

Pan European Policy Recommendations (B3)

Critical Raw Material Closed Loop Recovery Project



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Acronyms

CRM	Critical Raw Materials
EEE	Electrical and Electronic Equipment
EoL	End of Life
EPR	Extended Producer Responsibility
EU	European Union
HREEs	Heavy Rare Earth Elements
LDAs	Large Domestic Appliances
LREEs	Light Rare Earth Elements
PCBs	Printed Circuit Boards
PGMs	Platinum Group Metals
POM	Placed on Market
PPM	Parts per Million
REEs	Rare Earth Elements
WEEE	Waste Electrical and Electronic Equipment
WG	Waste Generated

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1.Executive Summary

The European Union (EU) is largely dependent on imports of critical raw materials (CRMs) from non-EU countries. For this reason it is important to ensure CRMs are recovered from waste electrical and electronic equipment (WEEE) so as to continue their continued circulation within the European market and increase the security of Critical Raw Materials.

The Critical Raw Material Closed Loop Recovery project aimed to test the link between a targeted collection of WEEE and the subsequent economic viability and effectiveness of CRM recovery. This report presents a suite of accompanying pan-European policy recommendations and enabling actions that have been made in-line with the findings from the trials in addition to a comprehensive literature review of current relevant legislation.

The five innovative WEEE collection and CRM-recovery trials were undertaken in four European nations (Czech Republic, Germany, Italy and the UK) in order to establish how best to capture CRM-rich WEEE and recover targeted CRMs. The most successful collection trials partnered up with known and trusted organisations including retailers and charities and introduced secure collection points at conveniently located positions such as in shops, schools and universities. The innovative lab-based recovery trials included obtaining CRMs from batteries hard drives, printed circuit boards (PCBs) and magnets.

The availability and efficiency of recovery infrastructure is influenced by many factors and complex interactions between policies and priorities. While some policies directly target CRMs, others indirectly influence CRM recovery through enabling or hindering implications. They often can be categorized by their pulling or pushing character. The former are policies that aim to pull the market in a certain direction for example by informing consumers about a product (i.e. creating demand) while the latter aims to push the market in a direction through for example enforcing bans on certain products (European Commission, 2018). A number of themes emerged during the trial analysis culminating in the need for dedicated policy actions along two complementary areas:

1. Engaging consumers and waste handlers with targeted actions and campaigns highlighting the importance of proper disposal of CRM-rich WEEE. Ensuring traceability and increasing citizen's trust in the disposal process, especially for personal data-bearing products such as mobile phones, cameras (where data protection is a concern), might help to overcome lack of trust that was also evident from interviews conducted during the trials.
2. Authorities and policy makers must play an active role in the redesign and implementation of infrastructure that supports the collection and preparation of WEEE for re-use.

The five key themes identified from the trials include crosscutting barriers and opportunities for policy recommendations, which would affect multiple stakeholders involved in WEEE collection and preparation for re-use or recycling activities:



1. The need to raise awareness of the importance of WEEE collections and CRM-recovery amongst citizens and businesses
2. Eco-Design considerations with recycling considerations to be included at the early stages of product design
3. The need to increase trust and transparency to encourage citizens to recycle their unwanted electrical items
4. An introduction of CRM-recovery within Standards and,
5. The redesign of collection infrastructure with particular attention to the role of consumer behavior

To investigate how the lessons learned from each of the trials could be transferred to other Member States, a comparison exercise has also been conducted to complement this report. The criteria for the Compliance Promotion Exercise was used in addition to an analysis of the individual situations of the four Member States where the five collection and treatment trials took place.

Reliable data analysis and economic modelling was not possible, due to inconsistencies in the data collected from Member States within Eurostat statistics. However, the trials demonstrated that issues underlying the lack of CRM recovery are prevalent across all trial regions, as such it was not possible to develop a suite of policy options tailored to each of the trial host nations individually. However, the research and consultation undertaken to develop the policy recommendations to increase the recovery of CRMs did identify a set of actions relevant and applicable to all of the trial regions; Italy, Germany, Czech Republic and the UK, and across Europe, which include:

- 1. Redesign and harmonise WEEE collection infrastructure**
- 2. Increase awareness amongst citizens and businesses**
- 3. Create incentives for collection and recycling organisations**
- 4. Continue innovation and research on CRM recovery and foster international collaboration**
- 5. Introduce CRM-specific requirements into standards**



1. Introduction

1.1. Project Background

The European Commission created a list of critical raw materials (CRMs) for European Union nations; the third revision of this list was published in 2017 (Table 1). The criticality of raw materials is chiefly determined by their economic significance to the EU and the risk associated with their supply.

Table 1: Critical Raw Materials, Third List (2017)

Antimony	Gallium	Natural graphite
Baryte	Germanium	Natural rubber
Beryllium	Hafnium	Phosphorus
Bismuth	Helium	Scandium
Borate	HREEs	Silicon metal
Cobalt	Indium	Tantalum
Coking coal	LREEs	Tungsten
Fluorspar	Magnesium	Vanadium

HREEs=heavy rare earth elements, LREEs=light rare earth elements, PGMs=platinum group metals

Although the domestic production of certain critical raw materials exists in the EU, notably hafnium in France, in most cases the EU is dependent on imports from non-EU countries. China for example, is a major supplier of critical raw materials, accounting for 70% of the global supply of rare earth elements, magnesium, antimony and natural graphite amongst others. Brazil, America, Russia and South Africa are also important producers of critical raw materials. The risks associated with the concentration of production are in many cases compounded by low substitution and low recycling rates.

The supply of CRMs to the EU is a higher risk than other raw materials as most CRMs are virtually unrecovered from waste electricals and electronic equipment (WEEE) and high losses of CRMs are attributed to the current collection and recycling arrangements.

In 2015, an estimated 9.8 million tonnes of Waste Electrical and Electronic Equipment (WEEE) is generated in the EU and 3.5Mt of WEEE generated is reported as properly collected and recycled. Many modern electrical and electronic products contain a number of the materials classified as Critical Raw Materials (CRMs) by the European Commission and are at risk of not being captured if WEEE is not re-used or recycled.

1.2. Project Aims and Objectives



The CRM project was developed in partnership with European experts such as the Wuppertal Institute in Germany, a research institution specialising in climate, environment and energy and practitioners such as Axion Consulting, Ecodom, Asekol, Re-tek and RecyclingBörse in order to propose a series of innovative trials to establish the best ways to collect CRM-rich WEEE and recover the CRMs from them. The overall aim of which is to generate the evidence required to develop policy recommendations for each of the participating EU nations and for pan-European policy development.

The policy interventions and options will describe how and where the outcomes of the trials can be implemented across Europe, providing a clear pathway to increase material capture of CRMs from WEEE in Europe.

1.3. Trial Summaries

The table below summarises the various collection and recovery activities which were undertaken for each trial.

Table 2: Trial summaries

Trial Host		Axion – United Kingdom	
Trial Partners		Dixons Carphone, British Heart Foundation, John Lewis, E3 Recycling, ITRI, TOMRA	
Target Products		ICT and consumer electronics – specifically targeting data bearing devices	
Target CRMs		Cobalt, Antimony, Tantalum, Rare Earth Metals, Platinum Group Metals, Gold, Silver, (Tin and Copper – not CRMs)	
Website Link		http://www.axionconsulting.co.uk	
Collection Activity 1 <i>Charity Electricals Take-back at British Heart Foundation Stores and Online Platform</i>			
In-store collection of electricals for re-use and recycling. Electricals that were suitable for re-use were sold via the British Heart Foundation eBay site. Items not suitable for re-use were dismantled by E3 Recycling, and the printed circuit boards (PCBs) extracted for the recovery trial. The collections campaign was supported by communications and surveying.			
Details		Nov 2016 – Apr 2017 Greater Manchester – Sale, Salford, Cheetham Hill, Harpurhey (UK)	
Collection Activity 2 <i>Retail Electricals Take-back at Dixons Carphone Stores</i>			
In-store collection of unwanted electricals for re-use and recycling. Electricals were assessed for re-use by E3 recycling. Any items not suitable for re-use were dismantled and the PCBs extracted for the recovery trial. The collections campaign was supported by communications and surveying.			
Details		Feb 2017 – Jun 2017 Greater Manchester – Stockport, White City, Cheetham Hill, Bolton (UK)	
Collection Activity 3 <i>Incentivised Electricals Take-back at John Lewis Stores</i>			
In-store collection of unwanted electricals for re-use and recycling. Customers were offered the incentive of free data wiping (usually £30). This trial partnered with the British Heart Foundation for the selling on or re-			



usable electricals. Any items not suitable for re-use were dismantled and the PCBs extracted for the recovery trial. The collections campaign was supported by communications and surveying.	
Details	Jun 2017 – Aug – 2017 York and Leeds (UK) and Leeds (UK)
Recovery Activity <i>Component Extraction from Printed Circuit Boards (PCBs)</i> <p>Proof of concept, laboratory scale trial. De-soldering of PCBs to remove whole components and harvest the tin from the solder. The individual components were then sorted into different groups based on a range of scenarios (e.g. rich CRMs, maximising material purity or recovery). The sorting took place at the TOMRA test facility in Germany. The fractions were then chemically analysed for CRM content.</p>	
Details	May 2017 – Feb 2018 Manchester (UK) and Mülheim-Kärlich (Germany)

Trial Host	Re-tek – United Kingdom
Trial Partners	Enscape, University of the West of Scotland
Target Products	Display equipment, ICT, consumer electronics
Target CRMs	Cobalt, Gold and Silver
Website Link	http://www.enscape.eu/what-we-do/criticalrawmaterials/
Collection Activity 1 <i>Employee Amnesty</i> <p>Amnesty periods where employees could bring household unwanted electricals to be collected via the business WEEE collections. This scheme operated across 2 private companies, 2 not-for-profit organisations, 1 local authority and 3 social enterprises. Items that were suitable for re-use were sorted by Re-Tek and had the data wiped. Items not suitable for re-use had the printed circuit boards removed for the recovery trial and the remaining product was recycled.</p>	
Details	Sep 2016 – Jan 2017 Various locations across Scotland and England (UK)
Collection Activity 2 <i>Household Waste and Recycling Centres</i> <p>Containers for housing re-usable WEEE were placed next to the existing containers for standard WEEE collections (which focus on recycling and disposal rather than re-use). Residents and site staff were then able to keep potentially re-usable electricals separate to help preserve quality. These items were then assessed for re-use by Re-Tek.</p>	
Details	Sep 2016 – Jan 2017 Cumnock and Kilmarnock (UK)
Collection Activity 3 <i>School Collection Hubs</i> <p>Following interactive school workshops with students, the schools then act as collection hubs for waste electricals. Students are able to bring in waste electricals from home which are then collected and assessed for re-use by Re-Tek.</p>	
Details	Sep 2016 – Jan 2017 Cumnock and Kilmarnock (UK)
Collection Activity 4 <i>Unite Halls of Residence</i> <p>The concierge at the Unite Halls of Residence acted as a collection point for any waste electricals from students at the end of the winter term and the start of the spring term. Leaflets were distributed across all students in the Halls. Re-Tek collected the containers and assessed electricals for re-use.</p>	



Details	Dec 2016 – Jan 2017 Unite Halls of Residence – Durham, Newcastle, Edinburgh, Glasgow (UK)
Recovery Activity <i>Electrochemical CRM Extraction from Solution</i> <p>Proof of concept, laboratory scale trial. The PCBs extracted from the non-reusable electricals were crushed and then put into solution with either acid or different microbes to release the CRMs into solution. These solutions underwent further separation chemistry techniques before passing through an electrochemical cell to extract cobalt, silver and gold from solution.</p>	
Details	Feb 2017 – Sep 2017 Paisley (UK)

Trial Host	Ecodom - Italy
Trial Partners	AMSA, STENA, ENEA, SEVAL, Institut für Materialprüfung Glörfeld GmbH
Target Products	display equipment, ICT, consumer electronics, small household appliances
Target CRMs	Graphite, cobalt, platinum group metals, gold, silver
Website Link	http://www.ecodom-consorzio.it/it/iniziativa/crm-recovery
Collection Activity 1 <i>Collections in Public Squares</i> <p>A large blue collection container was sited in a series of public squares across Milan on 4 consecutive Sundays in each square (21 Sundays in total). The containers were manned and extensive communication campaigns were carried out in the local area before the events. Wider communications were carried out via social media, local radio and local television.</p>	
Details	Sep 2016 – Dec 2016 May 2017-Jun 2017 5 public squares across Milan (Italy)
Collection Activity 2 <i>School and Community Collection Day</i> <p>Two collection days ran in Comano School. The first was just for students of the school and followed engagement sessions with students. The second day was open to the local community to donate electricals too.</p>	
Details	Feb 2017 Comano School, Milan (Italy)
Collection Activity 3 <i>Collection in two COOP Grocery Stores</i> <p>Ecodom had developed the design for the new WEEE bring banks: 2 units were placed indoors, in 2 Coop Grocery Stores. They were collected every 1 or 2 weeks. Communication activities had been organised in order to increase collection activities. Any display screens collected were tested by ENEA to establish the re-use potential of these devices. Products ready for market at the end of the trial were made available for events and dissemination activities.</p>	
Details	Jun 2017- Dec 2017 2 Grocery Stores located in Via Gozzoli and Via Palmanova, Milan (Italy)
Recovery Activity 1 <i>Maximising Recovery from Existing Processes</i> <p>The collected WEEE was sorted, separated and pre-processed into CRM-rich and non-CRM-rich fractions. These fractions were passed through STENA's existing precious metal recovery process and the CRM levels assessed to determine if the method of collection and levels of sorting led to an overall increase in CRM capture and a CRM recovery.</p>	
Details	Oct 2017 – Apr 2018 Angiari (Italy)



Recovery Activity 2 <i>Recovery of CRMs from rechargeable batteries</i>	
<p>Laboratory scale process to extract graphite and cobalt from rechargeable batteries. Anodic and cathodic parts were separated and thermally treated, then treated to form a solution from which CRMs could be extracted.</p>	
Details	Oct 2017 – Apr 2018 Colico (Italy)

Trial Host	RecyclingBörse - Germany
Trial Partners	Hamburg University of Technology, Fraunhofer Institute
Target Products	Display equipment, ICT, consumer electronics, small household appliances
Target CRMs	Tantalum, Neodymium
Website Link	https://www.Recyclingboerse.org/it/europa-projekt-wrap-crm/
Collection Activity 1 <i>Re-use Olympics in Schools</i>	
<p>Collection days in schools with a competition to see which school could collect the most items for re-use. Items were assessed for re-use by RecyclingBörse with non-re-usable items being disassembled for the recovery trials.</p>	
Details	May 2017 – Jul 2017 Herford (Germany)
Collection Activity 2 <i>Monthly Kerbside Sack Collections from Households</i>	
<p>Each household received a sack which, once filled with WEEE, was placed at the kerbside for a monthly collection.</p>	
Details	Mar 2017 – Dec 2017 Herford (Germany)
Collection Activity 3 <i>Re-use Boxes for Households and Businesses</i>	
<p>Householders and businesses could request a box for collection of WEEE. These boxes were returned to the RecyclingBörse depot, shops or collection points. For households, this was an alternative method of collection compared to the kerbside sack.</p>	
Details	May 2017 – Oct 2017 Herford (Germany)
Recovery Activity 1 <i>Biological Extraction of Tantalum</i>	
<p>Printed circuit boards were broken up by electrohydraulic fragmentation. Use of bio-leaching and biosorption to extract elemental tantalum located within the tantalum capacitors which were extracted from the circuit boards after fragmentation.</p>	
Details	Apr 2017 – Dec 2017 Hamburg (Germany)
Recovery Activity 2 <i>Extraction of Neodymium from Magnets</i>	
<p>Neodymium-containing Magnets were extracted from hard disk drives. These magnets underwent a multi-step process to remove their protective coating prior to homogenization by melt-spinning to produce Nd-Fe-B flakes that could be used to create new sintered magnets.</p>	
Details	Apr 2017 – Dec 2017 Hamburg (Germany)



Trial Host	Asekol – Czech Republic
Trial Partners	Green Solution, Enviropol
Target Products	ICT, consumer electronics, small household appliances
Target CRMs	Rare Earth metals, platinum group metals, gold, silver (copper and aluminum – not CRMs)
Website Link	https://www.asekol.cz/asekol/
Collection Activity <i>Mobile Collection Units in Areas Not Suited to Permanent Collection Containers</i> Mobile collection units that accept textiles and WEEE were placed in specific areas of Prague for a 24-hour period. They were located in areas of Prague that were unable to site permanent, stationary collection units due to the historic beauty and importance of the surroundings. The locations of these collections were advertised via posters, social media and news reports.	
Details	Mar 2017 – Jul 2017 Prague (Czech Republic)
Recovery Activity <i>Optimising Concentrations of CRMs</i> Non-reusable WEEE was processed on a small WEEE processing line. Processes included, but were not limited to, crushing, magnetic separation, electrostatic separation and sensor separation of metals. The three fractions from the WEEE processing which had the highest concentrations of CRM were identified and then further refined to increase the CRM content of these fractions.	
Details	Oct 2017 – May 2018 Jihlava (Czech Republic)

1.4. This Report

This report summarises the policy and infrastructure implications resulting from the collection and recovery trials, including the barriers and opportunities identified for collection, preparation for re-use and recovery of CRMs.

Additionally, an extensive review of existing policies that support development of infrastructure for recovery of critical raw materials (CRMs) is presented in **Annex ii**, with the objective to provide an overview of the potential influence that a variety of policy options may have on capturing CRMs from end-of-life electronic and electrical equipment (EEE).

The literature review is largely focused on the European Union, however it also includes policy examples from countries outside the EU such as the USA, Japan and Korea that have implemented policies to address the increasing imbalance between demand and supply of CRMs (Bareková and Kemp, 2016, European Commission, 2018).

The availability and efficiency of recovery infrastructure is influenced by many factors and complex interactions between policies and priorities. While some policies directly target CRMs, others indirectly influence CRM recovery through enabling or hindering implications. They can often be categorized by their pulling or pushing character. The former are policies that aim to pull the market in a certain direction for example by informing consumers about a product (i.e. creating demand) while the latter aims to push the market in a direction through for example enforcing bans on certain products (European Commission, 2018).



This report should be read in conjunction with the separate report “Pan-European Infrastructure Development (B4)”.

1.5. Methodology

In order to present a range of policy recommendations based on the WEEE collection and CRM recovery trials, each of the trial reports were analysed to identify areas that could be improved by introducing policy measures as presented in Section 4 (**a full list of these findings can be seen in Annex iii**). Each of the trial hosts also had telephone interviews to discuss and expand on the report analyses. A range of 31 industry experts from Government, trade associations, academia and the electricals industry were also invited to participate in a survey (**Annex iv**) in order to get their input at the early stages of this report.

In order to not make recommendations of policies already in place and to ensure accuracy, relevance and consistency, a policy literature review was also conducted (Section 5). Existing policies with reference to the broader global waste and raw materials frameworks, specifically on WEEE and CRM Raw Materials were reviewed, and opportunity gaps were identified and included within the policy recommendations.

To investigate how the lessons learnt from each of the trials could be transferred to other Member States, a comparison with different criteria first used in the [Compliance Promotion Exercise](#) in combination with an analysis of the individual situations in the four trial host nations has also been considered.

Out of the 22 criteria used in the Compliance Promotion Exercise, the following five have been considered as relevant in the context of the trial activities, aiming in particular at ensuring high level of products rich in CRM, and ensuring the subsequent recovery or, through preparation for re-use, an extension of the life-time of the product or component where CRMs are used:

1. Performances in separate collection
2. Treatment capacity for first treatment
3. Achievement of recycling/preparation for reuse target
4. Performance of recycling/preparation for reuse target
5. Development of recycling/preparation for reuse target

2. Key Barriers Preventing CRM Recovery and Opportunities to Increase CRM Recovery

2.1. Findings from the collection and recovery trials

The five collection and treatment trials each had their own unique focus and set-up, but all activities shared three distinct stages:



- **Collection phase:** in order to explore new and innovative ways to collect CRM-rich WEEE.
- **Preparation for re-use:** including various functionality and re-usability tests by dedicated, trained professionals.
- **Recycling and recovery:** the majority of trials focused on testing approaches in order to concentrate the fractions rich in CRM before end-processing (usually done via integrated smelters using a mix of pyrometallurgical and hydrometallurgical approaches). See Table 2 for a full summary.

