances
UNU: United Nations University
WEEE: Waste Electrical and Electronic Equipment
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Annexes

Table 11. Treatment methods for fluorescent lighting components

<table>
<thead>
<tr>
<th>Output fraction</th>
<th>Purpose</th>
<th>Acceptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass</td>
<td>Glass</td>
<td>Glass industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lamp industry</td>
</tr>
<tr>
<td>Glazing</td>
<td></td>
<td>Ceramics industry</td>
</tr>
<tr>
<td>Abrasive sand for cleaning</td>
<td></td>
<td>Cleaning industry</td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
<td>Industry</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Fusion agent</td>
<td>Within black copper foundry</td>
<td>Metal industry</td>
</tr>
<tr>
<td>Clinker</td>
<td></td>
<td>Building/cement industry</td>
</tr>
<tr>
<td>Sand replacement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under layer for asphalt road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass wool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silicon substitute</td>
<td></td>
<td>Incinerators</td>
</tr>
<tr>
<td><strong>Mercury</strong></td>
<td><strong>Cathode</strong></td>
<td>Chlorine/ caustic soda industry</td>
</tr>
<tr>
<td>Mercury</td>
<td><strong>Lamp industry</strong></td>
<td></td>
</tr>
<tr>
<td>Fluorescent/ phosphor powder</td>
<td>Controlled landfill</td>
<td></td>
</tr>
<tr>
<td>Powders</td>
<td><strong>Waste</strong></td>
<td>Controlled landfill</td>
</tr>
<tr>
<td>New use</td>
<td></td>
<td>Rare earth Industry</td>
</tr>
<tr>
<td><strong>Caps &amp; Metallic components</strong></td>
<td><strong>Metal foundries</strong></td>
<td>Metal industry</td>
</tr>
<tr>
<td><strong>Plastics</strong></td>
<td><strong>(Mix of) plastic</strong></td>
<td>Plastic industry</td>
</tr>
<tr>
<td>Plastic waste</td>
<td></td>
<td>Controlled landfill</td>
</tr>
</tbody>
</table>

**Source:** WEEE LABEX - Treatment, 2013
<table>
<thead>
<tr>
<th>Battery Type</th>
<th>Recycling Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaline manganese and zinc carbon batteries.</td>
<td>Hydrometallurgical and pyrometallurgical processes are viable to recover zinc, steel and ferro manganese or padding for use in the construction industry.</td>
</tr>
<tr>
<td>Nickel cadmium batteries</td>
<td>Pyrometallurgical processes are used to recover cadmium of 99% purity, which is reused to produce new Ni-Cd batteries as well as ferronickel.</td>
</tr>
<tr>
<td>Nickel metal hydride batteries</td>
<td>This kind of batteries is processed to recover nickel, iron and other metals.</td>
</tr>
<tr>
<td>Rechargeable lithium ion batteries</td>
<td>This kind is processed to recover cobalt, iron and other metals.</td>
</tr>
<tr>
<td>Lead Acid Batteries</td>
<td>Lead is recovered for reuse in new batteries.</td>
</tr>
<tr>
<td>Button batteries</td>
<td>Silver oxides are collected for recycling silver by jewelers for use in watches. Batteries also can be recycled to recover mercury, zinc and steel.</td>
</tr>
</tbody>
</table>

