European Commission

Study on options for return schemes of mobile phones, tablets and other small electrical and electronic equipment in the EU

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May – *2022*

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PDF ISBN 978-92-76-53418-1 doi:10.2779/237189 KH-07-22-475-EN-N

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Study on options for return schemes of mobile phones, tablets and other small electrical and electronic equipment in the EU

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EXECUTIVE SUMMARY

Objective of the study and background

Waste Electrical and Electronic Equipment (WEEE) currently constitutes one of the fastest growing waste streams in the EU and globally. Small WEEE in particular, such as mobile phones, tablets, and laptops has proven to be a challenging waste stream, with a low collection rate but high-embedded value of interest in a circular economy. Low collection rates in turn have a negative effect on the percentage of recovered, in particular recycled, small WEEE and thus both an effect on the attainment of the regulatory collection and recovery targets on laid down in the WEEE Directive[1].

The **objective** of the present study is to identify and conceptualise policy measures for action at the EU level to incentivise the return and take-back of small used and waste EEE, in order to ensure maximum collection rates and subsequent re-use, repair, refurbishment and recovery.

The scope of the study concerns **mobile phones** (including smartphones and feature phones), **tablets, laptops** and their **chargers.** The study is structured in three main phases:

1. **Problem definition:** includes an estimate of the magnitude of household storage of small used and waste EEE, collection levels of small WEEE, and potential losses to the circular economy along with an analysis of the relevant drivers and causes;
2. **Identification and typology of return systems in the EU** as well as of other measures to facilitate the separate collection of small WEEE;
3. **Identification of policy actions:** an impact assessment of each of the identified policy actions to incentivise the return of small used and waste EEE is proposed, and on its basis, recommendations for policy actions are developed.

Problem definition

The focus of the **problem definition** is the low collection and return rates of small used and waste EEE along with the household storage of small EEE. The **challenges regarding return rates** of small WEEE from users are mainly related to the following factors:

- household storage can impact the amount of waste available for collection;
- lack of user/consumer awareness on collection points and on appropriate disposal practices;
- quality of the collection network (e.g., opening hours for municipal collection points and distance for consumers in areas of low population density); and
- challenges related to the organisation and financing of take-back operations.

At the collection and treatment level, other challenges exist related to the WEEE value chain:

- illegal collectors, scavengers and illegal exports of WEEE, due to the lack of law enforcement by local authorities;
- disposal via municipal household waste;
- unreported exports of used EEE outside the EU, which can impact the amount of waste available for collection and proper treatment;
- high costs of small WEEE recycling, which can impact demand for small WEEE by recyclers.

[1] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)

Based on literature, it is estimated that between 25% and 50% of Europeans keep their old, unused devices stored at home. The **key drivers behind household storage** can be summarised as follows:

- tendency to keep used EEE as backup;
- storage for later resale;
- emotional attachment;
- data storage and security concerns when returning devices;
- lack of trust and transparency about the recycling process;
- lack of easily accessible disposal or take-back options, or lack of awareness thereof;
- small size of devices which makes it convenient to store them and then forget their location.

Key findings from the literature review and stakeholder survey identified the following four main **areas for improvement to address household storage and low collection rates** of mobile phones, laptops, tablets and their chargers:

- **Distinction between waste EEE and used EEE**: to encourage direct re-use and preparation for re-use, further clarifying options available between used EEE and waste EEE for consumers and collection operators can incentivise reuse and prevent significant amounts of functional devices from being sent to waste recycling operations;
- **Identification and prevention of losses through exports:** both through the reporting of data on exports of used devices, in particular the monitoring of export flows outside the EU, and through law enforcement of illegal waste exports by local authorities, allowing for a more accurate and transparent identification of the amount of waste generated and available for collection;
- **Consumer behaviour**:
    - **Incentivising consumer behaviour** through improvements of existing collection networks;
    - **Increasing consumer awareness** on proper disposal and take-back options, with the aim of both reducing household storage and inappropriate waste disposal, which can in turn improve take-back and collection rates;
- **Circular economy opportunities**:
    - **Supporting the recycling sector**: support the market for recycled materials and ensure the technical and economic feasibility of critical raw material recovery;
    - **Improving the collaboration of all actors across the value chain**: ensuring transparency and the interaction of all stakeholders concerned could help create more efficient circular models and fill specific gaps (e.g. on unreported flows).

For the purposes of this study, the different types of return systems are categorised based on their "incentive form": reward (providing a financial benefit to the consumer), convenience (facilitating take-back) and charity (encouraging take-back through a charitable cause) incentives. Where relevant, the main **barriers and opportunities for the replication and scaling up** of the different return systems were analysed in terms of economic, technical, behavioural and regulatory factors, as outlined in the following table.

<table>
<tr><th colspan="4">Drivers (D) and barriers (B) for replicability and scalability of return systems</th></tr>
<tr><th>Factors</th><th>Reward systems</th><th>Convenience systems</th><th>Charity systems</th></tr>
<tr><td>Economic</td><td>• (D) Growing market for second-hand and repaired small EEE.
• (D) Relative ease of scalability beyond the initial investments from a technological and financial perspective.
• (B) Increasing competition from other systems, both commercial and non-commercial for attractive pools of used EEE.
• (B) Limited national or regional pool of commercially attractive used EEE or WEEE.</td><td>• (D) May benefit from growing market for second-hand and repaired small EEE, if focus on re-use and repair is increased.</td><td>• (B) Less likely to benefit from the growing market for second-hand and repaired small EEE, due to focus on redistribution of reusable or repaired small EEE for free or on the sale of small WEEE to recyclers.</td></tr>
<tr><td></td><td></td><td colspan="2">• (B) Reliance on funding from external actors to support the system.
• (B) Not clear to what extent these systems would be able to compete with reward systems.</td></tr>
<tr><td>Technical</td><td>• (B)/(D) Require relatively complicated infrastructure, and technology but beyond the initial challenges it is expected that these systems will be able to scale up with relative ease.</td><td colspan="2">• (D) Easier to replicate compared to reward systems, due to reliance on more accessible methods and tools, such as bins and postal services.
• (B) More sophisticated or technology-intensive systems such as automatized bins and pick-up vehicles may be more difficult or costly to replicate.</td></tr>
<tr><td>Behavioural</td><td>• (B) Different levels of awareness in certain Member States or regions especially concerning the residual value of small EEE and WEEE.</td><td colspan="2">• (B) Different levels of environmental awareness in certain Member States or regions.</td></tr>
<tr><td rowspan="3">Regulatory and administrative</td><td colspan="2">• (B) Administrative procedure for transboundary shipments of waste in case of activity in multiple Member States</td><td></td></tr>
<tr><td rowspan="2"></td><td colspan="2">• (B) feasibility based on a local or Member State specific network of supporting actors.
• (B) Potential lack of regulatory drivers for re-use and repair activities.</td></tr>
<tr><td>• (B) May depend on support from local public authorities.</td><td>• (B) Regulatory obligations which apply to waste management activities may be a complicating factor for charity systems.</td></tr>
</table>

Identification of possible further action

Based on the critical review of the results from the problem definition and the identification of existing return systems as well as desk research and an extensive stakeholder consultation, **eight relevant policy actions**, reported in the table below, were selected for the impact assessment analysis.

Policy actions selected for the impact assessment analysis
Policy action #1: **Financial Incentives**
Policy action #2: **Door-to-door and postal services**
Policy action #3: **Targets for re-use**
Policy action #4: **Data privacy certification scheme**
Policy action #5: **Drop-off points databases**
Policy action #6: **Personalised End-of-Life (EoL) information**
Policy action #7: **Reduced VAT rates on re-use services**

Policy actions selected for the impact assessment analysis
Policy action #8: **Deposit-refund systems**

In addition, a list of complementary policy actions was defined, which consist either of cross-cutting policy actions or other policy actions selected among those suggested during the two workshops conducted under this study.

Complementary policy actions
Product passport
Creating the enabling regulatory framework for re-use and preparation for re-use
Communication campaigns and educational measures
Separate monitoring and reporting of small WEEE covered by the study
Improve the implementation of art. 5 of the WEEE Directive on separate collection[2]
Tackling free-riding of online sellers not compliant with WEEE legislation
Leasing model

The policy actions identified have undergone an analysis of economic, environmental and social impacts. Subsidiarity and proportionality were also considered in the assessment. In this respect, the study concludes, that while harmonisation and support is needed at EU level, a number of actions are better addressed and implemented at the national level.

A **semi-quantitative impact assessment** was performed on the eight policy actions selected. The quantified impacts of the options were assessed against a business-as-usual scenario (i.e. no regulatory change with today's situation scenario) modelling the flows of targeted WEEE and used EEE at EU scale, using quantitative data wherever possible. The instruments that resulted in the highest estimated environmental, economic and social cumulative positive impacts are '**financial incentives'**, **deposit-refund systems'** and '**targets for re-use'**. It should be noted that targets as such, while not having a direct impact on return rates, trigger measures ensuring environmental, economic and social benefits.

The '**financial incentives'** policy action for small WEEE with low residual value has shown to be one of the most efficient policies regarding its effect on increasing the quantity of recycled materials. However, it has a relatively high cost of implementation compared to the other policy actions given that a minimum financial reward has to be set for each device returned which is, in general, higher than their estimated recycling value. The impacts of this action on devices stored at home which tend to be older models with low residual value are to a large extent expected during the first 3-year period of implementation. Throughout its implementation, the action is expected to generate a +20% increase in the collection of devices, among which an estimated 20% are re-usable devices and 80% are to be recycled.

Another type of financial tool and the most efficient policy action in terms of incentivising the return of used and waste EEE according to almost every impact indicator assessed is the '**deposit-refund systems' (DRS)** option. Although availability of reliable data about the impact of DRS is very limited, a strong collection, recycling and re-use potential can be expected, compared to other policy actions, with most GHG emissions mitigation potential overall, revenue generated, and jobs created. This action will impact every device subject to the deposit-return scheme, estimating that about 62%[3] of

[2] Article 5 of the Directive 2012/19/EU.

[3] Based on data from Uyttenbroek (2017). No other sources are available to further substantiate the study's hypothesis.

consumers will return their devices to retrieve their deposit, with 50% of the collected devices going to re-use and 50% to recycling. However, besides limited availability of reliable data, literature and expert interviews suggest that feasibility is limited today.

The policy action **'targets for re-use'** showed high impacts in terms of emissions avoided, as a consequence of the extension of lifetimes which has a high reduction potential, and with regards to additional revenue generated for stakeholders in the sector. The measures put in place to achieve this action are proposed to be set in the long-term. This enables a real impact on re-use of small EEE by focusing on equipment that can still be used, and thus extends the lifetime of devices, incorporating different reverse supply chains and operations. A short-term impact of this action would be the decrease of small WEEE generated at the end of the first lifetime, as policies to encourage re-use will lead to the lifetime of used devices being extended and the moment for them becoming waste being delayed.

The policy actions '**data privacy certification scheme'** and '**drop-off points databases'** both have a high feasibility and a highly significant indirect effect. Indeed, they both rely on existing systems that were deemed scalable and replicable. The potential of these two actions lies in increasing the quantity of recycled materials and avoided emissions. They both aim at increasing collection and thus enable further re-use and recycling. Yet, the impacts are quite limited by the current low recycling and re-use rates, as collected WEEE are distributed in the subsequent treatment operations following current practices, ultimately leading to an increase in WEEE collection, but not necessarily to significant increase in recycling and preparation for re-use. However, the '**data privacy certification scheme'** should be seen as a key enabler of other policy actions, since data privacy is a major concern for consumers when returning their devices. In this regard, it is considered to have high indirect effects. Similarly, the policy action **'drop-off points databases'** is considered to have high indirect effects as it represents a key enabling factor in increasing durably and sustainably the collection of devices.

The policy action '**personalised End-of-Life (EoL) information'** has shown to have moderate direct impacts, but potentially highly significant indirect effects on the quantity of recycled materials and avoided emissions. Personalised EoL information is in fact considered as a key enabler applicable for most policy actions, since it could directly and favourably change consumer behaviour. However, particular attention has to be paid to user consent and data protection rules when implementing this policy action.

'Door-to-door and postal services' have shown to be one of the most efficient policies regarding the potential for recovering recycled materials and overall good performance in terms of average emissions avoided, revenues generated, and jobs created as it drives re-use rates upwards over time. This action addresses the collection of mobile phones currently in hibernation or that would otherwise have been hoarded at their end of life. Based on the analysis conducted for the purposes of this study, over the ten years of the policy implementation, collection is expected to increase by 14% with an average of 40% of devices going to re-use and 60% to recycling. It should be noted that costs related to door-to-door collection were not directly assessed in this study.

The **'reduced VAT rates on re-use services'** policy action is specifically aimed at increasing re-use activities with preferential financial measures to effectively reduce consumer prices of the second-hand/ re-used devices and consequently increase demand. It shows a relatively high increase in the re-use rate, but a slight reduction of devices going to recycling compared to the current situation. The associated costs at a national level are the highest, as they reflect the loss of revenue from decreased VAT on re-use services. In the impact assessment conducted for the purposes of this study, these costs outweigh the increase in revenue for re-use organisations and benefits for consumers.

The table below provides a summary of the conclusions on the feasibility and impact of each proposed policy action.

Nr.	Policy action	Feasibility	Impact	Conclusions
1	**Financial incentives**	Moderate	Significant	This instrument is expected to have a significant punctual impact during implementation, with a limited long-term effect on consumer behaviour. The moderate feasibility is due to the costs required for its implementation. Implementation level: Member State.
2	**Door-to-door and postal services**	Moderate	Significant	The impact assessment observed a significant impact with short and long-term benefits and an increase in re-use collections as the action matures. The feasibility and scalability are also moderate as examples of functioning postal collection systems exist in some MS, but fire-risk due to the li-ion batteries is a barrier. Costs related to door-to-door collection were not directly assessed in this study. Implementation level: Member State.
3	**Targets for re-use**	Moderate	Highly Significant	The impact assessment observed a highly significant impact on re-use rates due to supporting measures put in place to meet targets and thus on emissions avoided and jobs created. Costs of additional re-use facilities were not considered which could impact the feasibility of the action. Furthermore, contracts with re-use organisations are expected to improve implementation. Feasibility could be hampered by data security concerns. Implementation level: Member State.
4	**Data privacy certification scheme**	High	Not possible to be determined due to absence of data…	The action impact was measured as being lower than anticipated, in part due to testing limitations stemming from limited data availability. As this action increases collection, it must be coupled with developments of re-use or recycling streams in order to ensure the adequate recovery of the collected devices.
			…but highly significant indirect effect	Though displaying limited impacts on its own, a data privacy certification scheme is still considered a key enabler for most policy actions. Its indirect effect could therefore be deemed high.

Nr.	Policy action	Feasibility	Impact	Conclusions
5	**Drop-off points database**	Moderate to High	Not possible to be determined due to absence of data…	The action impact was found to be lower than anticipated in part due to limited data availability. In fact, the flow of the collected devices estimated in the impact assessment is considered identical to the current situation. To have a real impact, there should be some feedback on increasing re-use and recycling of these additional devices collected.
			…but highly significant indirect effect	Though it is estimated to have limited impacts on re-use and recycling as a standalone policy (it all depends on the quality and extent of the collection scheme and subsequent operations), implementing a drop-off points database is considered key in enduringly and sustainably increasing the collection of devices. Its indirect effect is thus quite high when coupled with other actions. Implementation level: Member State.
6	**Personalised EoL information**	Moderate	Not possible to be determined due to absence of data…	The action impact was measured as being lower than anticipated due in part to limited data availability.
			… but highly significant indirect effect	Though displaying limited impacts on its own, personalised EoL information is still considered as a key enabler for most policy actions, since it could directly and favourably change consumer behaviour. Its indirect effect could therefore be deemed high. Implementation level: Member State.
7	**Reduced VAT rates on re-use services**	Low	Significant	Relatively high impact on re-use rates alone was observed during the impact assessment. The high costs of the policy reflect the loss of revenue, a cost borne by national governments alone that negatively impact the feasibility of the policy action. The impact of this policy action is rated as significant, based on the assumptions made in this study. However, no empirical piece of evidence or other modelling has proven the efficiency of reduced VAT rates on re-used small EEE specifically.

Nr.	Policy action	Feasibility	Impact	Conclusions
				Implementation level: Member State.
8	**Deposit-refund systems**	Low	Estimated as highly significant but more data needed to substantiate	Impact assessment results are aligned with anticipated results, with a high impact estimated regarding almost every impact indicator assessed. However, assessments of this action in practice and numerous barriers need to be analysed for this solution to work. More studies are recommended to assess the impact of a deposit-refund system. Implementation level: Member State.

By combining the results of the impact assessment with the qualitative evaluations from the workshops and desk research, the two policy actions "Financial incentives" and "Door-to-door and postal services" have been identified as **quick wins**. They are considered as quick-wins since they are assumed to have a significant impact and are implementable in the **short term**. In addition, the actions can build on experience gained from the successful implementation of existing and similar actions in some Member States.

Both the recommendations on financial incentives and on door-to-door and postal services are in line with the recommendations of the WEEE compliance promotion exercise (BIPRO, 2018) on improving WEEE collection infrastructure. The implementation of financial incentives was also recommended in Frederiksson *et al.* (2021) as a conclusion of the study of analysing the efficiency of the deposit-refund scheme.

1. INTRODUCTION

1.1 Objectives and main phases of the study

The objective of the present study is to identify and conceptualise policy measures at EU level to support take-back schemes to return or sell back small WEEE and small used EEE in order to ensure maximum collection rates and subsequent re-use, repair, refurbishment and recovery. The study also considers effective EU actions which incentivise citizens to return their small WEEE to collection points for subsequent recovery and options which, in line with the waste hierarchy, aim for maximum value retention (i.e. re-use over repair and repair over recovery).

As described in detail in Section 2.2.2, the devices covered in the study are:

- **mobile phones** (including smartphones and feature phones);
- **laptops** (including tablets); and
- their **chargers**.

The study is structured into three main phases:

1. **Problem definition (Section 2):** this first part of the study aims at establishing the problem definition and collection of evidence with regard to low levels of collection and the storage of small used and waste EEE. In this phase, the magnitude of household storage of small used EEE, the collection of small EEE and WEEE and the potential losses to the circular economy are estimated, together with the analysis of the potential for reverse supply chains for re-use, repair, refurbishment and recovery of small WEEE. The underlying drivers and causes are analysed in order to identify main opportunities and barriers for increasing the collection of the devices in scope;
2. **Identification and typology of existing return systems for small EEE in the EU as well as other measures to facilitate separate collection under the WEEE Directive (Section 3)**: through this exercise, insights are collected on drivers and challenges experienced by such systems in practice. In turn, these insights will help to assess the potential of replicability and scalability of promising systems and will feed into the conceptualisation of actions at EU level to support such systems;
3. **Identification of possible further action at EU level (Section 4):** as a final step and based on previously collected data and insights, this study will present the potential actions at EU level to incentivise the return of small both used and waste EEE and an impact assessment for these measures.

1.2 Background of the study

Unsound management and treatment of waste electrical and electronic equipment (WEEE), hazardous substances present in EEE such as heavy metals, brominated flame retardants and phthalates can pose risks for human health and the environment through emissions into the air, soil and water. Such risks may gain additional dimensions if WEEE is exported to countries outside the EU/EEA where it could be treated in an unsafe and unsound manner.

WEEE also contains various materials with a high economic and strategic value, such as gold, copper and critical metals. Recovery and recycling of such materials may render the EU less dependent on the supply of such resources from outside the Union and boost resource efficiency of Union's industries. EEE and WEEE also have clear potential higher up in the waste hierarchy, as the lifetime of many devices can be lengthened through re-use, upgrading and repair of used EEE as well as repair or refurbishment of WEEE.

Giving small used and waste EEE such as mobile phones, laptops and tablets, a "second life" seems to be gaining acceptance within mainstream consumer patterns. Although with very small market shares, a few companies have now tapped into the reusability of EEE as a business model (e.g. modular smartphone). In addition, manufacturers in the sector are increasingly being urged to extend the useful lifetime of their equipment through standards and interoperability. One of the most prominent examples are chargers for smartphones, the variety of which has already been significantly reduced over the years as a result of initiatives from the EU. Currently, there are new efforts to achieve further interoperability and to ensure that consumers are no longer obliged to buy a new charger with every new device.

The relevance of the described challenges and opportunities is magnified by the fact that WEEE currently constitutes one of the fastest growing waste streams in the EU and globally. Eurostat statistics show an average growth of EEE placed on the market in the EU of 2.9%, culminating in a volume of 10.09 million tonnes in 2016 (Eurostat, 2020a). In the same year, 3,121,676 tonnes of WEEE were collected in the EU. In 2017, the amount of collected WEEE was 3,242,717 tonnes.

1.2.1 Regulatory context

First legislative efforts to ensure sound management of WEEE in the EU, as well as increased recovery, date back to 2003 in the form of the first WEEE Directive (2002/96/EC). In subsequent years, it was replaced by Directive 2012/19/EU, notably to strengthen separate collection and recovery, including providing for more ambitious targets. Most notably, the WEEE Directive lays down, as of 2019, a collection target of 65% of the average weight of EEE placed on the market in the three preceding years in the Member State concerned, or alternatively 85% of WEEE generated on the territory of that Member State[4]. In addition, Article 5(1) of the WEEE Directive determines that Member States shall adopt appropriate measures to minimise the disposal of WEEE in the form of unsorted municipal waste, to ensure the correct treatment of all collected WEEE and to achieve a high level of separate collection of WEEE.

Within this context, it should be noted that the take-back obligation under Article 5 on separate collection requires Member States to ensure that:

(a) systems are set up allowing final holders and distributors to return WEEE free of charge. Member States shall ensure the availability and accessibility of the necessary collection facilities, taking into account, in particular, the population density;

(b) when supplying a new EEE, distributors are responsible for ensuring that WEEE can be returned to the distributor at least free of charge on a one-to-one basis as long as the EEE is of equivalent type and has fulfilled the same functions as the supplied EEE. Member States may derogate from this provision provided that they ensure that returning the WEEE is not thereby made more difficult for the final holder and that it remains free of charge. Member States making use of this derogation shall inform the Commission thereof;

(c) distributors provide for the collection, at retail shops with sales areas relating to EEE of at least 400 m^2, or in their immediate proximity, of very small WEEE (no external dimension more than 25 cm) free of charge to end-users and with no obligation to buy EEE of an equivalent type, unless an assessment shows that alternative existing collection schemes are likely to be at least as effective.

[4] Commission Implementing Regulation (EU) 2017/699

Such assessments shall be available to the public. WEEE collected shall be properly treated in accordance with Article 8;

The Waste Framework Directive (WFD) reflects the polluter-payer principal through the extended producer responsibility (EPR) schemes under Article 8a. Under the EPR mechanism, producers are made administratively and/or financially responsible for waste management.

Finally, the WEEE Directive also constitutes the basis for extended producer responsibility for WEEE generated in the EU. Based on this mechanism, producers of EEE are given the financial and, in some cases, administrative responsibility for the separate collection and sound treatment of WEEE. It requires the separate collection and proper treatment of WEEE and sets targets for their collection as well as for their recovery. Recovery targets include preparation for re-use and recycling of WEEE.

1.2.2 Policy context

The resource efficiency potential of WEEE was iterated in the first Circular Economy Action Plan (CEAP 2015), which underlined the importance of critical raw materials for the EU and in particular those present in electronic devices and also announced legislative and non-legislative actions to increase the low level of recovery of such critical raw materials. The European Commission furthermore supported the implementation of the WEEE Directive through various initiatives such as reports reviewing some of its aspects including targets and preparation for reuse, a compliance promotion initiative and technical studies.

The electronics sector and ICT have also been identified as a "key product value chain" under Commission's second Circular Economy Action Plan (CEAP European Commission, 2020e). The CEAP 2020 in this respect envisages the following measures:

(1) Regulatory measures for electronics and ICT including mobile phones, tablets and laptops under the Ecodesign Directive (2009/125/EC), so that devices are designed for energy efficiency, durability, reparability, upgradability, maintenance, re-use and recycling;

(2) Focus on electronics and ICT as a priority sector for implementing the 'right to repair', including a right to update obsolete software;

(3) Regulatory measures on chargers for mobile phones and similar devices, including the potential introduction of a common charger[5], improving the durability of charging cables and incentives to decouple the purchase of chargers from the purchase of new devices; and

(4) Improving the collection and treatment of waste electrical and electronic equipment including by exploring options for an EUwide take back scheme to return or sell back old mobile phones, tablets and chargers.

1.2.3 Challenges concerning small WEEE

Within the context described above, small WEEE such as mobile phones, tablets, chargers and laptops has proven to be a challenging waste stream. Despite legislative measures, administrative efforts and public or private initiatives, the collection rate of such WEEE remains low. Based on the different

[5] The common charger or universal charger as it is often called will only be achived through the combination of GROW.H2 intiative on "common charging and unbundling for mobile phones and similar devices" and the initiative by DG ENER under the Eco-design which will revise the External power Supply(EPS) regulation.l

figures available on the collection of mobile phones in Europe, it is has been found that there is a low return rate of devices by consumers to collection points. The highest collection rate estimated for mobile phones alone in the EU is of 15% of devices put on the market (see Section 2.4.1.2 for more details). At a national level, a 2018 study indicates that the official collection rate for mobile phones and their components in Germany is of 5%. Data available at the EU level indicates a collection rate of approximately 60% for the wider WEEE category "IT and telecommunications equipment", out of which only around 5% are re-used (Gurita *et al.*, 2018).

Low collection rates directly impact the rate of recovered small WEEE and thus the attainment of the regulatory targets laid down in the WEEE Directive. From a waste hierarchy perspective, low collection and return rates also limit the possibility for repair and refurbishment of small used EEE and WEEE. Recovery, repair and refurbishment activities also face specific challenges related to the lack of information on the composition of WEEE, as well as the possibilities for disassembly and repair. Ultimately, low collection, repair and recovery rates present a lost opportunity to maintain valuable materials and circular jobs in the EU economy based on safe and sound waste management practices.

