A circular economy approach for lifecycles of products and services

D2.1: Report on development of reusing/recycling system for electronic products

PROJECT INFORMATION	
Type of Project	European Commission Horizon 2020
Call	CIRC-01-2016-2017 Systemic, eco-innovative approaches for the circular economy: large-scale demonstration projects
Grant Agreement No.	776503
Project Duration	01/05/2018 – 30/04/2021 (36 months)
Project Coordinator	Nottingham Trent University (NTU)
Project Partners	Enviro Data (ENV), Jonathan Michael Smith (JS), Kosnic Lighting Limited (KOS), Centre of Research for Energy Resources and Consumption (CIR), European EPC Competence Center GmbH (EECC), The Institute for Ecology of Industrial Areas (IETU), SWEREA IVF AB (SWE), Make Mothers Matter (MMM), ONA PRODUCT (ONA), INDUMETAL Recycling (IND), GS1 Germany GMBH (GS1G), Laurea University of Applied Science (LAU), Center for European Policy Studies (CEPS), Institute of Communication and Computer Systems (ICCS), Recyclia (REC), S.A.T. Alia (ALIA)

DOCUMENT INFORMATION

Title	D2.1: Report on development of reusing
Version	Final
Release Date (dd/mm/yy)	25/01/2019
Work Package	WP2
Dissemination Level	Public

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DOCUMENT HISTORY

Version	Date (dd/mm/yy)	Description	Implemented by
1.00	08/02/2019	First draft	INDUMETAL
1.01	11/02/2019	1st draft review	CIRCE
1.02	20/02/2019	1st draft review	EECC
1.03	22/02/2019	2nd draft	INDUMETAL
1.04	25/02/2019	2nd draft review	CIRCE
1.05	26/02/2019	2nd draft review	EECC
1.06	27/02/2019	Final	INDUMETAL

Summary

Deliverable 2.1 "Report on development of reusing/recycling system for electronic products" is a deliverable of Work package 2 "Collaborative recycling/reuse", delivered from the Task 2.1 "Reuse and recycling systems for electronic product" and focused on:

1) Analysis of procedures, technologies and systems required for the reusing/recycling system of EEE and identification of potential barriers, drawing up conclusions on the most adequate approaches for enabling an efficient collaborative reuse/recycling of electronic products
2) Description of the dynamics of electronic products flows and waste management, and the definition of the physical and socio-economical characteristics of the areas in which electronic products are collected
3) Description of intelligent containers and their transformation requirements to enhance reusing and recycling especially focused on LEDs and Tablets
4) Selection of the collection points of interest for the demonstration activities carried out in WP6.

For achieving these objectives, firstly an extensive review has been done, compiling data about WEEE management, ratios of recycling and reuse and successful experiences or initiatives across Europe. Additionally, a search of smart bins in the markets has been carried out in order to contact with the providers and assess the feasibility and adaptability of theses smart bins in the CIRC4Life project. Finally, an evaluation of different local governments has been done in order to select not only the collection points for the demonstration activities but also the schools where the student's awareness will be done.

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Acronyms and abbreviations

Abbreviation	Description
CSR	Corporate Social Responsibility
E.C	European Commission
EASME	Executive Agency for Small and Medium Enterprises
EEE	Electrical and electronic equipment
EoL	End of Life
EPRA	Electronic Products Recycling Association
ERN	European Remanufacturing Network
GDLs	Gas discharge lamps
ICO	Information Commissioners Office
ICT	Information and Communication Technology
LEDs	Light emitting diode
TVA	The Danish Voluntary Agreement on WEEE
WEEE	Waste of electrical and electronic equipment
WRAP	Waste and Resources Action Program

1   Introduction

Waste of electrical and electronic equipment (WEEE) is one the fastest growing waste streams in the EU, growing at 3-5% per year, with a generation above 12 million tonnes estimated for 2020 [1] [2]. WEEE is a complex mixture of valuable materials that can cause major environmental and health problems if not properly managed due to their hazardous content. The improvement of WEEE prevention, collection and recovery is essential to boost circular economy and enhance resource efficiency, which require new approaches in the design, manufacturing, use and end of life (EoL) of electrical and electronic equipment (EEE).
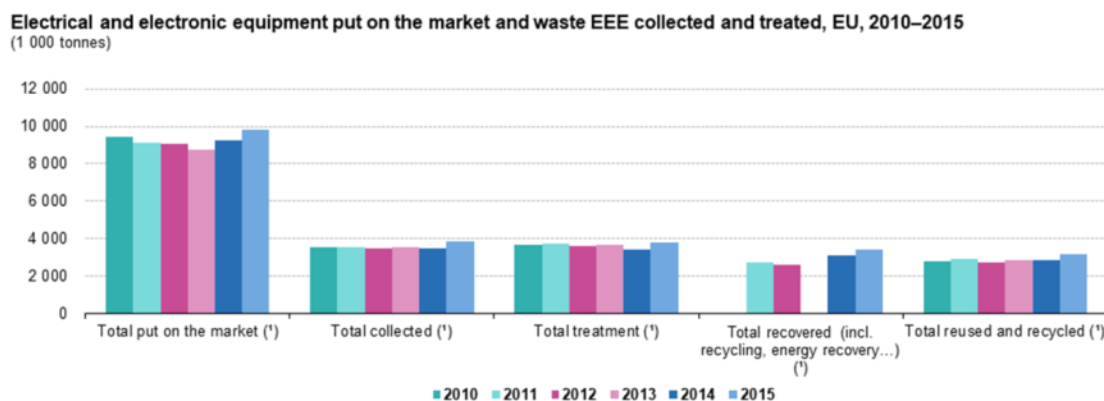
Figure 1: Overview of current situation: Comparison EEE vs WEEE [3]

The objective of Task 2.1 "Reuse and recycling systems for electronic product" is to develop a logistic system for the collection of electrical and electronic waste to be recycled and reused (when possible). The logistic system should be connectable and/or integrated to the ICT platform, so traceability of the waste disposed of by the user is initiated. The collection will also be the moment in which incentives (Task 2.5) are applied to the user due to their attitude towards recycling and reuse. For achieving these objectives, the tasks described below have been performance.

2   Analysis

Throughout this subtask, an analysis and definition of systems that enable key players through the value chain to recycle and reuse the electrical and electronic products has been performed, focusing on aspects such as national and international experiences, collected amounts, methodologies/technologies, systems employed or ratio of success and implementation. Additionally, potential barriers (including legal ones) have been identified and studied, drawing up conclusions on the most adequate approaches for enabling an efficient collaborative reuse/recycling of electronic products.

2.1   Recycling of electronic products

CURRENT SITUATION

The first WEEE Directive (2002/96/EC) provided a legal framework in order to structure the WEEE management, promote the recycling and avoid its landfill. A recast WEEE Directive (2012/19/EU) entered into force in 2012, setting out ambitious targets for the following terms:

- **Collection**: gathering of waste, including the preliminary sorting and preliminary storage of waste for the purposes of transport to a waste treatment facility
- **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
- **Preparation for re-use**: checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing
- **Recycling**: any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes

However, only one-third of WEEE in the EU is being reported by compliance schemes as separately collected and managed. The remaining two-thirds are either collected by unregistered companies and treated or even illegally exported, or disposed of as part of residual waste [4]. The total amount of WEEE properly collected in the EU was 3.9 million tonnes in 2015; 88% of this amount was recovered, whilst the amount recycled/re-used was 81%, with re-use only representing 1.4% [5]. These rates have been sufficient in the past, but from 15 August 2018 the targets are more ambitious and it is critical to make stronger efforts.

At present, the main driving forces for WEEE treatment are the removal of hazardous substances and the recycling of metals, since they have a high market price and have so far contributed mostly to meet the WEEE recovery/recycling targets [6]. However, other alternative and complementary solutions are still needed to move the EEE sector towards a true circular economy, allowing to reach the regulatory targets and helping to reduce the illegal export of WEEE and the derived impacts.

Concerning the electronic products of the project and their recycling, LEDs currently represent less than 1-2% of the lamp waste stream [7]. The lamp recycling industry is currently geared to the treatment of gas discharge lamps (GDLs) focusing especially on the recovery of mass material fractions like glass, metals and plastics.

Although LEDs are collected with other GDLs and go through this normal processing route, in principle, LEDs can be recycled with other WEEE as they do not contain mercury, and are therefore more similar in nature to other WEEE than to GDLs. The development of adapted recycling technologies for LED lamps is, however, an important task to recover the main materials and to avoid the irrecoverable dissipation of the valuable

elements within the LEDs (rare earths, semiconductors and precious metals). Figure 2 shows a theoretical recycling process for LED lamps.
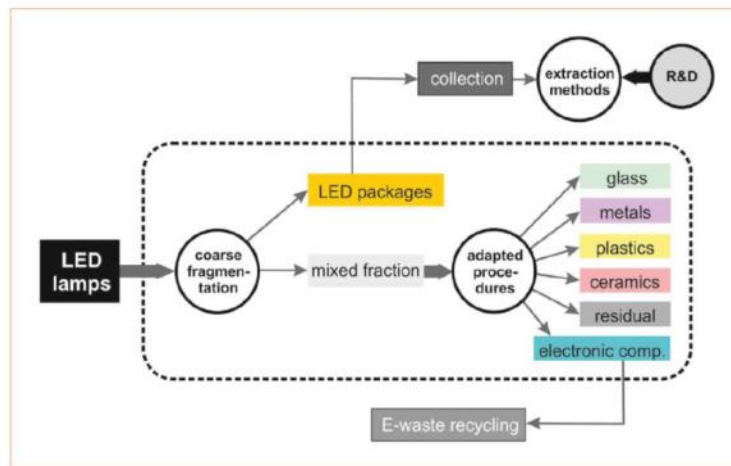
Figure 2: Schematic illustration of a recycling process for LED lamps [8].