### Tabla 13. Detailed revisión of legislation by country

<table>
<thead>
<tr>
<th>Stages PDCA /General Aspects</th>
<th>Specific Aspects</th>
<th>Selected Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Country overview</td>
<td>Canada</td>
</tr>
</tbody>
</table>
| **General and Administrative Aspects** | • Country of North America.  
• Form of Government: federal parliamentary monarchy.  
• 10 provinces and 3 territories.  
• Capital: Ottawa  
• Population: 35.16 million (World Bank, 2013).  
• Total area: 9,984,670 km².  
• Currency: Canadian Dollar  
• Official Languages: English, French.  
• Continent: America | • Republic of Colombia is a country located in the northwestern region of South America. It is constituted in a unitary, social and democratic State of law whose form of Government is presidential.  
• Capital: Bogotá D.C.  
• Total area: 1,141,748 km².  
• Language: Spanish  
• Continent: America | • Kingdom of Bhutan is a South Asian country located in the Himalayan mountain range and without any exit to the sea. It is bordered to the north by the Republic of China and to the south by India.  
• Capital: Thimphu  
• Currencies: Bhutanese Ngultrum, Indian Rupee  
• Official language: dzongkha language.  
• Total area: 38,394 km².  
• Population: 742,737 (2012 estimate).  
• Continent: Asia. | • Republic of South Africa is a sovereign country, a member of the European Union, constituted in a social and democratic State of law and whose form of Government is the semipresidentialist republic.  
• Capital: Pretoria, Cape Town, Bloemfontein  
• Currency: South African Rand  
• Total area: 1,219,912 km².  
• Population: 52.98 million (World Bank, 2013).  
• Official languages: English, Afrikaans, Xhosa language.  
• Continent: Africa | • French Republic, is a sovereign country, a member of the European Union, constituted in a social and democratic State of law and whose form of Government is the parliamentary republic. Its territory is organized in 9 provinces.  
• Capitals: Pretoria, Cape Town, Bloemfontein  
• Currency: South African Rand  
• Total area: 1,219,912 km².  
• Population: 52.98 million (World Bank, 2013).  
• Official languages: English, Afrikaans, Xhosa language.  
• Continent: Africa | • Republic of South Africa is a sovereign country of Southern Africa whose form of Government is the parliamentary republic. Its territory is organized in 9 provinces.  
• Capitals: Pretoria, Cape Town, Bloemfontein  
• Currency: South African Rand  
• Total area: 1,219,912 km².  
• Population: 52.98 million (World Bank, 2013).  
• Official languages: English, Afrikaans, Xhosa language.  
• Continent: Africa |
|                              | WEEE regulations | Colombia             |
|                             | • Canadian Environmental Protection Act.  
• Specific rules and regulations on WEEE. | Waste Prevention and Management Act of Bhutan, 2009.  
<p>|                              | Law 1672 of 2013. Guidelines for the adoption of a public policy for the integral management of waste electrical and electronic | The Second-Hand |
| Regulations scope | General Environmental regulation. | A set of principles for electronics product stewardship were sanctioned by the Canadian Council of Ministers of the Environment (CCME) to regulate e-waste management within Canada. A non-profit, industry-led organization, Electronics Product Stewardship Canada (EPSC), was established in 2003 to design, promote, and implement sustainable solutions for the recycling of electronic waste. | Law 1672 of 2013 applies to natural or legal persons who import, produce, market, consume electrical and electronic equipment and manage their respective waste. Resolutions establish the obligation to formulate, present and implement the Systems of Selective Collection and Environmental Management of Waste of Batteries and / or Accumulators; Computers and / or Peripherals and light bulbs. | Waste Prevention and Management Act of Bhutan, 2009. This Act shall extend to all forms of waste from residential, agricultural, commercial, medical or industrial sources. Waste Prevention and Management Regulations, 2012 Chapter VII E-Waste Management. The regulation is applicable to every producer, importer, exporter, transporter, consumer or bulk consumer involved in the manufacture, import, export, sale, purchase, and processing of electrical and electronic equipment or components, and includes collection centres, e-waste | The Waste Act has been in force since 2009 and regulates and controls the management of all waste. Before the Waste Act was developed, there was no specific law to regulate waste including e-waste. There is a law in South Africa that is called the Second-Hand Goods Act. It has been developed to fight the theft and resulting illegal sales of stolen items. The NEMA introduced a number of guiding principles into the |</p>
<table>
<thead>
<tr>
<th>Environment Canada regulates policy regarding the handling and disposal of toxic waste, import and export of hazardous waste, and hazardous recyclable material.</th>
<th>National Recycler Qualification Program (RQP) defines the minimum requirements for the end of life electronics processors and recyclers.</th>
<th>The Electronics Reuse and Refurbishing Program (ERRP) is a certification designed for businesses related to the reuse and refurbishing of electronics products.</th>
<th>South African environmental legislation, including the life-cycle approach to waste management, producer responsibility, the precautionary principle and the polluter pays principle. Waste management licence as required by the Government Notice No. 718 of 3 July 2009.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronics Product Stewardship Canada (EPSC).</td>
<td>Environment Canada.</td>
<td>Department of Information Technology and Telecom – DITT.</td>
<td>E-Waste Association South Africa (eWASA), a non-profit organisation that has been working with manufacturers, vendors and</td>
</tr>
<tr>
<td>Environment Canada.</td>
<td>Ministry of Health and Social Protection.</td>
<td>National Environment Commission - NEC is the apex body mandated with the responsibility of providing leadership in environment and related issues in the country.</td>
<td></td>
</tr>
<tr>
<td>National Recycler Qualification Program (RQP).</td>
<td>Computers to Educate: Programme that manages the National E-waste Recycling Centre - CENARE, which carries out the management of computers delivered to educational institutions, at the end of their useful life. Ministry of Commerce, Industry and Tourism. The National Government created the National Committee for Waste Electrical and Electronic Equipment (WEEE) as a consulting body of the Ministry of Environment and Sustainable Development.</td>
<td>E-waste Management Entity: private sector company that will be chosen on a competitive basis to handle and manage e-waste in the country, performing tasks for environmentally sound management of e-waste. ADEME - Environment and Energy Management Agency, provides technical support to the ministry in charge of ecological affairs.</td>
<td>distributors of electronic and electrical goods and e-waste handlers (including refurbishers, dismantlers and recyclers) to manage e-waste effectively since 2008.</td>
</tr>
</tbody>
</table>

| Principles | • Extended Producer Responsibility – EPR. • Active participation • Creation of stimuli • Decentralization • Innovation, science, and technology. • Gradualness. • Sustainable production and consumption. • Prevention. | A person has the right to a safe and healthy environment with equal and corresponding duty to protect and promote the environmental wellbeing of the country as enshrined in the Constitution of the Kingdom of Bhutan. The Middle Path and Gross National Happiness. Precautionary Principle. Every person shall take all | Reduction, re-use, recycling and recovery of waste. |
precautionary measures in maintaining a clean and healthy environment.

All developmental activities that generate waste shall be planned and executed in harmony with the carrying capacity of the country’s fragile ecological settings and geographical terrains.

Polluter Pays Principle


Avoid, eliminate, or substitute the use of products or unnecessary packaging that generate waste.