The main factors identified in literature to date and by stakeholders that may limit the collection or return rates of small EEE include:

- household storage as consumers are reluctant to return their small used EEE and as a result store them at home;
- discarding through municipal waste streams;
- scavenging, incompliant collection activities; and
- illegal exports of WEEE to third countries.

2. PROBLEM DEFINITION

2.1 Objectives

This first phase of the study aims to establish an exhaustive and representative **problem definition** in relation to the **household storage** and the **low level of collection** or take-back of **small used EEE and WEEE**. A solid understanding of the problem will allow for the identification of the key underlying drivers to be considered for the development of possible policy actions. As such, this section provides recent trends and developments in regard to the market, including the reverse supply chain markets as well as household storage and end of life practices. Where relevant, additional supporting information is also provided in the Annex of this report (see Sections 7.1, 7.2, 7.3).

2.2 Scope

For the purposes of the study, it was necessary to identify the key **terms and relevant definitions** in order to ensure the overall coherence and robustness of findings as well as to **select the main devices** for the problem definition. A summary of the main elements of the scope of the problem definition is provided in the following section and a detailed background of the approach and methodology used for the scope definition is provided in the Annex to this report (Section 7.1).

2.2.1 Identification and definitions of key terms

The problem definition served as the starting point for identifying the key relevant terms of the study and focuses on the following two areas and related aspects:

(1) **Low collection or return rates** of **small used and waste EEE**, notably mobile phones, laptops (including tablets) and chargers:
- Current collection and return rates (in accordance with the take-back obligation laid out in Article 5 of the WEEE Directive on separate collection);
- Trends on end-of-life practices, including preparing for re-use, refurbishement, recycling and recovery;
- Potential losses to the circular economy (of recoverable materials at end-of-life).

(2) **Household storage** of **small used and waste EEE** including mobile phones, laptops (including tablets) and chargers:
- Underlying reasons behind consumer behaviour in relation to household storage of these devices;

(2) **Distinction** between **small used and waste EEE**, in regard to their relevance for the possible solutions to be assessed during the third phase of the study.

Table 26 in Annex 7.3 provides the definitions of the key identified terms, along with additional clarifications on some of the definitions, particularly those for which no official definitions exist at EU level such as repair, refurbishment, remanufacturing and obsolescence. Particularly important for this study are the definitions of re-use and preparation for re-use. In art. 3 of the Waste Framework Directive (2008/98/EC) re-use is defined as "Any operation by which products or components that are not waste are used again for the same purpose for which they were conceived" while preparation for re-use is defined as "Checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing".

Finally, supporting information on the approach and methodology used for the identification and definitions of key relevant terms for the purposes of this study are provided in Annex 7.2 to this report.

2.2.2 Selection of devices

The main devices covered in this study include **mobile phones** (including smartphones and feature phones), **laptops** (including **tablets**) and their **chargers**. These devices are frequently and commonly assessed in existing studies, which is important in regard to the availability of necessary data needed to carry out an in-depth and exhaustive assessment. They also represent high market volumes as well as potential substantial losses / missed opportunities in regard to the economic value of recoverable materials.

It should be noted that other devices such as e-readers, devices used for storing data (hard drives, USB sticks, SD cards) and accessories (headphones) may also be relevant in regard to household storage of small used EEE and low collection of small WEEE. However, the availability of data on such devices is very limited. Further information on the approach applied for the selection of devices covered by the study is provided in Annex 7.1.1.2 to this report.

2.3 Overview of the current situation

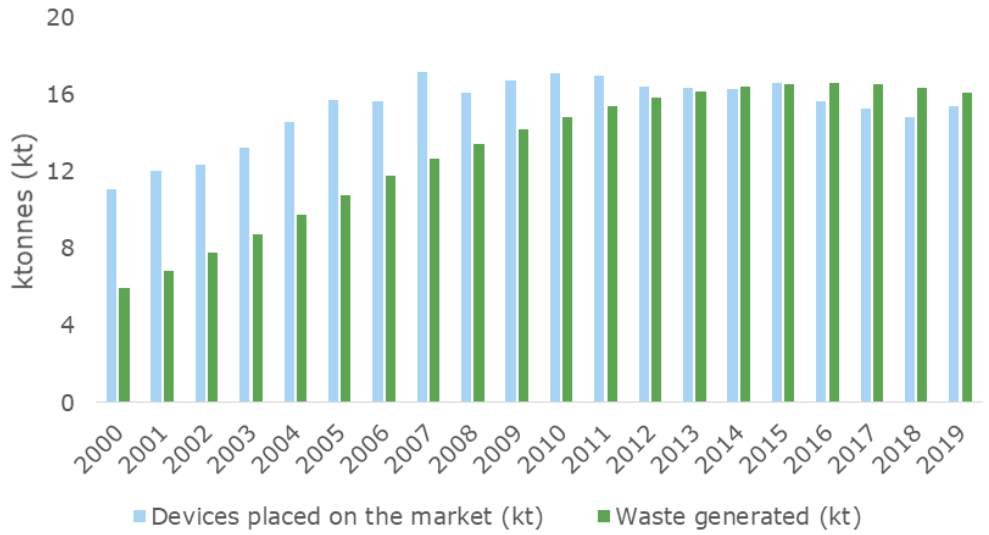
2.3.1 Key trends on quantities placed on the market and waste generated

Figure 1 and Figure 2 show the volumes of mobile phones, laptops and tablets placed on the EU market and the corresponding amount of waste generated from 2000 to 2019. Since 2013, there has been an overall decline in the volume of laptops and tablets placed on the market, with a slight increase observed in 2019 (Figure 1).[6] For mobile phones, the amount placed on the market has remained relatively stable (Figure 2).

Figure 1: Laptops and tablets placed on the EU market and waste generated from 2000-2019 (kt)[6]

[6] Based on UNITAR extractions using the UNU keys for the volumes of waste mobile phones (UNU key 0306) and laptops and tablets (UNU key 0303) generated and corresponding volumes placed on the market.

Figure 2: Mobile phones placed on the EU market and waste generated from 2000-2019 (kt)[6]



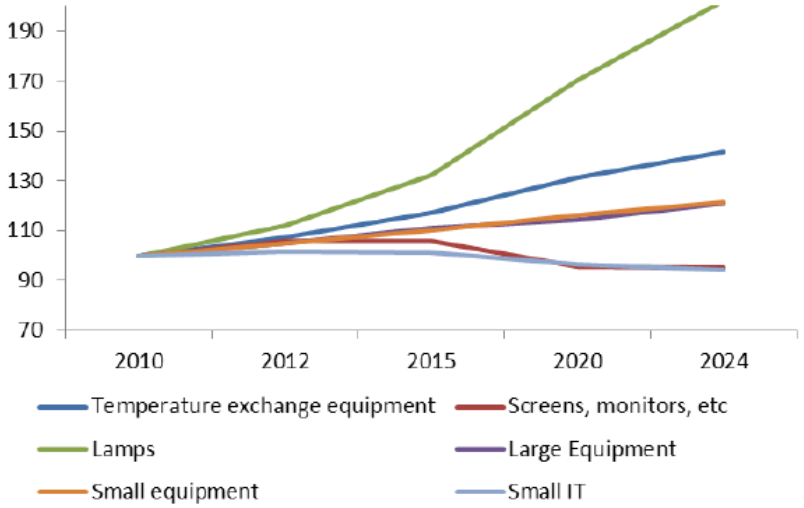
Regarding waste generation, from 2000 to 2015 the amount of waste generated from laptops, tablets and mobile phones increased significantly, while the quantities of waste generated since 2015 have remained relatively stable. This trend can be explained by both regulatory and technological factors; notably in relation to the revision and updates of the WEEE Directive since 2003 and technological developments in product design such as smaller, thinner and therefore lighter devices (in terms of weight) being placed on the market.

The figures presented above also highlight that for **laptops and tablets** from 2016 onwards, the quantity of waste generated exceeded the quantity placed on the market. Likewise, for **mobile phones** by 2014, the volume of waste generated was higher than the amount placed on the market. As mentioned previously, developments in product design characteristics have resulted in smaller new devices, which are comparatively lighter in weight with respect to their older counterparts; and as such can have an overall impact on the total volumes of waste generated. In other words, as older and larger (and heavier) devices are becoming waste, new and smaller (and lighter) devices are being placed on the market. Furthermore, evolutions in average product lifespan can also play a role, as in general the longer the lifespan of a product is, the less likely it will be replaced by newer products. However, due to complex socioeconomic (behavioural) factors and technological changes, the relationship between average lifespan and quantities placed on the market is highly uncertain (European Commission, 2014).

In regard to future expected trends, the 2014 Commission study on collection rates of WEEE estimates that while the amount of waste generated from most WEEE categories is expected to increase in coming years, the overall waste arising from small IT equipment in particular will likely decrease (Figure 3). This is mainly attributed to lighter laptops and tablets replacing desktop computers on the market. However, within the same small IT category, the study foresees a slight increase of waste generated from mobile phones, which is linked to the expected increase in sales. These estimates from 2014 should however be treated with caution due to the characteristics of the mobile phone market e.g. product design developments, price fluctuations, consumer behaviour trends, etc. Estimates can therefore change drastically from year to year. For example, more recent figures estimate that the market for mobile phones is currently experiencing a slowdown due to a decrease in overall replacement rates driven by higher prices, increased service life and a growing second-hand market (see Section 2.3.1.1 and 2.3.2.1 for additional details on key market trends) (EESC, 2019; IMF, 2018). Also, as discussed earlier, the increase in waste arising from mobile phones

would be almost insignificant in terms of overall weight due to the recent trends in lighter devices being placed on the market. Finally, concerning future expected trends in household storage and collection rates of mobile phones, tablets, laptops and their chargers, no significant developments have been identified in existing literature compared to the situation studied in 2014 by the European Commission.

Figure 3: Estimated evolution of waste generated from specific WEEE devices, 2010-2024 (2010 indexed as 100; unit=kt) (European Commission, 2014)



2.3.1.1 Mobile phones

Technical description and trends in product design

Mobile phones are wireless electronic devices used for telephone and multimedia communications. The main devices considered under the mobile phone category are the following:

- smartphones;
- feature phones, and
- their chargers.

Mobiles phones do not include cordless phones (which have a base unit that they must be returned to and are ultimately connected to a landline).

Feature phones are mobile devices providing basics functions: voice calling, text messaging and in some cases, basic multimedia and internet capabilities. They have a small display and button-based input. The main accessories that can be used with these are power charging cables and headphones.

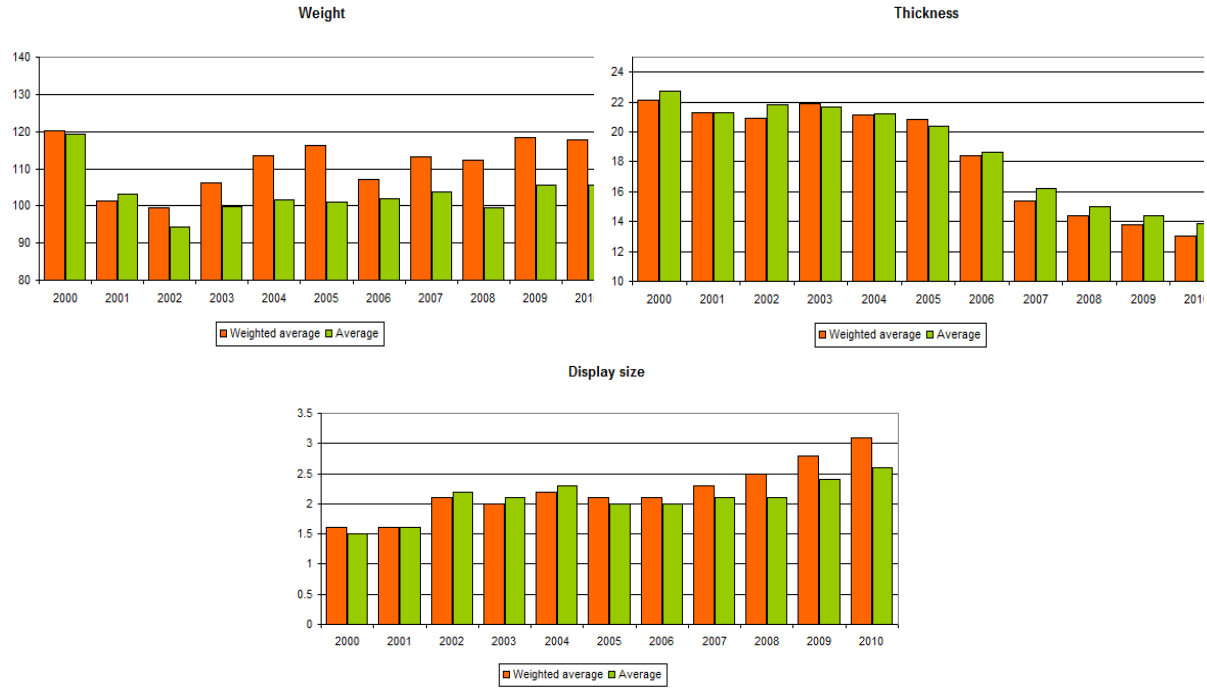
Smartphones are mobile devices that combine cellular and mobile computing functions in one device. They have stronger hardware capabilities than feature phones, and their features include web browsing, multimedia functionality, alongside core phone functions such as voice calls and text messaging. They can be used with a wide range of accessories, including:

- power charging cables;
- wireless power stations;
- USB adapters;
- add-on batteries;
- headphones (or combined headphone-microphones);
- bluetooth-enabled powered speakers.

Since the first models were built and commercialised in the '70s, the design and performance of mobile phones have changed significantly. As reflected in Figure 4, between 2000 and 2010, key trends included a **reduction in thickness** and **wider screens** (the screen size of smartphones in particular has tended to increase up to 7", especially in the case of phablets[7]), which resulted in an average weight in 2010 similar to those observed in 2000 (approximately 120 g).

Although the overall **weight** of mobile phones has gradually decreased since the first models built in the '70s, which weighed approximately 4 kg (Basel Convention, 2010), to less than 120 g in 2010 (Figure 4), a slight increase in the average weight of smartphones has been observed in recent years due to other product developments. For example, between 2017 and 2018, there was an average weight increase of 5.6 g, from 161 g in 2017 to 166.6 g in 2018, which was attributed to taller and wider screens, the wider use of glass as opposed to aluminium/plastic equivalents (which tend to result in thinner and lighter models) and the increase in battery size (GSM Arena team, 2018). These figures are similar to those reported in the 2019 European Economic and Social Committee (EESC) study, which estimated the average weight of a mobile phone at 164 g (EESC, 2019).

Figure 4: Trends in weight (g), thickness (mm) and size (inch) of mobile phones from 2000 to 2010 (GSM Arena Team, 2010)



In terms of **average product service life** (effective time during which the product is used, including re-use (Cooper, 1994), even if in practice, the service life may be longer, available sources indicate that on average, the **service life** of mobile phones is less than three years. For example, in 2020, the average service life of a mobile phone in the Netherlands was estimated to be 2.5 years (Circle economy, 2020) while the EESC study estimates that the average lifetime is around 21.6 months, which is a bit less than two years (EESC, 2019). Other estimates of this lifetime, reported as an active use lifetime, are summarised in the market report of the Commission's Ecodesign study: 1,7

[7] Phablets: mobile devices that display the same features as that of a smartphone, but with a size of screen somewhere in between a smartphone and a tablet.

years, 1,75 years and 2,18 years depending on the geographical scope and measurement method (survey, battery life measurement) (European Commission, 2020b).

In regard to the **composition of mobile phones**, in general, they are mainly composed of metals and plastics, with small quantities of critical raw materials (see Table 31 in Annex 7.3 for a list of common materials used in a typical feature phone). It should be noted, however, that reported figures on the material composition of mobile phones should be treated with caution as they may change drastically in time due to economic and technological factors and can vary widely across the numerous different brands and models (EESC, 2019).

Figure 5: Estimated composition of a mobile phone (EESC, 2019)

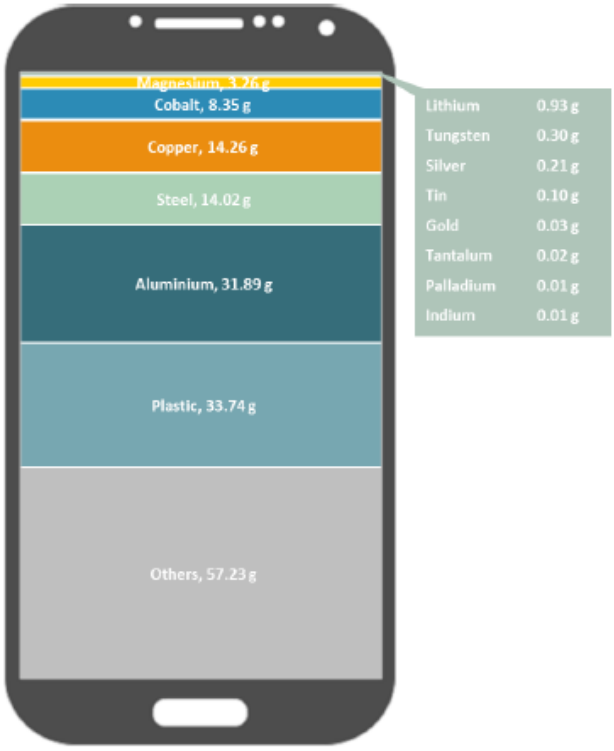
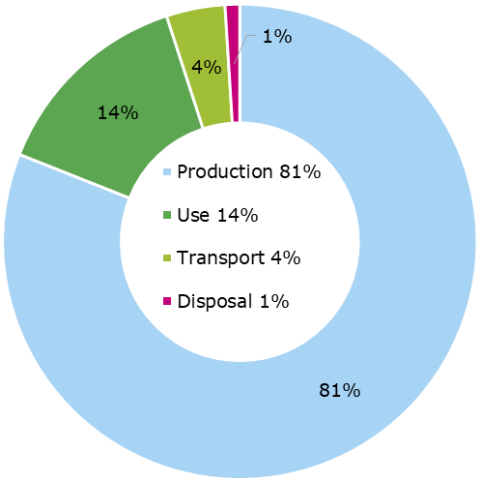


Figure 6: Average share of emissions of a mobile phone (EESC, 2019)



Finally, several sources indicate that the main environmental impacts over the lifetime of a mobile phone occur during the production phase (Apple, 2020; EESC, 2019). As reflected in Figure 6, the production phase accounts for approximately 81% of the lifecycle carbon emissions of mobile devices, followed by the use phase (14%). The estimates are based on a mobile phone with a 21.6 month lifetime.

From a circular economy point of view, which aims at optimising resource consumption throughout the lifecycle, improving manufacturing processes and extending the service life of mobile phones is therefore essential. Extending the average first lifetime to 34 months instead of 22 months could save up to 20 million tonnes of CO_2eq (EESC, 2019).

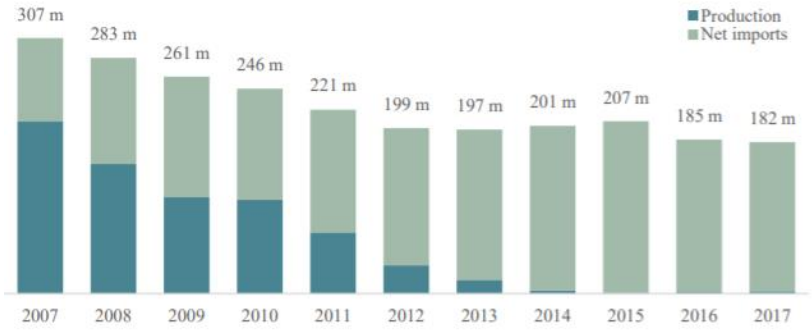
Production and consumption trends

Most of the mobile phones sold in the EU are imported, with production mainly taking place outside the EU, specifically in Asia (China, South Korea, Malaysia, Singapore and Taiwan). This includes the mining and extraction of raw materials to the manufacturing of components and assembly (EESC,

2019). Some EU-based brands do however exist (e.g. Fairphone), although the different components used are mainly manufactured in Asia.

The production of mobile phones in Europe has drastically decreased from almost 67% of the total units sold on the market in 2007 to almost none, with 1.5% of total units sold in 2017 (EESC, 2019). As reflected in Figure 7, out of the 307 million units sold on the EU market in 2007, 207 million units were produced in the EU, with the remaining 100 million units imported from third countries. By 2017, the production of mobile phones in the EU decreased significantly to only 2.8 million units of the total 182 million units sold on the EU market.

Figure 7: Estimated number of mobile phone units (millions) sold in EU-28 from 2007 to 2017 (EESC, 2019)



Global and European consumption trends of mobile phones have also undergone a period of rapid changes, driven by technological advances such as the emergence of smartphones in the 2000's. For example, as seen in Figure 8, in 2018, smartphones were by far the main type of mobile phone device owned, representing over 90% of ownership in 10 Member States surveyed, compared to other mobile devices that are not considered smartphones (EESC, 2019). Further, in 2019, more than 90% of adults surveyed in many EU Member States owned a mobile phone device (EESC, 2019). In 2018, the number of mobile phone subscriptions in the EU exceeded the number of inhabitants (1,220 subscriptions per 1000 inhabitants) (Eurostat, 2020b).

Figure 8: Mobile phone ownership in selected EU countries, 2018 (EESC, 2019)

The market for mobile phones is currently experiencing a slowdown, due to factors such as an increase in prices and consumers using their devices longer due to advancements in technology, which have resulted in a subsequent decrease in replacement rates and increased service life. For example, the average service life of a smartphone in five European countries (France, Germany, Great Britain, Italy and Spain) increased by almost three months from 23.4 months in 2016 to 26.2

months in 2018 (Kantar Worldpanel, 2017). Table 1 summarises some of the main factors identified behind the decreasing replacement rates of mobile phones.

Table 1: Factors leading to decreasing replacement rates of mobile phones (Kantar Worldpanel, 2017)

Factor	Explanation
Higher prices of new devices	The top three smartphone companies (Apple, Samsung and Huawei) saw an average price increase of 52% between 2016 and 2018.
Speed of innovation	The speed of innovation has slowed down in the past few years, which does not encourage consumers to replace current models with new ones as more recent versions do not propose any particularly disruptive new features. As such, the relatively high performance of existing models means that most users, particularly in economically developed regions like Europe, are more likely to use their phones longer, instead of replacing them with newer models. In addition, mobile phones are not drastically different from one brand to another.
Movement away from phone contracts with telecommunications carriers	Phone contracts including the purchase of a new phone along with the phone subscription used to create a natural mobile phone upgrade cycle, but such contracts are now declining.

Other aspects to consider with respect to the potential future trends in the market of **mobile phones** include:

- **Mobile phones tend to have a relatively high economic value, even when used**: the average selling price for a new smartphone worldwide was 200 EUR in 2016, and the average selling price for a used smartphone the same year was 118 EUR (Baldé *et al.*, 2017);
- **Due to the high market value of new phones, there is a rapidly growing market for refurbished or re-used mobile phones**, which has also been fuelled by the rapid succession of new models: the global market for refurbished smartphones grew by 13% in 2017 in contrast with the global new smartphone market that grew by 3% (Counterpoint, 2018);
- **Innovations in product design**: although the tendency to design thinner phones in terms of size but with higher performance (sensors, battery, screen, etc.) has resulted in a reduction of the amount of certain materials used (e.g. plastic) during manufacturing, energy consumption during use has increased (EESC, 2019);
- **Development of 5G networks**: could eventually lead to an accelerated renewal of devices, as new services and features allowed by 5G will not be available for older devices (CNBC, 2019);
- **Obsolescence**: software and operating system updates are frequent and often exceed the technical performance of devices, leading to unexpected slowdowns and a lack of support from developers on these products (EESC, 2019).

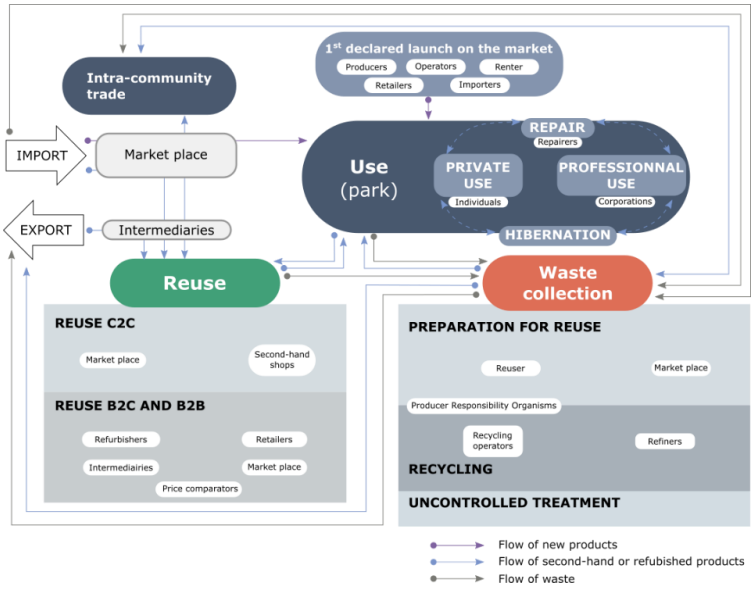
Another trend regarding consumer behaviour is **household storage**: mobile phones are hoarded in households in significant volumes, resulting in significant impacts in regard to the amount of WEEE collected through official dedicated collection schemes (see Section 2.4.1.1 for more information on household storage).

As for **mobile phone chargers**, key trends to note include (European Commission, 2019b):

- **A high but not universal degree of interoperability** of different charging solutions has resulted in the proliferation of several charger types, causing not only an inconvenience for consumers but also limited interoperability, performances and safety issues and an increase of WEEE[8] (European Commission, 2019b). As such, the Commission is currently evaluating the possibility of different measures aimed at introducing a common charging and unbundling solution for mobile phones and other small electronic portable devices (European Commission, 2021b).
- **Potentially significant variations in charging performance** e.g. charging speed between brands and devices, due to the wide range of fast charging solutions on the market;
- **Market in constant evolution**, with USB Type-C connectors, which are expected to gradually replace legacy USB connectors (within the next few years) as well as innovations in fast and wireless charging technologies which are likely to continue at a rapid pace;
- **Illicit markets and product safety**: substantial markets for counterfeit chargers, particularly stand-alone chargers, which are very difficult to effectively control, especially if sold online. This raises concerns in terms of the direct and/or indirect economic losses for holders of the intellectual property rights (usually the large mobile phone manufacturers themselves), as well as in terms of product safety for users (as substandard chargers – which do not necessarily have to be counterfeit – could pose higher risks for electric shock, electrocution and fire hazards).