In relation to tablets and following the categorisation and treatment of WEEE Directive (2012/19/EU), it is compulsory the removal of the battery, the Hg lamp (when appears), and the LCD (if bigger than 100 cm^2). After this depollution step, tablets are treated with other electronic devices according to the common WEEE recycling process in order to recover valuable fractions (see Figure 3).
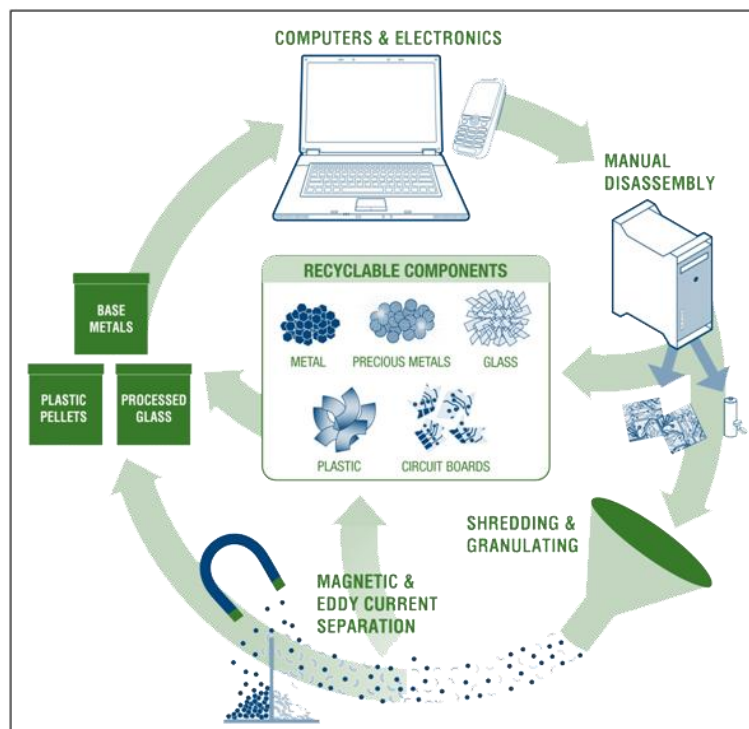
Figure 3: Schematic illustration of a recycling process for computers and electronics .

KEY FIGURES

The amount of the recovered and recycled WEEE, in 2015, by the main European countries is detailed in Table 1:

Table 1. Recovery and Recycling of waste electrical and electronic equipment (WEEE) in 2015 [9]

Country	Collected	Recovered		Recycled	
	t	t	%	t	%
Belgium	118,545	103,120	87.0	91,739	77.4
Denmark	72,482	66,711	92.0	61,010	84.2
Germany	721,870	652,130	90.3	572,564	79.3
Ireland	48,626	45,576	93.7	40,458	83.2
Spain*	184,818	149,261	80.8	142,165	76.9
France	617,401	552,822	89.5	505,466	81.9
Netherlands	145,371	139,076	95.7	119,448	82.2
Finland	62,544	59,690	95.4	57,858	92.5
Sweden	143,955	131,928	91.6	120,387	83.6
UK	663,100	563,759	85.0	536,580	80.9
Norway	105,592	97,578	92.4	86,991	82.4

Data from 2014

Focusing on the project products, tablets and lighting products, data related to their shipment forecast are relevant, since they will mark the future amounts for collecting, recycling and reuse. The amount of these products put in the market is detailed in Figure 4, Figure 5 and Table 2.

Figure 4: Global lighting market: LED lighting market trends [10].

Table 2. Top five tablet companies, Worldwide Shipments, Second Quarter 2018 [11]

Top Five Tablet Companies, Worldwide Shipments, Market Share, and Year-Over-Year Growth, Second Quarter 2018

(Preliminary results, combined company view for the current and past quarters, shipments in millions)

Company	2Q18 Unit Shipments	2Q18 Market Share	2Q17 Unit Shipments	2Q17 Market Share	Year-Over-Year Growth
1. Apple	11.5	34.9%	11.4	29.9%	0.9%
2. Samsung	5.0	15.1%	6.0	15.6%	-16.1%
3. Huawei	3.4	10.3%	3.1	8.2%	7.7%
4. Lenovo + Fujitsu**	2.0	6.0%	2.2	5.9%	-10.9%
5. Amazon.com	1.6	4.9%	2.4	6.4%	-33.5%
Others	9.5	28.8%	13.0	34.0%	-26.8%
Total	**33.0**	**100.0%**	**38.2**	**100.0%**	**-13.5%**

Source: IDC Worldwide Quarterly PCD Tracker, August 1, 2018
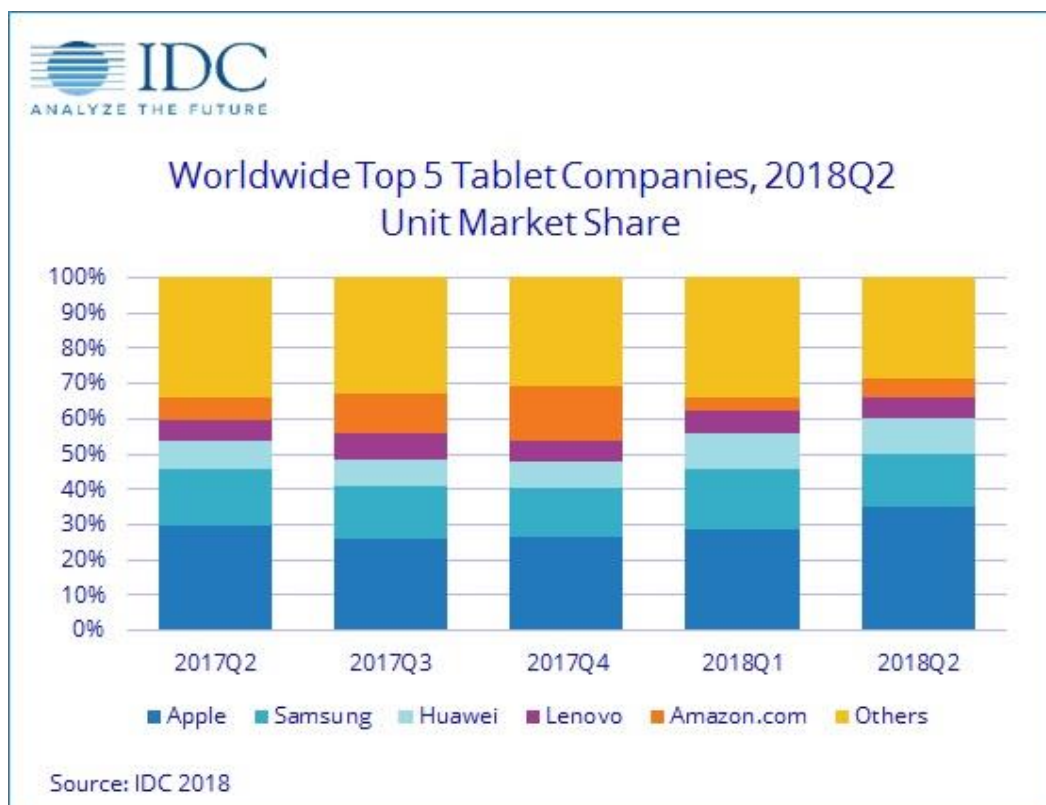
Figure 5: Worldwide Top 5 Tablet Companies, 2018 [12].

Taking into account these values, it is expected that in the near future, these products will turn into waste and will arrive to the recycling plants. Currently, it is complicated to find data about the collection and recycling of tablets and LEDs as they are minor streams and the majority of the recycling plants don't record these specific streams. Due to the lack of national and European data, Indumetal's records are shown below.

Table 3. Lamps gathered at Indumetal's Facilities

Product	2015	2016	2017
Fluorescent tube (FT)	611,645	615,940	681,433
Compact fluorescent lamps (CFL)	150,170	136,981	105,867
Gas-discharge lamps	50,956	43,214	37,151
Broken lamps	9,296	12,968	6,885
LEDs (tubes and retrofit)	5,507	8,613	14,439
Incandescent light bulb	20,377	17,933	13,230
TOTAL (kg)	847,951	835,649	859,005
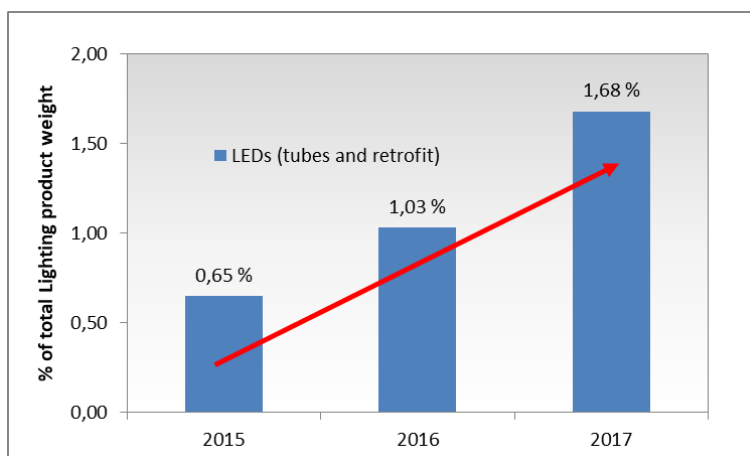
Figure 6: Growing ratio of LEDs collected at Indumetal's facilities, 2015-2017.

For tablets, the collection rates are also very low, being around 1 tonne per year and coming mainly from post industrial sector. Data from Indumetal's facilities are detailed in Table 4.

Table 4. Tablets gathered at Indumetal's Facilities

Product	2015	2016	2017	TOTAL
Tablets (kg)	1,072	662	1,222	2,956
From Post Industrial	*962*	*660*	*1,217*	*2,839*
From Post consumer	*110*	*2*	*5*	*117*

2.2   Reuse of electronic products

CURRENT SITUATION

As detailed previously, in last years, all the efforts have been focused on diverting waste electronic and electrical equipment (WEEE) from landfill and getting consumers to recycle end-of-life gadgets. However, after the enforcement of Directive 2012/19/EU on WEEE, which introduced inter alia new recovery and recycling & preparation for re-use targets as well as six 'collection-oriented' WEEE categories ('EU6'), the reuse and terms such as remanufacturing and refurbishment are the cynosure of every eye.

Additionally, if the Waste Framework Directive is checked, it defines "re-use" as any operation by which products or components that are not waste are used again for the same purpose for which they were conceived. On the other hand, "preparation for re-use" is described as checking, cleaning or repairing operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing.

In this framework, the European Commission supported a study "*Study on WEEE recovery targets, preparation for re-use targets and on the method for calculation of the recovery targets*" [13] with the aim of, among other objectives, identifying the current situation of EEE/WEEE re-used and prepared for re-use in the EU. The main conclusions are detailed in Table 5. For detailed information per country see Appendices.