Both barriers and opportunities for the collection and recovery of CRMs were identified within each of the five trials. These have been clustered in themes in order to better identify the most suitable policy recommendations. Each theme is linked to a target group, representing the main stakeholders responsible (i.e. compliance schemes, national and local authorities, producers and waste handlers) to overcome the barrier or identify who could leverage the opportunity.

All the barriers and opportunities initially identified (Annex iii), clustered and grouped per theme were discussed and cross-checked with the member of the trial to ensure that the overall occurrence of the full set in each of the countries was accurate (Annex iii).

Some themes had cross-cutting barriers and opportunities which would affect multiple stakeholders involved in WEEE collection and preparation for re-use or recycling activities, such as:

- Awareness Raising (collection and preparation for re-use)
- Eco-Design (collection and recycling)
- Trust and transparency (collection and recycling)
- Need for standards (collection and preparation for re-use)
- Redesign of collection infrastructure (collection and preparation for re-use).

The top 3 barriers identified a need to:

- Redesign collection infrastructure
- Raise awareness
- Reduce administrative burdens





Figure 1: Breakdown of action items per target group (WEEE Flows Model)

Many of the barriers identified above are consistent with the findings from the literature review presented in section 3.3. Additional evidence from the trials allows for targeted policy recommendations to be derived section 4.

Clustering the barriers and opportunities per target group resulted in most action items pointing to national authorities and waste handlers (Figure 1).

This suggests the need for dedicated policies along two complementary areas:

- 2 Engaging consumers and waste handlers in general with targeted actions and campaigns highlighting the importance of proper disposal of CRM-rich WEEE. Ensuring traceability and increasing citizen's trust in the disposal process, especially for personal data-bearing products such as mobile phones and cameras (where data protection is a concern), might help to overcome the lack of trust that was also evident from interviews conducted during the trials.
- 3 Authorities and policy makers must play an active role in the redesign and implementation of infrastructure that supports the collection and preparation of WEEE for re-use.

In this area we can observe an almost equal share of requests for a decrease in the administrative burden associated with the organisation of collection campaigns, and collection events that deviate from the usual and established collection channels.

Similarly, the redesign of collection infrastructure with a specific focus on the collection of CRM-rich WEEE is necessary to ensure CRM recovery. Given that smaller items typically contain higher concentrations of CRMS but often represent a lower proportion of items within return streams (Figure 2), it is important separate them at the point of collection. This



is illustrated in the recent study by Magalini (2018) for EERA that compared two reports – EERA’s own study in 2016 as well as a report under the ProSUM project showing the under-represented and over-represented products arriving at recyclers. For example, it shows that only 8% - 14% of laptops placed on the market each year reach recycling and recovery channels, whereas over 100% of CRT TVs placed on the market are returned to recyclers by volume.

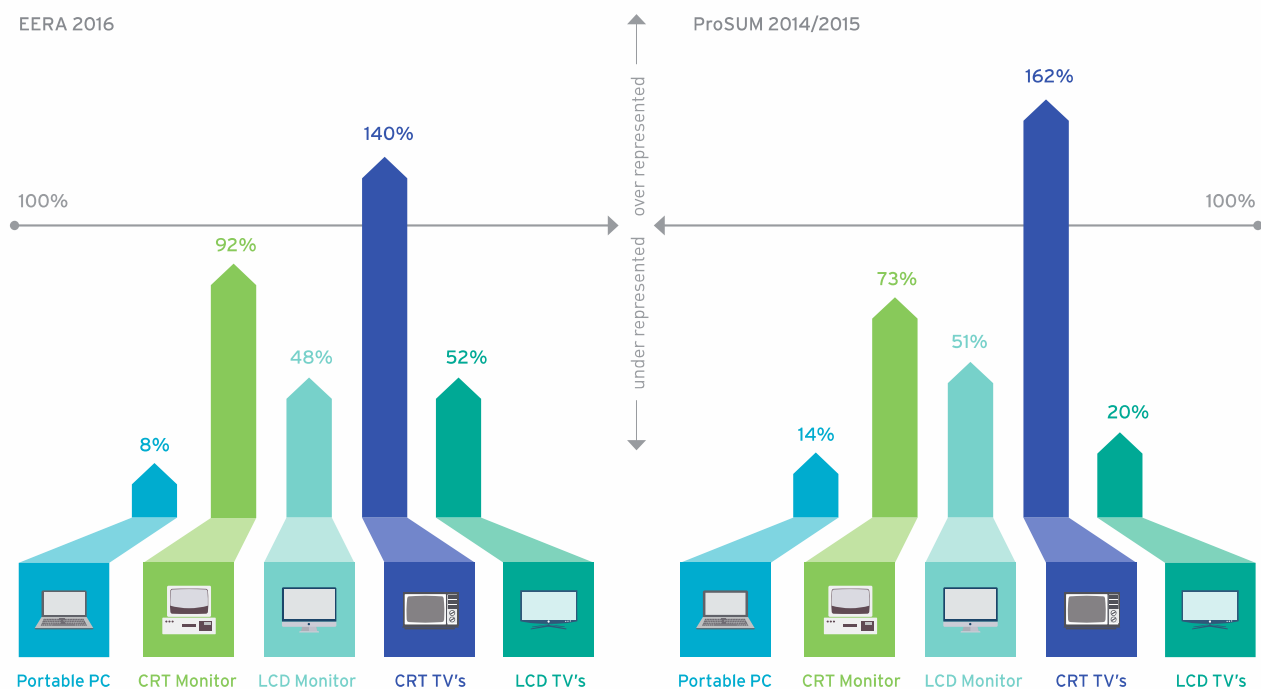


Figure 2: Scavenging of products in mixed EEE and display streams (Magalini F., 2018 EERA)

These findings are reinforced by the trials almost all of which identified barriers linked to the way current collection systems work and their effectiveness in ensuring small WEEE in particular is channelled into the system.

Increasing consumer awareness and overcoming the intention-behaviour gap overlaps with the design and convenience of the collection infrastructure. There are opportunities to influence behaviour change by designing dedicated and more user-friendly collection points as the first step to engage with consumers. Experience from the trials highlighted that the easier and more convenient it is for consumers to deposit their unwanted electrical products, the higher the likelihood to have small WEEE returned to the correct collection point.

The opportunity to have dedicated and more conveniently positioned citizen collection infrastructure should not be hampered by administrative and/or financial burdens (e.g. need of dedicated permits)



The key lessons learned from the collection trial in the Czech Republic also showed that opportunities exist to establish synergies with other waste streams, particularly in the case of dedicated collection campaigns targeting intermittent household waste products (e.g. textiles, clothes, shoes, etc.). Similarly, the trial run by RecyclingBörse in Germany used a sack to collect various types of waste in addition to WEEE directly from households.

Please refer to “Pan-European Infrastructure Development (B4)” sections 3 and 4 where the economic costs and benefits of the trials are analysed and the relationship between collection and recovery is discussed.

2.2. Findings from the literature review: barriers

An overview of potential barriers to the successful capture of CRMs has been made based on the information derived from the policy literature review (section 4). The barriers and opportunities do not refer to any specific country or region as global sources of information were used. The potential challenges that a country or region will face when developing infrastructure to capture CRMs from WEEE have been outlined below.

The key findings have been grouped into themes as follows:

- Missing state action for accelerating CRM recovery
- Lack of reliable secondary materials market
- Missing disposal infrastructure / incorrect disposal of products containing CRMs
- Missing knowledge on CRM flows and recovery technology
- Missing focus on CRM recovery within policy and at the point of collection
- Missing conceptualization of global circular product value chain.

2.2.1. Missing state action for accelerating CRM recovery

A missing focus on CRM recovery within EU legal frameworks will cause an absence of action from governments and can cause restrictions in power such as the ability to issue sanctions and penalties in the case of non-compliance (Huisman, et al., 2015). Thus, a well working general waste management framework to recover CRM-rich WEEE such as the Waste Framework Directive and the WEEE Directive is considered beneficial for building up an effective CRM recovery infrastructure. Ambiguity and missing capacities among institutions and stakeholders will likely result in weak law enforcement (European Commission, 2017b). For actions to be taken to ensure enforcement measures, the role and responsibilities of institutions and other entities must be clearly defined and sufficient human and financial resources allocated accordingly (European Commission, 2017b). The explicit inclusion of CRM recovery in legislative texts will further help to avoid confusion and neglect of these materials.

Recommendations to prevent illegal transport of WEEE include intensified monitoring and control, awareness campaigns and banning of cash payments for WEEE transactions (Huisman, et al., 2015). Furthermore, international standards on offences and harmonisation



of provisions are important to avoid illegal activities and simplify enforcement of policies (Huisman, et al., 2015).

2.2.2. Lack of reliable secondary materials market

CRM recycling is not always deemed economically feasible (European Commission, 2018) due to the high investment and operating costs of sorting and recycling technologies (European Commission, 2018) compared to the potential output material, this results in the private sector being reluctant to invest in CRM recovery infrastructure. Rapid product developments, new material and innovations also bring a change in waste products and waste material composition, which poses a risk and leads to uncertainty whether to invest in a particular technology today that might not be able to deal with the waste material in future.

This can be further aggravated if there are high administrative burdens associated with the collection of CRM-rich WEEE. For example, the complex process of acquiring licenses and permits as seen in the Asekol-run collection trial in the Czech Republic. Permits were required for each of the sites where the mobile collection units were positioned in addition to parking fees which made the collection activities an expensive operation.

A further risk for private investors and adding to uncertainty is an unstable secondary product and material market, caused for example by a lack of demand for secondary material due to high costs, lower or inconsistent quality of secondary materials as well as volatile market prices (Dominish, et al., 2017).

Policy actions should aim towards providing a stable secondary material market to support and incentivize a secure financial framework, by using economic instruments (Dominish, et al., 2017) to reduce investment risk and long-term feasibility of technology through for example the development of standards on minimum production requirements, modularity or the labelling of product components. Public procurement policies can further work as an efficient tool to promote good business practices (2017 *ibid*).

2.2.3. Missing conceptualization of global circular product value chain

The recovery of CRMs is partially dependent on the quantity of WEEE that is correctly disposed of and collected allowing the material to be further processed. A lack of awareness, knowledge or willingness is often the reason behind CRM-rich WEEE being illegally dumped (fly-tipping) or incorrectly discarded (placed in the residual waste bin). Costs incurred to correctly dispose of such products might further enhance this problem.

A lack of collection points could be a result of high administrative burdens and requirements, thus presenting a challenge and disincentive to the number and quality of the collection provision. Society needs to be informed of the importance of correct recycling as well as of the donation opportunities. Awareness campaigns and access to information regarding correct disposal, including where and when, e.g. easy to find information on municipality



websites, could see an increased collection of WEEE. Cooperation with community groups could provide an effective channel to reach out to society and facilitate the execution of recycling education programs using locally tailored messaging. An example of this was seen in RecyclingBörse's 'Re-use Olympics' trial run by a local community group where local school children competed to collect the most unwanted electrical items from their families and neighbours.

Hoarding of electronic products in households has also been recognized as a growing problem. Findings show that one of the reasons for the hoarding of computers and other IT equipment is the growing concern about data security (Claes, et al., 2018). The importance of trust and reputation (2018 *ibid*) should not be neglected, but rather taken as an opportunity to establish a long-term relationship with the customer to positively impact the collection of goods in the long-term. Providing a service of secure data destruction and prevention of data misuse could mitigate the concern and increase correct disposal of unused electronic items. Another reason for hoarding electronic equipment is to have a backup in case of breakage or damage. This challenge could be addressed if a temporary back-up device in the case of breakage or loss was provided as part of a service/leasing business model from producers or distributors of electrical equipment.

2.2.4. Missing knowledge on CRM flows and recovery technology

Missing knowledge on available or new recovery technology can pose a barrier for the successful capture and recovery of CRMs. The ability to easily disassemble products at end of life (EoL) constrains the extent to which mixed materials can be separated (Reuter, et al., 2013, Dominish, et al., 2017).

The availability of data and knowledge on product and materials mass flow will further endorse the implementation of effective and appropriate collection and recycling infrastructure (European Commission, 2017b). Thus, the allocation of funding resources is considered critical to assess the required information regarding CRM data, their occurrence, infrastructure systems and recovery technology. Research and funding should include calls for CRM specific recovery projects to ensure that CRMs are covered, in addition to ensuring that CRM recovery is specifically included within policies.

2.2.5. Missing focus on CRMs by policy makers

Generalised' bans, like a ban on recyclable materials in landfills, can push for the implementation of recycling systems and support the transition to a Circular Economy (Dominish, et al., 2017). However, it does not necessarily involve the establishment of infrastructure for the capturing of CRMs as they make up a low percentage of the overall constituents of an item of WEEE and might be neglected if the focus is on the larger recoverable fractions. Also, setting generic or weight-based recycling targets risks having a negative effect on CRM recycling as they may encourage nations to focus on materials that are easy to recycle and occur in high quantities in order to quickly meet the targets. Policies featuring circular economy and recycling, recovery and collection targets should therefore provide guidance specific on CRMs and encourage their recovery.



Further, in order to meet the future demand for CRMs, many countries' strategies focus on finding adequate substitutions that would allow for a more flexible material input and reduce dependency on a limited number of CRMs. A report by Critical Raw Material Innovation Network describes 35 country profiles on CRM substitution policies (CRM_Innonet, 2015). Japan, for example, heavily focuses on substitution efforts (Chapman et al., 2013).

Substitution possibilities could help Europe to become more flexible in material inputs thereby easing the pressure on supply risks for certain materials (European Commission, 2018). On the other hand, this might negatively affect the efforts for the development and implementation of CRM infrastructure recovery since the use of adequate substitutions could reduce the pressure and need to implement recovery systems (Chapman et al., 2013). This could contribute to a secure supply of CRMs but risks a reduced effort to implement and work on CRM-capturing infrastructure.

2.2.6. Missing conceptualization of global circular product value chain

While new products and materials are being developed at a rapid pace, the integration of innovative design for disassembly and recycling is still not the norm. The missing conceptualization and integration of the whole product value chain in the design and production phase results in increased difficulties for efficient and effective recovery systems.

Missing incentives to include disposal and recycling management in the product design phase could be a result of missing product stewardship from producers after the sale of the product, which is addressed by many countries through extended producer responsibility (EPR) policies. Close cooperation, transparency, reporting, approval procedures and audits are critical factors for successful implementation thereof (European Commission, 2017b). However, without EPR, no direct and short-term revenues are received for making efforts to include design for recycling, thus few incentives are there for companies to do so (Dominish, et al., 2017).

Risks and investment costs pose further barriers to trial new business models that are in-line with the concept of circular economy.

Policy options that aim to accelerate the transition to a circular product value chain should include the provision of incentives to establish secondary materials markets, support to preparation for re-use networks, multi-stakeholder dialogue, capacity building and support of new business models that are based on the circular economy concept (European Commission, 2017b).

2.3. Key Barriers: Summary

A detailed explanation to the barriers, sub-barriers and underlying causes is provided in summary table 3 below, including potential policy actions that could provide support to successfully overcome the identified challenges and barriers.



Table 3: Summary of key barriers

Barrier	Sub barrier	Underlying cause	Opportunities for policy actions
Missing or weak state action to improve CRM recovery	Lack of mandate and power to undertake actions	Legal framework missing CRM focus	Development of national strategy, guidance and regulations for the recovery of CRM-rich WEEE, for example: <ul style="list-style-type: none"> • Strategic Frameworks • Roadmaps • Directives • Waste Management legislation
	Lack of legal basis to pronounce sanction and penalties		
	Confusion on responsibilities among institutions	No clear allocation and definition of responsibilities	Measures to be included: <ul style="list-style-type: none"> • Allocation of state resources • Clear allocation of roles and responsibilities to institutions • Clear definition of stakeholder requirements (producer, consumer, recycler, etc.) • Restrictions
	Weak law enforcement	Missing capacities (manpower, financial capacities, knowledge...)	Intensification of control and monitoring procedures Campaigns Improved guidelines on waste and non-waste EEE
	Illegal transport of WEEE	Missing monitoring capacities Economic benefits of illegal WEEE transport	
Missing knowledge (material, value chain, mass flow, recovery technology etc.)	Missing knowledge on recovery technology	Missing research and capacities	Allocation of funding resources for: <ul style="list-style-type: none"> • CRMs specific research projects • Information platform
	Missing data and		



	information on CRMs	Missing access to information	<ul style="list-style-type: none"> Roundtables and stakeholder dialogues Facilitation of knowledge access Strengthening of international collaboration and cooperation among stakeholders such as manufacturers and recyclers Support of knowledge exchange
Missing focus on CRM recovery	Focus on reduction of waste to landfill	Emphasis on materials with higher tonnages leading to strong visual results (in data)	Ensuring circular economy policies specifically include CRM recovery Avoid substitution policies that undermine CRM recovery efforts Formulation of specific recycling and collection targets for CRMs
	Focus on finding substitutions and alternative input materials	Reduce dependency and need for recycling of CRMs	
	Focus on materials easy to recycle to achieve targets in time	Generic recycling and collection targets	
Missing implementation of CRM recovery infrastructure	High investment and operating costs of CRM recovery infrastructure	Missing profit and potential of high risks due rapid product developments, change in waste streams and quantity, volatile market prices of materials	Provision of financial incentives and instruments Support in initial investments and marketing of new business models and secondary material markets Set example through public procurements policies by favour best practice model Smarter regulation, or streamlined enforcement regimes

	High administrative burden	Missing knowledge and capacities	
	Lack of demand for secondary material/lack of market	Lower or inconsistent quality of secondary material	
Missing disposal infrastructure or incorrect disposal of products containing CRM	Confusion on regulations and collection systems	Inconsistency among states/regions/cities	<p>Easily accessible information</p> <p>Active information of consumers about collection points</p> <p>Awareness raising activities</p> <p>Penalties for incorrect disposal</p> <p>Bring back incentives (free data destruction, financial incentives, EEE deposit system...), etc.)</p>
	Illegal dumping/ Incorrect discarding of waste	Missing collection opportunities Missing awareness, knowledge or willingness	
	Hoarding in households	Missing trust, concern on data security Backup option in case of breakage/damage	
	Missing occurrence of collection points	High administrative burdens and requirements	Streamline administrative burdens for implementation collection points
	Costs for disposal	Missing willingness to pay	Integration of recycling costs in buying price
Missing conceptualization of a circular product value chain	Missing incentive and interest to consider disposal management in product design	Missing or limited product stewardship Long-time gap between sale of product and disposal	<p>Enhanced design for circular economy:</p> <ul style="list-style-type: none"> Extended Producer Responsibility could incentivise producer to design for recycling

	Focus on product sales and known business strategies	High risk associated with new, unproven business models	<ul style="list-style-type: none"> • Certification schemes for product transparency • Standards and requirements • Eco-Design
	Increased complexity of products and composition New materials	Products not designed for disassembly and recycling	Provide incentives/support for: <ul style="list-style-type: none"> • Business models with focus on services rather than on products sales • Innovations that work towards the transition to a circular economy • Secondary products and materials markets • Repair centres

3. Existing Policies Encouraging or Preventing CRM Recovery

The following section provides a literature review on existing policies with reference to the broader waste and raw materials frameworks, specifically on WEEE and CRM Raw Materials. Although the literature review is not all-encompassing, the policies identified are clustered in a way that covers the influencing factors discussed in the framework presented in Figure 3. A short background and rationale on the relevance of the policy options to the collection, recycling and recovery of CRMs is followed by a qualitative assessment of the opportunities and risks and examples of policies, from both within and outside the EU.