The following Figure 9 provides an overview of the main types of stakeholders and corresponding operations involved in the mobile phone value chain in France.

Figure 9: Actors in the mobile phone value chain (France) (AFNUM, 2019)



[8] WEEE may also be referenced as "e-waste" throughout the report, and both refer to the same definition (see Table 26).

2.3.1.2 Laptops and tablets

Technical description and trends in product design

In accordance with Commission Decision (EU) 2016/1371 of 10 August 2016 establishing the ecological criteria for the award of the EU Ecolabel for personal notebooks and tablet computers, a laptop (also referred to as a notebook) is defined as "*a computer designed specifically for portability and to be operated for extended periods of time both with and without a direct connection to an AC main power source*". A laptop must have an integrated display, with an attached keyboard, moveable keys and pointing device (mousepad, etc.). It can be powered by an integrated rechargeable battery or other portable power sources.

The functionality of a laptop is usually similar to a desktop computer and can operate in most cases the same software. A tablet computer is also designed for portability and meets all of the following criteria:

- includes an integrated display with a diagonal size greater than 6.5 inches and less than 17.4 inches;
- lacks an integrated, physically attached keyboard in its as-shipped configuration;
- includes and primarily relies on a touchscreen input;
- includes and primarily relies on a wireless network;
- includes and is primarily powered by an internal rechargeable battery.

Both laptops and tablets can be used with different accessories. The following table presents the main types of accessories used with laptops and tablets as well as the technical components which characterise a typical laptop.

Table 2: Common technical components of laptops & tablets and accessories used

Accessories used with laptops & tablets	Common technical components of laptops (EC, 2007) & tablets
• Charger • Headset • Mouse or external mousepad (primarily laptops) • External hard drive (primarily laptops) • External keyboard (primarily tablets) • Speakers • Extra screen	• Screen • Battery • Clamshell • Keyboard (primarily laptops) • Trackpad (primarily laptops) • Speakers • Microphone • Webcam • Various types of connectors • Hard drive

The size of a laptop varies and can range from 11.6 to 17.3 inches (Danish cable TV, 2020). In regard to the average lifespan, depending on the source, a laptop can have an average lifespan of around 5 years (Balde *et al.*, 2015) to 3-5 years (Business News Daily, 2020). As in the case of mobile phones, however, the average lifespan of a laptop can vary widely due to socioeconomic and technological factors that can affect how long consumers use their devices for and the overall replacement rate (see the following section). Although a laptop could technically still be used beyond its average lifespan, its utility can be limited by software obsolescence (meaning that components become less capable of running more advanced applications) (ECOS, 2020).

Regarding **material composition**, according to EuRIC (European Recycling Industries' Confederation), the material balance of a typical laptop is approximately 70% mixed plastics/metals,

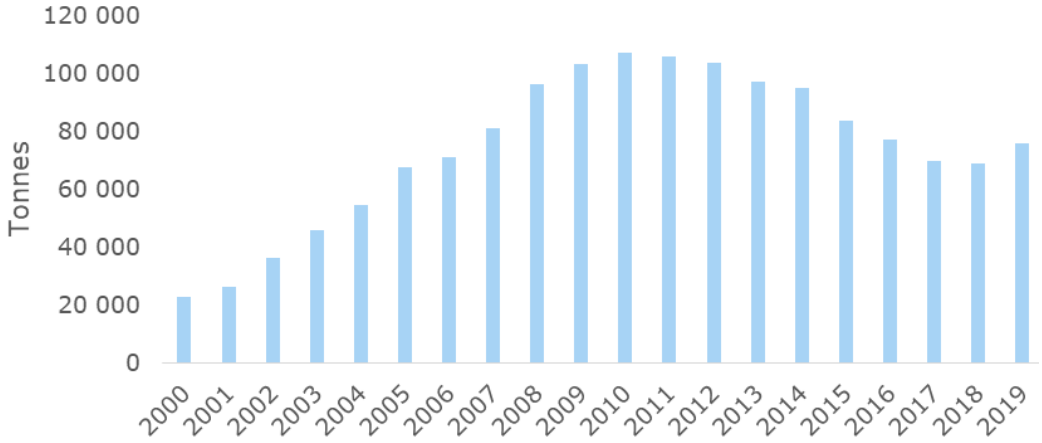
13% printed circuit board, 10% electronic components and 7% battery.[9] Regarding **printed circuit boards** (PCBs) in particular, which are used for electrical conduction in mobile phones and laptops, various kinds of metals are used such as aluminium (Al), copper (Cu), and tin (Sn), as well as precious metals, notably gold (Au), silver (Ag), platinum (Pt), and palladium (Pd). Metals represent about 40% of the overall value of waste PCBs, while non-metal elements constitute the rest (MDPI, 2019). As such, in the context of a circular economy, PCBs can be considered as an example of "secondary resources" in the electronic waste stream, and are perceived as the most **complex, valuable, and hazardous component** of WEEE. Developments in the composition of laptops and tablets are further discussed in the following section.

Production and consumption trends

Laptops and tablets are mainly manufactured in Asia and the USA. The largest producers of laptops are: Apple, Lenovo, Acer, Dell, ASUS, Microsoft and Toshiba; while for tablets they are: Amazon, Apple, Huawei, Lenovo, and Samsung (European Commission, 2019b).

In 2017, the total value of imported laptops in the EU was 23.1 billion Euro, which corresponds to approximately 74.4 million individual units (European Commission, 2019b). Similar EU market data for tablets is not available, however, according to the 2019 report "Impact Assessment Study on Common Chargers of Portable Devices", approximately 23.2 million tablets were imported to Western Europe in 2016 (European Commission, 2019b). As indicated in Figure 10 below, from around 2010 until 2018, there has been an overall decrease in the volumes of laptops and tablets placed on the EU market (UNITAR). Available data from 2019 (Figure 10) and 2020 indicate an increase in the sales of laptops, which in 2020 has been primarily driven by the COVID-19 pandemic resulting in a higher demand for quality portable computers since many people were working or studying from home (Eurostat, 2020c).

Figure 10: Laptops and tablets placed on the EU market from 2000-2019 (t) (UNITAR)



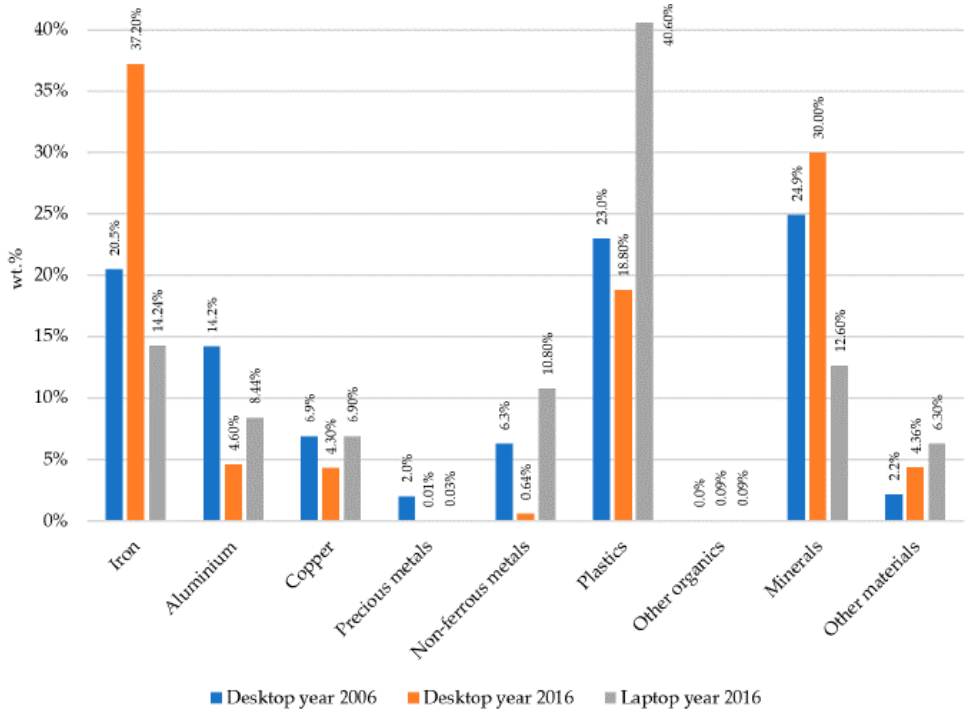
Moreover, consumers are increasingly choosing laptops over heavier (and less mobile) alternatives such as desktop computers. Consequently, there has also been a reduction in the overall weight in terms of total volumes for this category of devices (Anthesis, 2020). For example, after 2004, a decrease in the weight of personal computers in terms of volumes placed on the market was observed as laptops and tablets started to replace desktop computers in sales (European Commission, 2014).

[9] According to stakeholder survey feedback carried out in context of current study.

Replacement of laptops is oftentimes driven by the purchase of products with improved functionality. In particular, possibilities for upgrades and re-use are relevant with respect to memory/storage capacity, software and firmware (JRC, 2019). In addition, there is also an apparent trend towards more integrated designs limiting the possibilities for product disassembly (JRC, 2019).

As reflected in Figure 10, the **composition of the materials** used in laptops is **gradually changing**. The evolution of material composition in desktop computers and laptops in 2006 compared to 2016 indicates that while there has been a decrease in the weight of precious metals and minerals, there has also been a significant increase in the weight of plastics in laptops, compared to desktop computers (MDPI, 2019).

Figure 11: Material composition of computers in 2006 and 2016 (MDPI, 2019)

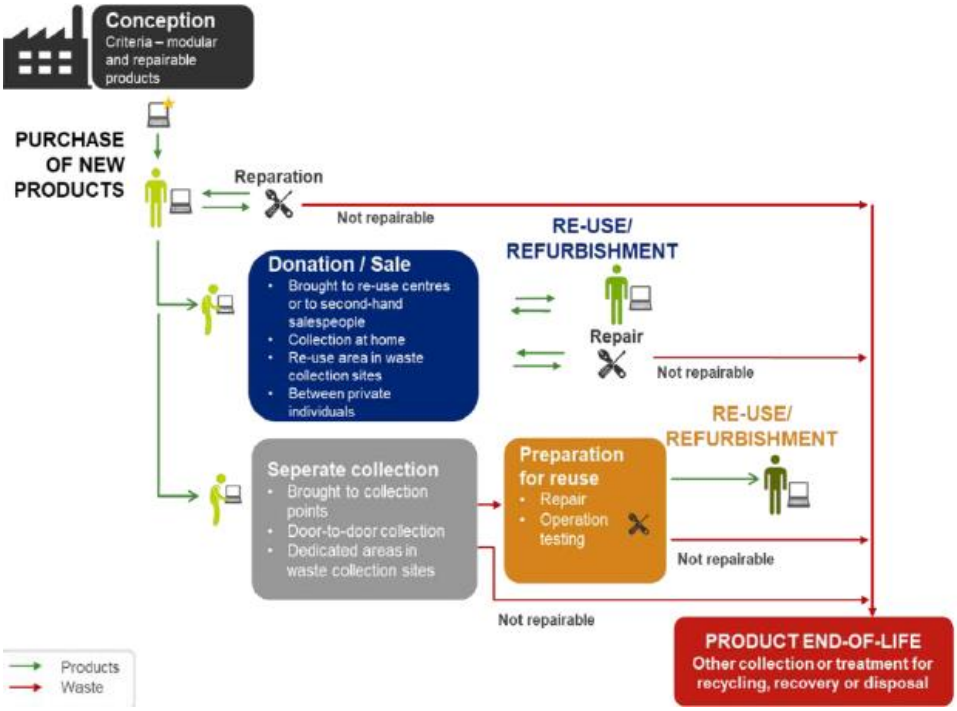


Similarly to smartphones, personal computers also represent a relatively mature category in terms of technological advancements and as such the changes seen from year to year in new models are in general incremental (PCMAG, 2020). Nonetheless, recent market trends in product design indicate that laptops will continue to decrease in overall size (thinner and lighter), however with larger and more performant displays (or screens). Other product developments include longer battery life, improved energy efficiency and the possibility of incorporating 5G in the future. Finally, there has also been a trend towards integrating more sustainable design principles. For example, one major laptop manufacturer claims that its latest laptop is now using 90% recycled magnesium in its chassis, with over 82% of the mechanical parts made from recycled materials, including ocean-bound plastic material in the speaker boxes (PCMAG, 2020).

2.3.2 Reverse supply chain market trends

Mobile phones, tablets and laptops hold significant opportunities within the context of a circular economy in terms of reverse supply chain operations such as re-use, repair and refurbishment (before becoming waste) as well as recycling and recovery (once it becomes waste). The reverse supply chain system refers to all operations that enable the re-use and repair of products, as well as the recovery of components and/or materials. Figure 12 summarises the main operations involved in the reverse supply chain, which are further detailed in the following section.

Figure 12: Re-use, repair and refurbishment & associated product and waste flows



Repair

Within possibilities for reverse supply chains, a first scenario is usually **repair**. Repair generally refers to operations which fix specific defects or faults and/or replace defective components (that made a device inoperable) in order to restore it to a fully functional state, allowing it to be used for its originally intended purpose (European Commission, 2017). Repair ensures the quality and functionality of the product/component, rendering it available for re-use and thereby extending the duration of the product's service life (European Parliament, 2019).

A recent study on sustainable consumption (Cerulli-Harms *et al.*, 2018) revealed that **a substantial share of EU consumers have never repaired products after they broke**. This share is of 36% on average, but in some countries, it can be higher, for example, 56% in the Netherlands. The main drivers for not repairing are the following:

- repair is expected to be expensive;
- getting a new product is more convenient; and
- the old product seems obsolete or out of fashion.

Convenience was reported as a major factor of influence regarding decision-making on repair.

Refurbishment

Another scenario is **donation or re-sale**, which usually implies **refurbishment** operations (particularly in the case of re-sale). Refurbishment (or reconditioning) refers to operations that are required to restore the product to its original intended purpose, before going back on the market (DigitalEurope, 2017). As such, refurbishment can also include repairs, however, it usually involves a lengthier process so that the device can be re-sold / placed back on the market. The resale of phones, laptops and tablets have a great potential in the EU market due to a growing second-hand market. For example, Refurbed, a German online marketplace for refurbished phones, laptops and tablets increased their sales by more than 500% between 2018 to 2019 (Sifted, 2020). Similar trends are reflected in the stakeholder consultation of this study. In addition, many initiatives exist within the EU, where consumers can donate their old devices. However, there are indications that a large portion of donated small IT is no longer viable for re-use. A Finnish recycling centre estimates that only around 20-25% of the small IT donated for re-use can be resold after repairs. The rest is therefore delivered to refurbishers or to a Producer Responsibility Organisation (PRO) as waste.

It should be noted that, contrary to refurbished or remanufactured products, repair does not necessarily imply that a device is being re-sold or placed back on the market. It can as such be used again by its original owner. A refurbished or remanufactured device, on the other hand, usually refers to a product that is placed back on the market and re-sold, implying both a **change in ownership** and, in cases of remanufacturing, a **new product guarantee**. See also Table 26 in the Annex for additional clarifications regarding the definitions and distinction between repair, refurbishment and remanufacturing.

Separate collection for recovery

Finally, another scenario within reverse supply chains is **separate collection**, which implies that the device is considered to be WEEE. The WEEE is ultimately collected and sent to designated sites, where it undergoes waste management operations such as preparing for re-use or treatment for recovery or recycling. An overview of EU collection rates and existing collection schemes is provided in Section 2.4.1.1 and Section 2.4.1.2.

Available literature and stakeholder input indicate that **reverse supply chain markets** have become **increasingly important** over the past years as a result of:

- voluntary industry and local initiatives that aim to further encourage and inform consumers concerning the possibilities for repair, refurbishment and re-use;
- shifts in consumer behaviour practices, in part due to economic drivers but also increasing environmental concerns; and
- a growing second-hand market (see Section 2.3.2.1 and 2.3.2.2).

Some of the **potential obstacles** identified in this study that may hinder further growth of the reverse supply chain market and related activities include:

- **Safe data removal and management from used/waste devices**: actions taken to guarantee safe data removal could help to address the issue of household storage and reassure consumers that their data is safe and protected when returning old, used devices. Companies such as Refurb, which is a Danish company that acquires used functional IT (including laptops and tablets) from large companies and public institutions, provide documentation demonstrating safe data removal and management.
- **Perceived value for used devices**: refers to cases when consumers have a high perceived economic value of their used devices. In such cases, even reward incentives may prove

insufficient to convince them to bring their devices to the reverse supply chain market. Consequently, consumers prefer to store their devices at home.

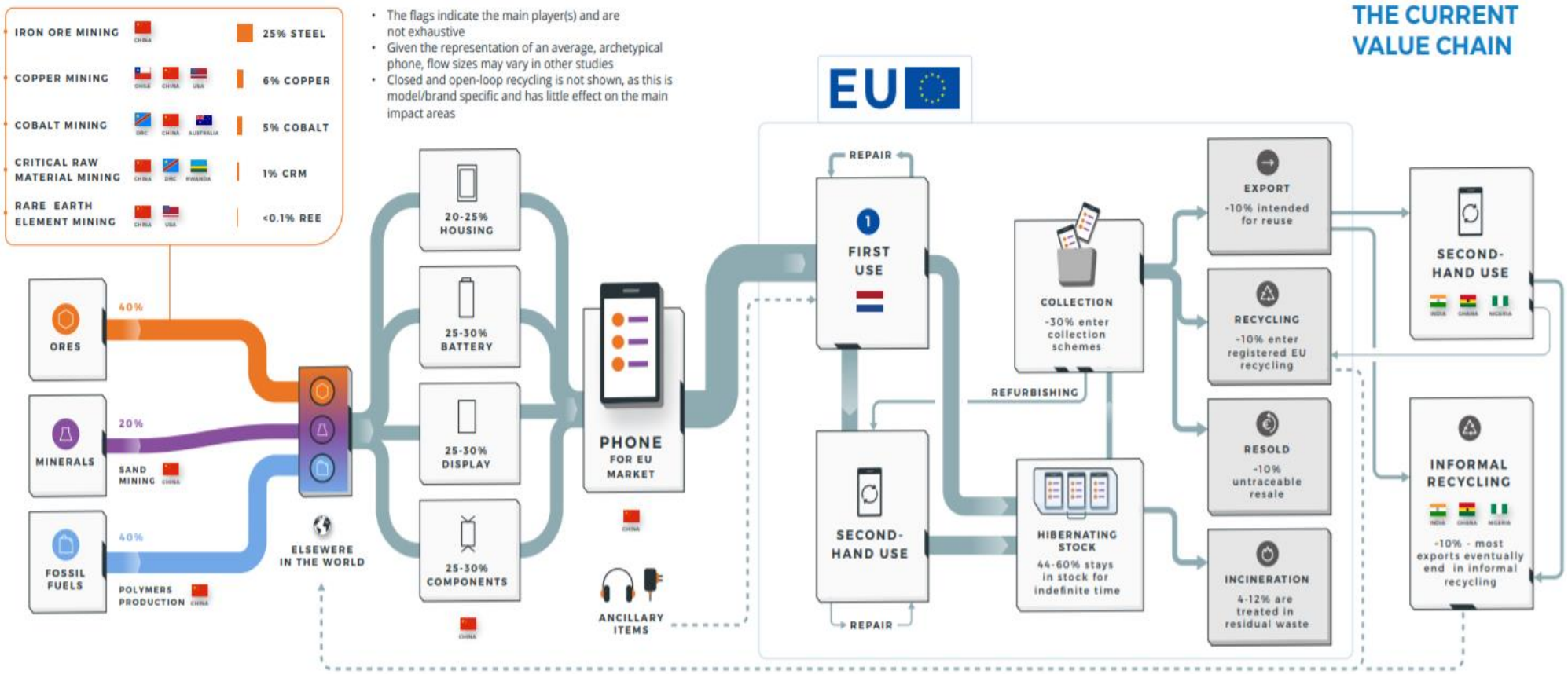
- **Technical requirements related to demonstrating whether the device can be re-used**: for some stakeholders, testing requirements or requiring proof of functionality e.g. microphone testing on mobile phones to determine the reusability of the device, can be time consuming and costly. Therefore, in some cases devices that could have re-entered reverse supply chains such as re-use (higher in the waste hierarchy) are sent for waste treatment operations instead.

2.3.2.1 Mobile phones

Precise figures on small used EEE and WEEE flows for mobile phones at EU level are difficult to obtain due to the fact that **data at the device level** is often not officially reported or monitored since it is usually included in the overall figures reported for the different categories of EEE, set out in the WEEE Directive[10]. Quantitative data at EU level related to the second-hand market is even more difficult to obtain as there has been no EU level obligation to report such information until recently. From 2021 on, the obligation to track flows of re-use as provided for in the Commission Implementing Decision (EU) 2021/19 will help to improve the measurement of flows of devices entering the different re-use flows including the second-hand market. Under this obligation, Member States have 18 months to report on the re-use flows for a given year, which in practice means data for 2021 will be available as of 2023. A review of existing sources does provide some important insights on the value chain of such flows. For example, Figure 13 provides a detailed mapping of used and waste flows of mobile phones in the Netherlands, including the fact that collection is not directly linked to the first use of a device but rather occurs after a household storage period. As reflected in the figure below, out of the approximately 30% of mobile phones that are collected by collection schemes in the Netherlands, 10% is exported as second-hand products, 10% is recycled within the EU and 10% is unregistered. These unregistered flows concern the unmonitored resold collected phones, of which there are estimations that roughly 30% is eventually recycled in the EU. Formal recycling of phones in the EU yields high rates for valuable materials (95-98%). Also, some of these unregistered flows are destined for (refurbished) re-use within the Netherlands or the EU, although there are no robust numbers to quantify that flow.

[10] Mobile phones are part of Category 6

Figure 13: Current value chain of mobile phones in the Netherlands (Circle economy, 2020)

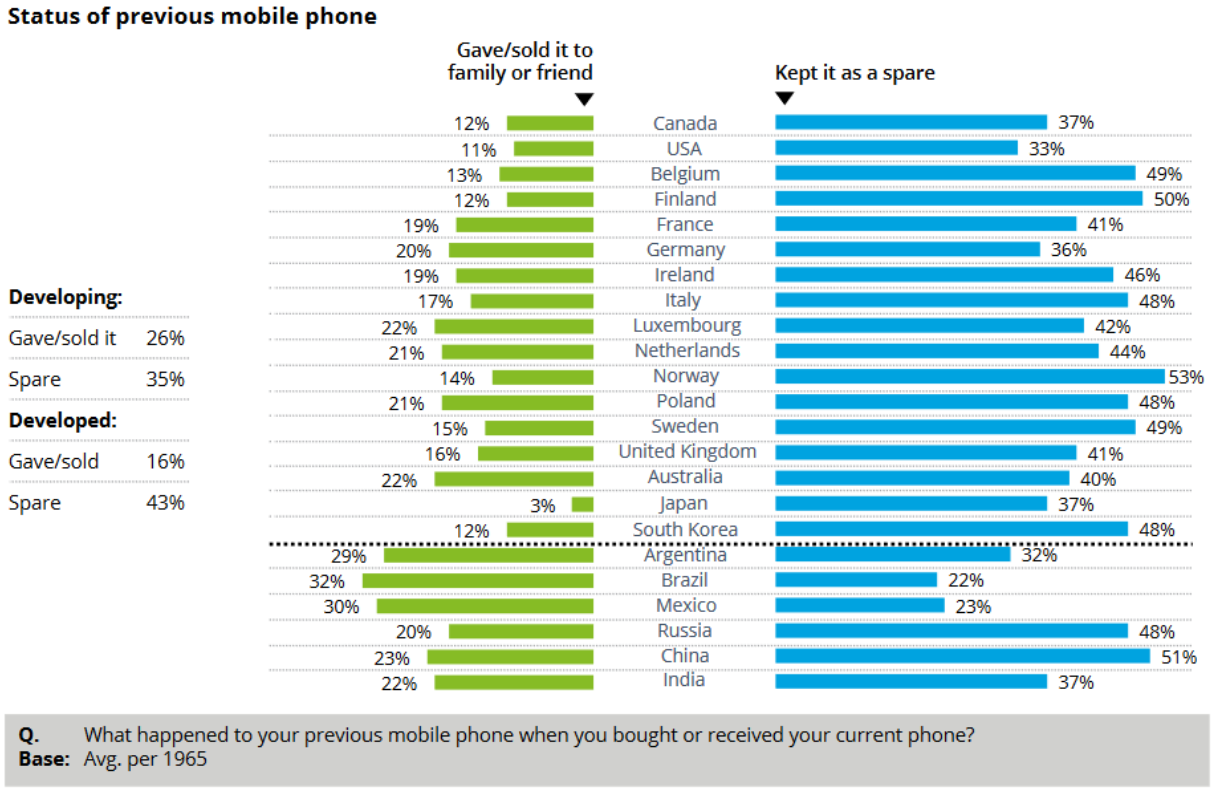


Second-hand market trends

Available data indicate that as the sales of new mobile phones decline, a new second-hand market is growing (Kantar Worldpanel, 2017; RCR Wireless 2019; Deloitte, 2017). Factors such as the affordability of used and refurbished devices compared to the higher and rising cost of new devices, longer average lifespan, etc., are supporting the growth of the second-hand mobile market (RCR Website, 2019). As shown in Figure 14, between 16% and 26% of consumers surveyed in developing and developed countries respectively either gave away or sold their old phones (Deloitte, 2017).