Table 5. Main conclusions of "*Study on WEEE recovery targets, preparation for re-use targets and on the method for calculation of the recovery targets*"

Country	Main conclusions
Flanders (Belgium)	- Well organized - A network of non-profit organizations involved in recovery activities - Flanders implemented a 5kg/capita target for re-use to be reached by 2015, all product and waste streams mixed. The target could be raised by 7kg/capita in 2020. - Actions are being implemented for improving the reporting of waste quantities
Denmark	- Social organizations has difficulties to access to WEEE, only through donations - There is no specific target for preparation for re-use
Germany	- Direct re-use of used EEE is well developed - There is no specific target for preparation for re-use
Spain	- A network of re-use centers is well implemented and all of them belong to the social economy - No distinction is made between direct re-use and preparation for re-use - There is an specific target for preparation for re-use, established by the legislative text RD 110/2015
Ireland	- The re-use of EEE is done mostly by re-use centres in the B2B business - There is no specific target for preparation for re-use
The Netherlands	- Re-use is very well developed in the Netherlands - Re-use centres are social organisations or classical businesses - There is no specific target for preparation for re-use but it is estimated that the Netherlands would not have any issue to reach a target
France	- There are three large networks of re-use centres (Emmaus, Envie, Réseau des ressourceries) but also a high number of facilities implemented at the local level - There is no specific target for preparation for re-use

KEY FIGURES

Besides the information detailed above, Table 6 gathers the amount of the re-use and preparation for re-use of WEEE, in 2015, by the main European countries.

Table 6. Reuse of waste electrical and electronic equipment (WEEE) in 2015 [9]

Country	Collected	Reuse	
	t	t	%
Belgium	118.545	3.548	2,99
Denmark	72.482	177	0,24
Germany	721.870	3.750	0,52

Ireland	48.626	636	1,31
Spain*	184.818	1.385	0,75
France	617.401	8.905	1,44
Netherlands	145.371	*No data available*	*No data available*
Finland	62.544	895	1,43
Sweden	143.955	306	0,21
UK	663.100	20.046	3,02
Norway	105.592	2.253	2,13

* Data from 2014

Concerning the electronic products of the project, tablets and LEDs, **no data related to their reuse** have been found.

EXPERIENCES AND INITITATIVES

Concerning experiences on the reuse of electronic products, currently it is hard to find widely implemented initiatives. Despite this, in Table 7 different international programmes are summarized.

Table 7. International experiences on reuse

Conseil Européen de Remanufacture (European Remanufacturing Council) **http://www.remancouncil.eu/**
The Conseil Européen de Remanufacture represents small and large businesses from all remanufactured product sectors and its objective is to become the focal point for remanufacturing policy dialogue in Europe. Among their activities, the Council publishes annually recommendations on research priorities for national and EU-level innovation funding that will most benefit remanufacturing in Europe. Council members have an influence upon the definition of these research priorities. The technical detail of these research priorities is developed by the European Remanufacturing Network (ERN) of universities and research organizations.
European Remanufacturing Network (ERN) **http://www.remanufacturing.eu/**
The mission of ERN is to accelerate the practical and scalable implementation of the circular economy. ERN funded under the Horizon 2020 programme, surveyed the level of remanufacturing activity by sector across the EU. It generated a number of high impact actions which could boost remanufacturing, for practitioners, policy-makers and researchers. Follow-ons to ERN should address the research pillar, support for the remanufacturing industry; and the policy and strategy needs of business through sector-focussed representation.
***The Danish Voluntary Agreement on WEEE* (TVA)**
The Danish Voluntary Agreement on WEEE is an agreement entered into in 2013 between the Minister for Environment, representatives from producers and distributors of electronic and electrical equipment (DI, FEHA and BFE) and three compliance schemes (Elretur, ERP and LWF). The agreement has run from 2014-2016. The agreement has been financed in 2014 and 2015 by Elretur, ERP and LWF and in 2016 by Elretur and LWF. To reach the WEEE directive (2012/19/EU) collection target for 2019 of 65%, TVA has carried out a series of reports on circular economy with the aim of identifying alternative ways and means of implementing the WEEE Directive (2012/19/EU) and the intentions outlined in the eco-design and circular economy directives. Among these reports, the "Circular Business Models for WEEE" explores how circular economy business models provide a cost-effective and value adding way of reaching the intended objectives of resource- productivity and efficiency and presents a roadmap for promoting one of the

circular business models, the re-use of WEEE in Denmark.

WRAP (Waste and Resources Action Program)
http://www.wrap.org.uk/

WRAP works with governments, businesses and communities to deliver practical solutions to improve resource efficiency. Their mission is to accelerate the move to a sustainable, resource-efficient economy by:
- re-inventing how we design, produce and sell products,
- re-thinking how we use and consume products, and
- re-defining what is possible through re-use and recycling

Focusing on sustainable electronics, WRAP is transforming the electrical and electronic equipment (EEE) industry using collective action to generate value through sustainability. For that, WRAP has created the *Electrical and Electronic Equipment Sustainability Action Plan 2025 (ESAP 2025).*

ESAP 2025 uses its relationships, convening power, insights and experience to enable businesses up and down the supply chain to make change efficiently and effectively. By working together with business ESAP 2025 is increasing profits, delivering better value for customers and protecting the natural resources on which the industry depends.

RREUSE
http://www.rreuse.org/

RREUSE represents social enterprises active in reuse, repair and recycling. RREUSE wants the EU and national governments to move from promoting just recycling and waste management to putting second-hand first. Their priorities are:

- Reuse targets
- Better design
- Approved reuse centers
- Supporting social enterprise

Electronic Products Recycling Association (EPRA)
http://epra.ca/

EPRA is an industry-led, not-for-profit organization that operates regulated recycling programs across Canada, ensuring that end-of-life electronics are handled in a safe, secure and environmentally-sound manner.

Besides the recycling activities, EPRA has designed The Electronics Reuse and Refurbishing Program (ERRP), in order to foster sound environmental, safety and security management practices related to the reuse and refurbishing of electronics, to ensure that products are handled in a responsible manner, thus facilitating the extended life of electronics. The ERRP is comprised of the following five parts:

Part A   Electronics Reuse and Refurbishing Standard (ERRS):
Defines the minimum requirements for reuse organizations seeking to be approved under the ERRP.

Part B   Implementation Guide:
Provides guidance on the application of the ERRS requirements and examples of suitable evidence of conformance.

Part C   Audit and Approval Process:
Defines the steps for application, audit and approval under the ERRP.

Part D   Terms and Definitions:

A glossary of key terminology.

Part E   Forms and Associated Documents:
Reuse/Refurbishing Application Form
Audit Report Form

STANDARDS

On 4th February 2013, the Commission requested the European Standardization Organizations to develop European standards for the treatment of WEEE. Under the M/518 "Mandate for the development of (a) standards for the treatment of waste electrical and electronic equipment (WEEE)", several European standards have been developed for the treatment of WEEE (including recovery, recycling and preparing for re-use).

In connection with the preparing for the reuse, the *FprEN 50614 Requirements for the preparing for re-use of waste electrical and electronic equipment* is being developed and its publication is foreseen towards the first six months of 2019. Additionally, a review of different standards has been done and is summarized in Table 8.

Table 8. Review of standards related to the "preparing for reuse"

STANDARD	SCOPE
FprEN 50614 Requirements for the preparing for re-use of waste electrical and electronic equipment	- To covers the preparing for re-use of WEEE arising from electrical and electronic equipment as listed in Annex I and Annex III of Directive 2012/19/EU. - Applicable to preparing for re-use operators only, no matter their size or main focus of activity. - Not to cover activities connected with used or second-hand equipment that have not become waste. - To assist in quantifying re-use, recycling and recovery rates in conjunction with EN 50625-1. In case of treatment operations (including the collection and logistics of WEEE) other than preparing for re-use the EN 50625 series applies. - Preparing for re-use processes can include the removal of whole components or parts where they are intended to either be used in the repair of faulty equipment or sold as re-use parts.
PAS 141:2011 Reuse of used and waste electrical and electronic equipment (UEEE and WEEE). Process management. Specification [14]	- To encourage the reuse of WEEE as favoured by environmental groups and promoted by the WEEE Directive [1], Article 1 - To reduce WEEE to landfill and incineration by diverting WEEE to be prepared for reuse - To assure and protect consumers of the quality and safety of REEE as differentiated from untested WEEE and UEEE - To prevent the export of equipment misdescribed as being fit for reuse to developing countries that has led to dumping of large amounts of non-working and difficult to dispose of WEEE with associated problems in dealing with the hazardous elements of WEEE - To provide a tool for identifying REEE and constituent components that have been subject to the tests set out in this PAS from untested WEEE and UEEE - To encourage job creation in organizations involved in

	WEEE and UEEE reuse
BS 8887-220:2010 Design for manufacture, assembly, disassembly and end-of-life processing (MADE). The process of remanufacture. Specification	- To specify requirements for the process of remanufacture, listing the steps required to change a used product into an as-new product, with at least equivalent performance and warranty of a comparable new replacement product. This remanufacturing process can include parts or components to be used in subsequent assembly.
ANSI-RIC001.1-2016 Specifications for the Process of Remanufacturing	- To promote a common understanding of remanufacturing and credibility for the remanufacturing industry - To promote continual improvement in the remanufacturing process and to help ensure that the products provided to customers by the remanufacturing industry are dependable and of a consistently high quality.

2.3   Potential barriers of a collaborative recycling/reuse

Potential barriers to the implementation of a collaborative model for recycling and reuse of waste electrical and electronic equipment have been studied, using information from the different specialist demonstrators participating in the project, and a later reflection process. The results are shown in Table 9, where they have been divided between barriers that can affect reuse, the combination of reuse and recycling (which is normally related to collection and its logistics), and the implementation of incentives. Additionally the barriers have been primarily analysed and potential actions have been proposed to overcome them.