Additional explanatory notes on the policies can be found in Annex i, clustered as follows:

- General waste management policies and WEEE policies
- Raw materials strategies and the circular economy
- Substitution policies

Collection and recycling targets:

- Product value chain and product stewardship
- Research and innovation, financial support and international collaboration
- Stockpiling policies
- Export restrictions of raw materials and WEEE.



Figure 3: Policy Framework



3.1. General waste management policies and WEE policies



Entrenched waste policies and incumbent infrastructure designed for linear systems and simpler waste streams are one of the reasons for insufficient collection and recycling infrastructure in order to support the circular economy approach of closed material cycles, particularly for a complex waste stream such as WEEE (Dominish, et al., 2017). Strong general waste management frameworks coupled with extended producer responsibility-based legislation such as the WEEE Directive have created an enabling environment for investment, both through the public and private sector, in improving collection and treatment infrastructure for all waste streams, including WEEE. Thus, underlying waste management policies eventually influence the recovery of secondary CRMs, as they facilitate separate collection of CRM-containing products such as small WEEE. In many cases, both general and targeted waste-product-specific policies define responsibilities of stakeholders, establish minimum or maximum thresholds, and specify compliance regimes and reporting requirements.

Table 4: Potential opportunities and risks regarding general waste management policies and WEEE policies supplemented by a selection of example policies.

Opportunity	Risk
+ Enhance or strengthen existing take-back and recycling systems	– New or change in waste collection system requires behavioural change that is slow
+ Pre-existing familiarity with recycling	– Unplanned legislation can create infrastructure mismatch
+ Selective bans (e.g. landfill bans) can foster the development and implementation of recycling system	– Difficult to assess causal linkage to CRM recovery, which may or may not exist
<p>Example of current policies:</p> <ul style="list-style-type: none"> • Waste Framework Directive (2008/98/EC) (EU) • Extractive Waste Directive (2006/21/EC) (EU) • Landfill Directive (1991/31/EC) (EU) • Waste electrical and electronic equipment Directive 2012/19/EU (EU) • National Waste Management Act (Australia) • The Electric Household Appliance Recycling Law (EHARL) [1998/2001] (Japan) • The Basic Act for Establishing a Sound Material-Cycle Society (Act No.110 of 2000) (Japan) • Swiss Ordinance on Avoidance and Disposal of Waste (2016) (Switzerland) • Waste and Contaminated Soils Act 22/2011 (Spain) • Waste Management Regulations 2003, (Newfoundland and Labrador regulations 59/03) 	

3.2. Raw materials strategies and the circular economy



Multiple countries came up with national strategies to secure the supply of raw materials. While these do not necessarily have their main focus on CRM recovery, it often forms a part of the overall strategy. The Raw Materials Initiative of the EU for example, promotes technology development for the production of primary and secondary materials, research for improved knowledge on CRMs and the establishment of improved frameworks as well as international cooperation. The Sustainable Process Industry through Resource and Energy Efficiency ([SPIRE](#)) is another programme for the EU that focuses on increased material recycling, which includes CRMs.

Circular Economy policies in the EU address the need to prevent waste and increase re-use and recycling as well as the need to increase the responsibility of producers and closed-loop material cycles (Dominish, et al, 2017). However, while long lifecycles of products are favoured in the Circular Economy, it also means that CRMs are kept locked up, which is in-line with the Waste Hierarchy ensuring CRMs stay within use in Europe but will have a negative impact on recycling input rates, considering that this will result in a delay in recycling (European Commission, 2018). Nonetheless, policies supporting the Circular Economy are considered to have a strong enabling influence on the general framework and quickening the path for successful implementation of infrastructure to capture CRMs. The Circular Economy Action Plan, for example, points out the need for improving waste collection and sorting to achieve high-quality secondary materials (European Commission, 2018). Also, the [Circular Economy Package of the EU](#) specifically mentions the prevention of products containing CRMs from becoming waste and highlights the aim to achieve best possible management of waste containing CRMs.

Table 5: Potential opportunities and risks regarding raw materials strategies and circular economy supplemented by a selection of example policies.

Opportunity	Risk
<ul style="list-style-type: none"> + Prevention of waste and the implementation of closed material loop + Addressing the need of implementing measures for improved collection, sorting and recovery + Increased recognition of importance of raw materials, including CRMs 	<ul style="list-style-type: none"> – Focus and resources could be put to easily extractable materials rather than CRMs – CRM list is reviewed frequently, more often than legislation but not as fast as changing technological innovation and material use
<p>Example policies:</p> <ul style="list-style-type: none"> • Circular Economy Package (EU) • Roadmap to Resource Efficient Europe (EU) • Raw Materials Initiative (EU) • Waste electrical and electronic equipment Directive 2012/19/EU (EU) • SPIRE Roadmap (EU). • Europe 2020 Strategy (2010) (EU) • Roadmap to Resource Efficient Europe [2011] (EU) • Circular Economy Action Plan (EU) 	



- The German Government's raw materials strategy (Germany)
- Critical Materials Strategy (USA)
- Law for the Promotion of Effective Utilization of Resources [2000] (Japan)
- España Circular 2030: Estrategia española de economía circular (Spain)

Further strong links to:

- Collection and recycling targets
- Product value chain and extended producer responsibility
- Research, innovation and international collaboration.

3.3. Substitution policies

While the criticality of raw materials becomes an increasing concern, several countries have developed substitution policies in order to reduce dependency on singular materials. A report by the Critical Raw Material Innovation Network describes 35 country profiles on CRM substitution policies (CRM_Innonet, 2015). Japan, for example, heavily focuses on substitution efforts (Chapman et al., 2013).

Substitution possibilities on the one hand help manufacturers to become more flexible in material inputs and reduce supply risks (European Commission, 2018), on the other hand it remains unclear whether it might negatively affect the efforts for the development and implementation of CRM infrastructure recovery as findings of adequate substitutions reduce the pressure and need to implement recovery systems (Chapman et al., 2013).

Table 6: Potential opportunities and risks regarding substitution policies supplemented by a selection of example policies.

Opportunity	Risk
+ Increased flexibility for material input, reduced dependency	– Reduced incentive to develop and improve CRM-linked collection and recycling infrastructure
<p>Example policies:</p> <ul style="list-style-type: none"> • The German Government's raw materials strategy (Germany) • The Horizon2020, the framework programme for research and innovation, addresses the challenge to secure raw material supply through the so-called Raw Materials Initiative, based on which a Strategic Implementation Plan (SIP) is developed. • Rare metal substitution material development project [since 2007] (Japan) • Critical Materials Strategy (USA) 	



3.4. Collection and recycling targets

According to a study by Bipro (2015) the most influential factor on the mass of material recycled and recovered, is the amount collected and processed. The implementation of the WEEE Directive requiring member states to comply with collection and recycling targets has created the enabling framework conditions for the development of take-back systems and recovery infrastructure. The revised targets from 2018 onwards are expected to have a stronger impact than amendments to the recycling and recovery targets (Bipro, 2015). From a CRM perspective, it may however provide an adverse incentive for recyclers who prioritise in order to comply with recycling targets, since their emphasis will likely be put on the recycling of materials that occur in high quantities and are easily extractable, rather than on CRMs specifically which make up a smaller percentage. Thus, weight-based and generic recycling targets are not necessarily enhancing the recovery of materials that only occur in small quantities (Bipro, 2015).

A recent report commissioned by the Environmental Services Association (ESA, 2018) criticised weight-based targets as a way of measuring recycling performance and concludes that more “sophisticated” methods and measures are needed to meet upcoming targets whilst ensuring that valuable materials such as CRMs are recovered from waste. As the WEEE Directive moved into the ‘Open Scope’ phase, a diverse group of potential new EEE has been under discussion in European Member States, and products such as furniture and clothes with electronic components may now become EEE and therefore in scope of the WEEE Directive. Depending on how strict the interpretation is, this could significantly increase the weight of EEE placed on the market and have wider implications for WEEE management and ultimately CRM recovery.

Caution needs to be given also on the terms used and their underlying definitions. Collection, recycling and preparation for re-use are distinct terms. A different interpretation of the terms could lead to a misunderstanding and entails a risk of misuse. For example, a high collection rate could be used as promotion for effective recycling systems, although the collection rate does not provide specification on the amount that is recycled.

Table 7: Potential opportunities and risks regarding collection and recycling targets supplemented by a selection of example policies.

Opportunity	Risk
<ul style="list-style-type: none"> + Setting targets can foster ambitions + Targets enhance and foster pressure on the implementation and need of take-back systems + Targets for collection as well as recycling rates can be an effective tool to increase the amount of material recovery 	<ul style="list-style-type: none"> – Generic and weight-based recycling targets entail the risk that focus is put on materials that have the largest shares of the product composition as compared to CRMs that are often present only in small quantities – Confusion of collection, recycling and recovery rate might lead to misunderstanding and different interpretation



Example policies:

- Waste Electrical and Electronic Equipment Directive 2012/19/EU (EU)
- SPIRE Roadmap (EU)
- Plan Estatal Marco de Gestión de Residuos 2016-2022 (PEMAR) (Spain)

3.5. Product value chain and product stewardship

Product stewardship is seen as a key enabler for improving recovery of materials and is implemented in different ways in a number of countries, as for example in Australia and Switzerland. The extension of the producer responsibility can strongly contribute to the adoption of design for recycling in the manufacturing phase (Dominish, et al., 2017). However, product stewardships only apply to certain products while others are exempt (Ibid). Other measures to close the loop of product lifecycles are the definition of production standards and parameters, including specification on raw materials selection and design for end-of-life product phase (European Commission, 2018). The Eco-Design Directive of the EU constitutes an example thereof. However, in the Eco-Design Directive no specific measures for CRM recovery, re-use or repairability are mentioned. Furthermore, while it highlights the need to consider all environmental aspects, it only applies to a certain number of products. Mobile and smart phones for example are exempt, given the reason that a mobile phone in Europe is in use on average for two years while the eco-design procedure takes four years to develop (European Commission, 2016). In the context to improve the recycling of CRMs, the need to integrate mobiles and smart phones into the Eco-design Directive is mentioned in the Report on the Implementation of the Eco-design Directive.

The promotion of Eco-Design, consumer product life guarantees, markets for secondary materials and the introduction of circular economy criteria in public procurement policies, as included in the EU Circular Economy Package (Dominish, et al., 2017), can positively influence stakeholders along the value chain to implement a Circular Economy approach. However, since the Eco-design Directive itself may not be the right vehicle for CRMs, we could use a more generic approach to promoting eco-design for CRM-rich products – e.g. through Extended Producer Responsibility measures, or the EU Ecolabel.

Table 8: Potential opportunities and risks regarding product value chain and product stewardship supplemented by a selection of example policies.

Opportunity	Risk
+ Extended producer responsibility: Can positively influence product design and infrastructure development	– Standards and production requirements as well as product stewardship only apply to certain products
+ Extension of lifetime of products	– Time for eco-design procedures exceeds average usage time of products
+ Design for re-use, repair and / or recycling	



+ Procurement policies and promotion of Eco-Design and markets for secondary materials can contribute to the implementation of the Circular Economy	
<p>Example policies:</p> <ul style="list-style-type: none"> • Eco-Design Directive [2009] (EU) • Product Stewardship Act 2011 [in revision] (Australia) • ORDEE (Ordinance on the Return, Take-Back and Disposal of Electrical and Electronic Equipment) [1998] (Switzerland) • Spanish legislation on Waste of Electric and Electronic Equipment (WEEE) (Spain) • Product Stewardship in Canada 	

3.6. Research and innovation, financial support and international collaboration

Producers, collectors and recyclers having extensive knowledge on CRMs is regarded as a key success factor for capturing CRMs and setting up an effective recovery infrastructure. Monitoring and tracking of WEEE is therefore needed to account for all WEEE (European Commission, 2017b). Under the Horizon2020 research and innovation programme, several projects are funded that work on knowledge generation of raw materials in the EU. A complete list can be found at

https://orama-h2020.eu/wp-content/uploads/ORAMA_WP5_DEL5.1_20180306_WEEE-Forum_v1.0-3.pdf. Projects focus on exploring technology for primary and secondary materials production, finding adequate substitutes, establishing a material knowledge base and the establishment of improved frameworks and proactive international collaboration.

Projects implemented under the Horizon2020 Programme are said to have contributed successfully to the participation of industrial stakeholders (European Commission, 2018). Moreover, the EU supports research projects that reduce the dependency on critical raw materials, such as the ‘Replacement and Original Magnet Engineering Options (ROME)’’, ‘Suprapower project’, ‘Inndwind.eu’ and ‘EcoSwing project’ (European Commission, 2017a). An example from outside the EU is South Korea, which has a strong focus on recycling of end-use products, design for recyclability, substitution of materials and production efficiency and has invested \$300 million over a 10-year period in respective research projects (Chapman, et al., 2013).

The Critical Raw Materials Strategy in the USA seeks to diversify their supply of CRMs by developing substitutes and improving their recycling capabilities, the above EU initiatives are in place to achieve the same result to negate the potential supply risks.

Financing systems for WEEE recycling can consist for example of an eco-levy or recycling fee, as is in place in Switzerland and Taiwan. The fee paid at the time of purchase is put in a WEEE disposal fund that can subsidise collection and recycling of WEEE, including CRMs.

Table 9: Potential opportunities and risks regarding research and innovation, financial support and international collaboration supplemented by a selection of example policies.



Opportunity	Risk
<p>Research:</p> <ul style="list-style-type: none"> + Improved knowledge of recovery technologies, occurrence of CRM, enabling environments, etc. allows for identification of suitable and feasible measures to enhance infrastructure implementation + Increased knowledge and data availability facilitate risk assessment for investments <p>International collaboration:</p> <ul style="list-style-type: none"> + Acceleration of novel technology development and implementation + Harmonisation of standards and provision + Joint pressure on industry and support for closing CRM cycle + Networks and collaboration can promote innovation <p>Finances:</p> <ul style="list-style-type: none"> + Funding of research projects, work programmes and stakeholder collaboration etc. + Eco-levy or advanced recycling fee as financing mechanism 	<p>Research:</p> <ul style="list-style-type: none"> – New findings on sources for primary material extraction could hinder implementation of recovery infrastructure <p>International Collaboration:</p> <ul style="list-style-type: none"> – Conflicts of interest, increased competitiveness might cause countries to actively hinder international collaboration <p>Finances:</p> <ul style="list-style-type: none"> – Requirements for payments of recycling fees at the time of disposal can lead to non-participation from citizens and businesses
<p>Example policies:</p> <ul style="list-style-type: none"> • Horizon2020 - the Framework Programme for Research and Innovation [2014] • China subsidizes REE producers on technological upgrades (China) • Funding for Technology (Switzerland) • ARPA-E: Funding of transformative research (USA) • “Replacement and Original Magnet Engineering Options” (ROMEEO) (International research consortium aiming at developing magnets without rare-earth materials) • Raw Materials Initiative (EU) • Waste Disposal Act (Taiwan) • ORDEE (Ordinance on the Return, Take-Back and Disposal of Electrical and Electronic Equipment) [1998] (Switzerland) 	

3.7. Stockpiling policies

Stockpiling or accumulating desired materials such as CRMs is one technique used by resource rich countries to create and ensure future supply. For example, China possesses



a near-monopoly on the majority of rare earth elements (REEs) and decreased their export quotas in 2012 to regulate industry and conserve supplies. The effect of stockpiling activities on influencing the development of CRM recovery infrastructure is not clear, the market price of CRMs is more likely to be the most important factor. Increased stockpiling activities might lead to higher market prices. This in turn could foster the need to speed up the process of building recovery infrastructure due to the increased economic value of the materials and consequently the increased economic justification to invest in recycling processes. Likewise, sudden influx of stockpiled materials poses a risk to market price fluctuations, as happened in 2000 with Beryllium stocks when the US Military Department of Defence closed their last primary beryllium facility placing more on the international material market (European Commission, 2015).

Countries known for stockpiling policies are Russia and the USA (Chapman, et al., 2013) as well as Japan and South Korea (European Commission, 2015). There are various reasons for stockpiling materials. In the US for example stockpiling ensures a secure supply of strategic defence material (Chapman, et al., 2013, Nicoletopoulos, 2014). Japanese stockpiles are intended to serve military as well as economic purposes (Barteková and Kemp, 2016).

Table 10: Potential opportunities and risks regarding stockpiling policies supplemented by a selection of example policies.

Opportunity	Risk
+ Increased scarcity might enhance the need and speed up the implementation of infrastructure for CRM recovery	– Could lead to market price distortion
Example policies: <ul style="list-style-type: none"> • South Korea: Builds up a stockpile of rare earths, among other critical raw materials, equivalent to the domestic consumption of 60 days • US: stockpile for strategic defence • Russia: Active program on materials stockpiles • Japan: Stockpiling for military and economic purposes 	

3.8. Export restrictions of raw materials and WEE

Export restrictions and quotas imposed by mineral rich-countries, such as China and Russia (Chapman, et al., 2013), largely affect countries that have limited primary resources, such as the EU, and which thus depend on primary resources from foreign countries. To reduce the risk of potential bottlenecks of certain material supply, the EU challenges trade restrictions and increases cooperation with other countries to promote joint research (Rabe, et al., 2016).

Increased costs for the export of WEEE can be caused by export taxes imposed on WEEE or hazardous materials. Currently proposed amendments to the Hazardous Waste Act in Australia will increase the costs for export of WEEE. This might act as a driver to set up in-



country processing schemes for WEEE. An economically viable recycling system requires a certain minimum amount of input material. Thus, for smaller countries with a waste stream below the minimum threshold or in countries with no efforts to implement recycling systems, increased export costs might result in increased illegal disposal activities or illegal transport of waste.

Table 11: Potential opportunities and risks regarding export restrictions of raw materials and WEEE supplemented by a selection of example policies.

Opportunity	Risk
<ul style="list-style-type: none"> + Export taxes/quotas or increased costs for export of WEEE could lead to higher material stock inside country and might increase feasibility for the implementation of recycling systems + Codes for each WEEE type and training for customs officer could exterminate illegal export 	<ul style="list-style-type: none"> – In-country waste too little for economically viable extraction methods – Increased illegal dumping – Increased illegal movement of waste without control of consequent operating processes
<p>Example policies:</p> <ul style="list-style-type: none"> • China: Export quotas to secure internal supply (China) • Australia: Proposed amendments to the Hazardous Waste Act (Australia) • Waste Shipments Regulation (EU, 2006e) [2006] (EU) • OMW (Ordinance on Movements of Waste) [2005] (Switzerland) 	

3.9. Information, awareness raising and society

Consumers and businesses have the power to act as a driver or barrier for high quality CRM-rich WEEE reaching the recycling stream through their purchasing behaviour, although this is strongly influenced by economics and marketing communications. Information and the promotion of certification schemes for products made from secondary materials and designing products with recycling in mind could enhance the purchasing preference for sustainable and circular products (Baldé, et al, 2017). This could improve the market demand for secondary products and materials. Caution needs to be exercised over the reputation and reliability of the certification scheme, and to ensure high quality. Otherwise, there might be a risk of linking recycled material with lower quality and expected lower costs, as concerns from producers have shown (Bipro, 2015).

To foster correct collection for recycling/re-use information regarding disposal opportunities (where and when) needs to be easily accessible. Several policies include requirements on the provision of information and communication to citizens, e.g. Waste Management Regulations 2003 of Newfoundland and Labrador. Furthermore, policies outlining the



responsibility of consumers to bring back their WEEE (e.g. Germans) are likely to increase collection rates.

A combined disposal system of different waste streams or take-back opportunities, like using street collection and charity take-back schemes (Claes, et al., 2018), could enhance the correct disposal rate. Penalties could also work as tool to reduce illegal disposal but would only work with increased monitoring and controls. Furthermore, to avoid illegal transport of WEEE, inspection plans on WEEE management and control procedures are recommended (European Commission, 2017b). Disposal costs are to be avoided if possible and any recycling costs should be integrated into product prices at the time of purchase, as is the aim of EPR schemes (see also 2.6).

Inconsistency of waste collection systems among regions, cities and states causes confusion over disposal systems by consumers and operators. Harmonization of systems can facilitate and increase disposal and collection rates.