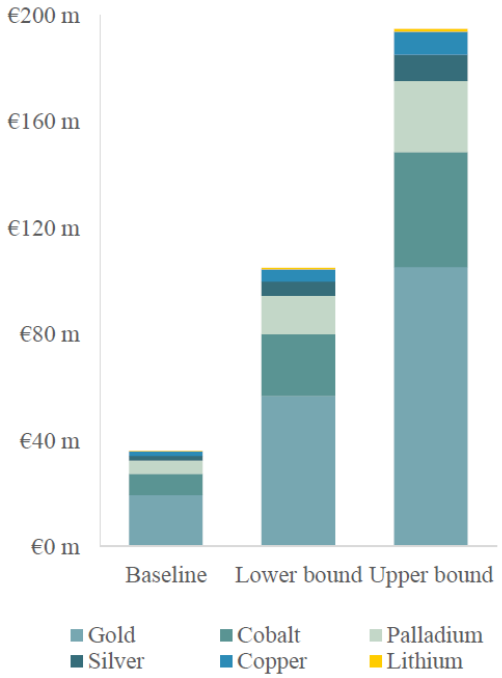
It should be noted that although collection schemes have the legal obligation to test collected devices and determine whether potentially functional devices can be sent to the second-hand market, it has been estimated in France that this flow is negligible in comparison with direct re-use (AFNUM, 2019). Most devices directed towards re-use or refurbishment have been given or sold by their previous holders to reverse supply chain actors, instead of going through WEEE collection schemes and being monitored by Producer Responsibility Organisations (PROs).

Figure 14: Survey results on the status of previously owned mobile phone (Deloitte, 2017)



Q. What happened to your previous mobile phone when you bought or received your current phone?
Base: Avg. per 1965

Figure 15: Value of material recovered from mobile phones sold in 2017



In addition to their contribution to the growing second-hand market, existing literature further highlights the significant untapped **potential for material recovery** from mobile phones.

Figure 15 and Table 3 reflect estimates from the EESC 2019 study on the potential value of recoverable materials of mobile phones sold in the EU in 2017. Findings of the study indicate that the environmental benefit and economic value of recoverable materials from mobile phones can be significant. For example, out of the estimated 50 million mobile phones sold in 2017, the value of recoverable materials could be anywhere from 36 € million under the baseline scenario up to 195 € million in the upper bound scenario (EESC, 2019). Out of the six materials covered, **gold**, **cobalt** and **palladium** were deemed to represent the highest economic value in terms of the materials that could be recovered from mobile phones.

Table 3: Estimated value of materials recovered from different scenarios of mobile phones sold in 2017 (EESC, 2019)

Scenarios	**Baseline**		**Lower bound**		**Upper bound**	
Variables[11]	Recycling rate: 12% Avr. lifetime: 21.6 months Refurbishment rate: 10%		Recycling rate: 35% Avr. lifetime: 33.6 months Refurbishment rate: 20%		Recycling rate: 65% Avr. lifetime: 45.6 months Refurbishment rate: 30%	
Materials	Weight (t)	Value (mill. €)	Weight (t)	Value (mill. €)	Weight (t)	Value (mill. €)
Gold	1	€19	2	€57	3	€105
Silver	4	€2	12	€5	22	€10
Copper	280	€2	818	€5	1518	€9
Cobalt	164	€8	479	€23	889	€43
Lithium	18	€0	53	€1	99	€1
Palladium	0	€5	0	€14	1	€27
Total	**467**	**€ 36 mill.**	**1363**	**€105 mill.**	**2532**	**€195 mill.**

[11] Description of variables used in the EESC (2019) study: Recycling rate: refers to the percentage of phones that, when no longer being used by their owner, are given to a collection point for recycling within the EU and thus reach proper recycling facilities; Average lifetime: refers to the average amount of time a mobile phone device is being used before the end of its first life, where it either changes owner, is refurbished, recycled, exported, thrown in general waste, or very likely – left hibernating in a drawer or similar. As such, the variable only refers to the time a device is used by its first owner. Rate of refurbishment: refers to the percentage of mobile phones sold in a given year that are eventually refurbished in order to be sold on the second-hand market. – i.e. they are sold or given away by their owner and upgraded or repaired to be sold as a refurbished device to a new customer.

2.3.2.2 Laptops and tablets

There is clear potential for increasing the service life of laptops and tablets through re-sale, repair and refurbishment. A study from 2015 in Finland indicates that laptops have a high potential for generating revenues stemming from the second-hand market and related activities due to the higher frequency of purchases (Ylä-Mella *et al.*, 2015). As such, companies and institutions are also placing increased focus on the potential of re-sale of IT equipment (mostly laptops), which can be economically beneficial, create increased accessibility for those who cannot afford new equipment and extend the product lifetime (Ylä-Mella *et al.*, 2015).

In regard to the **potential for recycling and recovery**, studies indicate that there is a potential for increased recovery and recycling of precious metals found in printed circuit boards (PCBs), however, this would require improved separation and recycling processes (Emile Van Eygen *et al.*, 2016). For example, one study carried out in Belgium estimates that approximately 39% of the materials in laptops can be effectively recycled to form secondary raw materials, while according to stakeholder input, a laptop can have a material recovery rate of up to 85%.[12]

Available data estimates that the primary disposal pathway in the UK for used laptops and tablets is **recycling**, with an estimated 3,713 kt recycled per year (Anthesis, 2020). In regard to other waste disposal / treatment practices at end of life, as mentioned previously and illustrated by the example for mobile phones in Figure 13, a significant share of laptops and tablets are unaccounted for and end up in unknown whereabouts after use.

2.3.3 Distinction between used EEE and WEEE

2.3.3.1 Definition: from EEE to WEEE

Based on the definition of waste in the Waste Framework Directive, used EEE becomes WEEE when "*the holder discards or intends or is required to discard, including all components, sub-assemblies and consumables which are part of the product at the time of discarding*".

- In this regard, the main determinant for the distinction between EEE and WEEE is the behaviour of the consumer. If the consumer decides to dispose of a **used device**, it may be sold in the second-hand market e.g. through a refurbisher. Otherwise, if the consumer decides to discard a device through WEEE collection points, it becomes waste destined for recycling or other waste treatment even though it may still be suitable for refurbishment or repair and get a second life. The intention of the consumers to discard their equipment or give it a next life is therefore an important factor for the type of channel the EEE or WEEE will end up in. Reliable tools guiding consumers in this decision-making process are currently missing. Consumers may in fact be unaware of the types of reverse supply chain activities that are available to them and maximise value retention. For example, some devices are better suited for Direct second-hand use (if fully functional), repair or refurbishment dedicated to used devices;
- Activities such as preparation for re-use, remanufacturing, recycling including separation of components and recovery of valuable materials are performed on discarded waste devices.

[12] According to stakeholder survey feedback carried out in the context of the current study.

2.3.3.2 Preparation for re-use: from WEEE to used EEE

As mentioned above, depending on the holder´s actions and intent, a reusable device may either be sent to **re-use**, be it directly or after minor repairs or cleaning, or be discarded and go through a WEEE collection and treatment scheme for preparing for re-use or recycling, other recovery or disposal. Along the value chain, consumers and operators may not be able to detect an EEE's market potential and therefore may not decide to hand it over to preparation for re-use facilities.

To minimize circular economy loss along this path, it must be made easier to detect the potential for re-use of a device. This can be done at the level of the holder to ensure the devices are not discarded and go directly to second-hand actors; but also by WEEE collection entities such as PROs. However, according to the stakeholder survey conducted for this study, WEEE collection entities barely assess the preparation for re-use potential of collected WEEE; cooperation with preparation for re-use actors is not a common practice and collected WEEE is sent all together to recycling facilities.

This distinction between used EEE and WEEE is important insofar as products not considered as waste are not covered by the WEEE Directive. The Directive also requires Member States to "*promote that, prior to any further transfer, collection schemes or facilities provide, where appropriate, for the separation at the collection points of WEEE that is to be prepared for re-use from other separately collected WEEE, in particular by granting access for personnel from re-use centres*". This has been unevenly put into practice in the EU, for different reasons. Ecosystem, a French PRO, explained in an interview that they have experimented several types of collection schemes, such as dedicated collection bins, in order to increase the potential of preparing for re-use and that it proved highly ineffective in comparison with a donation scheme that they put in place.

2.3.3.3 Main parameters of influence on the distinction between used EEE and waste EEE based on stakeholder's feedback

The results of the study's dedicated stakeholder survey in **Table 4** further indicate that most actors agree that the key factor to ensure a clear distinction between used EEE and waste EEE relates to consumer behaviour. Improving consumer behaviour would prove highly efficient in terms of improving WEEE and used EEE flow separation. The score is an average of fourteen PRO answers to this question. Once the holder discards the device, which then becomes waste, it would be difficult to bring this device back to the second-hand market, regardless of the actual technical and functional state of the device.

Table 4: Relevance of the main identified factors ensuring a clear distinction between small used EEE as opposed to small WEEE (stakeholder survey)

Key factors to ensure a clear distinction between small used EEE as opposed to small waste EEE	Average score (from 1 = not relevant to 10 = very relevant)
Consumer behaviour trends (e.g. tendency to be stored in households, re-sold on second hand market, sent to collection points, etc.)	7.6
Product design characteristics	5.4
Existing recycling/recovery capacity	4.1
Value/quality of recycled/recovered materials	5.1

One issue with preparing for re-use concerns the status given to management facilities treating devices considered to be waste. If a device has already been labelled as a waste, reverting it back to product status would require significant administrative efforts, as exemplified by the French legislation on classified facilities for protection of the environment (ICPE) (Ademe, 2016). The ICPE legislation provides a legal framework for waste management facilities, and therefore applies to preparation for re-use facilities. However, this framework involves heavy administrative burdens regarding the management of each device entering the facility. This extra burden could further undermine efforts for testing functionality and potential for re-use of devices within a specific used or WEEE flow.

2.4 Presentation of the problem definition

2.4.1 Nature, scale and magnitude of the problem

Small IT represented around 8% of the global quantity of e-waste generated in 2016 with approximately 3.9 Mt (ITU, 2017). In 2019, according to the Global E-waste Monitor, globally, only 17.4% of all e-waste was reported to be officially collected and recycled (Global E-waste Statistics Partnership, 2020).

At EU level, the collection rate in 2017 for Category 3 "IT and telecommunication equipment" (under the previous categorisation set out in Annex I of the WEEE Directive) was approximately 60% of EEE placed on the market in the three previous years (Table 30). However, since the calculation of the collection rate is based on weight, and that the weight of devices varies within this category (from printers to calculators), this value is not directly applicable to mobile phones, laptops and tablets.

Unfortunately, no data is available per type of devices for the amount collected, and estimations found in the literature are scarce and lack reliability. For instance in 2015, it was estimated that around 49% of waste generated in the EU from laptops and tablets was unaccounted for. Based on different figures available on the collection of mobile phones in Europe, it has been found that among the surveyed population a maximum of 25% of consumers bring devices to collection entities, and the highest collection rate estimated is of 15% of devices put on the market. However the calculation methodology is rarely available for those figures, and this data must be used with care (see 2.4.1.2 for more details).

Using the UNU keys, UNITAR offers estimations on the amount of waste generated based on the amount of devices put on the market and on the average use lifetimes (see 2.3.1.1). However, estimations on the potential collection rate (i.e. considering all available waste is collected) may not be used as an estimation for the collection rate achieved by the Member States due to a lack of reliable data on household storage of devices, on the second hand market and on illegal exports of waste devices.

EEE, particularly IT and communication equipment, include valuable recoverable materials such as gold, silver, palladium indium and tantalum (European Commission, 2010). Further, the presence of hazardous substances and scarce or valuable materials calls for recycling and treatment operations at the end of life of this equipment that are carried out in an environmentally sound manner in order to avoid the release of hazardous substances into the environment and prevent the losses of ecologically and economically valuable materials.

The above indicates that collection and recycling rates need to be improved worldwide and within the EU to avoid having an important amount of valuable resources being lost from the small WEEE stream, in particular for the equipment studied here. Significant environmental and economic benefits can be achieved through increased recycling of small WEEE as well as potentially high revenues from the recovery of valuable materials. Sources such as the EESC 2019 report and the 2020 Global E-waste Monitor report estimate that base metals (e.g. gold) used in certain devices, such as mobile phones and laptops, have a relatively high level of concentration at approximately 280 grams per tonne of e-waste

(Global E-waste Statistics Partnership, 2020). The Global E-waste Monitor report further states that existing methods used to separate and recycle e-waste can be **economically viable**, especially if carried out manually, with material losses at less than 5%. As such, separate collection and recycling can be economically viable for products containing high concentrations of precious metals. However, the recycling rate of most critical raw materials remains low, for example, less than 15% for germanium and magnesium (SCCREEN, 2020). However, several challenges related to market price fluctuations, material scarcity, availability, and access to resources, high recycling costs and technical difficulties in recycling certain materials have hindered more improvements in recycling and recovery in the EU (Global E-waste Statistics Partnership, 2020).

Due to the lack of available and robust data on product and waste flows, it is very difficult to assess accurately the potentially large amounts of electronic devices that undergo refurbishment and resale operations, stored in households, sent for storage (while waiting to undergo further recycling or refurbishment operations for example) and those disposed of through municipal household waste.

In the following section the two main problem aspects relating to low return rates of small EEE, household storage and low documented/official collection rate are further discussed and presented.

2.4.1.1 Household storage of mobile phones, laptops and tablets

Mobile phones

Specific data on the household storage of different types of mobile phone devices e.g. feature phones and smartphones is scarce. In general, however, existing studies indicate that both used and operational mobile phones are stored in significant quantities in households.

A study from the European Economic and Social Committee (EESC, 2019) estimates that approximately 800 million mobile phones or 70,000 tonnes of mobile phones were stored in households in 2017. This represents 13% of the total amount of IT and telecommunications equipment collected in EU-27 in 2017 (546,717 tonnes (Eurostat, 2020a) which demonstrates the magnitude of this issue. Results of the EESC study are based on survey data of four Member States and need to be considered with caution due to the fact that they do not consider differences across countries. For example, a report of the French professional association Alliance Française des Industries du Numérique (AFNUM) provides a wide estimate for stored devices in France ("54 to 113 million devices") due to difficulties in determining whether stored phones belong to an individual or a household (which has a strong impact on accurate extrapolations and assumptions of the survey results). Another factor that undermines the quality of these estimations is the lack of data regarding mobile phones stored by companies. Table 5 summarises the key figures available in existing literature on household storage and consumer habits in regard to used mobile phones. Overall, a range between 25% and 50% of Europeans keep their old, unused devices, and the amount of stored devices is higher than the total population depending on the source and its geographical scope.

Table 5: Key figures on household storage of used mobile phones

Scope	Key figures	Source / Year
Global[13]	Of the 6 500 consumers covered in the survey: • **44% keep their old mobile phones at home** • 25% give them away to friends or family	Recycling International (2008)

[13] Finland, Germany, Italy, Russia, Sweden, UK, UAE, USA, Nigeria, India, China, Indonesia and Brazil.

Scope	Key figures	Source / Year
	• 16% sell them • 3% said that they had recycled their old phone • 4% of old devices are sent to landfill	
EU	**800 million mobile phones** or about **70 000 tonnes** were stored in households in 2017.	European Economic and Social Committee (2017)
France	**100 million used mobile phones** are stored in households.	French Senate (2016)
	Household hoarding: the total amount of stored mobile phones is estimated **between 54 and 113 million devices**, among which 70% are still operational. Of the 1 008 consumers surveyed, 66% keep a spare phone for back-up purposes, and 20% keep a waste phone due to lack of knowledge, access to a collection point/recycling facility, concerns about data security issues, or by forgetfulness related to their small size. The approximate breakdown of the stock is (in million): - 22.1-45.2 functional smartphones - 16.1-34.3 functional feature phones - 9-20.9 non-functional smartphones - 15-35 non-functional feature phones	AFNUM (2019)
Germany	Around **124 million old mobile phones** are currently lying around **unused** in German drawers, cupboards and boxes.	Bitkom (2018)
Belgium	**3 million used mobile phones are stored in households.**	Recupel (2019)
UK	**40 million unused devices (including mobile phones)** are stored in households. Half of UK households have at least one unused electronic device (mobile phones, computers, smart TVs, MP3 players or e-readers) and 45% of homes have between two and five devices stored at home.	Royal Society of Chemistry (2019)
	Nearly **25% of the UK population have at least one unused mobile phone stored in their homes.**	TalkMobile (2016)
Netherlands	Roughly **half** (44% - 60%) **of all replaced, out-of-use phones** eventually end up in storage. There is an estimated **3 million units of stored broken phones** in the Netherlands.	Circle Economy (2020)

Laptops and tablets

In regard to trends in household storage of used laptops and tablets, Figure 16 and Table 6 summarise findings from a 2020 study carried out in the UK on electrical waste (Anthesis, 2020). Figure 16 provides a comparison of the amount of time (in years) that laptops and tablets are in use (TU) versus the time they are kept in storage (TS) in private households. In the figure below, the graph on the right with red bars indicate that around 50% of laptops and tablets leave the household within the first year of storage, while the remaining 50% of used laptops and tablets are usually stored in households from one to five years (graph on the left). As seen in Table 6, the volume of laptops and tablets stored in 2017 in the UK is estimated to be approximately 3,370 kt. This figure includes storage in both households and in commercial contexts. The estimated hoarding time is 1.5 years. Regarding household storage only, the report estimates that less than 50% of households are accountable for the 3,370 kt reported to enter hoarding per year (Anthesis, 2020).

Figure 16: Household storage of laptops and tablets, UK (TalkMobile, 2016)

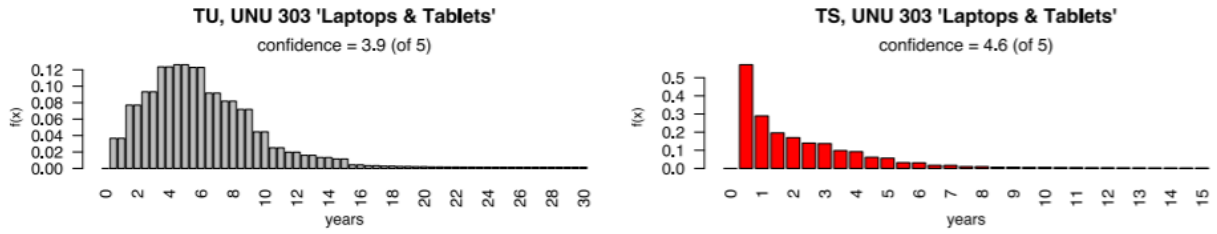


Table 6: Estimates on household storing of laptops and tablets in the UK, 2017 (TalkMobile, 2016)

Estimated annual tonnage entering into hoarding (Kt/yr.)	Number of units hoarded within a household (median [5% - 95%])	Estimated hoarding time in years (median [5% - 95%])
3.370	0 [0 – 5]	1.5 years [0 – 7]

Other findings from the UK study indicate that laptops and tablets are more likely to be used and stored in households for longer periods compared to mobile phones. Although the report does not provide further explanations on this trend, one explanation for this could be the relatively higher price of purchasing a new laptop compared to a mobile phone, and longer average lifetimes of laptops compared to mobile phones.

2.4.1.2 Collection of mobile phones, laptops and tablets

Mobile phones

Officially reported collection rates are available for the main categories of WEEE as defined under the WEEE Directive. Within the new categories established in 2018, laptops and tablets fall under the same WEEE category: Category 2 "screens and monitors having a surface greater than 100 cm^2", while mobile phones fall under Category 6: "small IT and telecom devices". All these devices, before 2018 and under the 10 categorisation, used to be Category 3: "IT and telecommunication equipment" (see Table 27 in Annex). Based on Eurostat data on WEEE Statistics, for 2017, the collection rate for this category 3 "IT and telecommunication equipment" across Europe was approximately 60% in relation to the average amount of EEE of this category placed on the market in the three previous years (Eurostat, 2020a). Some specific estimations for mobile phones are available in existing literature. In 2012, the collection rate of mobile phones was estimated at 15% in Europe, however, the calculation methodology is not available, and this data may not reflect the latest collection rates (Ellen MacArthur Foundation, 2012). Considering the consumer behaviour surveys listed in Task 3 of the Ecodesign study on mobile phones, smartphones and tablets, less than 26% of consumers in Germany[14] bring their mobile phones to collection points (European Commission, 2020b). Another figure for Germany in 2018 provides an estimation of the collection rate of mobile phones at 5%, which is particularly low (Gurita *et al.*, 2018).

[14] Based on the survey results listed in the Eco-Design study, one of highest return rates reported in Europe is that of 26% of German citizens brought their mobile phones to a collection point, considering that 64% of them sell it or give it away, and that 41% of those actually give them away at a collection point

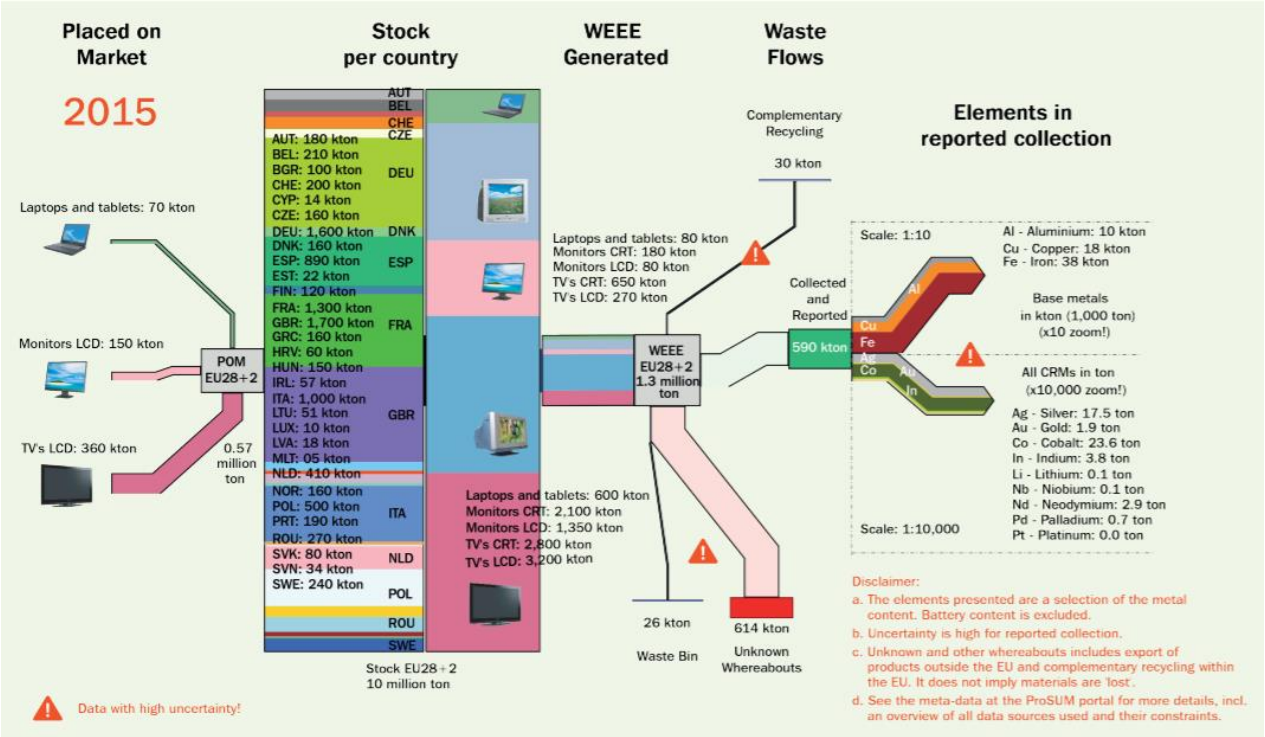
According to a 2020 study carried out by Circle Economy, this WEEE category is on track towards achieving its overall WEEE collection target in the EU, therefore there is no direct incentive to improve the collection rates of mobile phones in particular (Circle economy, 2020). The study concludes that part of the issue is that, because collection rates are calculated based on **weight**, targets can more easily be met by ensuring the collection of heavier (or larger) WEEE, such as televisions and other larger screens and monitors (Circle economy, 2020). More efforts would therefore be required to increase the number of mobile phones collected through dedicated official collection schemes.

Other challenges include the existence of **too many collection schemes**, which could lead to a lack of traceability, economies of scale and inefficient collection (AFNUM, 2019).

Laptops and tablets

It is difficult to estimate an accurate collection rate for waste laptops and tablets due to the large observed differences in reporting as well as the diversity in the specific types of devices covered by the waste stream in Category 2. In the figure below, 2015 estimates by the ProSUM project for EU product and waste flows for screens, laptops and tablets are provided. However, there is significant uncertainty regarding the reported figures. Of the waste generated by laptops and tablets in 2015, 47% was collected and 4% ended up in waste bins or in a complementary recycling system. A significant share of the waste generated from laptops and tablets is unaccounted for (49%). The reported figures on waste flows indicate a strong need for coherent and harmonised reporting practices to ensure more accurate data on the collection of waste laptops and tablets.

Figure 17: Product and waste flows: Laptops, tablets and screens in EU, 2015 (ProSUM, 2017)



2.4.1.3 Other waste disposal / treatment practices

The remaining mobile phones, which are not officially collected or do not enter the reverse supply chain market e.g. re-use, recycling, refurbishment, etc. are usually disposed of at end of life, as described below:

- **Along inappropriate waste streams**: in Denmark, 19.4 tonnes of mobile phones are disposed of along with household waste, which is less than 5% of the respective estimated waste fractions' total weight per year (Miljøstyrelsen, 2014). In Hungary, an insignificant amount of WEEE was found in the household waste stream, however, this represented 0.8% of the plastic and metal separate collection waste stream (stakeholder survey). Overall, it was estimated that 750,000 tonnes of WEEE end up in the municipal waste stream in Europe, of which 25% is identified as small IT devices (CWIT, 2015);
- **Entering illegal waste trade routes**. It has been estimated that there are 0.2 million tonnes of documented exported used EEE, 0.9 million tonnes of undocumented exported used EEE (of which 70% is functioning) and 0.75 million tonnes of undocumented export of waste EEE (of which 30% is actually waste) (CWIT, 2015). However, no official data at the device level is available.

In Europe, Japan and the USA, high environmental standards for recycling of WEEE induces high recycling costs. Consequently, illegal exports of WEEE to countries with cheaper and less environmentally sound treatment practices may appear more profitable than local recycling (Mmereki *et al.*, 2015). Exported waste streams often end up incinerated or landfilled because of insufficient processing capacity and demand in destination countries.