<table>
<thead>
<tr>
<th>Stakeholders responsibilities</th>
<th>Responsibilities are defined for: National Government, Producers, Marketers, Users or Consumers and Managers.</th>
<th>The regulation specifies responsibilities for Agencies/Players involved in ensuring effective prevention and management of e-waste.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extended Producer Responsibility – EPR</td>
<td>At the provincial level, Extended Producer Responsibility (EPR) targets electronic products. EPR is adopted from the European Union and uses an industry managed and financed approach to provide flexibility to brand</td>
<td>Extended Producer Responsibility – EPR. It is the duty of the producer of electrical and electronic equipment, throughout the different stages of the product’s life cycle. Producers are responsible for</td>
</tr>
</tbody>
</table>
| **Import / Export of WEEE** | Canada ratified the Basel Convention.  
Total amount of e-waste collected is approximately 20% of the total e-waste generated in Canada.  
A significant portion of e-waste generated is lost to municipal waste, exported to | Colombia ratified the Basel Convention through Law 253 of 1996.  
Department of Taxes and National Customs - DIAN (Acronym in Spanish) will design and implement special strategies to prevent and control the introduction or import into the country of Electrical and Electronic Devices of smuggling or those that can be recycled in other countries | Bhutan can either think of exporting e-waste legally to outside countries or make investment to handle WEEE from other countries in an economically viable way.  
Some options would include setting up all three levels of treatment facilities with option to import waste from other countries to be managed in Bhutan. | The Minister may specify: (a) the requirements in respect of the implementation and operation of an ERP programme, including the requirements for the reduction, re-use, recycling, recovery, treatment and disposal of waste; (b) the financial arrangements of a waste minimization programme, with the concurrence of the Minister of Finance; (c) the institutional arrangements for the administration of a waste minimization programme. |
<p>| <strong>developing countries or ends up in landfill.</strong> | do not comply with the provisions established in the WEEE Law. The Ministry of Environment and Sustainable Development and the Ministry of Commerce, Industry and Tourism, with the support of the DIAN, will establish a control and monitoring instrument for the import of used and refurbished, repaired, reconstructed EEE for the purpose of donation. | Another option would be to invest in lower level treatment facilities as feasible and export to other countries. Hazardous wastes shall not be imported into the Kingdom of Bhutan. Hazardous wastes may only be exported subject to the prior written consent of the country of import. |
| <strong>Generation rates</strong> | The total of electronic waste generated by Canada was 725 kt in 2014. The electronic waste generated per inhabitant was 20.4 kg. | Electrical and electronic wastes formed only 0.37% of the total municipal wastes and it consist mostly of printer cartridges from the offices and there are firms which recycles printer cartridges through re-filling. Most modern electrical and electronic equipment such as TV, computers, etc. became popular only recently hence are expected to be used to its full life unlike in other developed countries where electronic and electrical equipment are often discarded due to changing fashion. | According to the ADEME, the total amount of e-waste has increased from 174,444 t in 2007 to 470,556 t in 2012. Targets related to recovery and recycling are defined (Directive 2012/19/EU). |
| Information system and Records | The National Government, through the Ministry of Commerce, Industry and Tourism, will keep a register of permanent and sporadic producers and marketers of EEE, in order to promote the control of the adoption of national collection and waste management of these products. The National Administrative Department of Statistics – DANE (Acronym in Spanish) will carry statistics of consumption of electrical and electronic equipment that are commercialized in the country. Through the Environmental Information System of the country, an information mechanism on the generation and management of WEEE shall be established. Producers will be required to submit a report every year on the development of the Department of Revenue and Customs, shall report on an annual basis to the Department of Information Technology and Telecom the total number of appliances (EEE) put to market. Bulk consumers shall maintain records of e-waste generated by them and submit annual reports to the Department of Information Technology and Telecom. Department of National Properties shall maintain records of e-waste generated and auctioned by them and submit annual report to the Department of Information Technology and Telecom. Designated e-waste management entity shall periodically report to the Department of Information Technology and Telecom the results and volume of e-waste handled with a copy to the National Environment Commission Secretariat. Based on the reports received from the ADEME has regulatory responsibility for managing the registry of household and professional appliance producers, which themselves register and declare the quantities of equipment that have been placed on the market, collected and treated each year. The Minister must establish a national waste information system for the recording, collection, management and analysis of data and information that must include— (a) data on the quantity and type or classification of waste generated, Formal waste operators need to be registered so that the Government can keep track on the waste volumes and waste types (including e-waste) handled, recycled and disposed of by the South African waste management industry. Documenting the Receipt and Delivery of E-Waste, keep a daily record of: • the quantity of e-waste received • its origin • the quantity of e-waste sorted • the quantity of e-waste sold to a buyer (including total income derived from it). |
| Selective Collection and Environmental Waste Management System to the Ministry of Environment and Sustainable Development. Suppliers or shippers must fill out and provide the sheets and documents arranged by producers for the control of the waste of light bulbs that are collected within the Selective Collection Systems. monitoring and implementing agencies, the Secretariat of the National Environment Commission shall report annually to the National Environment Commission, the Cabinet and the Parliament on the national environment status and implementation of environmental laws in the country. | stored, transported, treated, transformed, reduced, re-used, recycled, recovered and disposed of; and (b) a register of: (i) waste management activities that have been licensed; (ii) the holders of waste management licenses authorized to commence the waste management activities recorded in terms of subparagraph (i); and (iii) the locations where the licensed waste management activities are or may be conducted. The MEC may establish a provincial waste information system which must at least include the information required by the national information system. | South African Waste Information Centre (SAWIC). Provincial Waste Information System. |</p>
<table>
<thead>
<tr>
<th>Targets</th>
<th>Collection targets Light Bulbs. Annual targets on collection are defined.</th>
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<tbody>
<tr>
<td></td>
<td>Collection targets Computers and / or Peripherals: Annual targets on collection and refurbishment are defined.</td>
</tr>
<tr>
<td></td>
<td>Collection targets of Batteries and / or Accumulators: Annual targets on collection are defined.</td>
</tr>
<tr>
<td>Permission and licenses</td>
<td>Waste Electrical and Electronic Equipment (WEEE) must be managed only by companies that have the respective license, permit or environmental authorization.</td>
</tr>
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<td></td>
<td>Producers will submit for approval to the Direction of Licenses, Permits and Environmental Procedures of the Ministry of Environment and Sustainable Development, the Systems of Selective Collection and Environmental Management of e-</td>
</tr>
<tr>
<td></td>
<td>Certain activities are “listed” and require a special waste management license.</td>
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<tr>
<td></td>
<td>Small-scale WEEE collection and transportation activities may not require a license.</td>
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<tr>
<td></td>
<td>Government has realized that there are small scale initiatives that, if managed correctly, will not have a negative impact on human health or the environment and has therefore developed thresholds.</td>
</tr>
</tbody>
</table>
| Technical Aspects | WEEE management | Waste, individual or collective. | Core waste management activities that must be registered are:
- Storage
- Recycling and recovery of waste
- Treatment of waste
- Disposal of waste.