Table 12: Potential opportunities and risks regarding information, awareness raising, and society supplemented by a selection of example policies.

Opportunity	Risk
<ul style="list-style-type: none"> + Awareness and education + Increase knowledge and communication about disposal place and time + Consumer responsibility + Ensure reputation and relationship of trust + Ensure safekeeping of discarded items + Engage with public through collection events and other interactions 	<ul style="list-style-type: none"> – Reluctance to use or buy recycled products – Data misuse and other incidents that negatively impact trust and reputation – Disposal costs – Risk assessment needed for grouping with other waste (danger of fire? contamination?)
<p>Example policies:</p> <ul style="list-style-type: none"> • Waste Management Regulations 2003, (Newfoundland and Labrador regulations 59/03) • SCREEN (Solutions for Critical Raw materials – a European Expert Network): Critical raw materials online campaign 	

4. Policy Recommendations



The following section uses the evidence generated from the collection and treatment trials, in addition to the literature review, in order to present policy recommendations for development within Europe to increase CRM recovery. For each of the policy recommendations, actions are outlined to demonstrate how the policies could be enabled and the counterfactual risks and impacts associated with them if they are not implemented.

The five pan-European policy recommendations are:

1. **Redesign and harmonise collection infrastructure**
2. **Increase awareness amongst citizens and businesses**
3. **Create incentives for collection and recycling organisations**
4. **Continue innovation and research on CRM recovery and foster international collaboration**
5. **Introduce CRM-specific requirements into standards.**

The first policy recommendation (**redesign and harmonise collection infrastructure**) has been identified as a priority to help ensure CRM-rich materials are collected and segregated as this is proven through the trials to support CRM recovery. Similarly the second policy recommendation (**Increase awareness amongst citizens and businesses**) aims to support the first by advising citizens and businesses to channel CRM-rich WEEE in a good condition to the correct facility, those collection and recovery facilities in turn should be incentivised to recovery CRMs from WEEE (policy recommendation 3). The availability of recovery technology available now and in development should be supported by EU investment and continuation of research and collaborative projects to ensure CRMs are kept in circulation within the EU market (policy recommendation 5) and in order to convey the significance of CRM recovery, specific requirements should feature within European standards (policy recommendation 5).

These policy recommendations are aligned with achieving the 3 infrastructure recommendations outlined in Pan-European Infrastructure Development (B4) section 5.

4.1. **Redesign and Harmonize Collection Infrastructure**

There is a need to build on the infrastructure already in place and to allocate funding to ensure that an increase of collection and recovery infrastructure can be built, that is tailored for collection to include CRM recovery. This needs to consider how to counteract:

1. Missing disposal infrastructure for CRM-rich WEEE
2. Missing CRM-recovery infrastructure

High administrative burdens placed on organisations seeking to recover CRM-rich WEEE may result in missing or sparse collection points, hindering a citizen's ability to responsibly donate unwanted electrical items. This can lead to incorrect or illegal WEEE disposal, rendering items that are perfectly suitable for re-use or recovery being lost from the system. Similarly, if collection points are not designed with re-use in mind, high-quality items are more likely to become damaged during the deposit or transit phase of collection.



Any inconsistencies among states / regions / cities / counties etc., can lead to confusion on obligations for WEEE disposal. Without the correct awareness, knowledge or willingness of citizens to correctly and responsibly dispose of unwanted electrical items, products can end up being hoarded unused within the home, depreciating in value and preventing CRMs from being recovered as demonstrated in [WRAP's research](#).

Actions to enable policy intervention:

- Redesign collection infrastructure to ensure products are collected in a way that supports re-use and CRM recovery
- Harmonise collection infrastructure to avoid confusion or incorrect disposal
- Create easily accessible and consistent information and undertake awareness raising activities such as campaigns
- Prioritise product re-use by introducing standards or certification schemes
- Support the development of innovative recycling technologies for CRMs
- Introduce penalties for incorrect disposal
- Ensure product take-back is conveniently located and not admin intensive
- Reduce administrative burdens where possible i.e. prohibitive permits.

Table 13: Summary for policy interventions, counterfactual risks and impacts

Opportunity / Challenge	Risk	Impact
Missing willingness to pay for costs of disposal	There may be unwillingness to pay the cost of disposal if the fees are not consistent or deemed to be disproportionately placed on any one stakeholder	Payments of recycling fees at the time of disposal can lead to non-participation and or increase fly-tipping
High administrative burdens / administrative requirements	Fewer collection points	Fewer WEEE items collected and being sent for CRM recovery
Inconsistent collection infrastructure within regions	Confusion on what WEEE to donate, how or where to donate items	Contaminated batches or lack of items collected
Missing awareness / knowledge of obligations, regulations or location of collection points	Confusion on what WEEE to donate, how or where to donate items	Contaminated batches or lack of items collected, non-participation and or an increase of fly-tipping
Lack of trust in the system and lack of knowledge on how to remove data from unwanted electrical items	Lack of trust and / or a fear of data theft from data-bearing devices	Increased hoarding of WEEE, fewer items donated

Not tailoring WEEE collection points to prioritise product re-use or CRM recovery	Items suitable for re-use being damaged, lower quality / less consistency in collection	Fewer CRM-rich WEEE being sent to CRM-recovery facilities Lack of demand due to perceived risk
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4.2. Increase Awareness

Increasing awareness amongst policymakers, organisations and citizens of the importance of CRM recovery is vital to ensure their successful recovery. Missing knowledge on the potential supply risks and the associated impacts may be due to a lack of available information or research conducted in this area. Facilitating knowledge exchange by supporting an online platform is one method counteract this.

Information on EEE flows and CRMs contained within them are not always captured by statistics. To better monitor and measure EEE flows, relevant governments bodies should have access to the latest information and statistics in order to initiate appropriate state interventions such as improved guidance. A regular collection of consistent EEE flows data will highlight where data gaps are present and may provide a better indication of where illegal activities are occurring or where EEE is lost from the system.

Many of the trial participants cited not knowing how or where to correctly deposit their unwanted electrical items, others noted that they were reluctant to hand over their data-bearing devices due to data security concerns. Without empowering citizens with the knowledge on how to sufficiently eradicate their personal data or provide information on how data is eradicated by recovery facilities, items suitable for re-use are likely to be hoarded at home. An awareness campaign may help to increase trust in the recovery system and lead to more electricals containing CRMs to be re-used or enter the recovery system.

Actions to enable policy intervention:

- Develop national strategies, guidance and regulations to recover CRMs i.e. roadmaps or strategic frameworks.
- Commission awareness-raising campaigns for all stakeholders and introduce educational programs i.e. community and school based.
- Facilitate knowledge exchange by supporting a platform.
- Support or create certification schemes that identify products designed for repair/re-use/recycling.
- Allocate funding resources for:
 - The continuation of CRM-specific research projects
 - An information platform
 - Roundtables, events and stakeholder dialogues.



Table 14: Summary for policy interventions, counterfactual risks and impacts

Opportunity / Challenge	Risk	Impact
Missing concept of a global circular economy value chain / not taking a systems-thinking approach look at all actors within supply chain	Importance of CRM recovery being unknowns to relevant actors	CRM- recovery not being included in policies or collection infrastructure design
		More virgin CRMs being extracted as opposed to recovering CRMs already within the European system
Missing knowledge-sharing platform unavailable to interested stakeholders	Research being repeated, CRM recovery may be seen as an unprofitable or high-risk investment / venture	Lack of investment in CRM recovery facilities, duplication of research
Missing monitoring capabilities	CRM-rich WEEE being illegally exported outside of Europe	Lost value from potential recovery, polluting other nations less-equipped to safely recycle WEEE
Lack of public campaign / educational literature	Stakeholders unaware of how, where or why to donate / dispose of WEEE	Incorrect or illegal disposal of WEEE
Lack of knowledge on how to remove data from unwanted electrical items	Lack of trust and / or a fear of data theft from data-baring devices	Increased hoarding of WEEE, fewer items donated

4.3. Create Incentives

It is important to create incentives for each of the various stakeholders involved to ensure CRMs are recovered. Incentivised trade-in for example is a proven method to encourage citizens to donate high-quality CRM-rich electrical items in a good condition. Prohibitive financial or administrative burdens placed on organisations seeking to invest in CRM-collection infrastructure may impact the number of available collection points or stop collection initiatives completely.

To encourage citizens to use collection points, access to them must be convenient and they must be easy to use. Each trial-host nation had different collection activities tailored for the cultural conditions of the area. For example, collection bins in Italy were placed in squares where the local community congregated on particular days. This method may be replicated in similar nations (see Section 6).

If industry is not sufficiently supported or incentivised to trial new resource efficient business models that prioritise re-use or invest in CRM recovery facilities, these ventures may be seen as too high a risk. Without a strong high-quality secondary material market, recovering CRMs



may be perceived as too risky to invest in. Similarly, either industry-lead or policy driven interventions are needed to include disposal management strategies within the product design phase.

Actions to enable policy intervention:

- Provision of financial incentives and support from electronic producers
- Introduce incentivised deposit schemes for the separate collection of CRM-rich products such as mobile phones.
- Modulated fees for products containing secondary materials / recovered CRMs
- Producers to introduce incentives for product donation (i.e. free data erasure as demonstrated in the Axion collection trial)
- Utilise public procurement policies and support industry by:
 - Investing in CRM recovery initiatives
 - Reduce risk to organisations to encourage them to try resource efficient business models that foster and support closed material cycles and secondary material markets
 - Encourage leasing, service, take-back, re-use, and repair business models
 - Encourage innovations that work towards the transition to a circular economy.

Table 15: Summary for policy interventions, counterfactual risks and impacts

Opportunity / Challenge	Risk	Impact
Lack of investment in CRM recovery operations due to perceived risk	CRMs not being recovered	More virgin CRMs being sourced
Lack of convenient collection facilities	Citizens not donating or disposing of the CRM-rich WEEE correctly	Increased hoarding of WEEE, fewer items donated
Poor / volatile secondary raw material market	Industry not investing in CRM-recovery initiatives	More virgin CRMs being extracted as opposed to recovering CRMs already within the European system
Missing capabilities i.e. manpower / finances / knowledge	Weak enforcement of legislation / confusion on responsibilities and obligations	Illegal activities, fewer items being donated
Disparate availability of incentivized deposit schemes	CRM-rich WEEE not entering the recovery / recycling system	Fewer items being donated and / or being sent to landfill

4.4. Foster Innovation, Research and International Collaboration

Increased knowledge on the amount and availability of CRMs and WEEE in markets could reduce the perceived investment risks and criticality assessments could increase willingness of the private sector to invest in infrastructure for the recovery of CRMs (Dominish et al., 2017).

International collaboration is important for knowledge exchange on research and technology on capturing CRMs as well as for international standards of recycling techniques and international agreements. However, due to increased competitiveness (Tello Pand Weerdmeester, 2012) countries might pursue different goals for participating in international collaboration; some might even follow an opposing strategy.

New material innovations in ever more complex electronic products happen in quick cycles, often out-pacing policy developments and the list of CRMs as defined by the European Commission is amended faster than policy cycles. Continuing support for research projects to keep up with technology and policy developments that specifically relate to CRMs would help to progress the recovery of CRMs from WEEE. Due to the time between product sale and disposal, product stewardship initiatives and innovation in designing products for disassembly and recycling should be encouraged. This will require international and cross-sectorial collaboration, funding and a sustained platform to exchange knowledge and share research being undertaken in this field.

Many of the recovery trials involved innovative lab-based or proof-of-principle experiments as these activities have not yet been scaled up to a commercial or industrial-sized operation. A lack of investment in CRM recovery infrastructure on an industrial scale may be a result of a lack of market demand for or available research on secondary raw materials. The volatility of market prices for secondary raw materials may also present a risk to potential investors due to rapid product development and the uncertainty of supply.

Actions to enable policy intervention:

- Continue support for research projects that specifically relate to CRMs in order to increase knowledge on materials, mass flows and technology
- Promote collaboration between stakeholders along the value chain
- Enhance the development and implementation of recovery technology and improved product / systems design
- Support international collaboration and network building to increase knowledge exchange in order to accelerate the successful recovery of CRMs
- Develop national and international agreements, product standards and requirements on recycling facilities, production procurement etc.

Table 16: Summary for policy interventions, counterfactual risks and impacts

Opportunity / Challenge	Risk	Impact
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Missing product stewardship initiatives and a long time between purchase and disposal	Missing incentive or interest to include disposal-management at the product design phase	CRMs not being recovered from products at end of life
Missing access to information / research already undertaken	Duplication of work	Progress on CRM recovery progressing at a slower pace
Missing knowledge / awareness on CRM recovery technology or techniques	Expertise not being shared in Europe	Silos in research and development
Products not designed for recycling / re-use / CRM recovery	Products being difficult to disassemble	Valuable CRM-rich concentrated components not separated out for recovery activities
Missing research capabilities	CRM recovery and collection innovation not developing at the same pace as technology or policy developments	Lost opportunities to recover CRMs

4.5. CRM-Specific Requirements for Standards

Generic or weight-based collection and recycling targets for WEEE result in nations prioritising heavy items such as large domestic appliances (LDAs), which typically do not contain high concentrations of CRMs. Historically, waste legislation has focused on a reduction of hazardous waste, particularly landfill diversion instead of taking a more strategic approach and prioritising high value material recovery such as CRMs.

If CRM-specific collection and recovery is not embedded within policies, there is little incentive for organisations to prioritise them. Without explicit allocation of responsibilities, stakeholders across the value chain can become confused or misinformed about their obligations. Missing legal frameworks for CRM-specific collection and recovery means those responsible are not empowered to issue penalties or sanctions in the case of non-compliance.

Increasing EU monitoring capabilities for the management of WEEE exports would improve supply conditions both within and outside of the EU, alongside an increase to the cost of WEEE for export (as is currently being proposed for the Hazardous Waste Act in Australia) may provide a driver for investment in local recycling infrastructures. An economically viable recycling system requires a certain minimum amount of input material. Thus, for smaller EU countries with a waste stream below the minimum threshold or in countries with no efforts to implement recycling systems, increased export costs might result in increased illegal disposal activities or illegal transport of waste.

Similarly, increased monitoring and visibility would see items that have been deemed suitable for re-use exported as opposed to waste being illegally transported under the guise of recycling.



Actions to enable policy intervention:

- Introduce extended schemes for electrical and electronic equipment
- Integrate critical raw materials and their recovery strategies into circular economy frameworks, sustainable waste management frameworks, raw materials strategies or similar policies
- Use the Ecodesign Directive to improve the design of EEE so as to increase the recycling of CRMs. Several Eco-Design regulations are asking manufacturers to provide technical documentation of “information relevant for disassembly, recycling or disposal at end-of-life”
- Clearly define and allocate institutional tasks and responsibilities
- Revise policies to ensure they align to a supportive overall framework for the implementation of CRM recovery infrastructure
- Develop national strategies within each of the trial host nations
- Develop guidance and regulations for the recovery of CRMs (i.e. strategic frameworks, roadmaps, directives, waste management legislation)
- Increase WEEE export monitoring capabilities to prevent illegal waste shipments and encourage re-usable electronics to be exported

Table 17: Summary for policy interventions, counterfactual risks and impacts

Opportunity / Challenge	Risk	Impact
Missing willingness to pay for costs of disposal	There may be unwillingness to pay the cost of disposal if the fees are not consistent.	Payments of recycling fees at the time of disposal can lead to non-participation
Focus on reduction of hazardous waste to landfill	CRM recovery not included in collection or recovery considerations	Emphasis on materials which will more quickly fulfil target requirements
Generic / weight-based targets	Heavy items prioritized for collection	Emphasis to amend collection and recycling targets to be focused on impact and value
Confusion on regulations	Inconsistent collection / recovery opportunities	Fewer CRM-rich WEEE items collected and sent for recovery
Increase export taxes / quotas for WEEE	Higher material stock in-country	Increased ability to use funds to implement CRM-specific recovery systems
Create codes for WEEE categories and provide training to customs officers	Administrative burden	Reduce illegal export of WEEE



5. Opportunity to Replicate in Other Member States

To investigate how the lessons learned from each of the trials could be transferred to other Member States, a comparison exercise has been conducted with criteria used in the Compliance Promotion Exercise in addition to an analysis of the individual situations of the four Member States where the collection and treatment trials took place.

Methodology

Out of the 22 criteria used (Annex ii) in the Compliance Promotion Exercise, the following five have been added as they were deemed relevant in the context of the CRM trial activities:

1. Performances in separate collection
2. Treatment capacity for first treatment
3. Achievement of recycling/preparation for re-use target
4. Performance of recycling/preparation for re-use target
5. Development of recycling/preparation for re-use target

Additionally, the knowledge gap of complementary streams has been considered using the ProSUM project dataset (Huisman, et al., 2017) and the clustering of Member States is based on the Common Methodology for estimate of WEEE Generated (Magalini, et al., 2014).

An analysis of the WEEE collection performance (considering the most recent dataset in Eurostat where all Member States reported data) shows that each of the four trial host nations (UK, Italy, Germany and Czech Republic) are in the group of Member States with collection performance reportedly below the 45% of WEEE placed on market (POM) target as per the WEEE Directive (up to 2019). While Italy and Germany report collection above 40% and are at the top of the cluster, the UK and Czech Republic are in the middle, between 30%-40% (Figure 4).



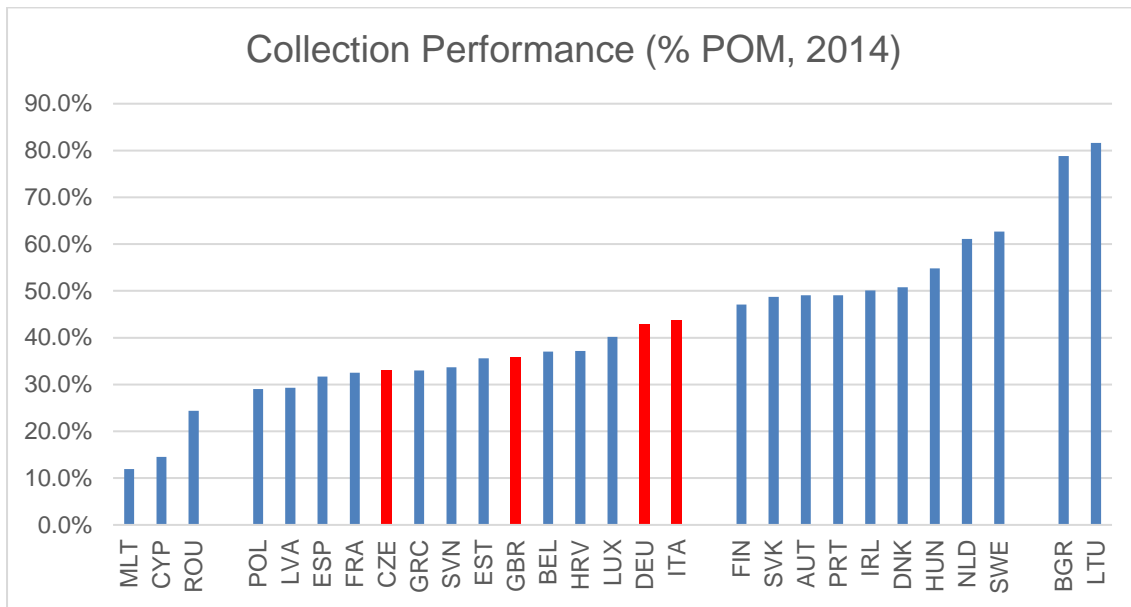


Figure 4: Collection Performances of Member States (WEEE Flows Model)

With regards to the availability of collection infrastructure, only Germany reported checks on the availability of treatment infrastructure by competent authorities. Both the Czech Republic and the United Kingdom reported that checks on the availability of treatment infrastructure is not monitored, and although there was no response from Italy regarding the same, it can be assumed that the availability of collection infrastructure is also not officially monitored by local authorities at the National level, as waste permits are under the remit of individual regions.

When considering the performances of Member States with regards to the recycling target (article 11 of the WEEE directive) the situation is similar across EU (Figure 5).