2.4.2 Drivers and causes of the problem

2.4.2.1 Household storage

Household storage of small used and waste EEE, and especially mobile phones, is broadly presented as being highly related to the low collection of used/waste EEE in the EU. It concerns both functional and non-functional devices. Key drivers to hoarding of small used EEE identified by European and national studies include (EESC, 2017; AFNUM, 2019; Circle Economy, 2020):

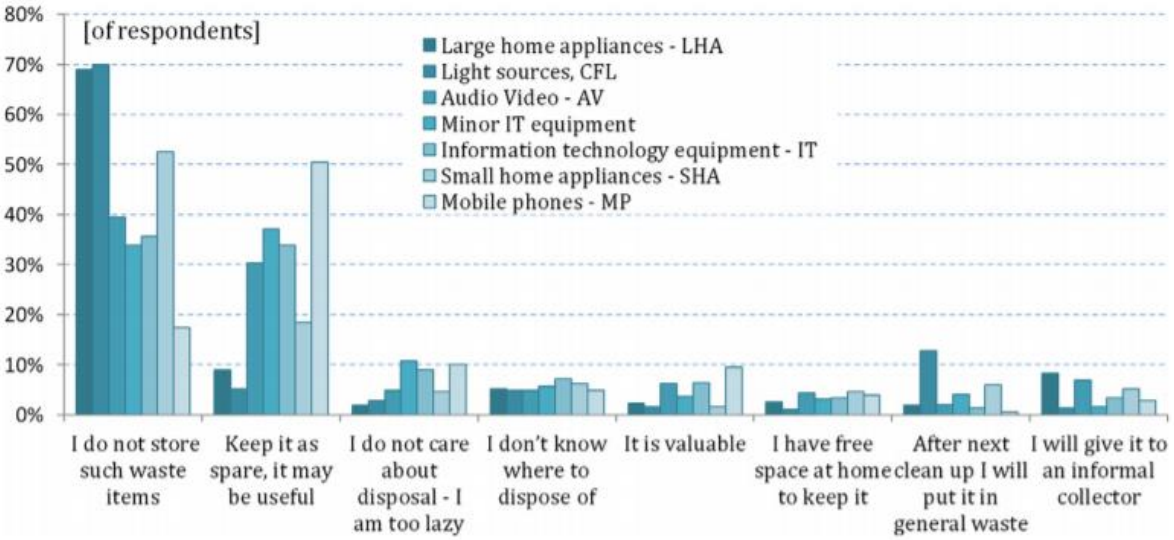
Table 7: Key drivers for household storage

Driver	Explanation	Source
Keeping used EEE as backup and data storage	This is the main driver mentioned in literature related to EEE hoarding, especially when it comes to mobile phones. About 43% of people surveyed keep a functional mobile phone as a backup device for oneself or relatives.	Circle Economy (2020) Deloitte (2017)
Storage for later resale	Some consumers keep unused devices with the aim to resell them one day, as this is a more profitable option than discarding them at collection points. Both mobile phones and laptops have a high market value.	Circle Economy (2020)
Emotional attachment	Mobile phones and laptops may be used daily by the holder during a	AFNUM (2019)

Driver	Explanation	Source
	certain period of time, therefore creating emotional attachment for some holders.	
Data storage and security concerns	Some consumers raised concern over data security management once it is handed over. These devices often contain personal data and are used as storage for its contents, and specific data suppression procedures are required to prevent later recovery.	AFNUM (2019) EESC (2017)
Lack of trust and transparency about the recycling process	Consumers may lack knowledge on product management along the recycling process and therefore find it untrustworthy.	EESC (2017)
Inconvenience or lack of awareness of proper disposal options	Most actors agree that weak collection points network or inconvenient opening hours and lack of communication on collection schemes lead consumers to storing devices at home rather than handing them over to a take-back or return scheme.	Circle Economy (2020) AFNUM (2019) EESC (2017)
Size makes it convenient to store in a forgotten location	Since these devices are quite small, they are easily forgotten once stored. Therefore, even if there was some knowledge about collection schemes or plans to resell the device, once stored it may stay stored for a much longer period of time than initially planned.	Circle Economy (2020) AFNUM (2019)

A study carried out in Poland quantified the different drivers, finding that "*the most likely to be stockpiled are computer accessories and other information technology equipment, comprising above 60% of responses, and mobile phones, being above 80% of responses. The most frequent reason for stockpiling is intended possible use of the equipment in the future*" (Nowakowski, 2019). The following Figure 18 provides additional details on the root causes behind household storage provided by the respondent per type of equipment.

Figure 18: Reasons for storage by type of equipment (Nowakowski P., 2019)



Altogether, the main drivers behind household storage include **the high perceived economic and emotional value**. As stated in a study carried in the UK in 2016, "*most participants cite that they had kept their old phones as a back-up or spare to their current phones. This suggests that the perceived value […] of owning a working device and hence the continuation of the ability to communicate or to be connected to the wider world is higher than the perceived economic/environmental value of returning the device*"" (Wilson *et al.*, 2016)

Results of the stakeholder consultation also reflect similar feedback and are summarised below in Table 8. One of the key issues highlighted by stakeholders in regard to household storage of small used EEE is the "small size of the devices concerned, which makes it convenient to store at home (and forgotten about)". Further, it was also put forward that consumers lack knowledge on the existence of free return schemes such as the 1 to 1 and 1 to 0 options that enable free return of WEEE at dedicated EEE retail points (see Section 1.2.1).

Table 8: Importance of the main identified drivers behind household storage (stakeholder survey)

Key drivers	Average score (from 3 = not important to 1 = very important)
Data security concerns	1.7
Emotional attachment	1.9
Kept as backup devices	1.9
Lack of awareness of proper disposal options	1.8
Small size of device makes it convenient to store at home (and forgotten about)	1.2

2.4.2.2 Low collection rate of small WEEE

Based on available data, the collection rate for mobile phones is estimated at around 15% and at 47% for laptops and tablets. However, as discussed previously, the calculation methodology of these estimates is not known. Furthermore, there are no device-specific collection targets at EU level.

However, these devices are so widespread (more than 120% of penetration rate for mobile phones in 2018 (Eurostat, 2020d)) that targeting specifically the collection of these devices would most likely have a direct impact on return rates. To note that implementing individual collection targets has already been studied as an option (European Commission, 2014) but was finally recommended only on a voluntary basis at Member State level and not at EU level.

There are different drivers and causes related to the low collection of small WEEE. This section will describe some of the overall issues related to the collection of WEEE and then highlight issues specifically related to small WEEE.

The recent behavioural study on Circular Economy (Cerulli-Harms *et al.*, 2018) listed several drivers that influence consumer decision-making on recycling. The study covered both big and small EEE, as well as clothes, therefore, these results must be considered with caution. The drivers in favour of consumers choosing to recycle are:

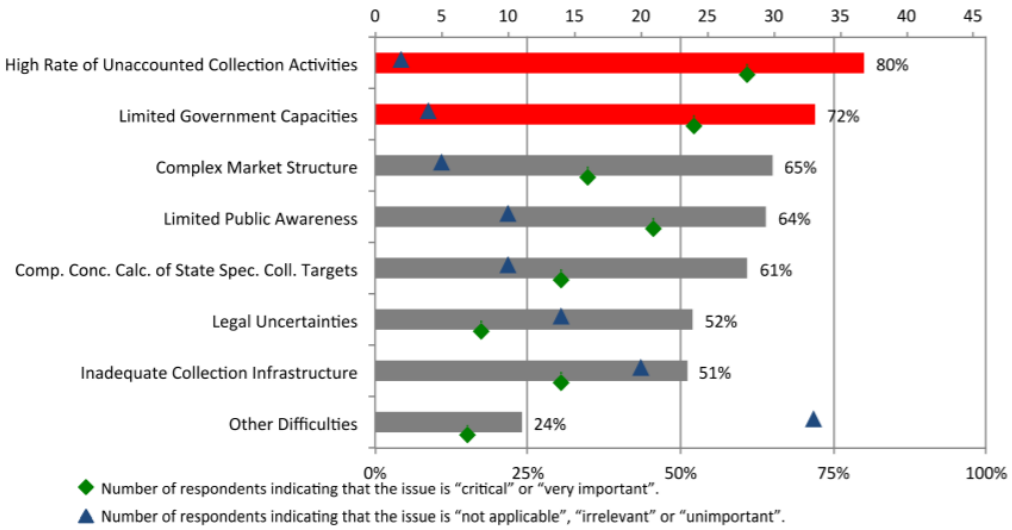
- concerns for the environment;
- need to dispose of products that are no longer in use *(mostly relevant for large WEEE)*; and
- the possibility of helping others (e.g. humanitarian associations or second-hand shops).

Factors seen as barriers towards recycling are as follows:

- complexity along with a lack of awareness (not knowing where to recycle products or who to contact);
- lack of time;
- lack of trust and lack of transparency (not knowing what is done with the products and whether they are actually being recycled);
- for smartphones: data security concerns.

The different factors related to the low collection of WEEE according to the 2014 "Study on Collection Rates of Waste Electrical and Electronic Equipment" (European Commission, 2014) are summarised below in Figure 19.

Figure 19: Key drivers for low collection rates of WEEE (EC, 2014)



One of the most significant challenges identified in the report included the **high rate of unaccounted collection activities.** Some of the key underlying drivers for this include "cherry picking" i.e. selective collection of profitable WEEE; absence of data and reporting on household storage; and illegal collection, treatment and export. Cherry picking in particular is a result of the high environmental standards and requirements for the recycling industry in Europe. In this context, recycling is only profitable under

certain conditions. For example, WEEE is considered to be an extremely valuable gold mine (World Economic Forum, 2018), however, most of the time only base metals are recovered from devices such as mobile phones (most likely due to the stringent requirements in relation to recycling operations) (Circle economy, 2020).

The lack of data at EU level on **household storage** has an impact on the amount of WEEE available for collection. In accordance with the WEEE Directive, the calculation of collection rate is based on the average weight of EEE placed on the market in the three preceding years. Therefore, stored devices are unaccounted for. As such, household storage can also have a direct impact on reported collection rates.

Furthermore, the thriving **second-hand market** has created to a certain extent competition between WEEE collection schemes and re-use/refurbishment operators. As such, the second-hand market can, in some cases, have an impact on the amount of the devices available for collection. Although this is not necessarily a negative consequence from an environmental and economic point of view, it is important to take this into account. In Romania, a study by Sofies found that the collection of WEEE was limited by a growing trend in overall EEE direct re-use (peer-to-peer or consumer to consumer) (Sofies, 2019). As the lifetime of these devices is extended through re-use, the generation of waste is prevented. For example, devices entering the second-hand market may remain in use longer than 3 or 4 years before being collected as waste and accounted for by the calculation of collection rates. In consequence, collection schemes compete with re-use and refurbishment operators that enable a longer lifetime of devices. From 2021 on, the obligation to report flows of re-use as provided for in the Commission Implementing Decision (EU) 2021/19 may help to improve the measurement of collection rates through a better evaluation of the actual waste generated, taking into account the extension of lifetime of specific products through re-use.

There are also issues related to collection and recycling of small WEEE. **Illegal collection, treatment and export** have also been an issue for more than 20 years due to international disparities in technical and legal standards for recycling. Treatment and disposal of WEEE are expensive in the EU compared to Asia. For example, one study estimates that it is around 400 times cheaper to dump hazardous waste in Asia than to legally dispose of it in the EU (European Commission, 2013a). Furthermore, the risk of being caught as well as being subject to fines and penalties for illegal practices are considered to be low. Such flows undermine efforts to improve the WEEE value chain through preparation for re-use and recycling in the European Union.

All previously mentioned, **challenges to increased return rates of small WEEE** can be summarised as follows:

- Household storage represents a large stock of used and waste devices;
- Consumer studies carried out on WEEE flows in the UK (Anthesis, 2020) and Greece (Appliances Recycling SA, 2017) list in particular lack of awareness on collection and appropriate disposal practices, including recycling options;
- Lack of awareness of consumers on not only the existence of dedicated collection points, but also on proper disposal practices of their WEEE i.e. consumers disposing WEEE in locations that are not destined as appropriate collection points (Appliances Recycling SA, 2017):
    - More specifically, the abandonment of WEEE in streets seems to be an option for discarding WEEE even if this practice remains at a relatively low level (about 10%); and
    - A significant share of the consumers surveyed discarded their WEEE in specific "Packaging Collection Points" even if there is an observed trend of improvement in this area (from 43% down to 18%).

The stakeholder consultation also highlighted several common issues in regard to the increased collection which provides indications concerning relevant drivers:

- Disposal of small WEEE in the communal/municipal waste stream;

- Quality of the collection network (e.g. opening hours for municipal collection points and distance from consumers in areas of low population density);
- Challenges related to organisation, financing and reporting on take-back operations.

Some of the issues that were highlighted are more relevant at the collection and treatment level that for return rates of small WEEE:

- Inefficient law enforcement by local authorities to address the presence of illegal collectors and scavengers;
- High costs of small WEEE recycling compared to large WEEE recycling, which can hinder a higher demand of collected WEEE from recyclers;
- Lack of incentives, for example to recover plastic materials and other valuable recoverable materials, which is technically feasible but economically challenging.

2.4.2.3 Potential for improvement

Key findings from the literature review and stakeholder survey identified the following five main areas, which require additional efforts to address household storage and low collection rates of mobile phones, laptops and tablets:

- **Distinction between waste EEE and used EEE**: further clarifying the circumstances and distinction between used EEE and waste EEE can prevent significant amounts of devices from being sent to waste recycling operations by feeding them back into the economy through direct re-use and preparation for re-use instead.
- **Data reporting on exports of used devices for the second-hand market:** improving the monitoring of export flows outside the EU of used devices for the second-hand market.
- **Law enforcement of illegal waste exports by local authorities:** allowing for a more accurate and transparent understanding of the amount of waste generated and available for collection.
- **Consumer behaviour**:
    - incentivising consumer behaviour through improvements of existing collection networks;
    - increasing consumer awareness, with the aim of both reducing household storage and inappropriate waste disposal, which in turn can improve take-back and collection rates.
- **Circular economy:** The following circular economy aspects were identified in the literature and by stakeholders as important opportunities to further drive increased collection of small WEEE:
    - **Supporting the recycling sector**: the demand for WEEE by recyclers could increase by boosting the market for recycled materials (e.g. establishing targets on the content of recycled materials in new devices) and ensuring the technical and economic feasibility of critical raw material recovery (e.g. through product design improvements such as increase recyclability, etc.). Consequently, a higher demand for WEEE from the recycling sector could in turn have a direct impact on increased collection.
    - **Improving the collaboration of all actors across the value chain**: Ensuring transparency and the interaction of all stakeholders concerned – particularly between collection scheme and reverse supply chain operators could help to fill certain knowledge gaps e.g. on unreported flows, how to better distinguish between used EEE and waste EEE, address common challenges, etc.

3. IDENTIFICATION AND TYPOLOGY OF EXISTING RETURN SYSTEMS IN THE EU

3.1 Objectives and methodology

In addition to the problem definition, a mapping and assessment of existing return systems in EU Member States and a number of additional relevant countries was conducted. The aim of this exercise was the identification of the main types of initiatives that facilitate the return of small WEEE/EEE and their assessment in order to identify any existing barriers and opportunities for the scaling up of such initiatives and replicating them within the EU. Identified drivers and barriers were then taken into account in the recommendations for possible further action at EU level (see Section 4).

The exercise was conducted through the following main steps:

- *Identification of relevant systems*: identification of return and reward, buy-back and other initiatives, clustering and selection of relevant initiatives to be further analysed;
- *In-depth assessment of identified initiatives*: in-depth analysis of the selected initiatives by means of desk research and interviews; and
- *Assessment of replicability and scalability of categories*: identification of barriers and opportunities for the scaling up and the replication of initiatives.

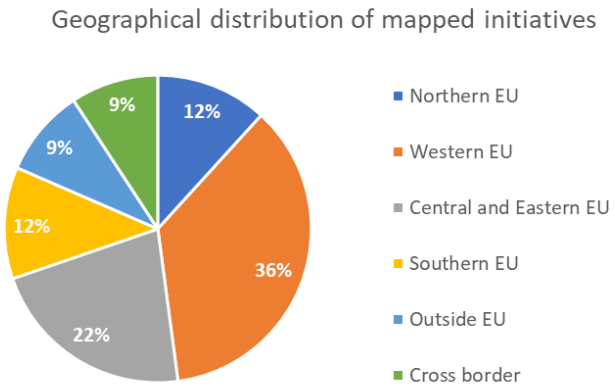
3.2 Identification of relevant systems

Relevant return systems were identified through desk research. The research was carried out for all EU Member States as well as seven additional countries, selected on the basis of their geographic, administrative, cultural and economic similarity with the EU, in order to raise the likelihood that any systems identified be relevant for the EU context in terms of replicability. The additional countries selected were Norway, Iceland, Switzerland, United Kingdom, United States of America, Canada and Australia. The results of the desk research were compiled with the following information:

- Name of the initiative;
- Short description;
- Types of small EEE/WEEE covered;
- Location of system/region covered;
- Period of operation;
- Operating entity.

Overall, 192 systems were identified, of which 65 were classified as general extended producer responsibility (EPR) schemes. After exclusion of the general EPR systems and other less relevant systems, a final selection of 119 most relevant systems was created. This selection was complemented with relevant systems indicated by stakeholders in a conducted survey.

The following chart provides an overview of the geographical distribution of the identified systems. As can be seen, systems in the western EU account for more than one third of the selection.[15]

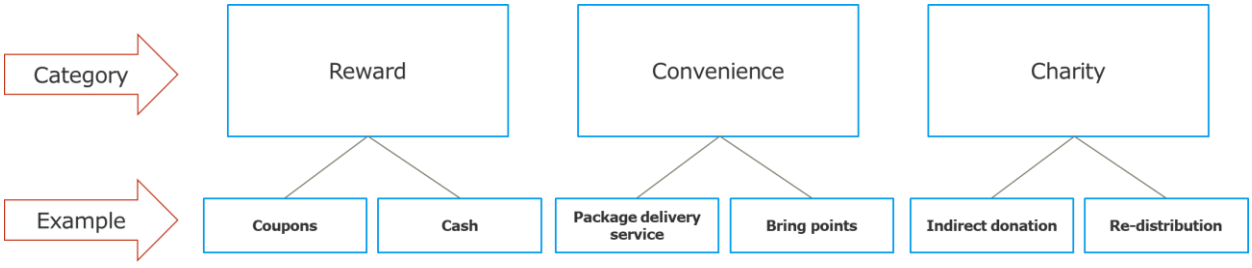


The final selection was subsequently analysed to identify important commonalities to enable effective categorisation. The final categorisation was based on the criterion "incentive form". This criterion refers to the methods applied by the selected systems to incentivize consumers and other actors to hand in their small WEEE. This criterions was chosen for the following reasons:

1. The incentive type directly relates to the reason why users hand over their small WEEE, and will therefore provide interesting indications regarding which actions could be taken at EU level to improve collection rates; and
2. Different collection systems applying similar incentive types are likely to have a minimum of similarity in terms of organisation and practical set-up.

The categorisation by type of incentive resulted in three main categories depicted in Figure 20.

Figure 20: Incentive type based categorisation of initiatives



Collection systems based on **reward incentives** offer an economic benefit or gain to the user in return for small EEE/WEEE handed in. Such benefits or gains are not limited to monetary compensation but can also include coupons, reductions, refunds etc.

Reward system

[15] It should be noted that the final selection and its resulting geographical distribution are based on a snapshot research and compilation of systems and thus should be considered as a mere indication. Furthermore, the selection contains a number of systems which have been closed or which only ran as a pilot for a limit time.

Refurb is a Danish company that acquires used functional IT (including laptops and tablets) from large companies (more than 200 employees) and public institutions. Refurb refurbishes, upgrades and cleans the EEE as required, and sells it again on the same terms of guarantee as new products.

Refurb´s collection methods differ depending on the quality and condition of the used EEE or the need of the company/institution. In some cases, the company/institution has a permanent container where the used EEE can be placed. In other cases, the used EEE is packed in boxes. Some companies/institutions transport their used EEE to Refurb and in other cases Refurb packs the used EEE at the company/institution. Refurb also sends cages out to companies in order to transport their IT in. Defective EEE is always collected in cages.

When the used EEE arrives at Refurb the first step is to delete data form all data-bearing devices. Then they then asses the need for repairs. If it is profitable, they repair the device - if not, they take out useful spare parts and shred the rest. Refurb has their own shredder, and materials from the shredder are sorted into 17 different fractions. The metal is then sold to a recycling company for recovery.

If some products are still functional but not new enough to have any market value in Denmark, they are sold in other countries. Approximately 80% of the used laptops are sold in Denmark and 20% are sold to foreign markets.

Collection systems based on **convenience incentives** contain elements that aim to make the handing in of small EEE/WEEE practically easier or less time-consuming i.e. convenient for individuals or organisations, and thus more attractive. Examples are pick-up services, drop-off points, hand-over location search engines (online) etc.

Convenience system and 1:0 take back obligation

The Ecolight Consortium in Italy has launched new smart bins designed for distribution and commercial spaces. RAEE EcoIsoles (Italian for "WEEE Eco-islands") are smart bins dedicated to the collection of small WEEE that meet the requirements of Italian Decree Uno contro Zero (Italian for "one against zero"). The small size of the container (1.5 x 1.2 x 1.5 metres) and its complete automation have made it an innovative tool for the collection of small electronic waste (e.g. mobile phones, small household appliances, light bulbs and energy saving lamps). The WEEE eco-islands are located in urban environments close to large shopping centres to easily reach the citizens. The operation of the eco-islands involves the registration of the consumer (through the regional health card), the identification of the type of waste to be thrown away and the separate disposal according to the same type. At the end of the operations, the machine will issue a receipt confirming that the waste has been delivered. Through a monitoring system, when the internal containers are full, the machine alerts the technicians by text message to come and empty them. The waste delivered is then tracked from the point of delivery until treatment and recovery. To date, there are still 30 functioning WEEE eco-islands located in the regions of Emilia Romagna, Veneto, Lazio, Lombardia and Toscana.

Collection systems based on **charity** incentives tend to be connected with charitable organisations or initiatives which may bring individuals or organisations to hand-in their small EEE/WEEE for a cause. This may include selling WEEE to recyclers, preparing the WEEE for re-use, etc.

Charity system

RefugeePhones is an independent voluntary initiative based in Sweden that distributed thousands of pre-paid cards and mobile phones to refugees between 2015 and 2017.

Their business was based on donations from mobile phone manufacturers and private individuals and on extensive collaboration with telecom operators. After checking the functionality of devices, data contained on the phones was deleted and the donated phones were reconfigured. The charity had an order system online, where refugees could fill out an application form.

Only high-quality phones were donated for re-use; lesser-quality phones were sold to an EPR scheme for recycling.

It should be noted that many identified systems applied a combination of various incentives. However, most of these systems generally seemed to apply a clear main incentive, which strongly influenced the organisational set-up of that system.

Combined incentives system

The Helsinki Metropolitan Area Recycling Centre (Kierratyskeskus) is a non-profit company founded in 1990 with the purpose of reducing resource consumption, increasing environmental awareness and creating opportunities for civic participation and employment.

Citizens, companies and institutions can hand in small EEE (including laptops and chargers) in any of Kierratyskeskus´recycling centres. Kierratyskeskus also has a pick-up service for a small fee. Once or twice a year, the organisation plans a collection tour with 30 stops around the metropolitan area to make it easy for citizens to hand over their EEE.

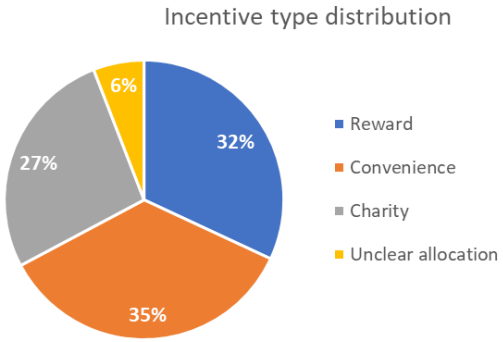
The EEE is transferred to a pre-sorting centre where resale potential is assessed. If it is economically reasonable, the EEE is repaired in one of the Centre´s four repair shops. Not all of the recycling centres have a repair shop, so EEE collected at centres without a repair shop are transferred to another centre for assessment. The repair shops differ in size. The Re-use Centre is planning on cutting the number of repair shops to two for better efficiency.

The EEE that cannot be resold is sent to the SERTY EPR scheme for recycling.

The following chart provides an overview of the distribution of incentive type over the 119 identified systems. As it can be seen, the convenience and reward incentives are only slightly more common than charity in the final selection.[16]

[16] It should be noted that the final selection and its resulting distribution of incentive types are based on a snapshot research and compilation of systems and thus should be considered as a mere indication. Furthermore, the selection contains a number of systems which have been closed or which only ran as a pilot for a limit time.

Figure 21: Incentive type distribution of the 119 identified systems



3.3 In-depth assessment of identified initiatives

Based on the described categorisation, a number of exemplary systems per category were selected for further analysis. This analysis was mainly based on consultation of the organisations managing the exemplary systems concerning the following aspects:

- Detailed description of the incentive form;
- Description of links to reverse supply chains, re-use, repair, refurbishment and recovery activities;
- Any distinction made between small EEE and WEEE, as well as the criteria applied for this distinction;
- Important actors involved in the system;
- Success rate of the system; and
- Main drivers and barriers of the system.

The following section provides an overview of the main findings of the analysis, overall and per incentive category. These findings take into account additional information identified concerning systems under the various incentive categories, which were not analysed in-depth. However, it should be noted that the findings presented below are mainly based on the results of interviews with a selection of systems per incentive category. As such, the findings should be considered as indications, to be considered under the assessment of the replicability and scalability of collection systems.