Table 9. Potential barriers for collaborative recycling/reuse

Topic under study	Kind of Barrier	Barrier	Notes for action
Reuse/Recycling	Technical and legal	Recyclers do not have control of the collection channel, depending on local and national legislation	Recyclers should be companies able to develop logistics for reuse tasks
Reuse/Recycling	Conceptual	A smart container is a future WEEE that introduces environmental footprint to the process	Necessary to minimize the number of containers. They should be ecodesigned
Reuse/Recycling	Legal	The law opts preferably for distributors as a collection center for reuse	CIRC4Life can focus effort on distributors for several of the project actions related to collection/logistics
Reuse/Recycling	Technical	Distributors could be better locations for remanufacturing/reusing (avoid transport, perhaps container…), but they are not prepared and they do not consider this as their business	Recyclers can work with distributors, making it easier for them to collect and to recycle, but having collaboration for reusing
Reuse	Technical and Economic	The integrity of WEEE for possible reuse should be ensured during collection/logistics, and it is very expensive to design intelligent containers	Explain and demand to the end user for proper packaging for disposal
Reuse	Legal	Although the law says that reusing should be enhanced, the administration is not implementing methodology or protocols, so possible reusing companies could feel no guarantee of a correct and legal work	The currently established recycling companies may offer reusing more easily due to their actual fulfillment of the law they have to perform
Reuse	Legal and Technical	Lack of administrative control over the traceability of WEEE, even if there is a national obligation to increase and measure the percentage of WEEE reused	CIRC4Life offers instruments for traceability
Incentive	Legal	In countries in which Collective Schemes are the legal responsibles for WEEE, their mission is to encourage recycling and to define the fees: they should be the main actors in defining incentives and/or incentivizing	Collective Schemes should be part of the initiatives (as in CIRC4Life)
Incentive	Technical	Awareness in schools is not useful for demonstrating the validity of incentives, since children do not purchase EEE and they are not receptive to economic incentives	Raising awareness at universities and technical schools Use non-economic incentives in schools (as competition between different schools, or other kind of prizes)

Incentive	Economic and Legal	Producers will probably pass the incentive on to the price of the product. The consumer may therefore not well understand the incentive	The consumer already pays through the ERP a price for recycling, and this has not avoided the problems
Incentive	Conceptual	May encourage the theft of WEEE at general collecting points to gain economic incentive in the system	Need to consider waste picaresque in the incentive model

2.4   Integration of intelligent containers in the logistic of the project and the market

Concerning the implementation of intelligent containers, a deep review has been done and several initiatives, currently implemented in Spain, have been identified and detailed below.

WEEE TECHNOLOGY (https://weeetech.co.uk)
WEEE Technology is an IT recycling business formed by a group of industry specialists. Our aim is to assist businesses with their Corporate Social Responsibility (CSR) by recycling their unwanted office equipment securely, ethically and efficiently.

WEEE Technology is approved and recognized to refurbish IT equipment through both the Environment Agency, carrying out the repair or refurbishment of Waste Electronic and Electrical Equipment (WEEE) and the Information Commissioners Office (ICO), ensuring current compliance with the data protection act.

WEEE Technology provides a bin, WEEElie Tech (see Figure 7), foe the collection of IT equipment. The WEEElie Tech bin provides a means for safe and secure disposal of redundant IT equipment. It's ideal for office clearance and office moves enabling you to dispose of your computer equipment in a flexible and hassle freeway. They are durable, lockable & portable, and also suitable for both indoors and outdoors.

Figure 7: WEEElie Tech bin provides by WEEE Technology.

RECICLA Y GANA (https://www.reciclaygana.org)
"Recicla y Gana" is a Spanish platform with the main objective of increasing the collecting ratio of different wastes for its ruse and recycling. For that, the company has developed a network of smart bins (see Figure 8) and has designed an incentive scheme in order to reward the effort of people. "Recicla y Gana" collects vegetal oil waste, textile waste, ink cartridge, mobiles, tablets and game consoles.

Figure 8: Smart bin provides by Recicla y Gana.

ID&A (http://www.ideabs.com/)

ID&A designs and build since 1997 equipment for urban waste collection that constitute a system called ID&A SIGMA® - Integrated Multi-level Governance System for the computerized waste collection - which includes the SISTEMA CENTRO AMBIENTE for collection points and computerized collection centers and the HORUS SISTEMA for electronic and electromechanical devices in the field of waste container mechatronics.

Figure 9: Smart bin provides by Recicla y Gana.

All the initiatives detailed above use intelligent containers for promoting the recycling and the reuse of, not only WEEE but other wastes as well. After checking how they work, it has been confirmed that some of them allow to:

- ✓ Perform the identification and accounting of the electronic products;
- ✓ Deliver such identification to the user for tracking of the destination of the equipment disposed

3 Development of the logistic systems

The aim of this subtask is to define how the different WEEE products (LEDs and tablets) will be collected for the demonstrations in order to preserve their operability, avoiding any possible blows or breaks. In the following sections, the logistic system for each WEEE is described.

3.1 Industrial LEDs

Kosnic is a leading designer, manufacturer and established expert in LED technology. Within CIRC4Life project, Kosnic is involved in:

- The development of a new efficient industrial LED lighting product, based on eco-design methods and LCA methodologies
- The manufacturing the designed lighting product
- The demonstration of the eco-shopping technology with lighting product
- The application of the customers view interpretation for the lighting product PDS development
- The features demonstration of the developed lighting products in the three CEBMs

Regarding the development of the logistic system for the industrial LEDs, Kosnic will base this system on an interaction between manufacturer-customer. For that, Kosnic's wholesaler customers will inform if there is any faulty product or product at the end of life time, and Kosnic will arrange to collect it via our parcel delivery partner. After receiving the faulty product or product of end of life time, the following steps are proposed:

1) Try to repair the faulty product first to extend the product life further, if not repairable, go to step 3.
2) Try to sell the repaired product with big discount to achieve the extended life of product.
3) Remove any package if there is, and remove any reusable components and parts, the remaining is put into special WEEE container for recycling.
4) Try to sell those old-fashioned stocks in our warehouse with big discount to avoid waste.

3.2 Domestic LEDs

Ona is a lighting product company who designs and develops their own products. Within CIRC4Life project, Ona is the responsible of the design, development and manufacturing of the domestic LEDs that will be used in the demonstration of the three CEBM.

Regarding the development of the logistic system for the domestic LEDs, Ona has detected some issues to be solved. Currently, the user who wants to remove his domestic lamp because he doesn't like it or something it's damaged should take it to a recycling center or call the City Hall. In this second case the municipality/city might have a service to request the gathering of this kind of products. As usual, this is a major barrier.

Another issue that inhibits the reuse and recycling of this type of products is the condition in which they arrive to the recycling plant. When they take these products to the recycling points they arrive much deteriorated, making recycling or reusing parts difficult for pieces, materials, etc.

It should be noted that this type of products are not submitted to deterioration, that is to say, they are not damaged and if they are well gathered, they have possibilities for a second life or the reuse of parts. In order to collect the different WEEE products, avoiding blows or breaks, of a domestic lamp with LEDs our proposal is:

1) Encourage the user to call the manufacturer of the product, in this case ONA.
2) The manufacturer will send a correct packaging for said product.
3) The manufacturer will collect the product.
4) The manufacturer will examine the product and decide:
   a. If you can reuse any piece.
   b. If you sell the piece, a lower price (reconditioned product)
   c. The recycling channel is dismantled and separated.

3.3 Tablets

Indumetal is a specialized industry in the integral handling of WEEE (Waste Electrical and Electronic Equipment) and complex scrap including: logistic services, on site dismantling of industrial facilities and decontamination and recycling. Within CIRC4Life project, Indumetal is involved in the tasks related to reuse and recycling systems, and its demonstration with tablet products in the CEBMs.

Regarding the development of the logistic system for the tablets and taking into account the information gathered previously, two smart bin suppliers have been contacted and offers requested. Finally, the proposals received and assessed are detailed in Table 10.

Table 10. Summary of the main topics of received offers

Items	OFFER 1	OFFER 2
Company	Recicla y Gana	ID&A
Characteristics of bin	- Design and fabrication under Patent U2012000367 - Operation with QR code and APP - Bin provides a bar code ticket	- Model EcoIsola - Automatic Access control - Operation with Ticket and APP
Price	5.850€ (taxes and transport not included)	6.250€ (taxes and transport not included)
Photos		

In both cases, following their Collection & Reward system, the end user must dispose the waste correctly packaged into the container. Taking this into account, smart bins can ensure and preserve the conditions of

the tablets and LEDs and no physical adaptation of containers would be needed.

Figure 10: WEEE collected through "Recicla y Gana" within the smart container.

3.3.1   Visit to the facilities of "Recicla y gana"

The company "Recicla y Gana" has been visited by Recyclia, Indumetal and Alia, in order to learn more about their smart containers and confirm their suitability for the project demonstrations. For that two different locations have been visited, Albacete and Cuenca.

A.   Visit to Albacete's facilities

The facilities of the platform "Recicla y Gana" placed in Albacete (Spain) are an area open to the public and where several intelligent containers allow the users to dispose different wastes such as:

- Used oil
- Toner/cartridges
- Clothes
- Small electronic devices (mobiles, tablets, consoles)
- Light bulbs/Coffee capsules/Batteries

During the visit, the different installed containers, the collected waste fractions and the functioning of the system have been examined. Aspects such as the type and distribution of waste, if the waste is packaged or the presence of labels identifying the waste were assessed.

Finally, the container destined to the tablets is specifically examined. The need of incorporating a new smaller container/basket with wheels inside the smart container is identified, since thus the waste will fall on it and the tasks of emptying and collection of waste by INDUMETAL will be easier, avoiding the transport and moving of the smart container itself. The waste collected in the specific container of the tablets is also analyzed in more detail, with special emphasis on packaging and labelling. After this examination, it is verified that the great majority of the waste in the container is mobile phones. Other devices are identified but in a very low quantity, including two tablets.