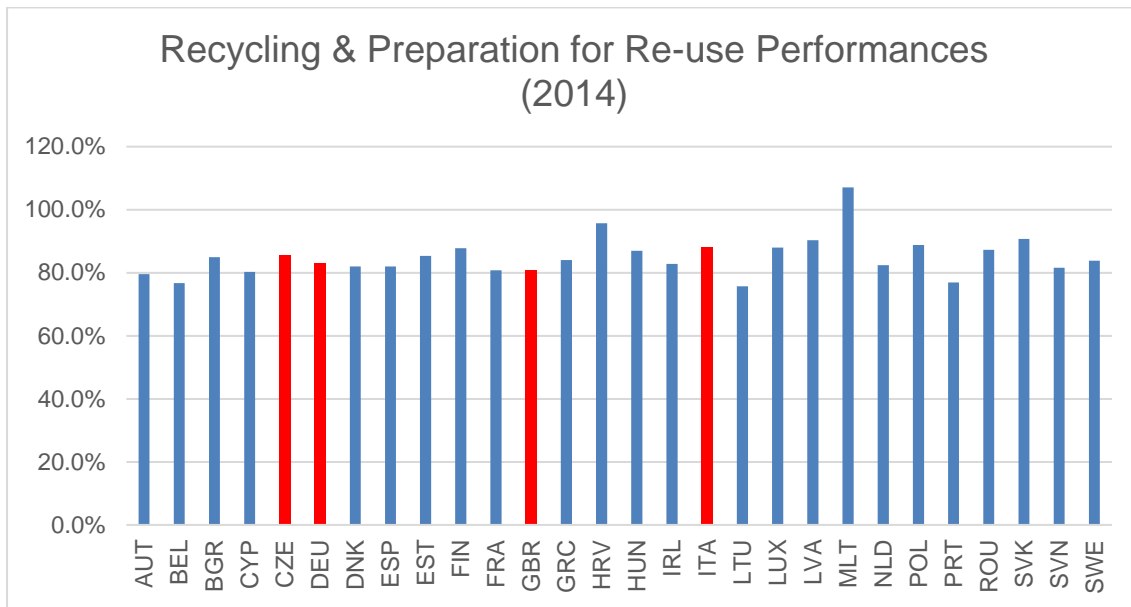


Figure 5: Recycling & Preparation for Re-use Performances (WEEE Flows Model)

Previous reports (BiPRO, 2017) have highlighted that the main concerns are not related to the achievability of the target (as reported by Member States), but rather in the consistency of approaches adopted for the calculations of the performances. Furthermore, all CRMs that are widely used in electrical and electronic equipment are in the majority of cases present only in very limited quantities (ppm) within individual products. This means that, despite their criticality, a weight-based recycling target will not represent a significant enough incentive for their recovery. Some of the precious metals are recovered because of their economic value, but from a legal compliance perspective, the recycling target does not create a binding instrument to ensure proper recovery for CRMs.

Trend performances from official Eurostat data have been considered and the average of 2010-2012 versus 2013-2015 compared. Figure 6 below shows those countries where average performance increased (+1) versus those where decreased (-1).

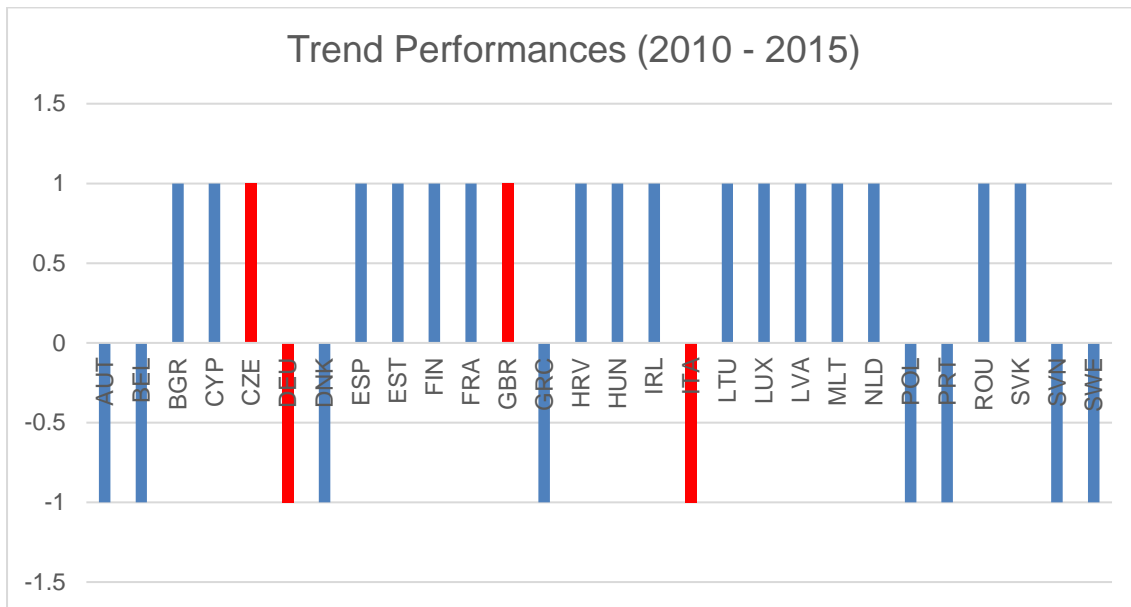


Figure 6: Trend Performances 2010-2015 (Eurostat, 2018)

The data gaps resulting from the ProSUM project EU dataset has been used to highlight the missing knowledge on waste generated (WG) in the 28 EU Member States, data is displayed in Figure 7 below and each of the trial host nations are highlighted in red.

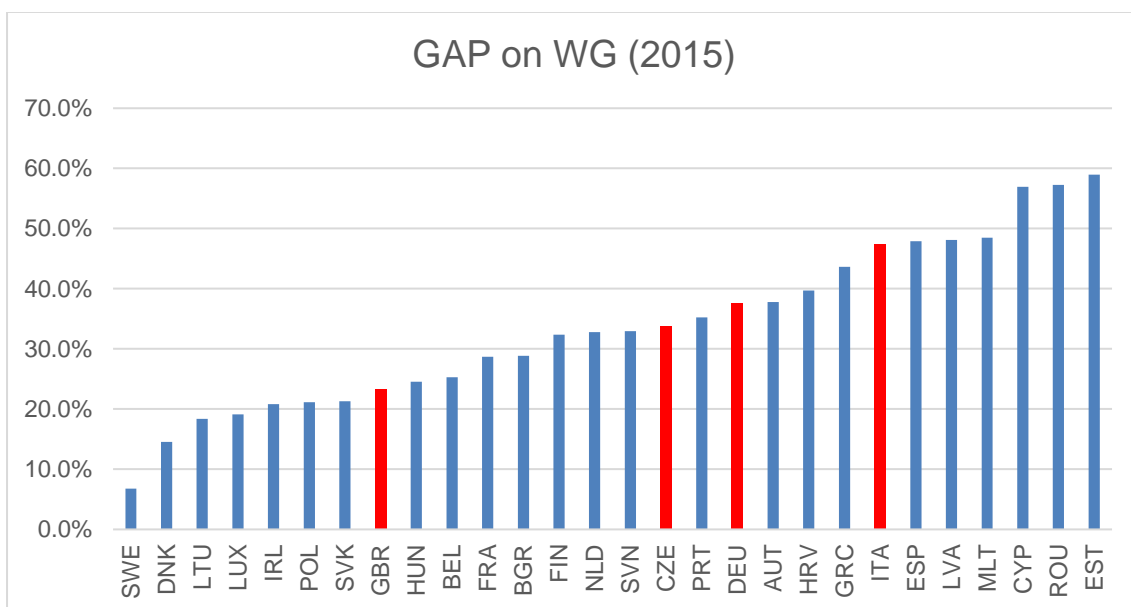


Figure 7: Knowledge GAP of Member States (2015 data)

When considering the various indicators, it has not been possible to identify clear patterns or clustering of countries in a unique way. Comparison is a challenge due to data from various Member States not being consistently collected within Eurostat statistics. Some Member States already started to actively investigate the knowledge gap on complementary flows



(WRAP, 2016) with the aim of improving the understanding of underlying dynamics behind collection and recovery of WEEE generally or CRMs specifically.

Therefore, reliable data analysis and economic modelling was not possible, due to inconsistencies in the data collected from Member States within Eurostat statistics. Nor was it possible to determine the ease of set up or impact of introduction. However, the trials demonstrated that issues underlying the lack of CRM recovery are prevalent across all trial regions. The research and consultation undertaken to develop the policy recommendations to increase the recovery of CRMs identified common elements that can be considered when looking at policy recommendations derived from the collection and treatment trials and their applicability within the trial regions and across all Member States:

- Almost all Member States are not yet able to reach the ambitious collection targets set for 2019 and onwards (65% POM or 85% WG) and collection of small WEEE is one of the key aspects to tackle. Thus, any action aiming at rethinking the collection strategy to foster collection can be transferred or replicated in various Member States
- The first step to ensure CRMs are recovered (or kept in the economic loop through preparation for re-use activities) is to secure their separate collection. Once this is achieved, there are two distinct strategic goals:
 1. Products suitable for preparation for re-use should be clearly identified, and their secure and safe handling should not compromise the reusability potential; in this respect standards should be developed and adopted to ensure CRM-rich WEEE is handled, stored and transported carefully.
 2. For the recovery of CRM through recycling processes, trials and industrial processes are being developed or adopted across Europe with the aim of ensuring the recovery of many of the elements (Summary Report EC technical working group, 2016). Concentration of products and fractions richer in CRM could help in overcoming some of the barriers and recycling cost factors that currently hamper the effectiveness of the recovery.

6. Conclusion

As the EU is largely reliant on imports of CRMs from non-EU countries, it is important to ensure CRMs are recovered from WEEE so as to continue their circulation within European markets thereby reducing the need to extract more virgin resources. The potential barriers, risks and policy opportunities that emerged from the WEEE collection and CRM-recovery trials were clustered into themes for this report.

The three most prevalent barriers that would need to be addressed in order to increase CRM recovery from WEEE in the EU were identified as requirements to:

- redesign the way CRM-rich WEEE is currently collected,
- raise awareness amongst citizens and businesses about the importance of and correct routes for recycling unwanted electricals and,
- ensure recyclers and collectors were not disproportionately burdened by administrative duties when seeking to collect CRM-rich WEEE for material reclamation.



All five policy recommendations are applicable to the four trial host nations as the clustering exercise (section 6) demonstrated that they were not dissimilar enough to require different policy measures, instead they shared common challenges in CRM-rich WEEE collection and recovery which requires EU-wide policy interventions.

The recovery of CRMs is dependent on the quantity and quality of the WEEE collected. Many of the trials highlighted that when working with known and trusted brands, citizen's security concerns were offset. Similarly, when high quality whole (undamaged) items were sent for recycling, the recovery phase was easier as the products could be disassembled more quickly. As such, harmonised, conveniently positioned and secure collection points are required to ensure CRM-rich WEEE can be separated out and remain in a good condition for re-use or ease-of-disassembly purposes.

Additionally, the lack of an established network of registered and authorized/certified preparation for re-use operators emerged as a key barrier from the trials which is also in-line with trial participant's concerns regarding the data security of their devices.

Policy actions should aim towards providing a stable secondary material market to support and incentivize a secure financial framework, by using economic instruments in order to reduce investment risks for recyclers and the long-term feasibility of recovery technology through, for example, the development of standards on minimum production requirements, modularity or the labelling of product components. Specific guidance or requirements for CRM recovery are not currently outlined within WEEE legislation; the Circular Economy Package specifically mentions the need to prevent products containing CRMs from ever becoming waste but no guidance on recovery. To encourage CRM capture from WEEE, policies featuring circular economy or collection/recovery targets should include targeting CRMs specifically.

Analysis following the policy literature review highlighted that the Eco-design Directive itself may not be the right vehicle for CRM capture, but that a more generic approach to promoting eco-design for CRM-containing products may be more effective, e.g. through EPR, or the EU Ecolabel. Similarly, the policy literature review revealed that weight-based collection and recovery targets are not suited to CRM-recovery as they may encourage nations to prioritise heavier items to more quickly achieve the targets as opposed to seeking out the valuable CRMs from WEEE.

The interviews conducted by the Wuppertal Institute during the trials highlighted that many citizens are unaware of how or where to recycle their unwanted electronics. Coupled with the fear of whether their data would be fully eradicated resulted in hoarding, whereby products are left at home rather than being recycled. Raising awareness is required to relay data security concerns and empower citizens to erase their own data. Similarly, many of the trials undertook marketing campaigns to accompany the collection activity including posters, leaflets and local radio advertising. These activities were effective as the amount of WEEE collected increased in the trial areas during the collection activities.



A continuation of CRM recovery research and knowledge sharing is required to scale-up the recovery activities from lab-based to commercial operations. It is also clear that there is no platform available for actors in the industry to exchange knowledge or seek out collaboration activities. An online platform to foster continued research efforts, alongside a continuation of available funding from the Commission is recommended to ensure experts in the field can progress CRM recovery within the EU.



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Annex

i. Existing Infrastructure in Trial Host Nations

The table below provides an overview of the infrastructure in place for CRM recovery in the four countries where the five trial studies were conducted. More information on the trials can be found at <http://www.criticalrawmaterialrecovery.eu/trials>.

Czech Republic														
Main policies referring to WEEE														
<ul style="list-style-type: none"> Waste Act 2001 (nбр. 185/2001) Management of Electrical and Electronic Equipment and Waste Electrical and Electronic Equipment, Decree 352/2005 (amendments: o Decree No. 65/2010 Coll. o Decree No. 285/2010 Coll. o Decree No.158/2011 Coll.) Decree No. 237/2002 Coll. on the Details of the Manner of the Take-back Procedure of Certain Products Selected End-of-Life Products, Draft Law, January 2016 														
Extended product responsibility														
<p>The extended producer responsibility applies to a number of WEEE groups, including IT and telecommunications equipment, consumer electronics, toys, monitoring and control devices, end of life vehicle, household appliances and more (CENIA, 2008). Producers and importers are obliged to take-back used products from consumers free of charge (Decree 237/2002). Further, they are required to inform the consumers about take-back places, types of products, opening and closing time and that no charges are imposed (Decree 237/2002).</p>														
Collection and recycling targets														
<p><i>Collection targets of waste electrical and electronic equipment (Ministry of Environment, 2014)</i></p> <table> <tr> <td>Target of collection rate:</td><td>by 31 December 2015</td><td>> 5.5kg/inhabitant/year</td></tr> <tr> <td></td><td>For the year 2017</td><td>> 45%</td></tr> <tr> <td></td><td>For the year 2018</td><td>> 50%</td></tr> <tr> <td></td><td>by 14 August 2021</td><td>65%^[1]</td></tr> </table> <p>The responsibility to meet the collection rate lies with the producers. However individual as well as collective fulfilment is possible. The current collection rate is considered to be 50% and thus lies just around the target rate (Marusova and Mazal, 2018).</p>			Target of collection rate:	by 31 December 2015	> 5.5kg/inhabitant/year		For the year 2017	> 45%		For the year 2018	> 50%		by 14 August 2021	65% ^[1]
Target of collection rate:	by 31 December 2015	> 5.5kg/inhabitant/year												
	For the year 2017	> 45%												
	For the year 2018	> 50%												
	by 14 August 2021	65% ^[1]												

¹ By weight and relative to the average annual weight of electrical and electronic equipment that was put on the market in Czech Republic in the previous three calendar years.

Recovery, recycling and preparing for re-use targets of electric and electronic waste^[2]
(Ministry of Environment, 2014)

Recovery target:
from 2018: 75%-85% depending on type of WEEE

Prepared for re-use or recycling:
from 2018: 55%-80% depending on type of WEEE

The Waste Management Plan further outlines information on objectives and targets regarding batteries and end-of-life vehicles among others (Ministry of Environment, 2014).

Collection points and systems

The producers are required to provide collection points in every city with more than 2,000 inhabitants. Only collection points or processors that are in contract with a collective system or manufactures, are allowed to accept products from the consumers (Marusova and Mazal, 2018).

Most of the WEEE is collected by collective systems. A list of collective systems and the groups of WEEE that they are permitted to handle, and finance is available on the website of the Ministry of Environment.

Processing

Asekol, one of the main collection systems, has processing capacities for all groups of WEEE and accordingly works with the local processors for the further handling of collected WEEE (Marusova and Mazal, 2018).

Circular economy and material resource efficiency

- Secondary Raw Materials Policy (2014)

The document sets out the targets for a selection of secondary raw materials regarding extraction, processing and use. Among the commodities are metals, ELVs, waste electrical and electronic equipment, batteries and accumulators (European Environment Agency, 2015).

- First (2015) and Second Action Plan on Self-Sufficiency (2017)

The Action Plan on self-sufficiency is elaborated based on the Secondary Raw Materials Policy and includes a focus on the substitution of raw materials by secondary raw materials (European Environment Agency, 2015).

It further outlines strategic approaches for the implementation of Circular Economy in Czech Republic with the aim to increase resource efficiency and use of secondary resources (European Environment Agency, 2015). The second action plan further puts emphasis on the need to increase the demand of secondary raw materials, including approaches like public green procurement (Eco-Innovation Observatory, 2017).

- Resource efficiency

² The percentage is calculated by the weight of waste electrical and electronic waste equipment that enters the recycling/recovery facility (after proper selection) divided by total weight of take-back electrical equipment and separately collected electrical and electronic waste.

According to the country profile of the Eco-Innovation Observatory, resource efficiency outcomes in Czech Republic are lower than on average in the EU. Nonetheless, eco-innovations are said to become increasingly important while also awareness is growing. Circular economy projects in industrial enterprise are upcoming and increasingly implemented (Eco-Innovation Observatory, 2017).

Germany

Main policies referring to WEEE

- WEEE Directive II, 2012 and the Electrical and Electronic Equipment Act (ElektroG) 2015 (transposition of WEEE Directive into national law)
- Elektro- and Elektronikgerätegesetz-Gebührenverordnung – ElektroGGebV (Cost regulation in regard to the Electronic Equipment Act)
- Further disposal regulations of specific waste:
- End-of-life vehicles: ELV regulation
- Used batteries: Batteriegesetz (BatterieG)
- RoHS Directive 2002/95/EG (RoHS) and the “Elektrostoff-Verordnung” regulation (2013) (transposition of the RoHS Directive into national law)
- Waste Management Act (Kreislaufwirtschaftsgesetz (KrWG))

Divided product responsibility

The system in place is called the divided product responsibility. This mechanism describes that the main obligations for electrical and electronic waste disposal lie within the shared responsibility of public sector recycling companies and electrical and electronic device manufactures (Umweltbundesamt, 2016).

Requirements by stakeholder (Umweltbundesamt, 2016, Grieger, 2018):

Public sector recycling companies: Establish electrical and electronic waste recycling centers and acceptance of such waste free of charge.

Electrical and electronic device manufactures: Free to provide own recycling mechanism

Retailers: Permitted to take back electrical and electronic waste

Other entities that like to work as collection point: Need to be mandated by municipalities, retailers or producers.

Consumer: Obligated to bring back their electrical and electronic waste to collection facilities.

Collection and recycling targets



The collection and recycling targets are set by the WEEE directive. While the old WEEE directive of 2003 required an absolute collection rate of 4 kg per capita, the newer one from 2012 sets a relative collection target, which is 45% of the amount that has been put on the market in the preceding 3 years. This should increase to 65% by 2019 (Umweltbundesamt, 2016).

Target recovery rate for non-reusable devices: 70-80%

Target recycling rate for non-reusable devices: 50-80%

The recovery and recycling quotas have been exceeding the target values defined by the EU. The quality and quantity however are still subject to improvement (BMU, 2018).

Collection points and systems

The collection system is based on a bring system, where the consumers are obliged to bring their WEEE to collection points. The disposal is free of charge. Currently there exist around 1,500 municipal recycling centers, established by public sector recycling companies (Umweltbundesamt, 2016). While manufacturers are allowed to set up their own recycling mechanism, retailers are also free to implement take-back systems and are required to accept WEEE at their shops (Umweltbundesamt, 2016, Grieger, 2018).