3.3.1 Findings for reward systems

As described above, collection systems based on reward incentives offer an economic benefit or gain to users in return for small EEE/WEEE handed in. From the 38 identified reward systems, two major sub-groups can be identified. One main sub-group concerns trade-in schemes operated by commercial entities as a core business activity. In most cases, these entities buy back small EEE. The second sub-group concerns telecom providers operating a take-back scheme for mobile phones. Some providers seem to offer a direct financial compensation for the returned phones, while others offer indirect benefits such a vouchers and discounts. Other identified reward systems include:

- Collection from schools in return for vouchers or credit points which can be used to purchase rewards;
- Entering individuals and organisations handing in small EEE or WEEE in draws to win prizes;
- Providing cash-back for an older phone model when it is sent back to the producer and a new model is ordered instead; and

- Exchanging a used smartphone for a refurbished or new one.

One interesting development concerns take-back schemes by the manufacturers of mobile phones. The companies Apple, Samsung and Fairphone have developed take-back schemes focused on their own devices. Apple is currently operating a trade-in scheme for mobile phones, tablets, and laptops in return for an "Apple store gift card", when applicable. Returned devices are refurbished or recycled, depending on their condition. Samsung has organised campaigns in various countries in and outside the EU during which customers who buy a new phone can hand-in their old ones in exchange for a financial bonus. Fairphone provides customers with the possibility of sending back a "Fairphone 1" or "Fairphone 2" in return for a cash back which will be payed when ordering a "Fairphone 3".

These developments can be seen as a departure from the more common EPR approach, as these companies do not use the collection network of a PRO, but set up their own collection infrastructure or arrangements for at least a part of their product range.

Apple is running a trade-in system for their devices (iPhone, iPad, Apple Watch, Mac, accessories, non-brand devices etc.). Apple offers product take-back and allows customers to hand in used devices online or in Apple stores. To ensure data privacy, the latest owner must delete the data on the device before trade-in. To estimate the remaining value of a device, the customers must answer a set of questions online, whereas the devices handed in in Apple stores are evaluated by retail specialists. Depending on the condition and the model type, a monetary value is calculated and paid out to the customer as a gift card or amount towards the purchase of a new device. Apple's trade-in process is part of the buy-flow process, but customers can also simply return an old device without a new purchase. Devices with a remaining value are transferred to re-use/refurbishment activities whereas those without value are sent to recycling. Apple has partnerships with trade-in vendors which organise the refurbishment and reselling process through existing channels. In select countries, iPhones directed to recycling can be dismantled by Apple's robot "Daisy". The materials obtained may be sold to specialised recycling companies. All devices are tracked until the end of the recovery process.

In 2019, 11.1 million devices were taken-back by Apple in the USA, with the number of devices sent to re-use/refurbishment greatly exceeding the number of devices directed to recycling. In 2018, for example, more than 7.8 million Apple devices got refurbished. [17] According to Apple CEO Tim Cook, one third of their USA-based customers use the trade-in system.

Fairphone is a social enterprise that develops and produces smartphones (so called Fairphones) in a way that contributes to a fairer production and a more transparent supply chain. Thanks to the modular design of their phones, Fairphone's aim is to allow easy exchange and repair of phone parts to increase the lifetime of the whole device. Several materials in different parts of the phone originate from recycled sources.

Since 2017, Fairphone takes back all types of smartphones (not only Fairphones) in France and Germany. In 2020, Fairphone collected around 17,000 phones from the European market which represents 18% of Fairphone's sales. Phones and batteries from African countries were also shipped back to Europe through a recycling initiative Fairphone supports.

[17] „Apple expands global recycling programs", Presse Release 2019, https://www.apple.com/newsroom/2019/04/apple-expands-global-recycling-programs/

In March 2021, Fairphone launched a new Recycling Service to increase its collection rate. With this new service, customers sending in an old phone are offered a discount on a new Fairphone or a direct cash back. Phones without remaining value are not refunded but can be sent in free of charge for recycling purposes. Customers can download a shipment label from the Fairphone website for free.

All phones are directly sent to Fairephone's French repair and recycling partner. The partner checks if any of the phones is black-listed (e.g. was stolen) and assigns a value to every phone. The value of the phone is calculated on the basis of its actual price on the second-hand market. Customers receive their refund as soon as the phone has been reviewed.

Phones in good condition are refurbished and resold on the (online) second-hand market whereas others are directed to a recycling company. In 2020, 40% of all phones collected could be re-used and 60% were recycled. Spare parts are also sourced from phones and are used internally by the repair and recycling partner.

Since 2020, Fairphone also offers a service to trade-in single parts (e.g. when a consumer upgrades a Fairphone 3 to a Fairphone 3+ with new parts). The parts are also repaired or recycled.

Fairphone's overall goal is to implement a collection and re-use/recycling system that is scalable.

Fairphone would like other (phone) companies to take over their concept and to take-back all types of phones irrespectively of their market value. Fairphone is also thinking about taking back other small EEE (e.g. tablets). The company aims to offer its Recycling Service in all European countries.

Applied methods, tools and technologies

Information from interviews indicates that reward systems rely on methods, tools and technologies with varying degrees of sophistication. In terms of methods, a main distinction concerns a focus on either active collection or passive reception of small EEE/WEEE. However, some of the interviewed systems indicated that a mixed approach is followed, under which small EEE/WEEE was either picked up or brought in, depending on the circumstances.

In terms of collection methods and tools, some systems set up relatively basic collection containers and drop-off bins, while one company has developed an automatised "ATM" in which mobile phones can be deposited and through which compensation is received. However, most interviewed reward systems, regardless of the applied method, seem to have considered ways in which the handing in of small EEE/WEEE could be made easier for the consumer. The automated ATM could be considered an extreme example of this, in which all steps of the deposit of used mobile phones is made easier and less time-consuming.

In terms of applied technologies, a first point of attention concerns data deletion software. Multiple interviewed systems highlighted the importance of using certified data deletion software in their systems. The use of such software is driven by data security concerns. One interviewed system indicated that data security is especially an issue in the case of small EEE bought from public authorities and institutions. Another point of attention concerns the automation of the small WEEE condition assessment. One interviewed system indicated that it is currently developing a diagnostics app that examines the device's condition more objectively and in a less time-consuming manner than through manual assessments. Another system also plans to develop a diagnostic app for similar purposes in the future. In addition, the "ATM" based system uses an automated diagnostic involving a detailed visual inspection which can provide technical information (such as model, carrier and IMEI number) of the device through its high definition camera equipment with the aid of Artificial Intelligence. Software in the ATM can check the phone for technical information (model, carried and IMEI number).

Finally, an important difference between the types of systems seems to concern the extent to which treatment of small EEE and WEEE is an integrated part of the system. Some of the interviewed systems indicated that repair, refurbishment and other similar activities were carried out as part of their internal processes. Other systems have outsourced these activities to partners. Most systems do not seem to directly engage in WEEE treatment operations such as shredding and recycling. However, one system did indicate that it operated a shredder for small WEEE that could not be repaired. Two systems indicated carrying out disassembly activities internally to source spare parts from mobile phones that are in a technically bad state.

Fate of the collected small EEE or WEEE

Information from interviews indicates that systems that provide a reward for returned devices are mostly aimed at second-hand sale and repair of collected small EEE. The only interviewed system which aimed to recycle collected mobile phones indicated that it was preparing to move towards increased re-use and repair operations. However, most systems with a focus on re-use and repair have also opted for a cascaded approach, under which devices are checked for suitability for direct sale and repair, as well as market value, upon which non-suitable devices are directed to recycling operations. Nevertheless, it should be noted that three systems which focused on repair and re-use operations indicated considerable percentages (between 70% and 95% of devices) which were directed to resale, with or without repair.

The interviews provide some indications that for mobile phones collected from individual consumers, reward system are less suitable for re-use and repair operations, and that a majority of these devices are directed towards recycling. There are also indications that devices which are less suitable for sale in the EU are sent for sale or donation in third countries.

Important actors involved in the systems

Information from interviews indicates that systems which apply a reward incentive are financially self-reliant through their commercial activities. One system indicated that it needed a crowd-sourcing campaign for its initial funding. In terms of actors involved, all systems operate in a network of partners that can be involved in various aspects of the chain, covering collection, transport, repair, second-hand sales and WEEE treatment. For most of these activities, the systems seem to have engaged with commercial partners. However, various instances of cooperation with non-commercial partners such as NGO´s, schools or radio stations are also indicated. This non-commercial involvement could concern, for example, awareness raising, but also the dismantling of collected small WEEE[18].

Finally, public authorities do not seem to be strongly involved as actors in the interviewed systems. One system did highlight that it benefited in its initial stages from a free-of-charge space for operations from the public sector in Slovenia. Another actor mentioned public authorities solely within the context of permitting, inspection or informing requirements.

Main drivers

Information from interviews indicate that most systems which apply a reward incentive are driven by economic drivers related to the growing market for refurbished EEE. This is in line with Section 2.3.2, which describes that the market for second-hand and refurbished mobile phones has been growing rapidly in the past years and is expected to grow further in the future. Two systems also indicated that the ability to provide a reward incentive for the small EEE and WEEE handed in constituted an important

[18] Such non-commercial dismantling is, for example, carried out by an NGO that provides employment to people with a disability.

driver. Interestingly, these two systems require individuals to actively hand in small EEE or WEEE. One of these systems, as well as an additional system, also highlighted the importance of developing consumer environmental awareness.

The embeddedness of actors in a network of partners enabling their activities was a driver perceived by two systems. Finally, the two systems based on the active bringing of small EEE or WEEE by individuals indicated that their measures to ease hand-over could also be considered as a driver for their activities. These measures included ensuring the accessibility of collection points for small WEEE and the reduction of the time needed for individuals to hand in their small EEE.

Other drivers of success mentioned concerned:

- increasing the visibility of the systems (e.g. via social media or radio broadcasts);
- standardisation or streamlining of the processes;
- access to large sources of small WEEE (e.g. network provides, OEMs, retailers); and
- certifications (e.g. ISO 9001 or 14001).

Main barriers

Information from interviews indicate that systems which apply a reward incentive face three important barriers. The first barrier concerns the value of small EEE (mobile phones and laptops) as perceived by the persons handing it in. It seems that the residual or second-hand value is often overestimated or not fully realised by the persons handing in small EEE, which leads to difficulties in the acquisition of such small EEE by the collection initiative. A second barrier concerns logistical and financial challenges faced during the initial phases of setting up the collection systems. Two systems indicated that it was challenging to set up the required logistics system. Another system highlighted financial challenges in its starting stages, for example due to considerable initial investments in data deletion software. A third barrier concerns technical challenges related to the repair of collected small EEE. Three systems indicated that collected small EEE is increasingly challenging to repair due to, for example, high prices for spare parts and difficulty of dismantling. Although this last barrier does not relate directly to collection of small EEE or WEEE, complications in subsequent repair operations may render the whole system less feasible in technical and commercial terms.

Other barriers mentioned concerned:

- lack of re-use targets and focus on re-use in the Ecodesign and WEEE Directives;
- lack of VAT exemptions on repair;
- lack of branch organisations for re-use of EEE products;
- initial lack of software systems that could support the business model (e.g. for suitable documentation, registration, management and control systems);
- improving geographical coverage of drop-off points;
- insufficient awareness raising regarding waste, waste management and the value of used devices;
- competition between collection systems set up by different telecom providers;
- data security considerations of individuals;
- reluctance of companies to buy repaired devices;
- attachment of individuals to old devices.

3.3.2 Findings for convenience systems

As described above, collection systems based on convenience incentives contain elements that aim to make handing in small EEE/WEEE easier or less time-consuming for individuals or organisations and thus more attractive. The two main groups which apply convenience incentives are PROs and NGOs active in the field of environmental protection and WEEE management. However, some commercial

enterprises also seem to rely on convenience incentives rather than economic ones. Four main methods can be distinguished for convenience:

- **Drop-off points:** dedicated locations at which small EEE can be handed over. Available information indicates that drop-off points are chosen on the basis of their proximity and accessibility (e.g. shops or shopping areas);
- **Bins or other containers:** making dedicated containers in which small WEEE can be handed over available. Such containers can be highly automated or specifically shaped to draw attention;
- **Pick-up service:** the system collects the small WEEE directly at the place where the person or organisation requiring to hand over its device is. This includes "on demand" pick-up services, but also incidental pick-up forms, such as the handing-over of small WEEE delivery services for other types of products; and
- **Postal dispatch:** sending small WEEE to collection systems via postal service.

An interesting development concerns the use of IT arrangements to increase convenience. Such arrangements may aim at informing individuals or organisations about the take-back possibilities (e.g. search engines) but can also be aimed at facilitating the hand-over process (e.g. online forms which calculate the value of the device).

Using a web-form provided by "**Cu un click ai empty trash!**", citizens of Bucharest can ask for a team to come and collect WEEE in private households and offices.

Kuhuviia.ee is an Estonian map application where anyone can find information about what to do with items they don't need anymore, including used electronics. The application has a specific sub-section for small WEEE.

Another example in this regard concerns the views of the operator of a system mainly based on reward incentives. During an interview, the Danish company **Refurb** indicated that it considered its efforts to wipe data from collected IT devices as a convenience measure.

Applied methods, tools and technologies

Information from interviews indicates that systems rely on methods, tools and technologies with varying degrees of effort and sophistication to realise convenience. In terms of methods, the list presented in the previous section was largely mirrored by the interviewed systems. The identified range of technologies and tools applied by the interviewed systems includes simple but aesthetically enhanced containers, active pick-up systems involving vehicles and technologically advanced automatic bins and drop-off points. As will also be discussed below, the interviews with the convenience systems provided indications that most of the applied tools were dependent on the cooperation of external actors for effective functioning. Such actors would provide, for example, collection infrastructure, space for deployment of containers or personnel to handle containers.

Fate of the collected small EEE or WEEE

The majority of the systems based on convenience incentives direct most of their collected small EEE and WEEE to recycling operations. One reason for this could be the variation in quality of the collected small EEE and WEEE. Another reason could be that most of these systems have been set up by or in cooperation with PROs which themselves have a stronger focus on recycling operations.

Two interviewed systems indicated to have a stronger focus on re-use and repair operations. However, despite this focus on re-use and repair, data from these systems show that 75-85% of the collected small EEE or WEEE is eventually sent to recovery operations. Again, the varying quality of collected EEE

or WEEE could be a factor. Another factor could be the increasing difficulty of repair of small EEE and WEEE, as already highlighted by reward systems, but also by one convenience system.

Important actors involved

Information from interviews indicates that systems which apply a convenience incentive are mainly reliant on public donors or on financial compensation by a PRO. This could be linked to the fact that most of the interviewed schemes seem to have a main collection function without any generation of funds. In addition, various systems indicated considerable practical involvement of public authorities, for example through facilitation, co-organisation but also permission for waste collection activities. However, one system also indicated that cooperation with local and national governments was sometimes challenging.

Furthermore, almost all interviewed systems rely on external actors for the treatment of the collected small EEE and WEEE. In this regard, two systems have established a partnership with social labour initiatives. Various systems also rely on external actors for the operation of the collection in practice. This includes the emptying of unmanned bins when these are full or the collection of small EEE and WEEE by post delivery services and bike couriers delivering parcels.

Finally, information from multiple systems indicates that actors providing space for the collection infrastructure (e.g. shops, public buildings, schools) play an important role in the feasibility of such systems. This is due to the fact that various systems have based their convenience incentive on the accessibility of collection points by individuals.

Main drivers

Information gathered from interviews indicates that the positive environmental and social awareness of individuals and companies is perceived as a driver by multiple systems.

Apart from this, drivers of success indicated by the interviewed systems varied considerably. The following provides an overview of other drivers mentioned by the different systems:

- the ease of integrating the system in existing infrastructure (e.g. postal delivery services);
- the integration of a system in the Corporate Social Responsibility policies of companies;
- support by local and national authorities (e.g. providing space or promoting the system);
- ease of the hand-over process (e.g. sending via post)
- the fact that the hand-over takes place free of charge; and
- the guarantee of data deletion by the system.

Main barriers

One barrier, which was mentioned by two systems, concerned the lack of regulatory drivers for re-use and repair. In this regard, one system indicated that it would consider a move to re-use and repair of products if a regulatory framework existed for these activities.

Apart from this, barriers indicated by the interviewed systems varied considerably. The following provides an overview of other barriers mentioned by the different systems:

- difficulties in the establishment of collection points near households and in highly frequented areas;
- need to raise awareness of citizens regarding WEEE;
- lack of political and practical support from local and national authorities (e.g. political support or pressure by authorities on certain actors to contribute to the system);
- lack of economies of scale which lead to relatively high costs per tonne for collection;
- difficulties in disassembly of devices and lack of spare parts;

- need for knowledge of different device models;
- low quality and short lifespan of devices; and
- PRO fees which are too low for the proper collection of mobile phones.

3.3.3 Findings for charity systems

As described above, collection systems based on charity incentives tend to be connected with charitable organisations or initiatives which incentivise individuals or organisations to hand-in their small EEE/WEEE. The available information indicates that charity incentives are mainly applied by NGOs. However, examples of application by commercial actors (e.g. telecom providers) and public authorities have also been identified. In terms of incentive set-up, two main forms can be distinguished. Firstly, the charity incentive can be linked to direct donation of collected used small EEE to beneficiaries. Secondly, the charity incentive can be linked to indirect donation to a specific charity (e.g. nature conservation or development aid) by the hand-over of small EEE or WEEE. The systems based on charity incentives generate funds from the sale of the collected small WEEE to recyclers or small EEE to second-hand users. In most cases, the collected small EEE or WEEE is sold to a third party for preparation for re-use or recycling.

Systems based on charity incentives are not per definition small scale. Around November every year, the Austrian system "**Ö3-Wundertüte**" sends red paper bags to households throughout Austria. Used mobile phones can be placed with or without accessories in the Ö3-Wundertüte and handed in postage free of charge at the post office. The system cooperates with Austrian post, which is responsible for the logistics, the hit radio Ö3[19] which leads the communication and the social recycling business "magdas" which organises treatment. The revenues from the sale of each donated mobile phone goes to the emergency aid fund "Licht ins Dunkel" and the emergency aid of Caritas.

Ö3-Wundertüte indicated in an interview that it collects 400,000 – 500,000 mobile phones (including some chargers and other phone equipment) annually. This amount corresponds to 40 to 70 tonnes/per year, which amounts to 20% - 31% of the actual mobile phone quantity placed on the market annually in Austria. This shows a considerable potential for collection systems based on charity incentives.

Applied methods, tools and technologies

Information from interviews indicates that systems which apply a charity incentive in most cases base their processes on more accessible methods, tools and technologies. In terms of methods, a considerable variation exists, ranging from bins or containers, pick-up service and postal dispatch, to dedicated collection events. In general, the collection tools and technologies used by charity incentive systems seem to be less complicated and technology dependent. In this regard, multiple systems indicated the use of regular and social media to promote their systems with the wider public.

It is also relevant to note that systems based on charity incentives are not per definition based on more accessible or low-tech processes. For example, one system indicated that it used certified data wiping software.

[19] Ö3 is a radio program from the Austrian Broadcasting Corporation (Österreichischer Rundfunk - ORF)

Fate of the collected small EEE or WEEE

Most interviewed systems indicated that they applied a cascaded approach to the collected small EEE or WEEE with an initial focus on re-use. Most systems carry out checks for the collected small EEE or WEEE to determine its suitability for re-use. Non-suitable devices seem to be directed to recycling operations at partner organisations, usually PROs. The majority of interviewed charities do not seem to carry out repair activities. However, as described in the section on barriers, the challenges experienced by some systems with regard to cloud based data wiping and locked mobile phones could imply that charity incentive systems do not always possess the technical means and knowhow to carry out deep or comprehensive repair operations.

Important actors involved

Information from interviews indicates that most systems which apply a charity incentive tend to rely on funding from external actors such as affiliated charities and sympathisers. In addition, most systems indicated that their operations relied on wider networks of mostly volunteer partners, which provide support or complementary activities. Examples of involved external partners include:

- educational institutions (universities);
- media outlets (e.g. radio station);
- local authorities;
- consultancies; and
- waste management companies.

Finally, most interviewed systems relied on PROs for the treatment of small WEEE that was not found suitable for re-use. The interviews indicate that the cooperation with such PROs is of a more commercial nature, since the systems are remunerated for the small WEEE delivered to the PROs.

Main drivers

Information from interviews indicates that environmental awareness and "good intentions" are perceived as the most important drivers for systems that apply a charity incentive. This is not surprising, as the main incentive of such systems is geared towards such intentions and awareness. However, one system also indicated that a changing political and behavioural context diminished the interest of the public.[20] This statement indicates that the perceived driver could also be considered a potential weakness of charity incentives.

Apart from this, drivers indicated by the interviewed systems varied considerably. The following provides an overview of other drivers mentioned by the different systems:

- free shipping provided by the partner postal service;
- the possibility to sell small WEEE to PROs;
- awareness raising events and promotion via regular and social media outlets;
- the use of local partners in developing countries to facilitate the administrative and regulatory processes (e.g. customs and waste shipment notifications);
- the assurance to donors that the data on their donated devices will be erased; and
- donations from actors of devices that have good quality and value.

[20] This system, which collects old mobile phones and re-distributes them to refugees, indicated that in the relevant Member State the political focus or narrative shifted from providing aid for refugees to integrating them. According to the system, this meant that companies were less likely to donate mobile phones.

Main barriers

Information from interviews indicated regulatory barriers or gaps which affected the charity incentive systems. Indications provided by interviewed systems include:

- implementation of Annex VII of the WEEE Directive in Member States' legislation leads to differing requirements concerning the testing of devices on suitability for re-use;
- heavy administrative burden resulting from regulatory requirements for WEEE management;
- the lack of regulatory discouragement of low quality new EEE; and
- regulatory requirements linked to the handing over (sending) of small EEE and WEEE via post.

In addition, two systems indicated that they faced technical challenges related to the re-usability of collected mobile phones. These technical challenges concerned permanently installed batteries, the deletion of cloud-based data and the coding of hardware parts, as well as the locking of mobile phones by a network operator.

Finally, two systems highlighted the lack of funding for their systems. One of these systems highlighted the opaque and complex EU funding system as an economic obstacle that required too much work for a small-scale charity to successfully apply for funding.

Apart from these points, barriers indicated by the interviewed systems varied considerably. The following provides an overview of other barriers mentioned by the different systems:

- varying quality of mobile phones handed over, which makes it difficult to offer a standard high quality of reusable devices;
- lack of trust in charity initiatives with regard to data deletion;
- the expenses of marketing and promotion of the system;
- competition with large established companies which copy collection events; and
- the fact that the price of new EEE does not fully reflect its environmental costs.

3.3.4 Assessment of replicability and scalability

The following section provides an assessment of the main barriers and opportunities for the replication and scaling of the collection systems identified and described above. The assessment has been structured on the basis of a set of factors which are likely to affect system replicability and scalability. The following table provides an overview of these factors.

Table 9: Factors influencing replicability and scalability

Factor	Replicability	Scalability
Economic	The extent to which a system is dependent on certain economic conditions. For example, in certain countries the monetary incentive offered for discarding a small WEEE (e.g. based on residual value) could be perceived as more "valuable".	The extent to which certain economic conditions could affect the scaling up of a system. For example, the scaling up of a specific system may require considerable financing, which may not be available or only available under strict conditions.
Technical	The extent to which a system is based or dependent on complex, demanding, or inaccessible technology and logistics. For example, the use of internet portals may not be as feasible for systems in every Member States.	The extent to which the scale of a system is dependent on certain technology and logistics. For example, scaling up of a certain postal take-back system may require immense expansion of postal processing

Factor	Replicability	Scalability
		capacities (e.g. including IT solutions) from a company.
Behavioural	The extent to which the system is dependent on unique behaviour of consumers and other actors in the value chain. For example, a system may benefit from the fact that consumers in a specific Member State or region have a high level of environmental awareness.	The extent to which the scale of a system is dependent on the behaviour of consumers and other actors in the value chain. For example, it could be that a system is strongly dependent on the behaviour of one or a number of specific sub-groups (e.g. dedicated companies). This dependence on a limited number of consumers can limit the scaling up potential of the system.
Regulatory	The extent to which a system is based or dependent on unique national/regional regulatory conditions. For example, national regulations (e.g. taxes) may have afforded a system specific advantages which render it more feasible.	The extent to which the scale of a system is dependent on the applicable regulatory framework. For example, administrative requirements stemming from rules on the shipment of WEEE from one EU Member State to another may render the scaling up of a system beyond national borders less feasible.
Administrative	The extent to which a system is based or dependent on unique national/regional administrative conditions. For example, national or local administration may have endorsed the system and supported it through funds or the unlocking of networks.	The extent to which the scale of a system is dependent on administrative conditions. For example, differing regional policies may be barrier to the expansion of a system to other regions within a Member State.

3.3.4.1 Assessment of replicability

Economic factors

The growing market for second-hand and repaired small EEE can be considered an important driver for the replicability of **reward** systems, as it seems to promise sufficient return on investment to maintain a commercially feasible system. However, the increase in number of reward schemes, which often operate on a commercial basis, may raise the competitive pressure on the market and thus put pressure on profitability. An important factor to consider in this regard is that the relevant systems seem to operate in multiple Member States and even internationally. As such, replication of start-up systems in one Member State may have to compete with established and expanding systems from other Member States.

Convenience systems may not fully benefit from the growing market for second-hand and repaired small EEE, as most systems direct their collected small EEE and WEEE to recycling operations. However, increased attention for re-use and repair by these systems may benefit from the growing market in the future. Nevertheless, it is not clear to what extent these systems would be able to compete with reward systems. In general, it seems that convenience systems fulfil a complementary role to reward systems, as they accept a broader range of small EEE and WEEE which may be of lesser quality.

It is less likely for **charity** systems to benefit from the growing market for second-hand and repaired small EEE, since these systems are often aimed at the redistribution of reusable or repaired small EEE

for free or at the sale of small WEEE to recyclers. One clear economic barrier for charity systems is their reliance on funding. Access to funding from external actors may not be available in other regions or Member States where the system is replicated.

Technical factors

From a technical perspective, it is relevant to note that **reward** schemes, which often operate on a commercial basis, require the setup of relatively complicated infrastructure, logistics, technology, and certifications. Information from the interviewed systems suggests that some of the required technology (e.g. certified data wiping software) provides advantages in the market. Such infrastructure, technology and certifications may require considerable investments up front. As such, technical replication may prove more challenging without significant starting capital.