Regarding the information and indications in the container, the posters and messages (both in the front of the containers, as in the rest of the premises) are analyzed. This information helps the end-user to employ the

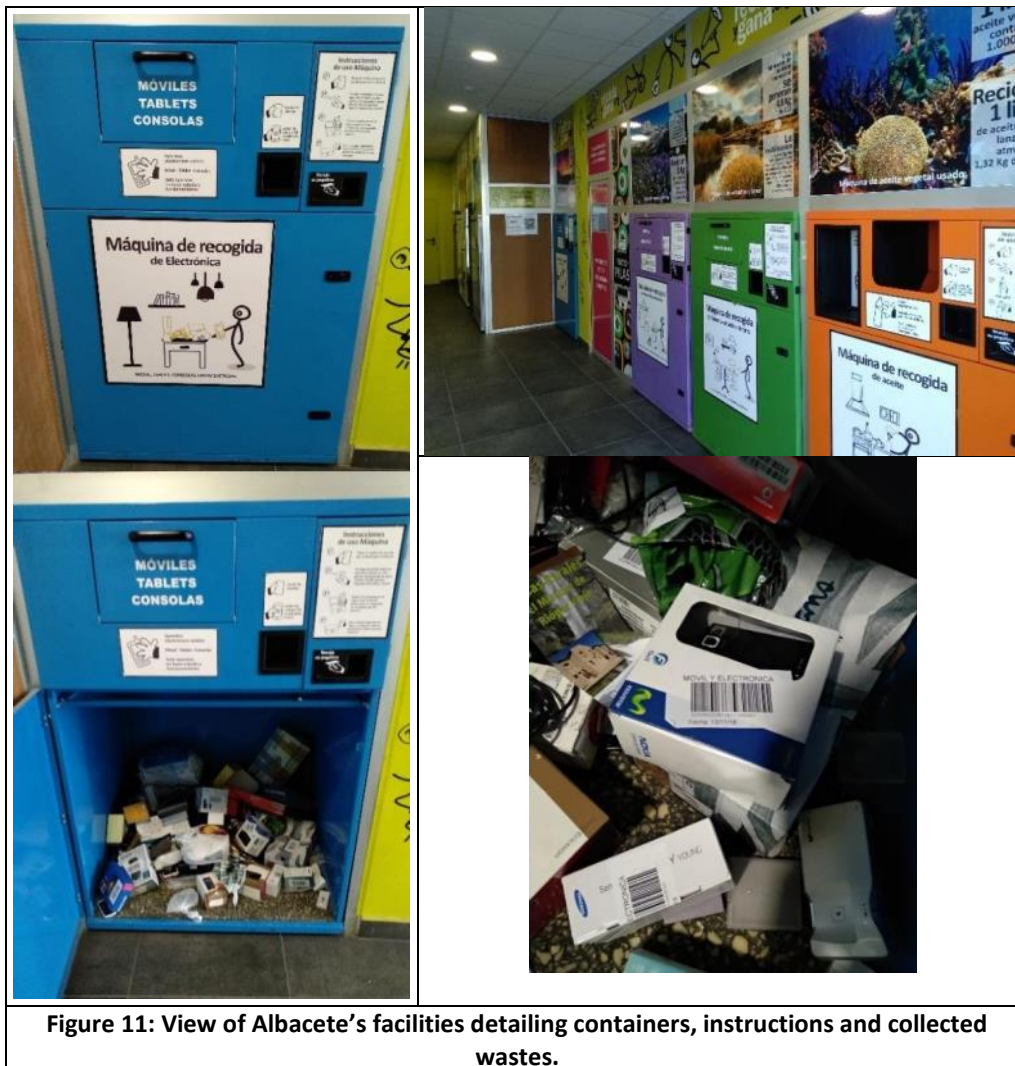container, to deliver the wastes in the best conditions and to get the incentives associated with the wastes.

Figure 11: View of Albacete's facilities detailing containers, instructions and collected wastes.

B.   Visit to Cuenca's facilities

The facilities of the platform "Recicla y Gana" placed in Cuenca (Spain) are a warehouse where all the types of intelligent containers are stored.

During the meeting, the functioning of the containers is showed (see Figure 12), focusing on the internal operation of the container for tablets, the electronics that incorporates and the printing process which provides the tickets to the user. Concerning the sensor employed for identifying the user, it consists in a QR code, included in a card or in a mobile app. On the other hand, the connectivity of the smart container is checked on site, confirming that its restart is very fast and without the need of a configuration. These aspects would facilitate the container mobility to different locations during the pilot.

Figure 12: Inside of the smart containers.

Finally, the functioning of IT platform linked to the containers is analysed, checking their specifications as a user and as an administrator (see Table 11)

Table 11. Specifications of the IT platform linked to the smart containers

Properties as administrator	Properties as user
- Monitoring of users	- Registration data
- Collection of containers	- Operations carried out
- Waste deliveries	- Monitoring of their waste
- Monitoring and control of the incentives delivered, etc.	- Valuation of their deliveries
	- Incentives received, etc

After this analysis, several issues associated with the functioning of the IT platform arise since they could have influence on CIRC4Life activities. These issues are detailed below:

- User registration process and card delivery:
    - ✓ Necessary information for registration (they do not use data of the census: data are provided by the user, so there is no problem due to Data Protection regulations).

- Protocol of connection of the intelligent container with the platform and transfer of the collected information (number of openings of the dumping door, number of printed tickets, etc.).
- Type of label printed by the container. This is an adhesive label that is added to the waste, using a standard "Code-128" protocol for the barcode it incorporates.
- Software associated with the management activities, in order to read the labels of the waste received in the recycling plant and to be able to contrast and consolidate it in the computer platform with the information collected by the intelligent container (e.g., whether the device is reusable or not).
- Deadlines for delivery of the incentive to the user: "Recicla y Gana" has set a maximum of 30 days from the time the user delivers the waste until the user receives the incentive.
- Control of the different operations carried out with each container.
- Incident resolution procedure.
- Prevention of possible fraud that could occur in the waste delivered in order to receive the incentive (the risk is interpreted as minor as the user is identified by the label and it is not a mandatory initiative).

C. Risks detected

As it has been detailed before, after analyzing the functioning of the ITplatform of "Recicla y Gana", the following potential risks have been identified.

1. Monitoring and treatment of incidences. The maintenance of the system requires continuous monitoring and treatment of incidents by the user as they arise, for example:
   - ✓ Problems regarding the user/password when accessing the platform.
   - ✓ Problems with user identification in the container.
   - ✓ Disposal problems:
      - The door does not open.
      - It does not print the label or the label is printed in poor condition.
      - There is no room for my residue in the container.
      - My residue worked, but it broke when I deposited it
   - ✓ Problems with the tracking and traceability of the waste delivered.
      - I delivered the residue but it does not show up in the system/platform/app.
      - My residue has not reached the treatment plant.
   - ✓ Problems with the incentive scheme.
      - I do not agree with the assigned incentive.
      - I do not get the incentive or I do not know how to get it.
      - I do not know how and where to use the incentive.
   - ✓ Others
2. Software for reading and loading data from INDUMETAL to the ICT platform of the project.
3. Coordination with other possible platforms (Getxo council, etc). It implies an extra coordination with other agents outside the project.
4. Deadlines for delivery of the incentive to the user. As mentioned above, the delivery time of the incentive to the user cannot be very long as it could cause the opposite effect to that desired and discourage the delivery of the waste in the pilot's intelligent containers.
5. User communication campaign. A communication campaign and promotion of the pilot experience are needed so that users can get to know the initiative and register on the platform and thus be able to participate in the delivery of their waste in intelligent containers and benefit from the incentives developed within each pilot. The campaign should include aspects such as the packaging of products, to preserve its characteristics.
6. Procedure if collection in the container of other WEEE is going to take place.
7. Adaptation of the CIRC4Life platform to users from different countries. Translating and adapting the platform to each pilot, so that users participating in these experiences have all the necessary information

in their own language.

8. The intelligent container should be placed indoors and in an area protected from vandalism.

D.   Relevant information and data of interest

Besides the risks detected and detailed above, some aspects have been identified which could be significant for the implementation of the container and the execution of the demonstrations:

1. The time required by the supplier for delivery of containers after signing the offer.
2. Possibility of placing a smaller container with wheels inside the intelligent container itself, where the tablets fall and are easily picked up by INDUMETAL instead of falling directly on the base of the container.
3. Standard in the generation of barcodes for container labels (Code-128).

Figure 13: Ticket supplied by the smart container.

4. Easy installation and uninstallation, quick and without the need for configuration every time it is plugged in.
5. Container measurements: width 1100 mm, depth 900 mm and height 1700 mm with an approximate weight of 150 kg.
6. The collection capacity of the machine is 0.7 m^3.
7. Possibility of additional analogue buttons incorporation.

4   Implementation of the logistic system

Based on the data collected previously, the aim of this subtask is (1) definition of the physical and socio-economical characteristics of the areas on which the demos are going to be implemented, (2) selection of collection points and (3) definition of the reuse and recycling logistics for the CEBM demonstration.

4.1   Industrial LEDs

Kosnic Lighting Limited is registered with the UK WEEE Producer Compliance Scheme operated by Comply Direct (www.complydirect.com) with registration number of WEE/GK0067TX. Kosnic uses the WEEE compliant recycling & collection service to make sure Kosnic is compliant with the latest UK WEEE Regulations. Kosnic has a recycling container (see Figure 14) in the warehouse. When there is a faulty product or product at the end of life time, the customer will inform and Kosnic will send logistic company UPS to collect these goods and bring back to warehouse to remove the package if there is and put them into the special container. Once the container reaches full, Kosnic will ask the recycling company to collect them and thus these LEDs will be transferred to dedicated recycling and treatment facilities. There, LEDs will be broken down and recycled and we will have documents, provided by the recycling company, to show they have collected and will be recycled properly. Each quarter, this information is reported to Comply Direct about the products Kosnic sold to the market breakdown by categories.

Figure 14: Kosnic's recycling containers for the storage of lighting products.

Figure 15: Industrial LEDs collected.