Processing

Depending on the type of product and its composites different processes are used to recycle the materials. There are currently around 200 operators, though many of them work as storage places and few carry out treatment operations (Grieger, 2018). For certain components a dismantling step is applied in order to remove motherboards, plugs and other valuable components as well as pollutants prior to the recovery processes. These fractions, containing valuable CRMs, are further processed in larger treatment centers (Grieger, 2018). The first processing step most often consists of shredding, which is then followed by a sorting procedure. Unfortunately, the sorting often precludes special metals (Umweltbundesamt, 2016).

Circular economy and material resource efficiency

Electrical and Electronic Equipment Act (ElektroG), 2015

Besides the purpose of protecting the health of people and of the environment from hazardous substances in WEEE, the Act focuses on the re-use and recycling of material. Among others, it requires producers to include dismantling, re-use and recycling operations into the conceptualization of the product design (Elektrogesetz.de, 2018).

Waste Management Act (KrWG), 2012

The Waste Management Act states that priority should be given to waste prevention and consumption avoidance and only afterwards to recycling and disposal. Measures should be applied according to the following ranking (Umweltbundesamt, 2014):

- Prevention
- Preparation for recycling
- Recycling
- Other types of recovery, particularly use for energy recovery
- Disposal



However, as the Umweltbundesamt states, this hierarchy of prioritisation is so far largely disregarded.

Italy

Main policies referring to WEEE

- Waste Electrical and Electronic Equipment (WEEE), Legislative Decree, No. 49/2014
- WEEE & RoHS Implementation, Decree 151, 2005
- Promoting the Design and Environmentally Friendly Production of EEE, Ministerial Decree No. 140/2016
- Simplifying the Take-back and Handling of Small Waste Electrical and Electronic Equipment (WEEE), Decree No. 121/2016
- Fees for Monitoring and Management of Waste Electrical and Electronic Equipment, Decree, June 2016
- Financial Guarantees by Producers of Electrical and Electronic Equipment, Ministerial Decree No. 68/2017

Extended product responsibility

Under the WEEE & RoHS Decree (151/2005) the responsibility of collection, treatment and recovery of WEEE is given to the producer, including manufacturers, resellers, importers, internet retailers, and others (Valpak, 2015). Decree 121/2016 further obliges retailers to collect WEEE free of charge when a new similar product is purchased. Very small items (<25cm) must be collected regardless of whether any business is done or not (Weeemodels, n.d.).

Collection and recycling targets

Based on the WEEE Directive of the EU, the collection respective recycling and recovery targets are as following (Pellegrino, 2016):

Collection target from 2016: 45% of new equipment sold
 from 2019: 65% of new equipment sold or 85% of WEEE generated

Recovery target: from 2018: 70%-80% depending on type of WEEE

Prepared for re-use
 or recycling: from 2018: 50%-75% depending on type of WEEE

Collection and recycling targets



The collection and recycling targets are set by the WEEE directive. While the old WEEE directive of 2003 required an absolute collection rate of 4 kg per capita, the newer one from 2012 sets a relative collection target, which is 45% of the amount that has been put on the market in the preceding 3 years. This should increase to 65% by 2019 (Umweltbundesamt, 2016).

Target recovery rate for non-reusable devices from 2018: 70-80%

Target recycling rate for non-reusable devices from 2018: 50-80%

The recovery and recycling quotas have been exceeding the target values defined by the EU. The quality and quantity however are still subject to improvement (BMU, 2018).

Collection points and systems

Consumers can bring their WEEE to collection centres or collection sites. The former represents the majority of collection facilities and are operated by municipalities and businesses. Residents of the respective municipality can drop off their WEEE free of charge (University of Leeds, 2018). Further collection points are drop-off places operated by distributors, private collection centres or collection sites, operated by installers and major users, though the latter two mainly target public and private entities (University of Leeds, 2018). An agreement signed in 2015 between National Italian Municipalities Association, WEEE Clearing House, EEE producers and Associations of Waste Collection Companies defines terms regarding collection and management of WEEE for a period of three years.

Processing

WEEE is grouped into 5 different categories: Products of refrigeration and air conditioning, other large household appliances, TV and monitor, IT and consumer electronics, luminaires and lighting sources (Pellegrino, 2016). Producer Compliance Schemes ensure distributors bring household WEEE to authorized treatment facilities. Treatment facilities have the responsibility to register as member in the National WEEE Clearing House and report their amount of WEEE treated.

Circular economy and material resource efficiency

- Promoting the Design and Environmentally Friendly Production of EEE, Ministerial Decree No. 140/2016

The decree outlines details regarding environmentally friendly design and production of EEE, also considering extractability of secondary raw materials from WEEE.

- Waste Electrical and Electronic Equipment (WEEE), Legislative Decree, No. 49/2014

The main objective of the legislation is the prevention or reduction of negative impacts along the whole product chain of EEE items. It further strives to increase resource efficiency with the overarching goal to achieve the sustainable development objectives (University of Leeds, 2018).

- Towards a Model of Circular Economy for Italy

The overview and strategic framework of the Model of Circular Economy for Italy aims to increase resource efficiency and through the inclusion of Eco-Design improve production models. Further, new business models, extended producer responsibility, modularity and



reparability, industrial symbiosis and other strategic approaches are pursued, following the EU waste hierarchy (Eboli, 2018).

United Kingdom

Main policies referring to WEEE

- The Waste Electrical and Electronic Equipment (Amendment) Regulations, 2018
- End-of-Life Vehicles (Amendments) Regulations 2010
- Collection of Waste Electrical and Electronic Equipment from Designated Collection Facilities, Code of Practice, January 2016
- Collection of WEEE from Designated Facilities, Code of Practice, February 2007
- Re-use of WEEE and Used Electrical and Electronic Equipment, Specification, PAS 141:2011

Extended product responsibility

The producer, referring to manufacturer or importer, who places EEE on the market, as well as the distributor who makes the products available, are the main stakeholders responsible for compliance with the regulation (Gov.Uk, n.d (a)). Producers are obliged to be part of a Producer Compliance Scheme (PCS) (exemption for small scale producers), which aims to support the implementation of the obligation on recovery, re-use and recycling of WEEE (Gov.Uk, n.d (a)). When selling a new item, distributors are required to take back the old household EEE for free (Gov.Uk, n.d.(a)).

Collection and recycling targets

Collection and recycling targets are based on the EU targets, which are based on the average annual growth in tons of WEEE collected since 2013 as well as the amount of EEE put on markets.

1. Collection target from 2016: 45% of new equipment sold
2. Collection target from 2019: 65% of new equipment sold or 85% of WEEE generated

Depending on the type of WEEE, different recycling and recovery targets exist for treatment plants, ranging from 55%-80% for recycling targets and 75%-85% for recovery targets. These targets will be increased from 2019 onwards (The Waste Electrical and Electronic Equipment Regulations 2013).

According to the website letsrecycle.com, the PCSs did not meet the targets by 15% in 2017, collecting a total of 522,901 tons of WEEE instead of the 532,818 tons required.^[3] If a producer compliance scheme (PCS) misses its target, it has an option to pay a compliance fee for the tonnage shortfall, this resulted in an £8 million fund in the UK for 2017 via the disbursement of the 2017 WEEE compliance fee fund.

³ Note: Since 2014, WEEE from businesses that are similar to household appliances, such as lightening, IT equipment, etc. can be count towards target.



Collection points and systems

When purchasing new EEE items, stores are obliged to take back the same type of item from the customer for free. For very small WEEE (<25cm) stores have to take back the item regardless whether a new item is bought or not (Gov.Uk, n.d (b)).

Alternatively, there are designated collection facilities (DCF), that accept all types of WEEE (Gov.Uk, n.d (b)). Stores, obliged to take back WEEE, have the possibility to join a PCS, who will organize the transport and arrange recycling or preparation of re-use at Approved Authorized Treatment Facility (AATF) or transport the waste themselves, provided they comply with all the regulations (Gov.Uk, n.d (b)).

As a third option, the [Distributor Take Back Scheme \(DTS\)](https://www.gov.uk/electricalwaste-producer-supplier-responsibilities/join-the-distributor-takeback-scheme) can be joined, which in turn exempts one from having to provide take-back services. This option entails a fee, which is used to support the recycling centres of the local municipalities (Gov.Uk, n.d (b)). If a retailer does not want to take back products in-store, their obligations can be negated if they belong to the Distributor Take-back Scheme: <https://www.gov.uk/electricalwaste-producer-supplier-responsibilities/join-the-distributor-takeback-scheme>

Processing

The treatment of WEEE strongly depends on the kind of WEEE item. Some treatment facilities use shredding technologies while others first apply manual, automated or combined disassembly processes (Health and Safety Executive, n.d).

The UK currently collects WEEE in five streams and treats them separately: LDA / COLD / SDA / DISPLAY / LAMPS.

Circular economy and material resource efficiency

- Circular economy and waste prevention programme

UK-policies are based on the waste hierarchy, prioritizing prevention, preparing for re-use and recycling over other recovery methods and disposal (UKELA, n.d.). As required by the EU Waste Framework Directive (2008/98/EC), the four countries of the UK set up different waste prevention initiatives. Most engagement was noted in Scotland and Wales, who strongly highlight the economic advantages of waste prevention and circular economy. Resource security is a central part in all plans and emphasis is put on businesses to take up the challenge rather than wait for policy initiatives. Waste reduction targets set by Scotland and Wales focus on the reduction rather than the value that is regained through circular economy (Hill, 2016).

- The Resource Security Action Plan

Joint initiative by UK Department for Environment, Food and Rural Affairs and the Department for Business Environment Innovation and Skills (BEIS). The security plan has its focus on recovery and circular approaches rather than finding substitutes or diversifying material input for production (Hill, 2016).

<http://www1.cenia.cz/www/sites/default/files/RECYCLING.pdf>[https://www.mzp.cz/C125750E003B698B/en/collective_systems/\\$FILE/OODP_Overview%20of%20collection%20schemes20150916.pdf](https://www.mzp.cz/C125750E003B698B/en/collective_systems/$FILE/OODP_Overview%20of%20collection%20schemes20150916.pdf)

https://www.researchgate.net/publication/308272027_China%27s_supply_of_critical_raw_materials_Risks_for_Europe%27s_solar_and_wind_industries



<https://www.umweltbundesamt.de/en/topics/waste-resources/product-stewardship-waste-management/electrical-electronic-waste#textpart-1>
<https://valpak.co.uk/docs/default-source/international-compliance/italy-weee---07-09-2015cf40ffc0a5336c89be6fff0000348758.pdf?sfvrsn=2>

<http://www.weeenmodels.eu/EN/regulations.html>

ii. Notes on example policies

Policy name	+/-	What influence could the regulation have in the short or long-term on infrastructure availability for capturing CRMs? (Texts mostly extracted/copied)	Addressing CRMs		Pull/push policy	
			directly	indirectly	pull	push
EU Regulations						
EU Waste Framework Directive [2008]	+	<ul style="list-style-type: none">▪ Increased collection rates▪ Increased recycling and reuse▪ Strengthening and push for waste management improvements▪ Targets on collection/recycling rates puts pressure on fast infrastructure implementation		X		X
	-	<ul style="list-style-type: none">▪ Targets on collection/recycling might shift focus to less critical but easier recoverable materials				
Circular Economy Package [2018]	+	<ul style="list-style-type: none">▪ Increase waste recycling. Recycling goal by 2025: 55% for municipal solid waste and 65% for packaging waste, 25% for wood, 70% ferrous metals, 50% aluminium, 70% glass, 75% paper and cardboard (increased rates for 2030 and 2035)▪ Lower amount of landfilling▪ Increased producer responsibility▪ Waste prevention	X			X



		<ul style="list-style-type: none"> Specifically mentions the prevention of products containing CRM from becoming waste Achieve best possible management of waste containing critical raw materials. Call for respective measures for collection, sorting and recovery 				
	–	<ul style="list-style-type: none"> Recycling targets might cause efforts to be put on easily extractable metals rather on extraction of CRM 				
Horizon2020 - the Framework Programme for Research and Innovation [2014]	+	<ul style="list-style-type: none"> Societal Challenge 5 on climate action, environment, resource efficiency and raw materials (SC5) Securing supply of raw materials through the “Raw materials initiative”, the EU Raw Materials policy and strategy Based on the initiative the new European Innovation Partnership (EIP) gathers stakeholders together to develop the Strategic Implementation Plan (SIP). The plan is composed of three pillars: Technology, non-technology and international cooperation. The main targets of the SIP include: Launch of 10 trial actions to promote technology for production of primary and secondary materials, finding substitutes, build up on materials knowledge base, creation of better framework and establish proactive international regulation 	X		X	
SPIRE Roadmap [2012]	+	<ul style="list-style-type: none"> SPIRE Public Private Partnership on energy efficient raw materials production and the nanotechnologies, advanced materials, biotechnology and advanced manufacturing and processing work programmes Work program on six key components <ul style="list-style-type: none"> Increased energy and resource efficiency Solutions for more efficient processing New processes and materials for market applications Waste2Resource: Avoidance, valorisation and re-use of waste streams within and 	X			X

		<p>across sectors, including recycling of post-consumer waste streams and new business models with the ambition to closing the loop.</p> <ul style="list-style-type: none"> ○ Accelerating deployment of R&D&I opportunities ○ Reach out to industry, policy makers, investors and citizens for awareness and stimulating societal responsible behaviour <p>▪ Specifically mentioned as a target: "more materials, including critical raw materials are recycled"</p>				
Raw Materials Initiative [2008]	+	<ul style="list-style-type: none"> ▪ Promotion of <ul style="list-style-type: none"> ○ Fair and sustainable supply of raw materials from global markets ○ Sustainable supply of raw materials within the EU ▪ Resource efficiency and supply of "secondary raw materials" through recycling ▪ Includes three pillars of actions: <ul style="list-style-type: none"> ○ Pillar 1: Secure access to raw materials by ensuring undistorted world market conditions. ○ Pillar 2: Foster sustainable supply of raw materials from European countries ○ Pillar 3: Reduce the EU's consumption of primary raw material. 	X			X
Strategic Implementation Plan (SIP) [2013]	+	<ul style="list-style-type: none"> ▪ Specific objectives and targets to achieve the (mission of) European Innovation Partnership (EIP) on Raw Materials ▪ Three pillar research and innovation actions: Technology, non-technology, international cooperation ▪ Concrete targets of the SIP include: <ul style="list-style-type: none"> ○ Launch of up to 10 trial actions to promote technologies for the production of primary and secondary raw materials ○ Finding substitutes for at least three applications of critical and scarce raw materials ○ Building up the EU raw materials knowledge base ○ Creating better framework conditions for raw materials in the EU 	X			X

		<ul style="list-style-type: none"> Establishing proactive international cooperation with the third countries 				
Europe 2020 Strategy [2010]	+	<ul style="list-style-type: none"> Raw materials are integral part of it Aims to ensure smart, sustainable and inclusive growth Closely linked to the flagship initiatives - "Industrial policy for the globalisation era 5" and "Resource efficient Europe" 	X			X
Eco-Design Directive [2009]	+	<ul style="list-style-type: none"> Definition of Eco design parameters for products, including raw materials selection and end-of- life product phase Use of materials issued from recycling activities Assessment of environmental aspects for each product life cycle phase 	X			X
	-	<ul style="list-style-type: none"> To quickly receive a positive response and reputation, product manufacturers might focus on more easy closures of material loops, rather than investing in extraction technology for CRMs 				
Roadmap to Resource Efficient Europe [2011]	+	<ul style="list-style-type: none"> Targets include: <ul style="list-style-type: none"> Waste is managed as a resource Achieve an absolute decline of waste generated per capita Ensure high-quality recycling Eradicate illegal shipments of waste Specifically mentioned: "Milestone: By 2020, ... critical raw materials, are recycled." 	X			X
	-	<ul style="list-style-type: none"> To quickly receive a positive response and reputation, focus might be put on more easily available secondary material 				

Waste Shipments Regulation (EU, 2006e) [2006]	+	<ul style="list-style-type: none"> It lays down rules for controlling waste shipments in order to improve environmental protection. It also incorporates the provisions of the Basel Convention and the revision of the OECD's 2001 decision on the control of transboundary movements of wastes destined for recovery operations (i.e. where a waste is processed to recover a usable product or converted into a fuel) in EU law 		X		X
Waste electrical and electronic equipment Directive 2012/19/EU	+	<ul style="list-style-type: none"> Contribute to sustainable production and consumption by preventing WEEE, reuse, recycling and recover such wastes Reduce disposal and promote efficient use of resources and retrieval of secondary raw materials Collection, recycling and recovery targets 	X			X
	-	<ul style="list-style-type: none"> No specific target criteria for critical raw materials could lead to the systematic and strategic bias of recovering more easily available materials with a stronger result regarding recovery rate by weight 				
Extractive Waste Directive (2006/21/EC) [2006]	+	<ul style="list-style-type: none"> Under this Directive, Member States are required to ensure that operators in the extractive industry draw up a waste management plan for the minimisation, treatment, recovery and disposal of extractive waste, taking account of the principle of sustainable development. This provision broadly follows the logic of circular economy. It shall also encourage the recovery of extractive waste by means of recycling, reusing or reclaiming waste, where this is environmentally sound. 		X		X
	-	<ul style="list-style-type: none"> No specific mentioning of critical raw material 				
Circular Economy Action Plan	+	<ul style="list-style-type: none"> The Commission will take a series of actions to encourage recovery of critical raw materials, and prepare a report including best practices and options for further action. The Commission is also encouraging action by Member States on this topic in its revised proposals on waste 	X			X

REACH	+	<ul style="list-style-type: none"> Aims to improve the protection of human health and the environment from the risks that can imposed by chemicals Through this a more careful and resource efficient use of materials might be fostered whilst enhancing the competitiveness of the EU chemicals industry. It also promotes alternative methods for the hazard assessment of substances in order to reduce the number of tests on animals Currently, the regulation applies to chemical substances which are manufactured or imported into the EU in quantities of 100 tonnes or more per year but with the new phase-in period it will be reduced to 1 tonne or more. 	X	X	
	-	<ul style="list-style-type: none"> Stricter regulations on chemicals that also are used for critical raw materials recovery and recycling might have impeding effects on infrastructure development and applicability 			
European Innovation Partnership on Raw Materials [EIP]		<ul style="list-style-type: none"> Promotion of production and export Improving supply conditions within and outside EU Providing resource efficiency and alternatives in supply Bring Europe to forefront in the raw materials sector Mitigating the sector's negative environmental, social and health impacts 	X	X	
Germany					
German Strategy on Raw Materials	+	<ul style="list-style-type: none"> The importance and growing significance of the substitution and diversification of critical raw material is mentioned <p>Generally:</p> <ul style="list-style-type: none"> Aims to achieve improved material efficiency, recovery, recycling Good recycling record. German strategy plans to improve the material efficiency of products by making funding available to projects working on resource-efficient technologies, substitution and recycling. Small and medium enterprises (SMEs) in particular will be targeted to increase their 	X	(X)	



		<p>awareness of the need and benefits of materials efficiency.</p> <ul style="list-style-type: none"> Information and Education Provide political support to German companies 				
	–	<ul style="list-style-type: none"> Diversification of supply sources of materials -> financial incentives for exploration (cover of risks, providing loans) <p>→ Could lead to reduced incentive of infrastructure development</p>				
USA						
Critical Materials Strategy		<p>Diversifying supply, developing substitutes and Improving recycling</p> <p>Result: Workshops to discuss the issues regarding CRM supply and use (Gkanas et al., 2015)</p>	X			X
ARPA-E		<p>Funding of transformative research on advanced energy technologies, not specifically on substituting CRM [35]</p> <p>Result: 122 funded projects through 12 open calls, worth approx. 370M USD; 12 programmes to develop high performance innovative technologies for power generation, distribution and use.(Gkanas et al., 2015)</p>	X		X	
Australia						
National Waste Management Act		<p>The aims of the National Waste Policy are to:</p> <ul style="list-style-type: none"> avoid the generation of waste, reduce the amount of waste (including hazardous waste) for disposal manage waste as a resource ensure that waste treatment, disposal, recovery and re-use is undertaken in a safe, scientific and environmentally sound manner, and contribute to the reduction in greenhouse gas emissions, energy conservation and production, water efficiency and the productivity of the land. <p>Key areas:</p> <ul style="list-style-type: none"> Taking responsibility- Shared responsibility for reducing the environmental, health and safety footprint of products and materials across the 		X		X