| Collection: | several national and provincial organizations dealing with the collection and recycling of electronic waste in Canada. All these organizations have drop-off locations around the country. | **WEEE Category:** WEEE are waste of differentiated management that shall be managed in accordance with guidelines established for the purpose by the Ministry of Environment and Sustainable Development. | Certain activities are “listed” and require a special waste management license. **WEEE Category:** E-waste is included within the definition of hazardous waste in the Waste Act due to its potential hazardous nature. |

| Disposal: | the general trend for e-waste disposal is to put it in the garbage, return it to the supplier, drop it off at a depot, or donate it. | **Disposal:** Disposal of Waste Electrical and Electronic Equipment (WEEE) in landfills is prohibited. It will be the responsibility of the Ministry of Environment and Sustainable Development to regulate the use and disposal of WEEE in security cells of landfills. |  |

| Pre-processing and processing stages: | recyclers have a smaller dismantling unit in most of the provinces before the e-waste is sent to specific processing centers for further processing where it is shredded and | **Information for management:** importers and producers shall provide information through information booklets, pamphlets and cautionary notes in advertisements to the consumers and bulk consumers about the hazardous nature of e-waste and potential damage to human health and environment arising out of improper handling of e-waste. **Collection:** channelized to the designated collection centres/drop-off sites or e-waste management entity. Bulk consumers, which are Government agencies, shall ensure that all electrical and electronic equipment at the disposal centres are properly labeled and discharged. |  |

| **WEEE Category:** | WEEE is a specific category of waste in Bhutan, not classified as hazardous waste. Waste categories: Medical Waste; Municipal Waste; Industrial Waste; and E-Waste. | **Collection:** There are two different approaches to collecting WEEE: the first has individuals deliver e-waste to collection points inside cities and there are more than 22,900 collection points in France. The second approach involves producers or individuals using out-of-town recovery centres and there are more than 4500 centres in France. **Depollution:** the depollution of household WEEE will be better managed through an arrangement whereby PRO will take direct charge of certain hazardous components, and through stricter traceability regulations. **Reuse:** The reuse of household WEEE will be encouraged through a principle whereby social and solidarity economy |  |
| Economic Aspects | Financing | Economic and financial instruments that facilitate the management of WEEE. Such instruments can come from public, private or international cooperation sectors, and will be consistent with the economic, legal and social reality of the country. In addition, the comprehensive management of WEEE shall become a source for the generation of wealth and employment. For the enforcement of Law 1672 of 2013, resources from the public, private and international cooperation sectors will be required. | If the opportunity is not economically attractive the Royal Government of Bhutan - RGoB will have to subsidise the operations of WEEE management entity or look at strategies to deal with e-waste with judicious investment cess on all electrical and electronic equipment at a percentage decided by the Department of Information Technology and Telecom – DITT in consultation with relevant agencies. Periodically transfer the cess collected to the e-waste fund which is to be managed by the DITT. | The “eco-contribution” charge has been displayed on the price tags of new appliances since the scheme was introduced. Household EEE users will be made more aware of the environmental impacts at end of life of the equipment they are purchasing. This will be achieved by means of a variable eco-contribution charge designed to encourage eco-friendly design of equipment in terms of its reuse or recycling. Required finance for day-to-day functioning of the system (for collection, transport and | The Minister may specify: (a) the requirements in respect of the implementation and operation of an EPR programme, including the requirements for the reduction, re-use, recycling, recovery, treatment and disposal of waste; (b) the financial arrangements of a waste minimization programme, with the concurrence of the Minister of Finance; (c) the institutional arrangements for the administration of a waste minimization programme.
be considered as sources of financing. The National Government may incorporate the necessary budget items to fully comply with the provisions of the WEEE Regulations.

The National Government and the private sector will be able to search for resources, sources of income and mechanisms to promote a comprehensive management of WEEE.

Producers shall bear the costs of selective collection and environmental management of waste; Suppliers or vendors shall accept the return of light bulb wastes, free of charge to the consumer, when they supply bulbs for sale and are part of the collection and management system.

The DITT to finance the implementation of WEEE management regulation in an environmentally sound manner.

RGoB shall provide the seed money for the fund to take care of historic e-waste. The fund will receive periodic transfer of cess paid on electronic and electrical equipment by producers and importers to the Department of Revenue and Customs, funds collected through auction of WEEE by the Department of National Properties and fines imposed for non-compliance with the provisions of this Regulation.

The DITT as implementing agency can also levy fees if so required to ensure that there is sufficient fund to meet the management of e-waste in a sound manner.

NEC will ensure that there is enough fund to implement the provisions of the Regulation for environmentally sound management of the e-waste generated and historical WEEE.
Producers and importers are required to contribute towards a fund to be established under the regulation, which will be used to supplement the cost of implementing the regulation. They must pay an e-waste cess to the Department of Revenue and Customs at a percentage determined by the DITT from time to time, to cover the costs for environmentally sound management of the e-waste generated at the end of their useful life.

However, the biggest challenge in implementing the regulation on e-waste will be the investment required to establish e-waste treatment facilities since such facilities are relatively very costly and will be exacerbated by the relatively small scale of e-waste generated within, making sustainability a big challenge.

### Checking and Acting

| Supervision and control aspects | Supervision | The Ministry of Environment and Sustainable Development will establish management indicators by results that allow for evaluate and | The Royal Bhutan Police is mandated to assist the monitoring authorities to enforce the implementation of e-waste regulation. | The Government has an overseeing role and interacts with all stakeholders. |
monitor the different collection and management systems developed at national level for a comprehensive management of WEEE.

Management indicators will be established considering the coverage strategies, number of collection points, number of days of collection and the information and prevention policies adopted, as well as the donations and reconditioning of EEE when they contribute to the execution of programmes of social and public benefit.

The Ministry of Environment and Sustainable Development, urban and regional environmental authorities, as well as other Ministries will be responsible for following up on strict compliance with the provisions established in Law 1672 of 2013.

To exercise of
supervision and control, the Ministry of Environment and Sustainable Development will establish the parameters and mechanisms applicable to the competent environmental authorities to ensure the effectiveness of the process.