4.2 Domestic LEDs

Regarding the aspects in 1.2.2, the objective is to raise the mechanism mentioned above in our online store with the products that our brand markets in it. The test will be carried out firstly in the Spanish territory according to the scheme detailed in Figure 16.
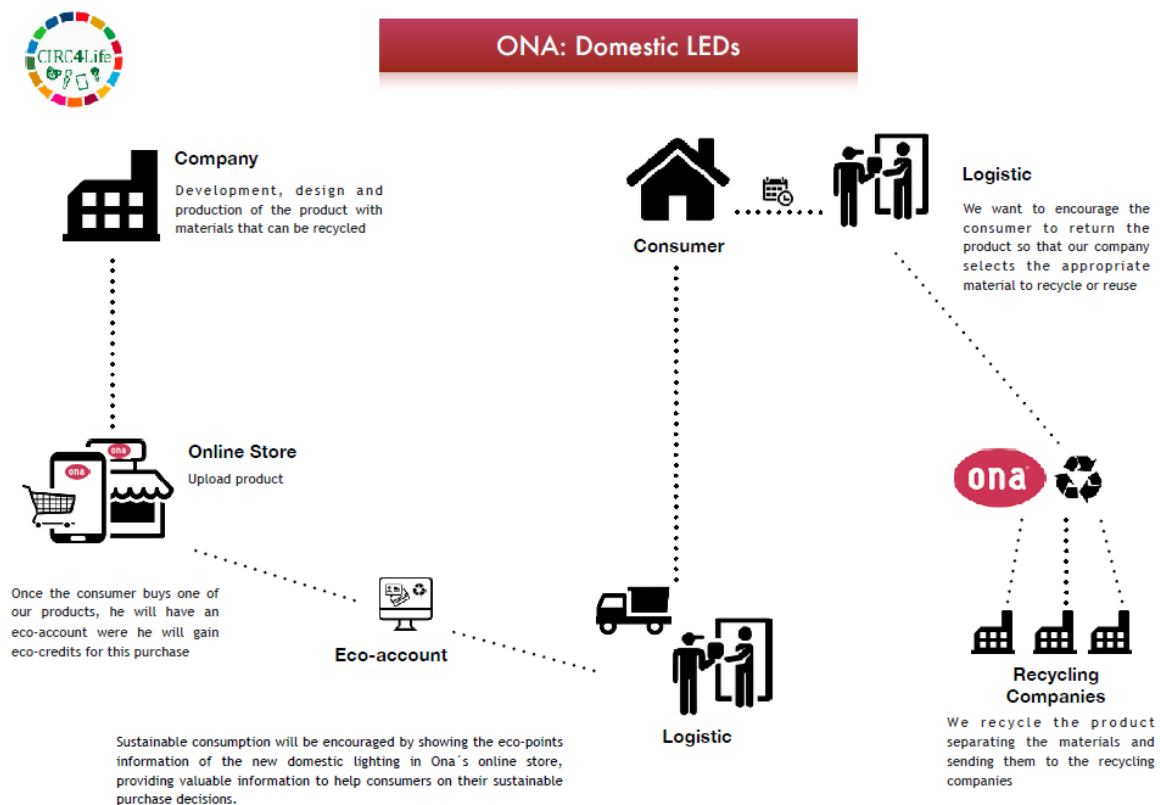

Figure 16: ONA's Logistic system for Domestic LEDs to be implemented.

4.3 Tablets

According to the objectives detailed previously, the results achieved for the tablets are described below.

4.3.1 Definition of the physical and socio-economical characteristics of the areas

Considering these objectives and the fact that the demonstration of CEBM for tablets is going to be carried out in the Basque Country, it has been decided to contact with the local authorities. Firstly, IHOBE, the publicly-owned company coming under the Basque Government's Ministry for the Environment, Territorial Planning and Housing has been contacted. IHOBE supports the Basque Government in the implementation of the **environmental policy** and in the spreading of the **environmental sustainability culture** in the Basque Autonomous Community.

During the meeting, held on 17th July 2018 at IHOBE's facilities, Indumetal made a short presentation of the CIRC4Life project explaining the main objectives, the consortium, the chronogram and the tasks. In addition to this, the activities to be developed in the Basque Country were detailed, with the aim of obtaining the collaboration and support of IHOBE in the following actions:

- ✓ Suggestions of potential agents to be involved in the CIRC4Life activities:
  - Contacts with local organisations (municipalities, local government)
  - Contacts with schools
- ✓ Support in the selection of the most suitable local government and in the dissemination activities
- ✓ Identification of barriers for the implementation of innovative business models as well as incentive scheme/s to be demonstrated in the Basque Country.

Finally, the following agreements were reached:

- To provide contacts in the different local governments and organisations in order to gather useful information for the project and to identify the location for the DEMO (IHOBE)
- To prepare a checklist, detailing all the requirements for the local governments in order to clarify, limitations, possibilities, or new ideas from their side (IND, CIR, REC, Jul 2018)

Figure 17: Photos during the meeting at IHOBE's facilities.

4.3.2   Selection of the area for the collection points

With the aim of selecting the most suitable local municipality for the implementation of the demo, and according to the agreements reached with IHOBE, the following check lists were identified and sent to IHOBE for its distribution:

- ✓ Population
- ✓ Facilities in the area: library, local sport centre, etc.
- ✓ Suggestion of other local centres with high and continuous attendance
- ✓ Shopping centre bigger than 400 m^2 with a section dedicated to the sale of electric and electronic equipment
- ✓ Local trading associations including electric and electronic distributors
- ✓ Local schools with activities of Agenda 21 for the students and level of activity
- ✓ Do the local government know about circular economy activities related to WEEE in the town? For example:
    - o Repairing, remanufacturing or reusing shops
    - o Specific actions of selective collection in shops
    - o Second hand shops offering guarantee for the sold devices
    - o Initiatives based on incentives after the delivery of electronic equipment
    - o Initiatives of collaborative economy (for example, sharing of electronic equipment)
- ✓ Distance to Indumetal's facilities
- ✓ Interest on participating in an incentive scheme for the citizen focused on improving the ratios of recycling and reuse in the town and the awareness of the end user
- ✓ Opinion about the development of an incentive scheme for the citizen in the town and the implementation of intelligent container as an innovative resource.

IHOBE distributed the document detailed in Table 12 among local municipalities. A translation of this checklist has been included in Appendices, Table 22.

H2020-IND-CE-2016-2017/CIRC-2017/TwoStage
CIRC4Life-776503   *A circular economy approach for lifecyles of products & services*

CHECK LIST

Entidad Local/ Municipio:	Valoración
✓ Distancia aprox.del municipio a Erandio:	✓ 0-10 km: 5 puntos ✓ 10-20 km: 3 puntos ✓ > 20 km: 1 punto
✓ Número de habitantes	✓ >50.000 habitantes: 5 puntos ✓ 20.000-50.000 habitantes: 3 puntos ✓ 0-20.000 habitantes: 1 punto
✓ ¿Dispone de biblioteca y/o polideportivos municipales?	✓ > 2 instalaciones: 5 puntos ✓ 2 instalaciones: 3 puntos ✓ 1 instalación: 1 punto ✓ 0 instalaciones: 0 puntos
✓ ¿Pueden sugerir algún otro centro municipal u oficial en que exista afluencia continua de gente?	✓ Si: 1 punto (por cada instalación) ✓ No: 0 puntos
✓ ¿Hay centros comerciales con más de 400 m² de venta de equipos eléctricos y electrónicos en el municipio?	✓ Si: 2 puntos (por centro comercial) ✓ No: 0 puntos
✓ ¿Existen asociaciones de comerciantes? ¿Incluyen a distribuidores de equipos eléctricos y electrónicos?	✓ Asociación con EEE: 4 puntos ✓ Asociación general: 2 puntos ✓ No: 0 puntos
✓ ¿Cuántas escuelas del municipio tienen actividades en el marco de la Agenda 21 Escolar y son activas en ello? ¿Trabajan con ellas desde el ayuntamiento?	✓ > 3 escuelas: 5 puntos ✓ 2 escuelas: 3 puntos ✓ 1 escuela: 1 punto ✓ Ninguna: 0 puntos

✓ ¿Conocen algún tipo de actividad de economía circular respecto a RAEE en el municipio? Por ejemplo:
  o Tiendas de reparación, remanufactura o reutilización
  o Acciones específicas de recogida selectiva por alguna tienda
  o Comercios de segunda mano con garantía para los equipos que venden
  o Alguna iniciativa de incentivos a la entrega de equipos a cambio de venta de nuevos equipamientos.
  o Iniciativas de economía colaborativa (compartir equipos electrónicos, por ejemplo). Etc...
	✓ Tiendas reparación: 2 puntos
	✓ Acciones recogida: 1 punto
	✓ Comercios garantía: 2 puntos
	✓ Incentivos: 2 puntos
	✓ Economía Colaborativa: 1 punto

✓ ¿Estarían interesados en participar en un sistema de incentivos a la ciudadanía destinado a mejorar los ratios de reutilización y reciclado en su localidad y la concienciación de las personas usuarias?	✓ Sí desde un principio: 2 puntos ✓ Quieren saber antes: 1 punto ✓ Negativa: 0 puntos

Valoración de municipios
22/10/2018

Table 12. Checklist template sent by IHOBE to local municipalities

All the received answers were gathered and scored for finally selecting the area with the highest score. According to the results (detailed in Table 13), the area with the highest score and therefore the most suitable for the implementation of the demo is **Getxo**.

Table 13. Summary of the local municipalities assessed

City/Town	Main points of the checklist		Total score
Amorebieta	✓ Population 19,000 ✓ 27 km to IND ✓ No big commercial centre	✓ Several facilities in the area ✓ Several schools	24
Balmaseda	✓ Population 7,800 ✓ 37 km to IND	✓ No big commercial centre	21
Berango	✓ Population 7,065 ✓ 12 km to IND	✓ Big commercial centre	16
Mancomunidad Durango	✓ Population 24,000 ✓ 50 km to IND	✓ Some facilities in the area ✓ Several schools	19
Getxo	✓ Population 79,000 ✓ 5 km to IND	✓ Numerous facilities in the area ✓ Many schools	29
Lea-Artibai	✓ Population 25,000 ✓ 60 km to IND	✓ Numerous facilities in the area ✓ Many schools	24
Mungia	✓ Population 17,000 ✓ 20 km to IND	✓ Some facilities in the area ✓ Several schools	22
Uribe-kosta	✓ Population 13,900 ✓ 14 km to IND	✓ Some facilities in the area ✓ Several schools	20
Zierbana	✓ Population 1,500 ✓ 20 km to IND	✓ Lack of facilities and schools in the area	13

4.3.3 Definition of the reuse and recycling logistics for the CEBM demonstration

The following sections point out the items of interest that have been defined in order to implement the logistics for the demonstration of the CEBM based on the collaborative recycling and reuse of electronic tablets:

a) Definition of potential collecting points

The collecting points are defined by the installation of intelligent containers necessary to ensure the traceability of the device. Following discussions with Getxo City Council, several potential installation points have been defined, which are constrained by several factors:

- Containers need access to electricity
- Containers should have some form of control: either be in a closed facility, or in an outdoor facility where surveillance is in place.
- The place where the containers are located must be accessible by a van/transport suitable for the operation of collecting the container with the deposited equipment.