		<p>manufacture-supply-consumption chain and at end-of-life.</p> <ul style="list-style-type: none"> – Improving the market-Efficient and effective Australian markets operate for waste and recovered resources, with local technology and innovation being sought after internationally. – Pursuing sustainability-Less waste and improved use of waste to achieve broader environmental, social and economic benefits. – Reducing hazard and risk-Reduction of potentially hazardous content of wastes with consistent, safe and accountable waste recovery, handling and disposal. – Tailoring solutions-Increased capacity in regional, remote and Indigenous communities to manage waste and recover and re-use resources. <p>Providing the evidence</p> <ul style="list-style-type: none"> – Access by decision makers to meaningful, accurate and current national waste and resource recovery data and information to measure progress and educate and inform the behaviour and the choices of the community. 				
Product Stewardship Act 2011 [in revision]		<p>The Act, which is currently under review, is designed to distribute responsibility among producers, sellers, users and disposers. Under the Act there are three categories of stewardship: 1) Voluntary stewardship schemes are industry-led schemes that are accredited under the act and are obligated to operate transparently without regulation. 2) Co-regulatory schemes are run by industry in a similar way to voluntary schemes, however they are regulated by government in terms of specific operational requirements, such as waste management targets. 3) Mandatory product stewardship legally obliges specific parties towards specific management actions of products.</p>		X		X
Hazardous Waste Act		<p>Amendments (currently proposed) to the Hazardous Waste Act that increase the cost for export of WEEE and may provide a driver for investment in local recycling infrastructure;</p>		X		X
Japan						

The Electric Household Appliance Recycling Law [1998/2001]	+	<ul style="list-style-type: none"> Outline of collection and recycling system for four household appliances (refrigerators, washing machines, air conditioners and TVs) Retailers are given responsibility to take charge of collecting used home appliances and manufacturers are responsible for recycling collected appliances. 		X		X
The Basic Act for Establishing a Sound Material-Cycle Society (Act No.110 of 2000)	+	<ul style="list-style-type: none"> Facilitation of policies for the transformation and basic principles on the establishment into a recycling-based society Clarification of responsibilities of the State, local governments, businesses and the public Articulation of fundamental matters for making policies for a recycling-based society 		X		X
Law for the Promotion of Effective Utilization of Resources [2000]	+	<ul style="list-style-type: none"> Establishing a sound material-cycle economic system by <ul style="list-style-type: none"> enhancing measures for recycling goods and resources by implementing collection and recycling of used product by business entities Reducing waste generation by promoting resource saving and ensuring longer life products and newly implementing measures for reusing parts recovered from collected used products and to address reduction of industrial wastes by accelerating reduction of by-products and recycle. 		X		X
Rare metal substitution material development project [since 2007]		<ul style="list-style-type: none"> Aims for reduction in the use of critical metals by 30-80% during the programme period Promotes RDI activities to develop practical substitutes (Gkanas et al., 2015) 	X			X
Switzerland						

ORDEE (Ordinance on the Return, Take-Back and Disposal of Electrical and Electronic Equipment) [1998]	+	<ul style="list-style-type: none"> Consumer Responsibility and EPR: Retailers, manufacturers and importers are obligated to accept used items of electrical and electronic equipment, in which they deal, free of charge. This obligation also applies if the customer does not purchase a new device or appliance. Consumers, in turn, are obliged to return equipment. The disposal of used equipment through municipal solid waste or bulk waste collections is prohibited. The ordinance is currently being revised and a guideline on for recycling of rare technical metals is being considered 		X		X
OMW (Ordinance on Movements of Waste) [2005]		<ul style="list-style-type: none"> In accordance with the Ordinance on Movements of Waste (OMW), electrical and electronic equipment is classified as "other controlled waste". Waste disposal companies in Switzerland that accept such equipment require the authorisation of the canton in which the equipment is located. The export and import of such waste requires the authorisation of the FOEN. Export to states that are not members of the OECD or EU is prohibited. 		X		X
Swiss Ordinance on Avoidance and Disposal of Waste [2016]		<ul style="list-style-type: none"> Main regulation on waste, includes following aspects (among others): <ul style="list-style-type: none"> - Prevention, reduction and recycling of waste products - Regulation on separate collection systems - Obligation of recovery of phosphor - Measures on waste prevention 		X		X
Funding for Technology		<ul style="list-style-type: none"> Funding has been allocated to the development of technical processes for the recovery of rare technical metals 	X		X	
Spain						
España Circular 2030 Estrategia española de economía circular		<ul style="list-style-type: none"> Framework for the implementation of a more circular economy in Spain Proposed action on increased transparency and information on products to enable consumers to make better and informed purchase decisions 		X		X

Plan Estatal Marco de Gestión de Residuos 2016-2022 (PEMAR)		<ul style="list-style-type: none"> Setting of recycling targets The objective is to transform the economy and society of Spain in terms of waste from linear to circular, in which materials are reintegrated into the production of new goods and new materials. Reuse and recovery are 50% of total waste generation, with energy recovery accounting for 15% of overall waste (3.4 Mt) and confined to the refuse fraction from treatment plant (total recovery rate should be 65% or more by 2020) 		X		X
Programa de Prevención de Residuos 2014-2020		<ul style="list-style-type: none"> By 2020 achieve a 10% reduction of the amount of waste produced in 2010 The program focuses on four strategies: reduce the amount in quantity of waste produced, reuse and extended life of products, reduction of harmful substances in materials and products, reduce environmental and human health impacts 		X		X
Waste and Contaminated Soils Act 22/2011		<ul style="list-style-type: none"> Legal Framework for waste management and prevention Outline of tasks and responsibilities 		X		X
<ul style="list-style-type: none"> Spanish legislation on waste of electric and electronic equipment (WEEE) 		<ul style="list-style-type: none"> Sets the conditions under which waste managers should operate, the communication and permit management system as well as the extended producer responsibility schemes, and the Production and Waste Management Register unique at national level. 		X		X
Canada						
Waste Management Regulations 2003, under Environmental Protection Act (O.C. 2012- 288) (Newfoundlan d and Labrador		<ul style="list-style-type: none"> Waste Management Regulations in Newfoundland and Labrador, including regulations on electronic waste, such as the electronic products stewardship plan and communication plans for informing consumers. https://www.assembly.nl.ca/legislation/sr/regulations/rc030059.htm#31_18 		X		X

Regulation 59/03)					
Product Stewardship in Canada		<ul style="list-style-type: none"> Canada has roughly fifty programs that could be considered product stewardship programs, primarily developed and operated at the provincial level. Programs vary widely in terms of government responsibility relative to producer responsibility, with a variety of policy, management, and financing structures. Generally, mandate programmes for the establishment of collection, transportation, reuse and recycling as well as disposal in case no other option exists Principles of pollution prevention hierarchy (puts reuse and recycling before disposal) In June 2004, CCME adopted Canada-Wide Principles for Electronics Product Stewardship to promote harmonization of approaches to the greatest extent possible and to prevent market distortions among jurisdictions in the development of electronics product stewardship programs. The report is available at: http://www.ccme.ca/assets/pdf/eps_principles_e.pdf. In June 2005, CCME followed with a list of recommended WEEE products to be considered by provinces for product stewardship approaches. More information is available at: http://www.ccme.ca/assets/pdf/eps_preamble_prdlst_e.pdf. In June 2007, the Canadian Council of Ministers of the Environment (CCME) adopted Canada-Wide Principles for Extended Producer Responsibility. The principles are available at: http://www.ccme.ca/assets/pdf/epr_principles_e.pdf. CCME is currently developing a Canada-Wide Action Plan for Extended Producer Responsibility. More information is available at: http://www.ccme.ca/ourwork/waste.html?category_id=128#356. 		X	X
South Korea					



Korea Resources Corporation - KORES (State-owned enterprise)	<ul style="list-style-type: none"> Public sector support for the expansion of Korean minerals sector to secure supply. <p>Further Korea's access to strategically important mineral resources by engaging directly, or indirectly through joint ventures or in the form of investments, in overseas exploration, development and production of strategically important mineral resources.</p> <ul style="list-style-type: none"> Managing Korea's stockpile of rare mineral resources. <p>(Gkanas et al., 2015)</p>				
Research & Development Policy	<p>South Korea is investing \$300m over 10 years for its research into forty technologies covering refining, smelting, processing, recycling and substitution. (Chapman et al., 2013)</p> <p>Strong focus on: Recycling end-use products, designing for recyclability, substitute materials, production efficiency (Chapman et al., 2013)</p>	X			X
China					
Export restrictions and quotas	<p>In China a top-down approach has focused on regulations for cleaner production, waste management and developing new technologies, led by the national Circular Economy Promotion Law introduced in 2009.</p> <p>China are limiting raw materials supply by means of export restrictions</p> <p>While quotas and restrictions for neodymium and dysprosium have been eliminated, China maintains export restrictions on other materials, including indium.</p> <p>(Rabe et al., 2016)</p>	X			X

iii. Barriers and Opportunities Identified from Trials



AREA	THEME	TARGET GROUP	TYPE	DESCRIPTION	COUNTRY	Confirmed also by:	COMMENTS
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Licences / permits may prohibit the long-term success of WEEE collection	Czech Republic		
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Need to request & pay for use of public space for collection events	Italy		
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Need to request authorization (and pay) to public authorities for communication campaign	Italy		
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Can result in an administrative burden for those conducting collection activities and may eat into profit margins	Italy		
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Gate fees / licence fees	UK		
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Time required to set-up collection program with schools or collection scheme to enable reuse, and lack of funding to support this.	UK		



Collection	Awareness raising	Waste holders	Opportunity	Collection events and interaction with public/waste holders can be an opportunity to engage with them on various topics	Germany		
Collection	Awareness raising	Waste holders	Barrier	More public awareness is needed	Germany		
Collection	Awareness raising	Waste holders	Opportunity	Direct marketing to let citizens know when collection activities will occur, can provide information on what can or cannot be deposited	Germany		
Collection	Awareness raising	Waste holders	Barrier	Need of awareness campaign to support collection efforts	Italy		
Collection	Awareness raising	Waste holders	Barrier	Importance of awareness of waste holders on the right choices to be made when disposing WEEE	Italy		
Collection	Awareness raising	Waste holders	Barrier	Need for more information on where WEEE can be taken	Italy		
Collection	Awareness raising	Waste holders	Barrier	Need for more information on where WEEE can be taken	UK		
Collection	Awareness raising	Waste holders	Opportunity	Need a recognisable and trusted brand or campaign	UK		
Collection	Awareness raising	Waste holders	Barrier	People are more inclined to hoard, saving them as back-ups in case their current item broke	UK		

Collection	Awareness raising	Waste holders	Opportunity	Some waste holders are aware of re-selling opportunities for valuable products (tablet, smartphones) and might prefer that option, thus keeping the products in the loop for longer	UK		
Preparation for Reuse	Awareness raising	Waste holders	Barrier	More public awareness is needed to promote preparation for reuse	Germany		
Collection	Eco-Design	Producers	Barrier	Inability to easily recover surface-mounted components of PCB boards	Germany		
Recycling	Eco-Design	Producers	Barrier	Value lost due to some components on PCBs not recoverable	UK		
Recycling	Eco-Design	Producers	Barrier	Time taken to dismantle items is not consistent / some items will take longer to process if being dismantled manually	UK		
Recycling	Eco-Design	Producers	Barrier	Presence of surface-mounted components on Printed Circuit Boards	Germany		
Recycling	Eco-Design	Producers	Barrier	More difficult to identify components containing Ta and Nd in smartphones and tablets	Germany		



Collection	Grouping with other waste streams	National & Local authorities	Opportunity	Mobile container for collection of small WEEE with textile waste. Offer groupage opportunities	Czech Republic		
Collection	Grouping with other waste streams	National & Local authorities	Opportunity	Opportunity to collect other household goods for reuse	Germany		
Collection	Hoarding/hibernation	Waste holders	Barrier	Evidence of long-term hoarding or evidence that people will use EEE until it no longer functions in CZ?	Czech Republic		
Collection	Hoarding/hibernation	Waste holders	Opportunity	Higher share of historical WEEE (pre-2005) collected: they might have less CRM but more Precious Metals. Is it easier to collect products stored for longer period at home when being closed to consumers?	Czech Republic		
Collection	Hoarding/Hibernation	Waste holders	Barrier	Hoarding and incorrect disposal i.e. through municipal waste channels	Italy		
Collection	Need for standards	National & Local authorities	Barrier	Inconsistency in quality of second hand items	Germany		
Preparation for Reuse	Need for standards	National & Local authorities	Barrier	Need to have standards on data eradication	Germany		

Preparation for Reuse	Need for standards	National & Local authorities	Barrier	Need to have standards on visual inspection	Germany		
Preparation for Reuse	Need for standards	National & Local authorities	Barrier	Need to have standards on testing	Germany		
Preparation for Reuse	Need for standards	National & Local authorities	Opportunity	Technical security check by testing electric security according to official guidelines DIN VDE 0701/02	Germany		
Collection	Redesign collection structure	National & Local authorities	Barrier	If perfectly good items are damaged during transit or at the drop-off point, items that could have been re-used are no longer suitable due to scratches / smashing / denting / scuffs etc.	Czech Republic		
Collection	Redesign collection structure	National & Local authorities	Opportunity	Other Compliance Schemes may invest and adopt successful collection methodology	Czech Republic		
Collection	Redesign collection structure	National & Local authorities	Barrier	Collection points need to be convenient/close/easy to access for users	Italy		
Collection	Redesign collection structure	National & Local authorities	Barrier	Avoid damages during transport phase	Italy		
Collection	Redesign collection structure	National & Local authorities	Opportunity	Waste holders requested to decide if product was suitable for preparation for reuse	Italy		



Collection	Redesign collection structure	National & Local authorities	Opportunity	Collection of small mixed WEEE increased significantly if citizens are offered a way to drop off items, reducing hoarding	Italy		
Collection	Redesign collection structure	National & Local authorities	Barrier	If perfectly good items are damaged during transit or at the drop-off point, items that could have been re-used are no longer suitable due to scratches / smashing / denting / scuffs etc.	Italy		
Collection	Redesign collection structure	National & Local authorities	Opportunity	Better collection could result in higher quality and re-usable items	UK		
Collection	Redesign collection structure	National & Local authorities	Barrier	Products that can be reused might be damaged in transit / at point of deposit	UK		
Collection	Redesign collection structure	National & Local authorities	Barrier	Prioritization of recycling versus reuse from local authorities	UK		
Collection	Redesign collection structure	National & Local authorities	Barrier	Current containers are not fit for the purpose of storing waste for preparation for reuse (damages, water-proof, etc..))	UK		
Preparation for Reuse	Redesign collection structure	National & Local authorities	Opportunity	Return of very small WEEE by regular post service	Germany		

Preparation for Reuse	Redesign collection structure	National & Local authorities	Barrier	Major cause of non-reusability is failure of visual inspection (importance to preserve products once waste holder is discarding)	Italy		
Collection	Security	Waste holders	Barrier	Safeguard the collected material	Italy		
Collection	Security	Waste holders	Barrier	Data leaked onto grey market / identity theft / sold	UK		
Collection	Security	Waste holders	Barrier	People not wanting to drop off EEE in fear of their data being stolen or damaged	UK		
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Opportunity	Products more suitable for Preparation for reuse PC, Laptops, Mobile Phones & Monitors	Czech Republic		
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Opportunity	Assessment of suitability for reuse done by professionals trained	Czech Republic		
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Barrier	Assessment of suitability for reuse identified by consumers are further checked by professionals once reaching the plant (Risk of damage during the transport?)	Germany		
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Barrier	Assessment of re-usability done from consumer is not consistent with tests done by professionals	Italy		

Collection	Trust & Transparency	Waste holders	Opportunity	Importance of trust and reputation on success of collection activities	Germany		
Collection	Trust & Transparency	Waste holders	Opportunity	Successful collection relies on people trusting the organisation(s) undertaking the activity	Germany		
Collection	Trust & Transparency	Waste holders	Opportunity	Importance of branding/trustable logo/visual communication when discarding WEEE	Italy		
Collection	Trust & Transparency	Waste holders	Barrier	Lots of barriers preventing citizens from handing in WEEE, easier and less stressful to keep items hoarded at home	Italy		
Collection	Trust & Transparency	Waste holders	Opportunity	Shops that are known and trusted will see a significant uptake of WEEE	Italy		
Collection	Trust & Transparency	Waste holders	Opportunity	Products are hoarded at home instead of re-used or recycled	UK		
Collection	Trust & Transparency	Waste holders	Barrier	Greater deposit of small mixed WEEE, trust that items are secure and safe from weather damage	UK		
Recycling	Trust & Transparency	Waste holders	Barrier	Lack of knowledge or trust in the system results in product hoarding	UK		

Collection	Awareness raising	Waste holders	Opportunity	Collection events and interaction with public/waste holders can be an opportunity to engage with them on various topics	Italy	Italy	there's the need to work closely with public/waste management company for the success of the initiative
Collection	Awareness raising	Waste holders	Barrier	More public awareness is needed	Italy	Italy	
Collection	Awareness raising	Waste holders	Barrier	Need for more information on where WEEE can be taken	Italy	Italy	
Collection	Awareness raising	Waste holders	Opportunity	Need a recognisable and trusted brand or campaign	Italy	Italy	
Preparation for Reuse	Need for standards	National & Local authorities	Barrier	Need to have standards on testing	Italy	Italy	
Collection	Redesign collection structure	National & Local authorities	Barrier	If perfectly good items are damaged during transit or at the drop-off point, items that could have been re-used are no longer suitable due to scratches / smashing / denting / scuffs etc.	Italy	Italy	

Collection	Redesign collection structure	National & Local authorities	Opportunity	Other Compliance Schemes may invest and adopt successful collection methodology	Italy	Italy	In Italy, where the responsibility is of the collection authority, it is the collection authority that could invest and implement the methodology
Collection	Redesign collection structure	National & Local authorities	Barrier	Current containers are not fit for the purpose of storing waste for preparation for reuse (damages, water-proof, etc..))	Italy	Italy	
Collection	Trust & Transparency	Waste holders	Opportunity	Importance of trust and reputation on success of collection activities	Italy	Italy	
Collection	Trust & Transparency	Waste holders	Opportunity	Successful collection relies on people trusting the organisation(s) undertaking the activity	Italy	Italy	
Collection	Trust & Transparency	Waste holders	Opportunity	Products are hoarded at home instead of re-used or recycled	Italy	Italy	
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Need to request & pay for use of public space for collection events	Germany	Germany	



Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Can result in an administrative burden for those conducting collection activities and may eat into profit margins	Germany	Germany	In Germany, it is not the administrative burden in the first place. The expenses needed for renting space and operations (personnel costs) are mostly higher than the gain of the material. However, WEEE collection at local authorities is financed indirectly via the general waste fees every citizen has to pay. Profit margins are not relevant here.
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Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Time required to set-up collection program with schools or collection scheme to enable reuse, and lack of funding to support this.	Germany	Germany	
Collection	Awareness raising	Waste holders	Barrier	Importance of awareness of waste holders on the right choices to be made when disposing WEEE	Germany	Germany	
Collection	Awareness raising	Waste holders	Barrier	Need for more information on where WEEE can be taken	Germany	Germany	
Collection	Awareness raising	Waste holders	Barrier	Need for more information on where WEEE can be taken	Germany	Germany	
Collection	Awareness raising	Waste holders	Opportunity	Need a recognisable and trusted brand or campaign	Germany	Germany	
Collection	Awareness raising	Waste holders	Barrier	People are more inclined to hoard, saving them as back-ups in case their current item broke	Germany	Germany	
Collection	Awareness raising	Waste holders	Opportunity	Some waste holders are aware of re-selling opportunities for valuable products (tablet, smartphones) and might prefer that option, thus keeping the products in the loop for longer	Germany	Germany	
Recovery	Eco-Design	Producers	Barrier	Value lost due to some components on PCBs not recoverable	Germany	Germany	