<table>
<thead>
<tr>
<th>Offences and Penalties</th>
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<tr>
<td>Every person commits an offense in contravention of specific provisions of the Act. The Act defines penalties for every person that commits an offence.</td>
<td>A person polluting the environment or causing ecological harm shall be responsible for the costs of avoidance, containment, abatement, medical compensation, mitigation, remediation and restoration. Administrative sanctions can be applied. Anyone found violating the Regulation will have committed an offence, and will be subjected to different types of penalties. Penalties range from simple fines to criminal offences which can attract imprisonment for life. Implementing agencies, failing to implement the regulation will be subject to administrative action as per the Civil Service Rules. In</td>
<td>In France, the Environmental Code, through articles R543 to R543-205-206, regulates the penalties incurred by a producer who does not comply with the WEEE regulations. So producers can be given a penalty of 450€ per EEE if they place on the market without the required markings and logos, or do not to inform buyers by the unit cost for disposal before 13 August 2005. This amount of penalty could reach up to 1500€ per device when the producer puts EEE on the market that does not meet the limitation of pollutants and when it does not contribute to the establishment of offences against the proper management of waste and the penalties depending on the crime.</td>
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<tr>
<td>addition implementing agency may also be criminally liable for their failure to implement the Regulation.</td>
<td>The Implementing Agencies shall also have the authority to assess and determine administrative sanctions for any violation of the provisions of this Act or its regulations.</td>
<td>collection and processing of WEEE.</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** document author with information related to regulations of Canada, Bhutan, Colombia, France, and South Africa.
### General Aspects

#### Scope
- The WEEELABEX normative requirements lay down measures related to the protection of the environment, human health and safety. It defines both, technical and management requirements for operators.

- This standard establishes responsible recycling ("R2") practices for the recycling of electronics globally. The R2:2013 Standard is applicable to all organizations within the recycling chain, regardless of their size or location.

- Environmentally Sound Management - ESM of used and end-of-life computing equipment (emphasis on reuse and recycling).

#### Pre-requisites
- The operator shall ensure that a management system is in place for all activities in the fields of health, safety, environment and quality.
- WEEE systems shall only contract with operators that comply with the requirements in this normative document or can demonstrate that they meet equivalent specifications.

- Electronics recycler shall be certified, throughout the duration of its R2 certification, to one or more environmental, health and safety management system standards (EHSMS).

- Certification: through an accredited thirdparty Certification Body.

- Facilities are encouraged to develop and use a certified comprehensive system of environmental, health and safety management by an independent and qualified auditor, and an accredited certification body.

- Encourage facilities to make use of environmental management systems such as: the ISO 14000 series, the European Eco-Management Audit Scheme (EMAS) or other similar programmes.

#### Principles
- Community’s environment policy which are aimed at preserving, protecting and improving the quality of the environment, protecting human health and utilising natural resources prudently and rationally.

- Precautionary principle and principles that preventive action.

- Polluter should pay.

- Waste hierarchy.

- Protection of the health and safety of workers and the public.

- Environmentally Sound Management - ESM of used EEE.

- Electronics recycler shall develop and adhere to a policy for managing used and end-of-life electronic equipment that is based on a “reuse, recover...” hierarchy of responsible management strategies.

- Hierarchy in descending order of preference: prevention; minimization; reuse; recycling, energy recovery; and disposal.

- ESM criteria to protect workers and communities.

- National self sufficiency, proximity, least transboundary movement, ESM, economic efficiency (Basel Principles).

- Operations should employ best available techniques (BAT) and be in line with best environmental practices (BEP) so that releases of hazardous constituents are prevented or minimized and considering technical, operational, and economic feasibility.

- EPR. Under this principle, producers take steps to manage their products.
| **Licenses and authorizations** | Valid permits required by all relevant authorities shall be maintained. | Electronics recycler must verify that its transporters, including its own fleet, have all the necessary regulatory authorizations, maintain adequate insurance coverage consistent with the material and method of transportation, and maintain an acceptable vehicle and driver safety record during the previous 3 years. | To facilitate the required permits and authorizations for entities that are in charge of the pre-certification stages without compromising the ESM of used ICT/EEE and WEEE. Computing equipment and materials derived from it should be only managed in ESM facilities that are licensed and permitted to manage these materials. | The facility must be properly licensed by all appropriate Governmental authorities. Facilities should be in compliance with all applicable local regulations and permits or other authorizations that are related to the environment or human health and safety. |
| Planning |
|----------|-----------------|-----------------|-----------------|
| **Policy, objectives and goals** | Operator shall have an environmental, health and safety policy. | An R2:2013 electronics recycler shall develop in writing and adhere to a policy stating how it manages used and end-of-life electronics equipment, components, and materials. | Systematic approach. This policy should be documented and implemented through a plan of action on ESM. Policy: kind of used computing equipment is accepted for ESM based on technical capacity of e-waste facilities. Flexibility to increase the rates of environmentally sound recovery of low risk waste. |
| **Legal and Administrative aspects** | The operator shall comply with European Community legislation and its corresponding transposition. Compliance with WEEELabex regulatory requirements does not exempt in any way from compliance with other legal obligations. In those cases where WEEELabex normative requirements differ from national or subnational legal or regulatory provisions, the stricter requirements will be applicable. WEEE which is intended for cross-border shipments shall be subject to the requirements of Directive 2002/96/EC. | Compliance (including documentation) with the laws and regulations of all importing, transit, and exporting countries. If R2 requirement conflicts with an applicable legal requirement, the recycler must adhere to the legal requirement. It is acceptable to outsource certain activities and requirements under the Standard to partners or downstream vendors. However, it is the responsibility of the electronics recycler to ensure that these downstream partners and vendors conform to the requirements of this Standard. Electronics recycler shall comply with all applicable environmental, health and safety regulations. | Implementation of Basel Convention guidelines to ensure that downstream materials recovery and recycling facilities operate in a appropriate manner. Compliance with the Basel Convention and other multi-lateral waste trade agreements. Evaluations at regular intervals to identify all applicable laws, regulations and authorization ensuring compliance with these requirements. Facilities should apply due diligence to select downstream suppliers and Managers and ensure that the facility must comply with all applicable health and environmental regulations. |
The operator shall maintain a record documenting compliance with legal and regulatory obligations applying to all activities undertaken on site.