Most of the **convenience** and **charity** systems seem easier to replicate, as they rely on more accessible methods and tools, such as bins and postal services. More sophisticated or technology-intensive systems such as automatized bins and pick-up vehicles may be more difficult or costly to replicate.

In addition, it is important to note that many convenience and charity systems are based on a network of supporting actors, sometimes voluntary in the case of charity systems, for the operation of the systems and further processing of collected small EEE and WEEE. The reliance on supporting networks implies a considerable level of location and context-dependency. As such, convenience and charity systems which are successful in one region or Member State may be less successful in others, if supporting networks are less available and/or accessible.

Behavioural factors

From a behavioural perspective, national and local circumstances concerning individual and company environmental awareness varies, especially concerning the residual value of small EEE and WEEE, which may play an important role in the viability of replication. Such awareness could be a driver or barrier, depending on the level of awareness in a specific Member State or region. This factor seems especially relevant in the case of **reward** systems, as the performance of these systems depends on the extent to which they can acquire small EEE at a feasible price.

In the case of a **convenience** or **charity** system, it is likely that a lack of awareness of individuals and companies will be an important barrier to replicability. It is assumed that, contrary to reward systems, these systems are more reliant on the intrinsic willingness of individuals and companies to hand-over small EEE and WEEE for free. As such, a system which is successful in a Member State or region with highly aware citizens and companies may not be as successful in a Member State or region with a lower level of awareness. In this regard, it should be noted that the European Commission has initiated an initiative to "strengthen the role of the consumer in the green transition". Among other things, the initiative aims to "ensure that consumers obtain reliable and useful information on products, for example on their lifespan and repair options"[21]. An inception impact assessment regarding this initiative has been published by the European Commission (European Commission, 2020f).

Furthermore, **charity** systems rely on environmental awareness and "good intentions" of individuals and companies as main drivers, which could be very location and context dependent. As such, charity systems which are successful in one region or Member State may be less successful in others, if levels of awareness are lower or certain charity interests are not considered urgent.

[21] See in this regard: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12467-Empowering-the-consumer-for-the-green-transition?cookies=disabled

Regulatory and administrative factors

From an administrative perspective, certain location and context-dependency can be identified for the **convenience** systems. Information from the conducted interviews indicates that public authorities seem to be more involved in the case of convenience systems through facilitation, co-organisation but also permission for waste collection activities. As such, support from public authorities may play an important role in the replicability of convenience systems.

In addition, it is important to note that many **convenience** and **charity** systems are based on a network of supporting actors, sometimes voluntary in the case of charity systems, for the operation of the systems and further processing of collected small EEE and WEEE. The reliance on supporting networks implies a considerable level of location and context-dependency. As such, convenience and charity systems which are successful in one region or Member State may be less successful in others, if supporting networks are less available.

As regards **reward** systems, no considerable regulatory and administrative drivers or barriers for replicability have been identified by the interviewees.

3.3.4.2 Assessment of scalability

Economic factors

As also discussed for replicability, the growing market for second-hand and repaired small EEE can be considered an important driver for the scalability of **reward** systems. However, it is uncertain to what extent scalability will be possible without expansion of systems into other Member States. The reason for this is that reward systems, especially the commercial ones, will have to ensure a steady flow of small EEE with sufficiently high quality or residual value. The fact that these systems are now able to "cherry pick" the commercially attractive devices is based on this premise. However, beyond a certain point of growth, the stock of used small EEE in one Member State may dry up. This may in turn force the systems to search for new supplies in other Member States. Systems may also face increasing competition from other systems, both commercial and non-commercial, for attractive stocks of used EEE. However, due to the relatively considerable technological and financial barriers for the establishment of a commercial reward system, the increase in competition from commercial systems may be more limited. From a general circular economy perspective, the "cherry picking" of commercial reward incentives systems lays bare one big disadvantage. Commercial considerations may stop such systems from collecting small EEE of lesser quality or even small WEEE, regardless of its reparability. As such, a sole reliance on such systems may not ensure full collection potential for small EEE and WEEE.

As regards **convenience** and **charity** systems, one important consideration for their scalability concerns the funding. Information from conducted interviews indicates that these systems are mainly reliant on public donors or on financial compensation by a PRO. As such, the extent to which convenience systems can scale up may correlate to the extent to which relevant donors are willing to provide necessary funding.

Technical factors

From a technical perspective, it is assumed that, beyond the initial technological and financial challenges described in the section for replicability, **reward** systems will be able to scale up with relative ease.

Also for **convenience** and **charity** systems, no barriers for scaling up are apparent with regard to the methods, technology or tools applied.

Behavioural factors

The behavioural considerations for the replicability of **all types** of systems could also be relevant for their scaling up, if such scaling up leads to the expansion of the system into new Member States or regions. The success of such expansion may depend to a considerable extent on the level of awareness of the citizens and companies of the region or Member State. Moreover, lack of awareness of the residual value of a small EEE or WEEE may create challenges for collection systems to ensure consistent acquisition, especially for reward systems.

Regulatory factors

From the regulatory perspective, one important barrier may concern the EU´s legal framework for the transboundary shipments of waste. Regulation (EC) No 1013/2006 on shipments of waste (Waste Shipment Regulation) lays down procedures which consignors of waste shipment will have to comply with for single or series of shipments between different EU Member States and from EU Member States to third countries. Especially the procedure of prior written notification and consent for specified hazardous waste streams requires considerable administrative and organisational effort from consignors. Small EEE and WEEE may, depending on whether they contain certain hazardous substances, be subject to this procedure. As such, **reward**, **convenience** and **charity** systems that operate in multiple Member States may have to factor into their operations the administrative and thus financial implications of compliance with the Waste Shipments Regulation. This in turn, may be perceived as a limitation for the scalability of these systems to multiple EU Member States. It should be noted that the Waste Shipment Regulation is currently undergoing a revision[22] process following an evaluation under the EU Better Regulation framework. The revision has also been announced in the EU Green Deal and the EU Circular Economy Action Plan 2020. According to the Commission, the revision aims to "facilitate that EU policy on waste shipments promotes recycling in the EU to support the transition to the circular economy". An inception impact assessment regarding this revision has been published by the European Commission (European Commission, 2020f).

In addition, information from the conducted interviews with **convenience** systems indicates a lack of regulatory drivers for re-use and repair activities. This may be considered a potential barrier for further scaling of these systems, at least towards increased re-use and repair of collected small EEE and WEEE.

As regards **charity** systems, information from the conducted interviews indicates that certain regulatory obligations that apply to waste management may be a complicating factor and, as such, limit their potential for scalability. A reason for this could be that the associated compliance requires means and capacity which such systems could allocate to development and growth.

Administrative factors

Convenience systems seem to rely often on the support of public authorities, therefore the extent of scalability will be partly dependent on the willingness of the relevant authority to facilitate and support, since the expansion to new regions or Member States may place a system under the competence of a new authority.

As indicated in the section on replicability, many of the **convenience** and **charity** systems are based on a network of supporting actors for the operation of the systems and further processing of collected small EEE and WEEE. Scaling up of the systems could lead to the geographic expansion of a system from one region or Member State to others, which would require a parallel expansion of the supporting network to ensure proper operation of the system. However, it is not certain whether the required

[22] See in this regard: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/7567584-Waste-shipments-revision-of-EU-rules

support networks can be replicated in every region or Member State. It should be noted that this barrier is less relevant in the case of supporting PROs, since these are active in all national regions and established in every EU Member State.

No considerable administrative drivers or barriers have been identified for the scalability of **reward** systems.

4. IDENTIFICATION OF POSSIBLE FURTHER ACTION AT EU LEVEL

4.1 Objectives to be achieved

This phase of the study aims to identify a set of relevant options that will incentivise the return and subsequent sound management of small used and waste EEE, in line with the circular economy.

The objectives to be achieved were defined based on policy review and exchanges with the European Commission. Two sub-objectives were considered:

- Maximising value retention of used EEE through reverse supply chains. Examples of reverse supply chains are therefore presented in this phase of the study, and re-use / repair / refurbishment and recycling are taken into account; and
- Achieving maximum separate collection rates for small WEEE.

It should be noted that the above objectives were further refined and prioritized to be adapted to various situations, notably:

- Product types (smartphones, laptops, tablets, chargers); and
- High or low value products.

The latter point is of particular importance, considering the conclusions of Section 2.4.1.2 on collection of mobile phones, laptops and tablets. High market value products are already exchanged on many platforms across the EU, either via classified platforms (i.e. directly between consumers, e.g. leboncoin in France) or via refurbishers. The AFNUM / Sofies report (AFNUM, 2019) on the 'Analysis of the French mobile phone market and stock' concludes that phones sent to re-use represent up to 34% of new mobile phones put on the market. A differentiated approach should therefore be taken in order to:

- Ensure that products with low market value leave the drawers, either for re-use (notably via social economy channels) or for recycling. This could imply the use of financial incentives, on top of informational and convenient solutions; and
- Ensure that products with high market value are increasingly re-used. Handing-over such products could require further information but also reassuring users on data privacy issues.

Furthermore, special attention should be paid to the implementation of article 5 of the WEEE Directive on separate collection. According to article 5(2), Member States must ensure that systems are set up to allow for the return of household WEEE free of charge, taking into account population density and the accessibility and availability of collection facilities. In addition, distributors[23] have to collect WEEE in exchange of a similar sold EEE (on a "one-to-one basis"), and at retail shops with sales areas relating to EEE of at least 400 m^2 have to collect very small WEEE (no external dimension more than 25 cm) free of charge from end-users, with no obligation to buy EEE of an equivalent type. Producers are also allowed to operate individual or collective take-back schemes.

[23] Any natural or legal person in the supply chain, who makes an EEE available on the market- see definition in the WEEE Directive Art. 3 (1) (g) and in Section 7.1.1.1

According to article 5, Member States are also entitled to designate operators authorised to collect household WEEE and require that collected household WEEE is handed over to producers according to the producer responsibility principle.

In 2017, a WEEE compliance promotion exercise[24] was conducted on behalf of the European Commission in order to assess, among other requirements of the WEEE Directive, the implementation of the above mentioned take-back obligation. The main recommendations regarding WEEE collection and take-back obligation were to:

- Develop sufficient infrastructure for consumers to give back WEEE and inform them about the available options;
- Use both municipality collection points and retailer collection points;
- Control compliance with 1:1, 1:0 take-back obligations to distributors;
- Consider implementation of density and/or distance obligations where appropriate;
- Consider appropriateness of home pick-up services (door-to-door collection) and targeted collection events where appropriate;
- Consider adoption of incentives to end-users, including financial incentives where appropriate;
- Encourage communication on existence of collection points.

4.2 Results

This section lists ambitious solutions which were selected to filter potential actions identified during the desk research, the interviews conducted and the results from earlier tasks conducted in the study. Section 7.4 in the Annex describes the methodology followed to identify and prioritize the proposed actions.

A selection of actions described below was presented to stakeholders and Member State experts during two workshops organised in February and March 2021. The feedback received was used to reassess, modify and complement the list of actions that would be part of the further analysis. Section 4.2.3 presents the list of actions selected for high-level impact assessment, together with an explanation of the concept, potential feedback from similar existing actions, suggested implementation steps and key success factors.

4.2.1 Key findings from stakeholder workshops

The two workshops conducted in February and March 2021 (see Section 7.6) provided feedback from:

- EU Member States (MS) representatives; and
- Stakeholders from various backgrounds including academia, industry, NGOs and PROs.

The workshops were used to draw synergies between actions, to better evaluate the impact and challenges in implementing those actions, and collect expert feedback about potential existing actions. The list of actions selected by stakeholders is presented in Table 10 and are further detailed in the following sections.

[24] BIPRO (2018)

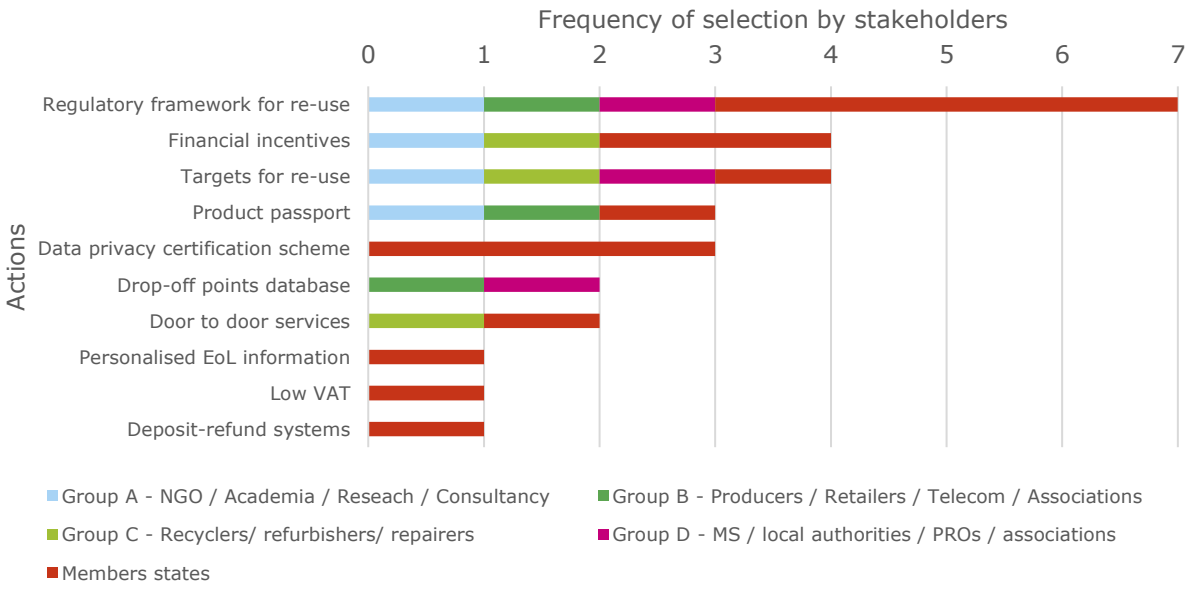
Table 10: List of actions presented to the stakeholders during the two workshops

Proposed Actions	
Financial Incentives	Reduced VAT rates on re-use services
Door-to-door and postal services	Deposit-refund systems
Targets for re-use	Product passport
Data privacy certification scheme	Creating the enabling regulatory framework for re-use
Drop-off points databases	Tackling "free-riding" of online sellers not compliant with EU WEEE legislation*
Personalised EoL information	Waste compensation principle*

* actions presented only during the second workshop and not selected for impact assessment

In order to better frame stakeholder needs and expectations, participants of both workshops were asked to rate the most promising actions. A prioritisation of actions therefore resulted from this exercise and from results of a questionnaire sent to Member States[25], as presented in Figure 22. It should be noted that the below ranking represents the opinion expressed by the majority of Member States' WEEE experts and stakeholders who attended the workshops. It should not be interpreted as the official opinion of the said stakeholder groups.

Figure 22: Stakeholder selection of suggested actions during the workshops



[25] A questionnaire was sent out asking the Member States representatives to analyse the first set of actions selected and prepare for an efficient discussion. Figure 22 presents in particular the response to a question on which suggested policy action MS found promising for implementation at EU level. The answers were compiled and used during the session and also helped to better shape policy actions.

4.2.2 Final list of policy actions

Based on the outcomes of both workshops, the final list of policy actions was modified by adding some actions suggested by stakeholders, among which those listed in Section4.2.4, and removing others due to their lower relevance/priority according to stakeholder groups and Member States during the workshops, namely the waste compensation principle and the best practices toolkit mentioned in Table 10.

The final list of policy actions, presented in Table 11 below, include:

- 8 policy actions selected for the impact assessment;
- 7 additional policy actions, consisting either in:
    - cross-cutting policy actions that were identified during desk research and confirmed during stakeholder workshops as key enablers for other suggested policy actions;
    - other policy actions selected among those suggested by Member States and stakeholders during the two workshops conducted in the framework of this study.

Table 11: Final list of policy actions

Policy actions selected for the impact assessment	Complementary policy actions
Policy action #1: Financial Incentives	Product passport
Policy action #2: Door to door services	Creating the enabling regulatory framework for re-use and preparation for re-use
Policy action #3: Targets for re-use	Communication campaigns and educational measures
Policy action #4: Data privacy certification scheme	Separate monitoring and reporting of small WEEE
Policy action #5: Drop-off points databases	Improve the implementation of Article 5 of the WEEE Directive on separate collection
Policy action #6: Personalised EoL information	Tackling free riding of online sellers not compliant with EU WEEE legislation
Policy action #7: Reduced VAT rates on re-use services	Leasing model
Policy action #8: Deposit-refund systems	

4.2.3 Policy actions selected for impact assessment

The policy actions selected for the impact assessment are described in the following sections. Each section is organised as follows:

- Firstly, a table briefly describes the action (objectives, type of instrument, etc.) as well as the value and categorisation (used EEE or waste EEE) of the targeted equipment. Policy actions are classified depending on whether they imply additional regulation at EU or national level ("mandatory" action) or not ("voluntary" actions), and depending on whether they would be implementable and deliver results in the short, medium or long term (period considered in the impact assessment from 2021 to 2030). They are complemented in Section 5.2 by an impact assessment of each action;

- Secondly, information about working principles, feedback from existing initiatives and possible implementation steps is provided.

4.2.3.1 Policy action #1: Financial Incentives

Financial incentives			
Objective(s) addressed		Incentivise return of WEEE for preparation for re-use or recycling via a convenient take-back scheme	
Barrier(s) addressed		Household storage: data security concerns, forgotten devices etc.	
Type of instrument(s)		Financial	
Condition of instrument		Mandatory at national level	
Implementation and results		Short Term	
Actors involved		Producers through EPR schemes (lead), Member States	
Product / waste		**Value**	
☐ EEE	☒ WEEE	☐ High	☒ Low

Action working principle:

This policy action addresses the issue of 'household storage' by incentivising users to return stored devices to collection points thanks to a financial reward. A minimum 'guaranteed' price would incentivise the return of devices, irrespective of their recycling value.

The financial incentive could be funded in the framework of EPR schemes, should be limited in time to be cost effective, and should target the stock of hoarded devices. A financial reward is not expected to create a lasting consumer habit, as the return rate will likely drop when the financial incentive policy is no longer provided.

Focusing on financial incentives for waste EEE, as opposed to used EEE, was made for two reasons:

- *competition between re-use and waste collection*: non-functioning and low-value devices are less likely to be prepared for re-use and therefore more suitable for WEEE recycling;
- *existing market solutions for EEE*: the buyback of high value devices is, although partly, ensured by private initiatives, e.g. Rebuy, Zoxs, FLIP4NEW, Backmarket, Volpy or Comparecycle[26]. Manufacturers and distributors also occasionally offer vouchers when returning devices for the purchase of new products[27].

[26] AFNUM (2019) demonstrates the dynamism of the second-hand market by assessing the quantity of re-used devices compared to the overall put-on-market quantities. Kantar (2021) shows that a significant share of respondents have already bought a re-used smartphone in the case of France (34%), Germany (38%) and Belgium (32%). This share has grown by 8 pts between 2020 and 2021 in France.

[27] See for instance Orange: https://boutique.orange.fr/bon-plan-promo/orange-reprise/

A similar system could however also be considered for the re-use of low-value EEE stored in drawers, especially considering that buyback solutions (see existing actions below) are often hybrid and therefore cover both EEE and WEEE. This option was however not assessed under this study.

Feedback from existing actions:

- Proximus, a telecommunications provider in Belgium, launched the yearly initiative "Don't miss the call" in 2020. The aim of the initiative is to make sure that mobile phones accumulated in customers' drawers are collected. People can bring their mobile phones (EEE and WEEE) to Proximus shops in exchange for a voucher worth between 5 and 350 €.
- Business initiatives such as Apple Trade-In or EcoATM make it possible to estimate and sell used EEE at physical drop-off points for devices that may have a market value, easing the phone collection process. If the device has no re-use value, it is collected for recycling through these iniatives;
- Refurbishing actors mentioned above such as Backmarket, Zoxs, Rebuy, Volpy, also use financial incentives to collect used and waste devices based on an assessment of their value prior to hand-over and on a convenient and secure send-back system which guarantees payment upon reception.

Proposed implementation (incl. funding):

Actors involved: Producers through EPR schemes (lead), Member States.

Recommended steps:

1) European Commission (potential supporting role): promote and support the policy action in a policy toolkit;
2) Member States: set the frame at the national level, possibly through obligation (like the French law, see below);
3) Producers through EPR schemes: for a limited period of time, set financial incentives including a minimum price for the buy-back of small WEEE.

Financing: Legislation to require EPR schemes to fund re-use and preparation for re-use already exist and includes the financing of the buy-back of WEEE. See the recent example of French law LOI n°2020-105 of 10.02.2020 ("loi AGEC") (Légifrance, 2020), under which producers, either individually or through EPR schemes, have to:

- contribute to funding re-use carried out by specific organisations (*article L541-10-5 du code de l'environnement* (Légifrance, 2021);
- conduct yearly collection operations together with a financial premium for users returning mobile phones tablets and laptops they are willing to discard (*article L541-10-20-II du code de l'environnement* (Légifrance, 2021).

EPR funding for financial incentives could be earmarked, and potentially appear on products' visible fees. Specific campaigns could be run to make collection more efficient. It should be noted that existing examples show that EPR schemes can support re-use; however, no examples of EPR schemes funding directly the return of used and waste devices in the format suggested in the action working principle above are currently available. Further research is needed in order to investigate the options for implementation, including the specific role and responsibilities of the different actors involved.

Synergies with other proposed policy actions:

- Policy action #2: Door-to-door and postal services
- Policy action #4: Data privacy certification scheme
- Policy action #5: Drop-off points databases
- Product passport: see complementary policy action in Section 4.2.4.

- Creating the enabling regulatory framework for re-use: see complementary policy action in Section 4.2.4.

Key success factors:

- Select appropriate financial incentives: the value must be high enough to incentivise the return of devices, without however implying an excessive cost burden for PROs;
- Ensure there is visible and accessible return infrastructure (either at the return location or online) in order to estimate the value of returned devices;
- The policy action needs to be paired with communication efforts[28], for instance with awareness raising campaigns.

[28] see for instance the website dedicated to the action www.jedonnemontelephone.fr.

4.2.3.2 Policy action #2: Door-to-door and postal services

Door-to-door and postal services			
Objective(s) addressed		Incentivise the return of used and waste EEE for re-use or recycling via a convenient take-back scheme.	
Barrier(s) addressed		Household storage: small size backup devices, forgotten due to their small size. Lack of awareness on collection schemes, difficulty in accessing collection points.	
Type of instrument(s)		Logistics	
Condition of instrument		Voluntary	
Implementation and results		Short term	
Actors involved		Producers through EPR schemes (lead), Member States, distributors, postal services	
Product / waste		**Value**	
☒ EEE	☒ WEEE	☐ High	☒ Low

Action working principle:

Make use of door-to-door and postal services to ease the return of used and waste EEE that are often stored at home and forgotten by consumers. Partnerships between PROs and postal services should be fostered and encouraged (toolkits, guidelines, communication on best practices, etc.). Certain measures could improve the success rate of this action:

- Setting lower tariffs for postal services when sending back used and waste EEE;
- Making pre-paid envelopes available to consumers (at the post-office or at the point of sale by distributor, telecom provider or online platforms for example) to be sent for collection and sorting or, alternatively, make it compulsory for the producers putting small EEE on the market to provide for such prepaid envelopes when the product is sold;
- This action could be coordinated with the policy action on providing buy-back financial incentives to further increase return rates (see Section 4.2.3.1) and ensuring that online sellers also comply take-back obligations (see Section 4.2.4.5) .

It should also be stressed that this action is motivated by the fact that collection costs can be high and may hamper recycling. As an example, the intrinsic value of recoverable materials contained in a smartphone is estimated at 1,6 Euros (see Section 7.5.1). Considering such limited unitary value, massification and cost reduction or pooling are important and could be achieved by leveraging existing door-to-door and postal services. A complementary action to the one described above would therefore be to launch a call for innovative projects with the ambition to build common solutions and business models between door-to-door activities for reuse and waste collection.

It can be anticipated that consumer trust in the handling of the equipment in terms of data security will be at the heart their decision to resort to this type of solution.

Feedback from existing actions:

Several initiatives in the EU use door-to-door and postal services to collect devices, including the following:

- **Ö3 Wundertute (AT)** is a yearly campaign implemented by the NGO Caritas and the Ö3 radio[29] in 2005 to mail mobile phones to a charity for re-use or recycling. Paper bags are sent to households throughout Austria and consumers can send back used mobile phones with accessories free of charge at the post office. The campaign achieves high collection (up to 31% of mobile phones put on the market in Austria) and re-use rates (60% of collected devices). The campaign is conducted through a partnership between a charity, a re-use organisation, a national radio and postal services;
- **Jedonnemontelephone (FR)** is a year-round mobile phone collection initiative implemented by the French PRO for WEEE. Consumers can send their devices for free either by printing out a label to stick on an envelope or by ordering a prepaid envelope. Devices are received as products (EEE) and can therefore be assessed for re-use. Interestingly, the same French PRO is testing a new collection solution, by providing a free pick-up service directly at home dedicated to large EEE (**jedonnemonelectromenager.fr**). At the time of writing of this report, the latter initiative has not been launched yet. Nonetheless, such a solution could perhaps be coupled with the collection of small equipment such as the devices studied in this report;
- **WEEEelectric (NL)** used parcel delivery services to collect small EEE. This option is interesting but has not been explored further as the feedback was limited and the service discontinued;
- **Seiffi (FI)** is a data safe collection service for WEEE offered by the PROs, a recycling operator and postal services. Consumers can leave WEEE in a post office, or post their device in a parcel post after receiving a product specific code;
- According to § 1-4 of the **Norwegian Regulations** on recycling and treatment of waste (Waste Regulations) (Lovdata, 2021), retailers selling in Norway without a physical location must offer a system for the return of small WEEE from private households free of cost. Based on the questionnaire sent to national experts, pre-paid envelopes could represent an interesting solution to implement this law.

Proposed implementation (incl. funding):

Actors involved: Producers through EPR schemes (lead), Member States, distributors, postal services.