Recovery	Eco-Design	Producers	Barrier	Time taken to dismantle items is not consistent / some items will take longer to process if being dismantled manually	Germany	Germany	
Collection	Grouping with other waste streams	National & Local authorities	Opportunity	Mobile container for collection of small WEEE with textile waste. Offer groupage opportunities	Germany	Germany	
Collection	Redesign collection structure	National & Local authorities	Barrier	If perfectly good items are damaged during transit or at the drop-off point, items that could have been re-used are no longer suitable due to scratches / smashing / denting / scuffs etc.	Germany	Germany	
Collection	Redesign collection structure	National & Local authorities	Barrier	Collection points need to be convenient/close/easy to access for users	Germany	Germany	
Collection	Redesign collection structure	National & Local authorities	Barrier	Avoid damages during transport phase	Germany	Germany	
Collection	Redesign collection structure	National & Local authorities	Barrier	If perfectly good items are damaged during transit or at the drop-off point, items that could have been re-used are no longer suitable due to scratches / smashing / denting / scuffs etc.	Germany	Germany	

Collection	Redesign collection structure	National & Local authorities	Opportunity	Better collection could result in higher quality and re-usable items	Germany	Germany	
Collection	Redesign collection structure	National & Local authorities	Barrier	Products that can be reused might be damaged in transit / at point of deposit	Germany	Germany	
Collection	Redesign collection structure	National & Local authorities	Barrier	Prioritization of recycling versus reuse from local authorities	Germany	Germany	
Collection	Redesign collection structure	National & Local authorities	Barrier	Current containers are not fit for the purpose of storing waste for preparation for reuse (damages, water-proof, etc..))	Germany	Germany	
Collection	Security	Waste holders	Barrier	People not wanting to drop off EEE in fear of their data being stolen or damaged	Germany	Germany	
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Opportunity	Products more suitable for Preparation for reuse PC, Laptops, Mobile Phones & Monitors	Germany	Germany	
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Barrier	Assessment of re-usability done from consumer is not consistent with tests done by professionals	Germany	Germany	
Collection	Trust & Transparency	Waste holders	Opportunity	Products are hoarded at home instead of re-used or recycled	Germany	Germany	

Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Licences / permits may prohibit the long-term success of WEEE collection	UK	UK	Bulked collections, e.g. Social Enterprise (SE) Hub, are considered Waste and fees apply for uplift. This is off-putting for the SE given that costs are impacted
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Need to request & pay for use of public space for collection events	UK	UK	
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Need to request authorization (and pay) to public authorities for communication campaign	UK	UK	
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Can result in an administrative burden for those conducting collection activities and may eat into profit margins	UK	UK	As per Row 2
Collection	Awareness raising	Waste holders	Opportunity	Collection events and interaction with public/waste holders can be an opportunity to engage with them on various topics	UK	UK	

Collection	Awareness raising	Waste holders	Barrier	More public awareness is needed	UK	UK	
Collection	Awareness raising	Waste holders	Opportunity	Direct marketing to let citizens know when collection activities will occur, can provide information on what can or cannot be deposited	UK	UK	
Collection	Awareness raising	Waste holders	Barrier	Need of awareness campaign to support collection efforts	UK	UK	
Collection	Awareness raising	Waste holders	Barrier	Importance of awareness of waste holders on the right choices to be made when disposing WEEE	UK	UK	
Collection	Awareness raising	Waste holders	Barrier	Need for more information on where WEEE can be taken	UK	UK	
Preparation for Reuse	Awareness raising	Waste holders	Barrier	More public awareness is needed to promote preparation for reuse	UK	UK	
Collection	Eco-Design	Producers	Barrier	Inability to easily recover surface-mounted components of PCB boards	UK	UK	
Recycling	Eco-Design	Producers	Barrier	Presence of surface-mounted components on Printed Circuit Boards	UK	UK	
Recycling	Eco-Design	Producers	Barrier	More difficult to identify components containing Ta and Nd in smartphones and tablets	UK	UK	Need for Manufacturers to play a part in the identification



Collection	Hoarding/ Hibernation	Waste holders	Barrier	Evidence of long-term hoarding or evidence that people will use EEE until it no longer functions in CZ?	UK	UK	
Collection	Hoarding/ Hibernation	Waste holders	Barrier	Hoarding and incorrect disposal i.e. through municipal waste channels	UK	UK	
Collection	Redesign collection structure	National & Local authorities	Barrier	If perfectly good items are damaged during transit or at the drop-off point, items that could have been re-used are no longer suitable due to scratches / smashing / denting / scuffs etc.	UK	UK	The facilities used to collect 'functional' goods need to have shelving to eradicate this issue
Collection	Redesign collection structure	National & Local authorities	Opportunity	Other Compliance Schemes may invest and adopt successful collection methodology	UK	UK	Limited appetite in UK with Compliance Scheme operators
Collection	Redesign collection structure	National & Local authorities	Barrier	Collection points need to be convenient/close/easy to access for users	UK	UK	See Row 27
Collection	Redesign collection structure	National & Local authorities	Barrier	Avoid damages during transport phase	UK	UK	
Collection	Redesign collection structure	National & Local authorities	Opportunity	Waste holders requested to decide if product was suitable for preparation for reuse	UK	UK	



Collection	Redesign collection structure	National & Local authorities	Opportunity	Collection of small mixed WEEE increased significantly if citizens are offered a way to drop off items, reducing hoarding	UK	UK	
Collection	Redesign collection structure	National & Local authorities	Barrier	If perfectly good items are damaged during transit or at the drop-off point, items that could have been re-used are no longer suitable due to scratches / smashing / denting / scuffs etc.	UK	UK	
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Opportunity	Products more suitable for Preparation for reuse PC, Laptops, Mobile Phones & Monitors	UK	UK	
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Opportunity	Assessment of suitability for reuse done by professionals trained	UK	UK	
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Barrier	Assessment of suitability for reuse identified by consumers are further checked by professionals once reaching the plant (Risk of damage during the transport?)	UK	UK	
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Barrier	Assessment of re-usability done from consumer is not consistent with tests done by professionals	UK	UK	

Collection	Trust & Transparency	Waste holders	Opportunity	Importance of trust and reputation on success of collection activities	UK	UK	Secure drop off points required at Recycling Centres
Collection	Trust & Transparency	Waste holders	Opportunity	Successful collection relies on people trusting the organisation undertaking the activity	UK	UK	
Collection	Trust & Transparency	Waste holders	Opportunity	Importance of branding/trustable logo/visual communication when discarding WEEE	UK	UK	
Collection	Trust & Transparency	Waste holders	Barrier	Lots of barriers preventing citizens from handing in WEEE, easier and less stressful to keep items hoarded at home	UK	UK	
Collection	Trust & Transparency	Waste holders	Opportunity	Shops that are known and trusted will see a significant uptake of WEEE	UK	UK	

Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Licences / permits may prohibit the long-term success of WEEE collection	UK	UK	Licensing of WEEE collection is important for controlling good practice and ensuring WEEE is dealt with appropriately
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Can result in an administrative burden for those conducting collection activities and may eat into profit margins	UK	UK	As with licensing, some level of administration is necessary to ensure good practice
Collection	Awareness raising	Waste holders	Opportunity	Collection events and interaction with public/waste holders can be an opportunity to engage with them on various topics	UK	UK	Potential to hold 'events' at stores or produce information leaflets on topics related to WEEE
Collection	Awareness raising	Waste holders	Barrier	More public awareness is needed	UK	UK	

Collection	Awareness raising	Waste holders	Opportunity	Direct marketing to let citizens know when collection activities will occur, can provide information on what can or cannot be deposited	UK	UK	If take-back is as profitable as our trials proved then retailers would be sensible to market this service to customers
Collection	Awareness raising	Waste holders	Barrier	Need of awareness campaign to support collection efforts	UK	UK	See row 10
Collection	Awareness raising	Waste holders	Barrier	Importance of awareness of waste holders on the right choices to be made when disposing WEEE	UK	UK	Same barrier as row 11
Collection	Awareness raising	Waste holders	Barrier	Need for more information on where WEEE can be taken	UK	UK	Same barrier as row 11
Preparation for Reuse	Awareness raising	Waste holders	Barrier	More public awareness is needed to promote preparation for reuse	UK	UK	
Collection	Eco-Design	Producers	Barrier	Inability to easily recover surface-mounted components of PCB boards	UK	UK	Our depopulation process had issues removing surface-mounted components

Recycling	Eco-Design	Producers	Barrier	Presence of surface-mounted components on Printed Circuit Boards	UK	UK	Same barrier as row 19
Collection	Hoarding/Hibernation	Waste holders	Barrier	Evidence of long-term hoarding or evidence that people will use EEE until it no longer functions in CZ?	UK	UK	This is an issue in the UK (and wider) - Axion/WRAP study estimated hoarding at up to 3%, especially for smaller items such as mobiles
Collection	Hoarding/Hibernation	Waste holders	Opportunity	Higher share of historical WEEE (pre-2005) collected: they might have less CRM but more Precious Metals. Is it easier to collect products stored for longer period at home when being closed to consumers?	UK	UK	WEEE will tend to be older due to average lifetime of items (can be between 3 and 10 years) - newer items more likely to be reused than recycled
Collection	Hoarding/Hibernation	Waste holders	Barrier	Hoarding and incorrect disposal i.e. through municipal waste channels	UK	UK	Same barrier as row 26



Preparation for Reuse	Need for standards	National & Local authorities	Barrier	Need to have standards on data eradication	UK	UK	Our trial used proven data eradication software but it may be required to establish a certification for end of life data destruction
Collection	Redesign collection structure	National & Local authorities	Opportunity	Other Compliance Schemes may invest and adopt successful collection methodology	UK	UK	If successful at one retailer, it is likely other will follow
Collection	Redesign collection structure	National & Local authorities	Barrier	Collection points need to be convenient/close/easy to access for users	UK	UK	
Collection	Redesign collection structure	National & Local authorities	Barrier	Avoid damages during transport phase	UK	UK	Same issue as row 34
Collection	Redesign collection structure	National & Local authorities	Opportunity	Collection of small mixed WEEE increased significantly if citizens are offered a way to drop off items, reducing hoarding	UK	UK	Collection in our trial took place in stores, which was a convenient location for consumers

Collection	Redesign collection structure	National & Local authorities	Barrier	If perfectly good items are damaged during transit or at the drop-off point, items that could have been re-used are no longer suitable due to scratches / smashing / denting / scuffs etc.	UK	UK	Same issue as row 34
Collection	Security	Waste holders	Barrier	Safeguard the collected material	UK	UK	Particularly important for attractive/high-brand items such as Apple products
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Opportunity	Products more suitable for Preparation for reuse PC, Laptops, Mobile Phones & Monitors	UK	UK	Could offer premium/incentive for certain items/models ?
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Opportunity	Assessment of suitability for reuse done by professionals trained	UK	UK	
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Barrier	Assessment of suitability for reuse identified by consumers are further checked by professionals once reaching the plant (Risk of damage during the transport?)	UK	UK	
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Barrier	Assessment of re-usability done from consumer is not consistent with tests done by professionals	UK	UK	



Collection	Trust & Transparency	Waste holders	Opportunity	Importance of trust and reputation on success of collection activities	UK	UK	Same with our trial and this is why well-known and trusted brands were used
Collection	Trust & Transparency	Waste holders	Opportunity	Successful collection relies on people trusting the organisation undertaking the activity	UK	UK	Same as row 54
Collection	Trust & Transparency	Waste holders	Opportunity	Importance of branding/trustable logo/visual communication when discarding WEEE	UK	UK	Same as row 54
Collection	Trust & Transparency	Waste holders	Opportunity	Shops that are known and trusted will see a significant uptake of WEEE	UK	UK	Same as row 54
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Need to request & pay for use of public space for collection events	Czech Republic	Czech Republic	
Collection	Administrative burden/red tapes	National & Local authorities	Barrier	Time required to set-up collection program with schools or collection scheme to enable reuse, and lack of funding to support this.	Czech Republic	Czech Republic	
Collection	Awareness raising	Waste holders	Opportunity	Collection events and interaction with public/waste holders can be an opportunity to engage with them on various topics	Czech Republic	Czech Republic	for example, different type of collected waste (textile + e waste)



Collection	Awareness raising	Waste holders	Barrier	More public awareness is needed	Czech Republic	Czech Republic	
Collection	Awareness raising	Waste holders	Opportunity	Direct marketing to let citizens know when collection activities will occur, can provide information on what can or cannot be deposited	Czech Republic	Czech Republic	we have pictograms on the containers
Collection	Awareness raising	Waste holders	Barrier	Need of awareness campaign to support collection efforts	Czech Republic	Czech Republic	
Collection	Awareness raising	Waste holders	Barrier	Need for more information on where WEEE can be taken	Czech Republic	Czech Republic	
Collection	Awareness raising	Waste holders	Barrier	Need for more information on where WEEE can be taken	Czech Republic	Czech Republic	
Collection	Awareness raising	Waste holders	Opportunity	Need a recognisable and trusted brand or campaign	Czech Republic	Czech Republic	for example, connection with Red cross (and collection of textiles)
Collection	Awareness raising	Waste holders	Barrier	People are more inclined to hoard, saving them as back-ups in case their current item broke	Czech Republic	Czech Republic	

Collection	Awareness raising	Waste holders	Opportunity	Some waste holders are aware of re-selling opportunities for valuable products (tablet, smartphones) and might prefer that option, thus keeping the products in the loop for longer	Czech Republic	Czech Republic	sometime items are moved to for example grandparents
Preparation for Reuse	Awareness raising	Waste holders	Barrier	More public awareness is needed to promote preparation for reuse	Czech Republic	Czech Republic	
Collection	Grouping with other waste streams	National & Local authorities	Opportunity	Mobile container for collection of small WEEE with textile waste. Offer groupage opportunities	Czech Republic	Czech Republic	
Collection	Grouping with other waste streams	National & Local authorities	Opportunity	Opportunity to collect other household goods for reuse	Czech Republic	Czech Republic	
Collection	Hoarding/Ibernation	Waste holders	Barrier	Evidence of long-term hoarding or evidence that people will use EEE until it no longer functions in CZ?	Czech Republic	Czech Republic	
Collection	Hoarding/Ibernation	Waste holders	Opportunity	Higher share of historical WEEE (pre-2005) collected: they might have less CRM but more Precious Metals. Is it easier to collect products stored for longer period at home when being closed to consumers?	Czech Republic	Czech Republic	



Collection	Hoarding/Ibernation	Waste holders	Barrier	Hoarding and incorrect disposal i.e. through municipal waste channels	Czech Republic	Czech Republic	
Collection	Redesign collection structure	National & Local authorities	Barrier	If perfectly good items are damaged during transit or at the drop-off point, items that could have been re-used are no longer suitable due to scratches / smashing / denting / scuffs etc.	Czech Republic	Czech Republic	
Collection	Redesign collection structure	National & Local authorities	Opportunity	Other Compliance Schemes may invest and adopt successful collection methodology	Czech Republic	Czech Republic	
Collection	Redesign collection structure	National & Local authorities	Barrier	Collection points need to be convenient/close/easy to access for users	Czech Republic	Czech Republic	
Collection	Redesign collection structure	National & Local authorities	Opportunity	Better collection could result in higher quality and re-usable items	Czech Republic	Czech Republic	
Collection	Redesign collection structure	National & Local authorities	Barrier	Products that can be reused might be damaged in transit / at point of deposit	Czech Republic	Czech Republic	
Collection	Redesign collection structure	National & Local authorities	Barrier	Current containers are not fit for the purpose of storing waste for preparation for reuse (damages, water-proof, etc.)	Czech Republic	Czech Republic	

Collection	Security	Waste holders	Barrier	Data leaked onto grey market / identity theft / sold	Czech Republic	Czech Republic	and to delete data is time consuming
Collection	Security	Waste holders	Barrier	People not wanting to drop off EEE in fear of their data being stolen or damaged	Czech Republic	Czech Republic	
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Opportunity	Products more suitable for Preparation for reuse PC, Laptops, Mobile Phones & Monitors	Czech Republic	Czech Republic	
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Opportunity	Assessment of suitability for reuse done by professionals trained	Czech Republic	Czech Republic	
Preparation for Reuse	Stage of assessment reuse potential	Compliance Schemes	Barrier	Assessment of suitability for reuse identified by consumers are further checked by professionals once reaching the plant (Risk of damage during the transport?)	Czech Republic	Czech Republic	
Collection	Trust & Transparency	Waste holders	Opportunity	Successful collection relies on people trusting the organisation undertaking the activity	Czech Republic	Czech Republic	
Collection	Trust & Transparency	Waste holders	Opportunity	Importance of branding/trustable logo/visual communication when discarding WEEE	Czech Republic	Czech Republic	

Collection	Trust & Transparency	Waste holders	Opportunity	Shops that are known and trusted will see a significant uptake of WEEE	Czech Republic	Czech Republic	it is already working with some of our partner shops
Collection	Trust & Transparency	Waste holders	Opportunity	Products are hoarded at home instead of re-used or recycled	Czech Republic	Czech Republic	

iv. Industry Expert Survey

Please note, all participants who completed the survey agreed to share their data amongst other participants.

QUESTION 1

In addition to those listed in the table below, what are the key policy instruments currently in place in Europe and globally to ensure e-waste is collected and recycled?

Directive	Summary	Notes
2012/19/EU 2002/96/EC	WEEE Directive (Waste Electrical and Electronic Equipment)	European Union
European Commission Circular Economy Package	Targets for reduction of waste and establishes an ambitious and credible long-term path for waste management and recycling	European Union
RoHS	The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Regulations 2012	International reach
Basel Convention	Control of Transboundary Movements of Hazardous Wastes and Their Disposal	International reach
2006/12/EC	Waste	European Union
689/EEC/91	Hazardous Waste	European Union
Regulation No. 1013/ 2006/ EEC	Supervision and control of shipments of waste within, into and out of the European Community	European Union
1999/31/EC	Landfilling of waste	European Union
2000/76/EC	Waste incineration	European Union
96/61/EC	Integrated pollution protection	European Union
2006/ 66/ EC	Batteries and accumulators	European Union



94-580	Solid Waste Disposal Act (SWDA) was passed by Congress in 1965. A major amendment to SWDA was the Resource Conservation and Recovery Act (RCRA),	North America
Policy N.24.051 on Hazardous waste	Provides the legal framework for e-waste	Latin America, Argentina
Federal Law N° 12.305	National Policy on Solid Waste, covers proper management of e-waste.	Latin America, Brazil
Law No. 1672	public policy guidelines on integrated management of WEEE	Latin America, Columbia, Peru, Paraguay
LPUR and LRHA	Law for the Promotion of Effective Utilization of Resources (LPUR) and the Law for the Recycling of Specified Kinds of Home Appliances (LRHA).	Japan
LCQ19	Regulation of electronic waste recycling sites and combat of associated illegal activities	Hong Kong

QUESTION 2

What key initiatives or publications have either recently been completed or are on-going in Europe and globally regarding the collection of e-waste and CRM recovery?

i.e. ProSUM database, JRC Science for Policy report: CRMs and the Circular Economy

QUESTION 3

In your opinion, what are the main barriers that hinder the collection of e-waste and what measures can be taken to remove these obstacles? Where possible identify country specific factors that may be relevant.

i.e. existing technology / infrastructure, citizen awareness

QUESTION 4



What examples can you give of successful e-waste collection and recovery infrastructure (both commercially and in terms of capture rates), either in Europe or globally?



QUESTION 5

What recommendations can you give as to the best places to place collection and recovery infrastructure?

i.e. close to areas of high population and availability of skilled labour.