The potential installation points of the intelligent containers have been proposed jointly by Indumetal, Recyclia, and the city council of Getxo, where the demonstration will take place, and are, in principle, the following:

- Subway stations: due to the intensive use of the subway by the population of Getxo, the six stations in the city are an interesting point of waste collection. The most interesting stations, due to the quantity of users, are Areeta and Algorta (see Figure 18 and Figure 19). The main problem is the access of the collection van, which forces the container to be at the height of the roadway, and the space of the access openings is not big.
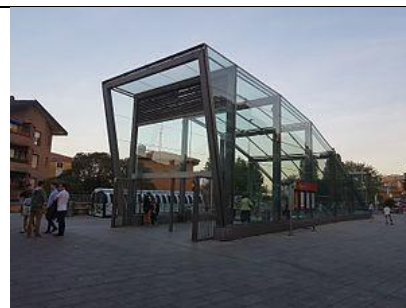

| Figure 18: Subway station Areeta (Getxo). | Figure 19: Subway Station Algorta (Getxo). |

- Fadura Sports Centre (see Figure 20): its car park has other containers for the collection of other waste, including one for general reuse. It is the largest sports centre in the city, with extensive hours of use, and has adequate space even inside the facility:

Figure 20: Entrance to the sports centre of Fadura (Getxo).

- The Aula de Cultura de Romo (Culture Place of Romo, one of the neighbourhoods of the city) is located in one of the most popular squares in Getxo, and has a concert hall, exhibitions, library and a service office for citizens. Its opening hours are long, and the change of habits of library users towards more technological means for cultural consumption within the library can encourage collection.
- There are no large malls for the sale of electronic equipment in Getxo, but there are certain retailers of interesting size. One possibility is 'Expert Cordevi Mancia', which belongs to a national distribution chain (Expert Cordevi), and with which the experience of installing a container can also be performed.

It should be emphasized that containers can be mobile, and that the pilot experience should also include schools and possible living lab locations, where the presence of at least one container during different working days is necessary.

b) *Collection and transport logistics*

The logistics of transport and collection is given by the usual practice of Indumetal, with a single change that consists of expanding the collection points to those where the containers are installed. It does not imply any variation of the company's usual practice, which carries out this same type of operations for the collection of waste in companies or in the collecting points currently designated by the municipalities with which it works in operations for the collection of WEEE for recycling. There is also no change of practice at the time of collection due to the fact that the device could be finally reused.

It is estimated that the project will be carried out with a collection frequency of 15 days when the container is installed at a collection point where its period of permanence is greater than 15 days. In cases where the container is moved to a specific operation of a shorter duration (e.g. a school, or for the realization of the living labs, collection will be on the same day or the next, depending on needs.
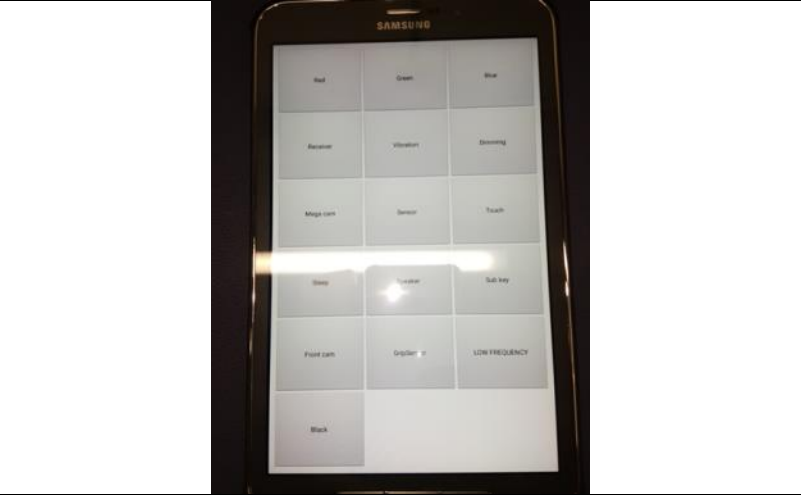
c) *Traceability requirements for re-use*

Indumetal will need to have access to the ICT platform in order to assign the received equipment its reusability or not. This will ensure the traceability of equipment entering the reuse process. According to the information in the smart container intended for use, a Code-128 reader and a working interface with the ICT platform will be required.

d) *Reuse protocol*

Indumetal will follow the procedure of remanufacturing already implemented in one of its facilities and detailed in Table 14.

Table 14. Indumetal's procedure for the remanufacturing of tablets

STEP 1: MATERIAL PREPARATION

STEP 2: EXTERNAL CHECKING

STEP 3: OPERATING CHECKING

STEP 4: OPERATING CHECKING OF TABLET'S CHARACTERISTICS

WIFI	BLUETOOTH
Buttons	Earphones
SIM Card	Battery
STEP 5: CLEANING & PACKAGING	

5   Conclusions

The aim of Task 2.1 is to develop a logistic system for the collection of electrical and electronic waste to be recycled and reused (when possible). For achieving this objective, the activities described thoroughly through this Deliverable 2.1 have been carried out. The main conclusions drawn are highlighted below:

Analysis about the recycling and reuse of LEDs and Tablets

LEDs
- ✓ Currently they represent less than 1-2% of the lamp waste stream and can be recycled with other WEEE as they do not contain mercury, and therefore are more similar in nature to other WEEE.
- ✓ The development of adapted recycling technologies for LED lamps is, however, an important task to recover the main materials and to avoid the irrecoverable dissipation of the valuable elements within the LEDs.
- ✓ Several initiatives have been launched for the reuse of WEEE but none is specific for LEDs.

Tablets
- ✓ There is a lack of data related to collection and recycling rates.
- ✓ Tablets are categorised by WEEE Directive (2012/19/EU), and according to their composition, it is compulsory the removal of the battery, the Hg lamp (when appears), and the LCD (if bigger than 100 cm2). After this depollution step, tablets are treated with other electronic devices according to the common WEEE recycling process.
- ✓ Several initiatives have been launched for the reuse of WEEE but none is specific for Tablets.

Potential barriers for collaborative recycling/reuse
- ✓ From a conceptual, technical, legal and economic point of view, several risks have been identified related to the Recycling & Reuse of WEEE and the Incentives schemes. Besides some proposals for next actions have been suggested

Development of the logistic systems

LEDs
- ✓ The collection system for industrial LEDs has been defined and will consist on a direct collection customer-manufacturer via Kosnic's parcel delivery partner.
- ✓ The collection system for domestic LEDs has been defined and will consist on a direct collection customer-manufacturer via ONA's web and Ona's parcel delivery partner.

Tablets
- ✓ The collection system for Tablets has been defined and will be using an intelligent container which can ensure and preserve the conditions of the tablets.
- ✓ The manufacturer of the intelligent container has been visited in order to learn more about their smart containers and confirm their suitability for the project demonstrations.
- ✓ After the visit, the properties, functioning, IT requirements and risks of the container have been identified and notified to the main partners, in order to face them and overcome the difficulties

Implementation of the logistic systems

LEDs
- ✓ Kosnic has the material needed for the collection and storage of all the industrial LEDs that will be collected during the demonstrations. Additionally Kosnic has given details about their registration with the UK WEEE Producer Compliance Scheme, for those LEDs on which the reuse is not possible.
- ✓ ONA has defined the area where the logistic system will be implemented as well as the flow that domestic LEDs will follow during the demonstration.

Tablets
- ✓ After a meeting with Local Institutions, a checklist has been prepared and distributed to different local municipalities. The received answers have been gathered and scored for finally selecting the area with the highest score. According to the results, the most suitable area for the implementation of the demo is Getxo.
- ✓ After a meeting with Getxo City Council, several potential installation points have been defined, according to several factors
  - o Access to electricity
  - o Control and security of the containers
  - o Accessible collection point
- ✓ The collection and transport of the tablets during the demonstration has been defined and will be carried out by the usual practice of Indumetal
- ✓ The traceability of the collected tablets will be gathered by the traceability module supporting the ICT platform while the identification of collected tablets will be carried out by means of the GS1-128 encoding of e.g. a GTIN (AI01) and Serial (AI21) in the barcode.
- ✓ The remanufacturing protocol has been defined for its implementation during the demonstration.

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Appendices

Conclusions by country of "*Study on WEEE recovery targets, preparation for re-use targets and on the method for calculation of the recovery targets*"

Table 15. Belgium's approaches and practices related to WEEE preparation for re-use

Country	Flanders (Belgium)
Organisation of the sector	The sector is very well organised in Flanders. Komosie, the Flemish network of non-profit organisations involved in recovery activities and energy-cutting activities, has collected and re-used/prepared for re-use textile, furniture, WEEE, etc. (everything that could be re-used in a house) for 20 years. It benefits from a partnership with OVAM, the waste management authority in Flanders, which approves every re-use centre. The region is divided in 31 areas, each with its own re-use centre required by the law VLAREMA. These centres collect EEE and WEEE from households through voluntary drop-off or thanks to their collection services but also from companies and municipalities. They latter pay them for the collection and preparation for re-use. Re-use centres are divided in two types: centres that pre-select reusable products (selective collection); these centres do not need a permit for transport and storage of waste; and centres that collect everything (integral collection) and need a permit. WEEE is mostly collected through integral collection (containers at collection sites, retailers, etc.).
Current state of discussions on preparation for re-use	Flanders implemented a 5kg/capita target for re-use to be reached by 2015, all product and waste streams mixed. The target is based on the output of re-use centres. The target could be raised by 7kg/capita in 2020. OVAM released a guide of good practices to distinguish products that could be re-used and those that should be considered as waste and prepared for re-use (if they meet specific conditions) or discarded. It defines criteria for different categories of EEE based on the general condition of the appliance, its energy consumption and the intention of re-use. A product with no market demand for second hand products (such as CRT screen) or consuming too much energy should be considered as waste and discarded. These criteria can be used by re-use and preparation for re-use centres to assess the potential of re-use of any product or waste. They shall also meet these criteria in order to put a second hand product available on the market. In addition, it can be used by authorities in charge of inspecting exports of used EEE to better identify waste from second hand products. Komosie implemented a quality management system for products to be prepared for re-use (ex: testing of temperature for cooling appliances). It also develops an "ecoscore" where the energy consumption of appliances is measured and displayed on a scale. Products with a higher consumption are sold cheaper in the shops of the Komosie network.
Position on target	Flanders aims to raise its re-use objective and is currently discussing with the Wallon and Brussels regions to improve the reporting of the quantities of waste

	prepared for re-use.