No operator shall initiate, contribute to, or otherwise allow shipments of WEEE that would result in treatment that is not in compliance with the objectives of the WEEELABEX normative.

The logistics operator shall ensure that there is insurance coverage or other financial resources in place adequate to the nature and size of the operations.

Complying with all applicable environmental and health and safety regulations and permissible exposure limits (PELs) for sampling and/or monitoring.

Electronics recycler shall perform due diligence on downstream vendors to which it ships these materials.

Recyclers shall possess insurance that is adequate to cover the potential risks and liabilities associated with the nature and size of the facility’s operations, and shall have adequate legal and financial assurances in place for the proper closure of its facility.

they are practicing an ESM on used ICT/EEE and WEEE.

<p>| Doing | Infraestructure | Collection facilities shall be secured to prevent damage to and theft of WEEE and components thereof. The operator shall possess infrastructure in terms of size, technologies installed and characteristics of the operations, which are suitable for the activities Recyclers shall maintain a security program that controls access to all or parts of the facility in a manner and to a degree appropriate given the type of equipment handled, sensitivity of media containing data, and the needs of the customers served. Investment in facilities and operations may mean an increase in recycling cost. Producers and other stakeholders should collaborate to ensure that there is adequate financing for computing equipment Development of infrastructure and compliance with these guidelines may mean an increase in costs. Stakeholders should collaborate to ensure that there is adequate financing for mobile phone material |
| Human Talent | All employees at the collection facility shall be familiar with the environmental, and health and safety risks of the facility. Employees and contractors involved in operations shall be instructed and trained to perform the tasks assigned to them. Employee training materials and information shall be available at the work place or be easily accessible to employees at all times. | Electronics recycler shall conduct on an ongoing basis a hazards identification and assessment of occupational health and safety and environmental risks that exist or could reasonably be expected to develop at the facility. Electronics recycler shall manage the environmental, health and safety hazards, minimize the risks it identifies, and prioritize the use of appropriate strategies to implement and maintain controls. | To identify, evaluate and minimize or eliminate hazards and risks to worker health and safety, and the environment and put in place awareness raising and training systems on these issues for their workers. Education and training for informal sector to properly manage of ICT/EEE used and WEEE. To identify realistic options and potential resources to integrate the informal | Personnel should be properly trained and also should be provided with appropriate personal protective equipment. Facilities should set up adequate employee training programmes. |</p>
<table>
<thead>
<tr>
<th><strong>Employees shall properly use required personal protective equipment as identified by a risk assessment.</strong></th>
<th><strong>Regular, documented environmental, health and safety training.</strong></th>
<th><strong>sector operations within local, regional and national programs.</strong></th>
</tr>
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<tbody>
<tr>
<td><strong>All employees shall be familiar with the environmental, health and safety policy of the facility.</strong></td>
<td><strong>Training for new hires and refresher courses for all employees that is understandable to them given language and level-of-education.</strong></td>
<td><strong>Environmental, health and safety measures should then be taken, including engineering controls administrative and work practice controls and personal protective equipment.</strong></td>
</tr>
<tr>
<td><strong>Employees and contractors involved in operations shall be instructed and trained to perform the tasks assigned to them.</strong></td>
<td><strong>Personal protective equipment must be available.</strong></td>
<td><strong>The operator shall trace and document the upstream logistic chain of WEEE.</strong></td>
</tr>
<tr>
<td><strong>Effectiveness and suitability of training shall be checked regularly.</strong></td>
<td><strong>Recyclers shall designate a qualified employee(s) or consultant(s) to coordinate its efforts to promote worker health and safety and environmental protection.</strong></td>
<td><strong>Electronics recycler shall develop a legal compliance plan to maintain full compliance with all environmental, health, safety, and data security legal requirements applicable to its operations, as well as full compliance with all applicable import and export laws covering shipments of Focus Materials - FMs and shipments of untested or non-functioning equipment or components containing FMs.</strong></td>
</tr>
<tr>
<td><strong>The operator shall implement a program to identify, evaluate and control incidents and accidents occurring at its facility.</strong></td>
<td><strong>The recycler shall keep the legal compliance plan up to date, identify and implement the steps necessary to comply with each</strong></td>
<td><strong>To develop “tiered checklists” of facility measures for ESM criteria. A tiered checklist can</strong></td>
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</table>

**Documentary support (processes and procedures)**

<table>
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<tr>
<th><strong>The operator shall establish and maintain a procedure to identify legal requirements that are applicable to the environmental, health and safety aspects.</strong></th>
<th><strong>Electronics recycler shall develop a legal compliance plan to maintain full compliance with all environmental, health, safety, and data security legal requirements applicable to its operations, as well as full compliance with all applicable import and export laws covering shipments of Focus Materials - FMs and shipments of untested or non-functioning equipment or components containing FMs.</strong></th>
<th><strong>Emergency Plan.</strong></th>
</tr>
</thead>
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<tr>
<td><strong>Documentation of the processes: identification of hazards, assessment of risk and, where appropriate, the elimination or reduction of the risk for all tasks performed on site.</strong></td>
<td><strong>The recycler shall keep the legal compliance plan up to date, identify and implement the steps necessary to comply with each</strong></td>
<td><strong>Procedures in place, documented or otherwise, to ensure scheduled inspection and monitoring of hazards and risk.</strong></td>
</tr>
<tr>
<td><strong>The operator shall trace and document the downstream logistic chain of WEEE.</strong></td>
<td><strong>To develop “tiered checklists” of facility measures for ESM criteria. A tiered checklist can</strong></td>
<td><strong>Facilities should develop a procedure to identify, access, and comply with applicable legal requirements.</strong></td>
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<tr>
<td><strong>To develop “tiered checklists” of facility measures for ESM criteria. A tiered checklist can</strong></td>
<td><strong>Written plans regarding emergency preparedness and financial guarantees for emergencies and facility closure should also be maintained.</strong></td>
<td><strong>To develop “tiered checklists” of facility measures for ESM criteria. A tiered checklist can</strong></td>
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</table>