Table 16. Denmark's approaches and practices related to WEEE preparation for re-use

Country	Denmark
Organisation of the sector	A few social organisations re-use EEE in Denmark but do not do any preparation for re-use activities in order to put WEEE back on the market. WEEE is not accessible to these entities. They solely rely on donations. A more professional market for re-use of EEE, where consumers can sell their used EEE for resale, is under development. Typically products such as smartphones, tablets and high-grade electronic equipment are re-used. Also the consumer-to-consumer market for used EEE seems to be on a rise.
Current state of discussions on preparation for re-use	Denmark launched in 2014 a study assessing different scenarios to develop preparation for re-use. It intends to answer questions such as: Who could be responsible for preparation for re-use? What should be the conditions to meet? Is there a demand for EEE re-used and is preparation for re-use always to be favoured over other treatment options? Finally, can preparation for re-use be profitable? Initiatives to extend the lifetime of EEE are also part of the government's national strategy of waste prevention. In that context test on preparation for re-use potential of collected WEEE is under way and also a lifecycle-analysis of re-use vs. recycling of WEEE.
Position on target	According to the Danish Ministry of Environment, Denmark has not implemented a specific target for preparation for re-use, notably because of the lack of specific target in the Directive. When there is no target a specific target in Denmark requires a visibility on how it could be achieved and what the potential for re-use of WEEE is.

Table 17. Germany's approaches and practices related to WEEE preparation for re-use

Country	Germany
Organisation of the sector	Some local initiatives to prepare for re-use WEEE, run by social enterprises, have emerged in cooperation with municipalities (ex: city clean in Hamburg). However there is an important competition between re-use centres and municipal waste companies hindering preparation for re-use and its wider application. Today, municipal waste companies get money from the sale of WEEE to recyclers and there is a high demand for energy recovery, making preparation for re-use not a priority according to Bag Arbeit e.V., the Association of Employment and Training Enterprises in Germany7. Direct re-use of used EEE (before the product become waste) is however well developed in Germany, for example through companies offering re-use services in the B2B sector (ex: re-use of computer bulks).
Current state of discussions on preparation for re-use	The German Environmental Agency (UBA) carried out a study in 2010 to assess the opportunities to professionalise the preparation for re-use sector, notably through the implementation of a quality label and development of a mobile testing facility in order to test the potential of re-use of appliances on collection sites. The study found out that testing at the collection site is economically advantageous if quantities of appliances are rather limited in volume and not too many large appliances need to be tested in the same day.

Position on target	According to the association Bag Arbeit e.V, a target would be the only mean to develop preparation for re-use in Germany. However the market makes it difficult for this type of treatment to be competitive today, given the other treatment options. The project created the basis for the decisions that have to be made by a future certification institution (in charge of awarding a potential label), including quality, testing and implementing measures of quality labelling [UBA 2012].

Table 18. Spain's approaches and practices related to WEEE preparation for re-use

Country	**Spain**
Organisation of the sector	In Spain, a network of re-use centres is well implemented and has been operating for 20 years (some of their members for more than 45 years). AERESS re-uses and prepares for re-use 5 to 6% of the EEE/WEEE it collects every year (419t). No distinction is made between what is re-used directly and what is prepared for re-use (waste and non-waste). All centres from the network belong to the social economy. They collect WEEE from municipalities, households and distributors and some have contracts with collective schemes. The 5 to 6% of re-use and preparation for re-use rate achieved therefore corresponds to the quantities of EEE re-used and WEEE prepared for re-use from all these sources.
Current state of discussions on preparation for re-use	The legislative text (RD 110/2015), transposing the 2012/19/EC Directive, includes a specific target for preparation for re-use, being a 3% for Category 4 and 4%for Category 5. Some regions are particularly willing to develop preparation for re-use. Catalonia published a guide for the development of activities of re-use and preparation for re-use in the collection centres and other public establishments of the region.
Position on target	Spain is the first country to implement a specific target for preparation for re-use for WEEE. However, it is not entirely clear if re-use centres will have full access to the waste stream, from the municipalities, distributors, logistics platform or sorting centres. In addition, AERESS expressed concern that recycling companies with dismantling capacities focus on the re-use of spare parts to reach the target, at the expense of the re-use of whole appliances. Finally, the target is to be fulfilled only with whole appliances.

Table 19. Ireland's approaches and practices related to WEEE preparation for re-use

Country	**Ireland**
Organisation of the sector	The re-use of EEE is done mostly by re-use centres in the B2B business. They buy materials (mostly IT equipment) from companies and refurbish it. Some charity shops and re-use centres also rely on donations but to a lesser extent. They do not have access to the WEEE stream.
Current state of discussions on preparation for re-use	The Ministry of Environment of Ireland has defined criteria for the approval of re-use centres. The latter will have to comply with quality standards and have reporting obligations. Some re-use centres specialised in the re-use of IT equipment from the B2B business are likely to be interested in being approved for the re-use of other type of equipment. In 2013, a study was conducted to investigate how preparation for re-use could

	work in practice. 'Rehab recycle', a company specialised in recycling services with a branch specialised in the re-use of equipment from the B2B sector, partnered with a compliance scheme, and conducted a trial to assess the reusability of WEEE collected through municipalities, retailers and voluntary drop-off. At the end of the trial, the collective scheme gave 'Rebab recycle' a month to sell the equipment. The re-use organisation refused to sign the contract with such a condition; therefore the refurbished machines still belong to the collective scheme and the equipment hasn't been put back on the market yet.
Position on target	According to 'Rehab recycle' and a researcher from the University of Limerick, a target, even a small one, would be necessary to encourage preparation for re-use. Retailers, compliance schemes and recyclers would yet be very reluctant because of the fear of competition of re-used products with primary products and loss of revenue from recycling.

Table 20. The Netherlands' approaches and practices related to WEEE preparation for re-use

Country	**The Netherlands**
Organisation of the sector	Re-use is very well developed in the Netherlands. Approved re-use centres have contracts with municipalities. Some are social organisations, while other are classical businesses. The municipalities or the re-use centre collect WEEE by households or the WEEE is discarded by the holder at collection points. The holders sort the WEEE and check if it can be re-used, and the re-use centre judges as a second step as well. If not, it is transported to a recycling facility. The concept of re-use is also very well implemented in the Holland culture. Marktplaats.nl is a website where consumers exchange products. The website is widely used by the population. Furthermore there is a wide spread refurbishment sector which focuses on B2B equipment, mainly IT.
Current state of discussions on preparation for re-use	There is no discussion today in the Netherlands regarding a possible target on preparation for re-use of WEEE, as the sector is already well organised.
Position on target	'Wecycle', the organisation in charge of WEEE collection and treatment on behalf of EEE producers, estimate that the Netherlands would not have any issue to reach a target, for instance 5% of collection, if it was implemented. The only question would be how to register it.

Table 21. France's approaches and practices related to WEEE preparation for re-use

Country	**France**
Organisation of the sector	There are three large networks of re-use centres in France (Emmaus, Envie, Réseau des ressourceries) but also a high number of facilities implemented at the local level (almost 2,000 players according to ADEME, the French Environmental Agency). These organisations rely on donations and sometimes on partnerships with the collective schemes. The ones that benefit from a contract with a collective scheme get access to the WEEE collected through municipalities and distributors, and report on the quantities of WEEE they actually repair and put again on the market. 'Eco-systemes', one of the French collective scheme

	estimated that around 20% of what is collected today is given for preparation for re-use, and 20% of it is actually re-used.
Current state of discussions on preparation for re-use	No specific target for preparation for re-use is discussed today. The French Environmental Agency (ADEME) is very active on the promotion of re-use and preparation for re-use. It released a significant number of studies these last years: on the amount of facilities in the sector, its organisation and the trends for the future, the attitude of French people toward re-use and preparation for re-use, etc.
Position on target	According to 'Eco-systemes', there is a need to clarify first the difference between re-use and preparation for re-use and define a way to report on these activities to be sure that Member States count the same flows. A target would also raise economic questions as a large amount of what is collected today is not reusable due to the damages during handling (except WEEE collected by distributors). This means that the players would need to be subsidised which make it a less interesting option than recycling.

Check list distributed by IHOBE among local municipalities

Table 22. Checklist template sent by IHOBE to local municipalities

Municipalities	Scoring
✓ Average distance from Indumetal's facilities (Erandio):	✓ 0-10 km: 5 points ✓ 10-20 km: 3 points ✓ > 20 km: 1 point
✓ Number of inhabitants	✓ >50,000 inhabitants: 5 points ✓ 20,000-50,000 inhabitants: 3 points ✓ 0-20,000 inhabitants: 1 point
✓ Is there municipal library and/or sport centre?	✓ > 2 facilities: 5 points ✓ 2 facilities: 3 points ✓ 1 facilities: 1 point ✓ 0 facilities: 0 points
✓ Is there available other municipal spaces with a continuous attendance of people?	✓ Yes: 1 point ✓ No: 0 points
✓ Is there any shopping centre bigger than 400 m2 with a section dedicated to the sale of electric and electronic equipment?	✓ Yes: 2 points ✓ No: 0 points
✓ Is there any local trading association including electric and electronic distributors?	✓ Association with EEE: 4 points ✓ General association: 2 points ✓ No: 0 points
✓ Are there local schools with activities of Agenda 21 for the students? What is the level of activity?	✓ > 3 schools: 5 points ✓ 2 schools: 3 points ✓ 1 schools: 1 point ✓ None: 0 points
✓ Does the local government know about circular economy activities related to WEEE in the town? For example: ○ Repairing, remanufacturing or reusing shops ○ Specific actions of selective collection in shops ○ Second hand shops offering guarantee for the sold devices ○ Initiatives based on incentives after the delivery of electronic equipment ○ Initiatives of collaborative economy (for example, sharing of electronic equipment..)	✓ Repairing shops: 2 points ✓ Collection action: 1 point ✓ Guarantee shops: 2 points ✓ Incentives: 2 points ✓ Collaborative economy: 1 point
✓ Would be the local authorities Interested on	✓ Yes from the beginning: 2 points

participating in an incentive scheme for the citizen focused on improving the ratios of recycling and reuse in the town and the awareness of the end user?	✓ They want to know more in advance: 1 point ✓ Negative answer: 0 points
✓ Opinion about the development of an incentive scheme for the citizen in the town and the implementation of intelligent container as an innovative resource	✓ Yes from the beginning: 2 points ✓ They want to know more in advance: 1 point ✓ Negative answer: 0 points