**Facility should operate in accordance with written procedures regarding operating methods for the plant and equipment.**

**Written plans regarding emergency preparedness and financial guarantees for emergencies and facility closure should also be maintained.**
<table>
<thead>
<tr>
<th>Tools, equipment, and machinery</th>
<th>All handling of WEEE including the loading, unloading and transport shall be carried out with appropriate tools, containers and fixing to avoid damage to WEEE.</th>
</tr>
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<tbody>
<tr>
<td>Records</td>
<td>Operators of collection facilities shall record the quantity of WEEE collected and forwarded by means of weight notes, piece count or documentation of number, size, and filling level of receptacles. Records of the operator’s activities and related legal provisions shall be controlled.</td>
</tr>
<tr>
<td></td>
<td>Recyclers shall maintain for at least three years commercial contracts, bills of lading, or other commercially-accepted documentation for all transfers of equipment, components, and materials. An electronics recycler does not need to track non-FMs beyond the first tier downstream vendor.</td>
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<td>Records of the inspections, testing and assessment of facilities performance should be maintained and be accessible to customers, auditors. A facility should monitor, track and evaluate facility performance, and maintain</td>
</tr>
<tr>
<td>Pre-processing stages</td>
<td>Collection and transport</td>
</tr>
</tbody>
</table>
and loaded for transport in such a way that they are not damaged during loading and transport.

Appropriate methods shall be used to prevent the breakage of flat panel displays during transport.

Uncontrolled tipping of containers of CRT display appliances, flat panel displays, temperature control equipment, and lamps shall not be permitted.

necessary to find ways to subsidize collection systems.

Separate collection of used mobile phones is recommended to preserve the working characteristics and resale value of those collected.

Collection points should use appropriate packaging material and crates, where necessary, to separate used mobile phones from each and to protect them from undue wear and to preserve their surface appearance, operational capability, and market value for possible reuse.

Used mobile phones should be collected with their battery chargers and accessories, even if the battery chargers and accessories are not to be reused.

Used mobile phones should be collected with their batteries in place in the phones.

Collection systems for used mobile phones should be accountable in a way that is practical and transparent to audit.
At the first point of collection, any loose batteries should be identified and properly managed.

| Reception, sorting and weighing | WEEE shall be sorted into the WEEE collection categories or any other groups of WEEE based on legislation. | To identify and sort used computing equipment that is to be refurbished or repaired from that which should undergo recycling and materials recovery. | WEEE shall be handled and stored with due care in order to avoid release of hazardous substances into air, water, or soil, as a result of damage and/or leakage. Storage areas of the collection facilities require:  
- impermeable surfaces for all WEEE storage areas  
- spillage collection facilities for all uncovered storage areas  
- weatherproof covering. Sites for storage (including temporary storage) of WEEE prior to their treatment require (including temporary storage): impermeable surfaces for storage areas and the provision of spillage collection facilities, and where appropriate, decanters and cleanser-degreasers; weatherproof covering for appropriate areas. | Electronics recycler shall store items removed, equipment and components destined for reuse, in a manner that:  
(1) Protects them from reasonably foreseeable adverse atmospheric conditions and floods and, as warranted, includes a catchment system, and  
(2) Is in full legal compliance, and  
(3) Is secure from unauthorized access, and  
(4) Is in clearly labeled containers and/or storage areas. | Used mobile phones which are destined for reuse should be packaged in such a way as to protect their integrity. If the batteries are removed, they should be packaged in such a way as to avoid contact with their terminals, to avoid short-circuits and fires. Batteries should be protected against extremes of temperature. Refurbishment facilities should store and handle used mobile devices prior to their refurbishment in a manner that protects the mobile phones and reduces the potential for releases of toxic substances into the environment and for injuries to workers. |
Maximum storage amounts of WEEE shall respect legal and regulatory requirements. Where such provisions are not available, the maximum amount of WEEE stored shall not exceed the amount of WEEE that can be treated within six months.

| Processing stages | Direct or Indirect reuse (repair / refurbishment) | The operator is only entitled to contract with a third party authorised to perform preparing for re-use activities, if it can ensure that WEEE and fractions thereof not used for re-use are returned to the collection facility. Any standard related to the marketing of equipment prepared for re-use should require that the party bringing the equipment prepared for re-use back on the market shall place its name on the equipment, shall safeguard the original manufacturer from any claim related to the equipment and shall deliver legal guarantees for it. Storage areas designated for the storage of WEEE intended for preparation for re-use shall have weatherproof covering. | Electronics recycler shall take all practical steps to direct tested equipment and components to reuse and resale, and to direct equipment capable of repair to qualified refurbishers. Recyclers shall, with respect to equipment and components it ships downstream: Label and sort each shipment in a manner sufficient to track throughput, Ensure that all data is sanitized; Handle and package shipments to prevent damage. Recycler shall, prior to shipping used electronics equipment and components that contain FMIs, either domestically or internationally, assure and identify each shipment as either: (1) Tested for Full Functions, R2/Ready for Reuse; (2) Tested for Key Functions, R2/Ready for Resale; and/or (3) Evaluated and Non-Functioning, R2/Ready for Repair. Any organization that remarkets used computing equipment should ensure that it continues to meet all applicable industry and Government standards and requirements, including the original product’s rated operational characteristics or higher. Not to allow the release of data stored on used computing equipment they receive and process, and should seek to destroy such data through electronic means. Documentation should certify the testing undertaken on the equipment to verify that it is working and that it is fit for its intended end use. Ensure that proper labelling or documentation of | Where refurbishers or other parties are exporting refurbished mobile phones, care should be taken to ensure compliance with all applicable laws governing product trade. When making any changes to the mobile phone, the refurbisher shall make sure and take responsibility for ensuring that the product meets all relevant regulatory requirements relating to the market into which the product is to be resold. Evaluation and/or testing and labelling can be carried out to decide if used mobile phones can be directly reused, or require repair, refurbishment or upgrading prior to reuse, or are to be sent for environmentally sound material recovery and recycling. |
For exporting refurbished computing equipment to other countries, care should be taken to ensure compliance with all applicable laws governing product and used product imports, technical standards, labeling and health and safety requirements.

Prolonging the life of a mobile phone does not result in the product exceeding the expected life of some of the components in the product. Aspects related to solder, parts used in the refurbishment of mobile phones, antennas and batteries replacement, replacement battery chargers, maximum power level, add or update software among others, are considered in these guidelines.

Any organization that remarkets used mobile phones should ensure that those mobile phones continue to meet all applicable industry and Government standards and requirements, including the original product’s rated operational characteristics.

Labelling may be a requirement and such labelling may be on the mobile phone itself or in the product packaging as determined by the aforementioned applicable regulations.

<p>| Manual / Mechanical dismantling | Crushing or compacting of WEEE prior to the treatment is not permitted. | Electronics recycler shall take all practical steps to separate as appropriate, through manual | Recycling facilities should dismantle and separate, through manual and | A necessary step in the material recovery and recycling of mobile phones is |
| The removal of lamps from appliances shall be carried out in such a way that environmentally sound recycling and recovery of components or whole appliances is not hindered. The treatment operator shall remove all liquids, substances, preparations, and components from WEEE, without damage or destroy components. During treatment of ICT equipment, personal data stored on the memory of the ICT equipment shall be destroyed. Non-waste materials shall be added to hazardous waste to make overall waste volume fall below the limit of hazardous waste classification (ban on dilution). If it is uncertain that hazardous substances are present in WEEE or components, the WEEE or components shall be treated as if they contain the substances. | Dismantling and/or mechanical processing, the materials in equipment and components that are not directed to reuse or refurbishment and direct them to properly-equipped materials recovery facilities. Prior to shredding or materials recovery of equipment or components, FM shall be removed using safe and effective mechanical processing or manual dismantling. Recyclers shall send removed FM to processing, recovery, or treatment facilities that meet all applicable regulatory requirements to receive the FM. | Mechanical processing. Facilities should not try to recover components or materials if they do not have proper capabilities. It must carefully remove and separate hazardous substances which usually need additional processing and/or environmentally sound final disposal. | Manual separation of batteries in order to minimize contamination of other materials during subsequent material recovery and recycling stages, and also to maximize recovery of the substances contained in the batteries. Manual and mechanical dismantling can be applied. |</p>
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<th>Sorting according to kind of WEEE and storage according to type of material</th>
<th>Substances, preparations, and components to be removed from ICT equipment or fractions containing these shall be clearly identified, labelled, and forwarded with related documentation. When storing CRT display appliances, flat panel displays, and lamps they shall be placed in containers or stacked in a stable manner to prevent damage or breakage.</th>
<th>The material recovery and recycling phase of end-of-life computing equipment should be taken into account by manufacturers during product design. Manufacturers should give consideration to the use of substitute materials for hazardous substances that perform the same function.</th>
<th>To challenge manufacturers to implement improvements in the environmental design of mobile phones to facilitate ESM of these at the end of life cycle. Design improvements include introducing reuse and recycling information into product marking; labelling of internal software; and further reducing the use of hazardous substances. Manufacturers should investigate the feasibility of replacing all toxic substance with benign substitutes.</th>
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<td>Treatment (including recovery and disposal)</td>
<td>Information is given regarding batteries, printed circuit boards, capacitors, switches containing mercury, and plastics having brominated flame retardants. The operator shall comply specific requirements for the treatment of CRT display appliances, flat panel displays and lamps.</td>
<td>Electronics recycler shall manage print cartridges through print cartridge remanufacturers, recyclers, or Original Equipment Manufacturers (OEM), in facilities that meet all applicable regulatory requirements to receive these print cartridges, and that use technology designed to safely and effectively manage print cartridges, including both ink and toner. Options are provided for treatment and disposal of concentrated metals streams; steel, aluminum, and copper scrap; precious metals from printed circuit boards; clean CRT crystals; CRT leaded glass and screens with liquid crystal display (LCD).</td>
<td>Processing and recycling of mobile phone handsets focus on the recovery of metals.</td>
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<td>Checking</td>
<td>The minimum monitoring requirements for shipments as laid down in Directive 2002/96/EC on WEEE and Regulation 1013/2006 on shipments of waste shall be strictly adhered to.</td>
<td>It shall also periodically audit its compliance with legal requirements, and take corrective action to address any issues of non-compliance.</td>
<td>Third Party Audits The competent authorities should inspect and verify that those companies are practicing ESM.</td>
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<td>Audits and supervision</td>
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The policy shall be updated or revised as changes occur to the activities of the operator and evaluated in order to monitor its effectiveness.

Electronics recycler shall confirm at least annually and document, through audits or other similarly effective means, that each downstream facility continues to conform to the requirements.

Recyclers shall provide, to each customer that is R2 certified or in the process, upon request and with appropriate intellectual property and commercial controls as legally appropriate and required by the discloser, the names and locations of all downstream vendors in the recycling chain that handle said customer’s FMs.

Quality controls shall be documented, implemented, and monitored internally to ensure effectiveness of data sanitization, purging, and destruction techniques.

| Acting Improvement | The operator shall demonstrate continuous improvement of its activities by a review and management process. |

**Source:** author of document with information from analyzed standards and guidelines.