Recommended steps:

1) European Commission (potential supporting role): promote and detail the policy action in a policy toolkit and encourage exchange of best practices, for instance national authorities promoting partnerships between for instance re-use organisations, PROs and postal services.
2) Producers through EPR schemes:
    a. set up the system and operate the system. Precise role will depend on local context, but should aim at coordinating the different stakeholders for collection, shipping and treatment of used and waste devices;
    b. launch communication campaigns to increase users' awareness.

Financing: Producers through EPR schemes.

Synergies with other proposed policy actions:

- Policy #1: Financial Incentives
- Policy #4: Data privacy certification scheme
- Policy #6: Personalised EoL information

[29] A radio program from the Austrian Broadcasting Corporation (Österreichischer Rundfunk - ORF)

- Tackling "free-riding" of online sellers not compliant with EU WEEE legislation, see complementary policy action in Section 4.2.4. Setting up postal collection services could help distance sellers to comply with their obligations.

Key success factors:

- Complement this action with awareness raising campaigns (e.g. Ö3 Wundertüte relying on a national radio channel for B2C communication);
- Although the Ö3 Wundertüte initiative receives devices as waste, receiving them as donations could facilitate the handling of devices by re-use organisations, i.e. with a product status (EEE) instead of a waste status (WEEE);
- Ensure compliance with data privacy norms and policies (e.g. data deletion, transfer service), see the Seiffi (FI) example above;
- Design this policy action to complement existing physical collection points located in densely populated areas.

4.2.3.3 Policy action #3: Targets for re-use

Targets for re-use			
Objective(s) addressed		Maximise value retention of used EEE through reverse supply chains	
Barrier(s) addressed		Weak market for repair and re-use activities: need for stronger incentives	
Type of instrument(s)		Regulatory	
Condition of instrument		Mandatory	
Implementation and results		Long Term	
Actors involved		Producers through EPR schemes, Members States (lead), European Commission, re-use organisations	
Product / waste		**Value**	
☒ EEE	☐ WEEE	☒ High	☒ Low

Action working principle:

The implementation of mandatory re-use targets set either overall or by category at EU level in the WEEE Directive or recommended to be set at Member States level, which can be done without amending the WEEE Directive, could create incentives to prevent waste and maximise value retention of used EEE along the value chain. Setting regulatory re-use targets could also enable to:

- properly monitor re-use rates for small EEE, as data is currently lacking; and
- make re-use organisations eligible for EPR schemes or public financial support. It may compensate market failures preventing re-use of products.

As described in Flemish example below, re-use targets are achievable when re-use organisations have contracts with public authorities. Another example, which however refers to preparation for re-use of WEEE and not to the direct re-use of EEE, is the approach set out by the revised German WEEE law – ElektroG – which allows municipal waste management authorities and operators of primary WEEE treatment facilities certified for preparation for re-use to have cooperation agreements.

Setting re-use targets would imply extending EPR to re-use. This would subsequently increase the amount of eco-fees and make re-use organisations eligible to receive EPR fees paid by producers.

Another key feature is to target re-used products rather than prepared for re-use waste, given the constraints generated by the regulatory obligations linked to the waste status.

Feedback from existing actions

Different EU Members States have implemented re-use targets (Gsell *et al.*, 2019):

- **Flanders** has increased its set target for re-use (not specific to EEE) to 7 kg/capita by 2022[30], with the social enterprise re-use sector now supporting 5,000 jobs. The targets are reached thanks to a network of 27 re-use centres collecting and repairing re-usable goods for resale in second-hand shops. Under an agreement with the Public Waste Agency of Flanders (OVAM), this network receives a public subsidy (Delanoeije & Bachus, 2020);
- In **France**, the contractual requirements for EPR schemes for EEE[31] sets an objective for both re-use and preparation for re-use of 2%, applicable from 2023 on. This objective applies to EEE or WEEE donated to re-use and preparation for re-use operators, collected by local authorities ("*collectivités*"), stemming from distributors take-back schemes, and collected by PROs. In addition, re-use targets are set for EPR schemes regarding furniture and textiles[32]. In the case of furniture, the terms of reference for EPR schemes[33] includes a provision on waste prevention including re-use. It states that the incumbent, for instance a PRO, contracts with social economy organisations re-using furniture, and allocates funding to these social structures based on the weight of effectively re-used furniture.

It should also be noted that even though preparation for re-use is combined with recycling as a joint recovery target under Article 11 and Annex V of the WEEE Directive, at a national level separate preparation for re-use targets can be applied. One such example is observed in Spain. Spain aims to achieve 50% preparing for re-use and recycling by 2020 of which 2% will be prepared for re-use deriving mainly from textiles, WEEE and furniture. Producers also have to reach a specific 4% preparation for re-use target for small IT and telecommunication equipment[34]. Although preparation for re-use as such is not included in the scope of the present policy action, feedback from such measures at a national level complements 're-use related' type of actions. It sheds light on the potential and impact of measures put in place to meet re-use policy objectives.

Proposed implementation (incl. funding)

Actors involved: Producers through EPR Schemes, Members States (lead), European Commission, re-use organisations.

Recommended steps:

1. Member States: collect figures on re-use rates for targeted EEE categories, in which laptops, tablets and mobile phones are included (for instance as per category 2[35], and category 6[36] of

[30] The current target is part of the implementation plan for household waste and similar industrial waste for the period 2016-2022 ('Uitvoeringsplan huishoudelijk afval en gelijkaardig bedrijfsafval'). The previous plan ('Milieuverantwoord beheer van huishoudelijk afval 2008-2015') had set a target of 5kg/capital of re-use, achieved in 2015 (OVAM, 2016)

[31] Arrêté du 27 octobre 2021 portant cahiers des charges des éco-organismes, des systèmes individuels et des organismes coordonnateurs de la filière à responsabilité élargie du producteur des équipements électriques et électroniques

[32] The French Environmental Law uses two different terms for re-use, depending on the status of the object: *réemploi* (product re-use) and *réutilisation* (preparation for re-use). Both categories of object are included in the obligations regarding for furnitures.

[33] Arrêté du 27/11/17 relatif à la procédure d'approbation et portant cahier des charges des systèmes individuels de la filière des déchets d'éléments d'ameublement (DEA) en application des articles L. 541-10, R. 543-240 et suivants du code de l'environnement

[34] This measure targets WEEE , and not EEE, but was included here as an example of a specific preparation for re-use target.

[35] Screens, monitors, and equipment containing screens having a surface greater than 100 cm^2

[36] Small IT and telecommunication equipment (no external dimension more than 50 cm)

the WEEE Directive), based on the Commission Implementing Decision (EU) 2021/19 (European Commission, 2021) on reporting re-use under the Waste Framework Directive;

2. European Commission: Following the results of the EU-wide reporting obligations on re-use under the Implementing Decision (EU) 2021/19 by 2023 consider setting quantitative targets on re-use of EEE in the WEEE Directive accordingly taking into account the above mentioned feedback from Member States on target design (see weight per capita target in Flanders);
3. Member States: set targets for re-use at national level.
4. Producers through EPR schemes: Re-use operators and related activities are to be financed by producers according to the "producer responsibility" principle.

Financing: Producers through EPR schemes financially cover the collection, treatment, recovery and environmental sound disposal of WEEE. The French example above shows that this can be extended to include re-use, and funding provided accordingly to actors performing re-use operations. Under their legal term of reference ("Arrêté du 27 October 2021"), PROs finance re-use and preparation for re-use activities for an amount at least equal to 5% of the received eco-fees[37]. Producers, either individually or through EPR schemes, must contribute to funding re-use initiatives developed by specific organisations (Légifrance, 2021).

Synergies with other proposed policy actions

- Policy #2: Door-to-door and postal services
- Policy #4: Data privacy certification scheme
- Policy #7: Reduced VAT rates on re-use services
- Product passport: see complementary policy action in Section 4.2.4.

Key success factors:

- Defining targets for re-use must be paired with actions tackling the issue of household storage, e.g. door-to-door and postal services (policy action #2). A re-use target would then maximise value retention of both high and low value devices, but also increase collection. As an example, WEEE producers in France must conduct (either individually or through EPR schemes) yearly collection operations and provide a financial premium for users returning waste mobile phones (Légifrance, 2021).
- Tracking of re-use flows must be improved (see complementary policy action on separate monitoring and reporting of small WEEE, suggested in 4.2.4.3). In particular, it is of paramount importance to create a harmonised reporting methodology that can be applied to the devices targeted by this action. Specifying the scope for reporting is a key step;
- Maximise the efficiency of re-use targets by differentiating product groups within relevant categories (Category 2 "screens, monitors, and equipment containing screens having a surface greater than 100 cm^2" and for instance Category 6 "small IT and telecommunication equipment" as set in Annex III to the WEEE Directive). There is a need to consider that, for instance, mobile phones are light devices and do not significantly contribute to reaching the weight-based WEEE Directive targets – see complementary list of policy actions in Section 4.2.4. .

[37] article L541-10-5 du code de l'environnement

4.2.3.4 Policy action #4: Data privacy certification scheme

Data privacy certification scheme			
Objective(s) addressed		Incentivise return of used EEE for re-use. Increase separate collection rates for small WEEE: Improve trustworthiness of collection by general public	
Barrier(s) addressed		Household storage: data security concerns	
Type of instrument(s)		Standards/labels	
Condition of instrument		Voluntary	
Implementation and results		Short to medium term	
Actors involved		European Commission (lead), standardisation bodies, re-use and recycling organisations, any actor operating a return or collection scheme including distributors	
Product / waste		**Value**	
☒ EEE	☒ WEEE	☒ High	☐ Low

Action working principle:

Confidentiality matters (data protection) need to be targeted as a priority since they were identified in this study as a main reason for household storage of EEE. Guaranteeing proper deletion of personal data will encourage consumers to hand over their used EEE to certified re-use organisations including refurbishers and distributors with return schemes, as these actors directly handle the "change of ownership" of devices. They are therefore at the forefront of consumer data privacy concerns.

In fact, concerns over personal data found in second-hand devices and subsequent personal data breaches have been raised in several publications. Data protection concerns, along with the lack of specific guidance and user empowerment, have led more customers to ask end-of-life operators to ensure that their devices are (physically) destroyed after their first use to avoid the risk of access to personal information (Polverini *et al.*, 2018).

An EU-wide certification scheme would help ensure harmonised data deletion processes in line with data privacy regulations such as the General Data Protection Regulation (EU) 2016/679, and would also take into consideration the fact that repair and re-use markets can be cross-border markets within the EU. Furthermore, standards already exist (see below) and could be leveraged for wide application in the EU.

During the stakeholder workshop, participants mentioned that manufacturers could also be encouraged, through the Ecodesign Directive, to provide a data deletion function, built-in to the product. In fact, the optimal approach to reliable data erasure is "data encryption by default plus a factory reset, which deletes the encryption key" (European Commission, 2020b). In the framework of the Ecodesign Directive, a specific requirement[38] to enhance trust in sound data erasure practices for mobile phones and tablets in general is being assessed (European Commission, 2020b). In the framework of this policy action, the adoption of a data deletion certification scheme was preferred, as a data deletion function is

[38] Under preparation, as of July 2021

currently proposed under the Ecodesign Directive implementing measures for mobile phones. This requirement could be extended to laptops, which are not covered by the proposal abovementioned.

Feedback from existing actions/studies:

Existing standards and certifications can be leveraged:

- The Ready for Reuse **R2** standard's objective is to guarantee trustworthy second-hand EEE. It could be used as a basis for a data privacy certification scheme as it asks refurbishers to delete existing data following a strict protocol of data sanitisation, including specific steps to be documented (SERI, 2020). The R2 certifications are associated with a refurbished device and contain a unique serial number. This number allows purchasers to access the device's testing record and thus assess that the device is in good working condition and that data has effectively been sanitised. R2 Certified computer refurbishing and recycling companies participating in the scheme are supplied with the labels (Furlong, 2015).
- The preparation for re-use standard **EN 50614:** requirements for waste electrical and electronic equipment preparation for re-use includes a provision on data deletion. However, this standard focuses on WEEE preparation for re-use only. It will need to be amended to cover EEE to target sold and second-hand products, thus maximising the certification's impact.

The need for data privacy standards was observed by re-use operators:

- Re-use and preparation for re-use operators need to guarantee the deletion of personal data contained in re-used EEE and WEEE before they are further treated. They tend to develop their own specific procedures to ensure the sanitisation of data bearing equipment. This generally occurs by running a dedicated data deletion software, aligned with existing standards (such as the National Institute for Standard and Technology (NIST) standard) or by applying in-house developed methods. These differences in methodology have spurred the European Data Protection Supervisor (EDPS) to advise in the "Proposal for a Directive of the European Parliament and of the Council on WEEE" that "Best Available Techniques" for privacy, data protection and security in this area be developed (Polverini *et al.*, 2018).
- A Danish company that acquires used functional IT from large companies (more than 200 employees) and public institutions does not buy used EEE from private households since sales tax and documentation requirements for safe data management make the process difficult. Feedback indicates that companies are not organised or regulated regarding data safety and safe deletion of data, security for re-use of reusable collected items, etc.[39]

Proposed implementation (incl. funding):

Actors involved: European Commission (lead), standardisation bodies, re-use and recycling organisations, any actor operating a return or collection scheme including distributors.

Recommended steps:

- European Commission: Implementing Regulation(s) under the Ecodesign Directive to mandate European Standardisation Organisations to develop an EU-wide standard for data erasure in the framework of the re-use of EEE, guaranteeing their compliance with standards on treating personal data (long-term);

[39] Interview with Refurb, see section 3

- National standardisation bodies: promote standards amongst stakeholders to encourage widespread uptake. This includes re-use and recycling organisations and any actor operating return and collection schemes.

Financing: Development of standards funded through license fees of standards users (depending on MS).

Synergies with other proposed policy actions

- Policy #1: Financial Incentives
- Policy #6: Personalised EoL information
- Policy #8: Deposit-refund systems

The actions are complementary as they reassure (through guaranteed data deletion and communication on how data is treated) and attract end-users (financially) to send-in their used EEE and WEEE.

Key success factors:

- Leverage existing software for data erasure (e.g.: BLANCCO) and existing labels for re-use activities (e.g. R2 Ready for Re-use Standard);
- Make sure policy objectives on data privacy do not mismatch re-use objectives, since concerns linked to data protection policies could incentivise the physical destruction of data bearing components instead of harvesting for re-use or recycling (Polverini *et al.*, 2018).

4.2.3.5 Policy action #5: Drop-off points databases

Drop-off points databases			
Objective(s) addressed		Achieve maximum separate collection rates for small WEEE: improve awareness at consumer level on used EEE/ WEEE disposal	
Barrier(s) addressed		Lack of awareness on collection schemes, difficulty in accessing collection points	
Type of instrument(s)		Technological	
Condition of instrument		Mandatory/Voluntary	
Implementation and results		Medium Term	
Actors involved		Member States and producers through EPR schemes, any actor operating a return scheme.	
Product / waste		**Value**	
☐ EEE	☒ WEEE	☐ High	☒ Low

Action working principle:

A lack of communication on collection schemes leads consumers to store WEEE at home rather than discarding them in appropriate collection points (see Section 2). Appropriate measures to further develop search tools about available collection points is needed to improve citizens' awareness. The level of information provided, as well as its quality – through regular updates and auditing for instance – needs to be improved.

This action would leverage the databases that already exist and ensure that they follow best practices. Several Member States have in fact already implemented drop-off points databases. They include, among others, **Kuhuviia.ee** (EE), **PRO Recupel** (BE), **PRO Wecycle** (NL), **PRO Ecotrel: e-collect.lu** (LU), **ISOH Waste Management Information System** (CZ), **PRO Ecolec Fundacion** (ES), **Kierratys.info** (FI). Databases also exist in Norway and in the UK: **Recycle Your Electricals** (UK) and **Sortere.no** (NO). In addition, the WEEE Directory[40], a database set up by the CWIT Project (Countering WEEE Illegal Trade) provides information on WEEE collection points databases and actors involved in the WEEE value chain for each EU Member State.

In order to make sure that the same level of information (based on best practices on the design and maintenance of databases observed at MS level) is available throughout the EU, the European Commission could provide guidelines or recommendations on the level of information to be provided to EU citizens in a convenient and accessible way about the WEEE collection points in the Member States.

[40] Available at : https://www.cwitproject.eu/reports-downloads/database-ewaste-stakeholders/

Additionally, funding[41] from the European Commission could be provided to guarantee that appropriate campaigns are carried out. Similar recommendations for awareness campaigns were described in the WEEE Compliance promotion initiative (BiPRO, 2018).

In addition, creating a uniform logo for collection and return points for WEEE[42] throughout Europe would help end-users quickly recognise where WEEE can be disposed of free of charge and reduce errors during disposal.

Proposed implementation (incl. funding):

Actors involved: Member States and producers through EPR schemes, any actor operating a return scheme.

Recommended steps:[43]

1. European Commission (potential supporting role): Based on best practices observed in Member States, provide guidelines or recommendations to Member States to encourage all databases to provide information maximizing separate collection rates and value retention, such as the type of service provided (donation for re-use, repair service, waste collection, etc.) or the type of device accepted (short term);
2. Member States/PROs: Databases and coordination of information on the available collection points should be developed in Member States or areas that do not currently have databases.

Suggestions to complement the action based on input provided during the workshop referred in section 7.6.5:

3. European Commission: Encourage the creation and adoption of a uniform logo for WEEE collection points. The logo could be used as a signal to consumers of WEEE collection and return points both physically, but also used in online search tools and databases;
4. Member States: Exchange best practices, for instance supported by EU instruments such as TAIEX – the Technical Assistance and Information Exchange instrument ('Peer-to-Peer'), and provide support, including through funding awareness campaigns. For example: encourage producers or third parties acting on their behalf and re-use operators to invest in advertising to end-users, raise awareness through campaigns, and connect the database to user-friendly apps (e.g. collaborations with Google Maps).

Financing: Member States could ensure the development of databases following potential EU recommendations/guidelines, adopt a uniform logo and provide financial support to develop awareness campaigns. During the WEEE Forum workshop, PROs observed that Member State authorities are better suited to facilitate this type of action, since they have better knowledge of the market and industry actors.

Member States could encourage private stakeholders or producers through EPR schemes (e.g. through regulation or funding) to develop and update their existing databases on a regular basis. Operators of databases should therefore develop and improve the ease-of-use of their databases and invest in the

[41] For example, the "Slovenia WEEE campaign project" a LIFE project aimed to raise awareness of the handling, treatment and recovery - including re-use and recycling - of WEEE across all the municipalities in Slovenia. (LIFE 3.0 - LIFE Project Public Page (europa.eu)

[42] An example of such logo has been developed in Germany by the Stiftung Elektro-altgeräte Register. The use of a collection point logo is mandatory for all WEEE collection and return points starting from January 1, 2022. More information available at: https://www.stiftung-ear.de/en/service/sammelstellenlogo

[43] The most efficient option of implementation: guidelines, regulatory minimum requirements or both, was not determined in this study.

proper communication tools and campaigns to guarantee information is widely shared and known by end-users.

Member States and producers through EPR schemes can design and maintain country-wide databases and associated search engines for all collection and reuse (such as repair stores) points which can be set up by the private sector.

Synergies with other proposed policy actions

- Policy #6: Personalised EoL information
- Policy #8: Deposit-refund systems
- Product passport: see complementary policy action in Section 4.2.4.

These actions are complementary since having accurate and easy access to information on collection facilities will improve the relevance of push messages and efficiency of deposit refund systems.

Key success factors:

- Create user-friendly platforms and search engines that are open to all to secure a wide uptake. Interviews and research have highlighted the importance of smooth service performance. Difficulties in navigation may in fact lead to missed opportunities in changing consumer behaviour (e.g. consumers may test the service once but not twice if they are disappointed with it);
- Branding the collection points with a uniform logo can help identify collection points of small WEEE;
- Stakeholder feedback showed that ensuring database maintenance has been a key challenge. Sufficient resources should be dedicated to database operation and maintenance.

4.2.3.6 Policy action #6: Personalised EoL information

Personalised EoL information			
Objective(s) addressed		Achieve maximum separate collection rates for small WEEE: improve awareness on used EEE/ WEEE disposal	
Barrier(s) addressed		Household storage: forgotten devices and landfilling, lack of awareness on collection schemes	
Type of instrument(s)		Technological	
Condition of instrument		Mandatory	
Implementation and results		Medium Term	
Actors involved		Telecom operators and distributors (lead), producers, retailers, collectors, Member States.	
Product / waste		**Value**	
☐ EEE	☒ WEEE	☒ High	☒ Low

Action working principle:

With the aim of incentivising end-users to return devices to collection schemes, this action would guarantee that the most relevant information is provided to the user, for example through push notifications at the optimal time – see proposals such as using virtual assistants and artificial intelligence in the AFNUM study (2019)[44]. The action proposed could leverage the 'dynamic information' retrieved thanks to the 'product passport' as mentioned in Section 4.2.4.1.

Cordella et al. (2020) have reported that consumers could be incentivised to sell their old devices by being made aware of the value the devices still have and of the availability of platforms to sell them (Cordella *et al.*, 2020). Thus, the information provided to users with their agreement could cover:

- monetary value of their device,
- best practices for deleting personal data before disposal (in line with the General Data Protection Regulation and data safety regulations),
- indications on the closest collection/repair facilities (in connection with action #5 on drop-off points),
- information on the environmental impact of new phones (see complementary action "Product passport"), etc.

Producers would also be involved by designing devices enabling the provision of such information to users. For example, consumers could use built-in apps or could, through a product passport that

[44] Promotion of information via innovative tehchnologies *"New web technologies, virtual assistants and artificial intelligence now make it possible to link and personalize the information available to the user, encouraging him to take its cell phone back into the collection and recovery system. Indeed, the location, models and software versions of the cell phones used are already shared with IT platforms. It is necessary to sensitize the holders of this data to offer innovative and personalized services to users, with their agreement, to motivate them to dispose of their cell phones and thus make the ecosystem more circular"* (AFNUM, 2019).

retrieves information about the health status of their devices, receive relevant information. In either case, user data protection and consent would have to be ensured.

Feedback from existing actions:

Although commercial push campaigns, used by telecom operators for instance, could have high success rates regarding outreach to consumers, the study hasn't identified campaigns launched with the objective of increasing WEEE collection rates.

However, some campaigns providing end-users with useful information have been identified, such as the 'Proximus - Don't miss the call' campaign aiming to collect mobile phones accumulated in customers' drawers. A dedicated website was created to provide end-users with step–by-step practical information for handing-over devices. The website informs consumers on the necessity of 'urban mining', on how to erase the data from their mobile phone or tablet before bringing it in, redirected them to an online mapping of all deposit centres, and finally a customised calculation of the value of their device (based on the phone model and condition) is provided.[45]

Proposed implementation (incl. funding):

Actors involved: Telecom operators and distributors (lead), producers, distributors, collectors, Member States.

Recommended steps:

1. European Commission (potential supporting role): consider measures, in the framework of product and waste prevention policies in the long term, which would provide consumers the options to retrieve relevant information listed the 'action working principle' above. More specifically this could entail the creation of a pre-loaded software on new devices or dedicated calculation and search tools provided at the point of sale or at collection points. This would be in line with the new Circular Economy Action plan[46], stating that "consumers receive trustworthy and relevant information on products at the point of sale", but would also enable consumers to receive information during the lifetime of the device and during hand-over at collection points;
2. (Telecom) Operators and distributors: make information available to their customers regarding take-back options at the point of sale or through notifications during use with specific messages and nudges sent to consumers (via an app[47] for example). PROs and/or national/local authorities would have to provide information regarding collection points.

Financing: Telecom operators and distributors in Member States will be encouraged and supported by the EU Commission to ensure specific information is available to consumers about the devices they may want to return. The Horizon Europe of LIFE funding programs can be used to develop the relevant tools that provide and facilitate information flow to consumers. For example: leveraging innovative technologies and deploying built-in apps; creating website and/or apps that calculate the value of devices and that provide direct information to the user.

Synergies with other proposed policy actions:

- Policy #1: Financial Incentives
- Policy #4: Data privacy certification scheme
- Policy #5: Drop-off points databases

[45] Proximus "Don't miss the call" initiative (2020) - See section 3.3

[46] COM/2020/98

[47] see for instance the app "Recycle!" developed by Fostplus – PRO for packaging- and Bebat – PRO for batteries - in Belgium

- Policy #8: Deposit-refund systems
- Product passport: see complementary policy action in Section 4.2.4.

All these actions can be amplified through better communication tools and channels.

Key success factors:

- Ensure compliance with data protection regulations: feasibility in terms of protection of personal data and consumer consent and perception of the handling of its data should be considered;
- Easy extrapolation of standardised information retrieved from the database of collection points;
- Access to useful information from the product passport that can quickly be re-used to provide relevant information to the user. Precautions concerning the type of information provided should however be taken. For instance, such information should relate to technical and/or environmental considerations only (not to be mistaken with commercial notifications). Alternative solutions being commercial messages by nature (resale, second-hand products, etc.) should only be provided with the agreement of users, with the possibility to modify this choice;
- Make sure information sent to users is reliable and relevant: consumers should be able to quickly identify collection points that are close to them and easily accessible. According to the "Don't miss the call" initiative, the success of the campaign can only be ensured if drop-off stations are everywhere: in shops, offices etc.;
- Ensure that information provided to the user is limited to relevant information, to avoid rejection by the user due to an overflow of information;
- Prevent complaints by developing a built-in app that does not require excessive memory capacity;
- As in policy action #1 on financial incentives, the effect of personalised information could be maximised if users are also able to calculate the value of their devices prior or during hand-over.

4.2.3.7 Policy action #7: Reduced VAT rates on re-use services

Reduced VAT rates on re-use devices			
Objective(s) addressed		Maximise value retention of small EEE	
Barrier(s) addressed		Weak market for repair and recycling activities: need for stronger incentives	
Type of instrument(s)		Financial	
Condition of instrument		Mandatory[48]	
Implementation and results		Medium Term	
Actors involved		European Commission, Member States (lead), re-use organisations	
Product / waste		**Value**	
☒ EEE	☐ WEEE	☒ High	☐ Low

Action working principle:

This action aims at setting reduced VAT rates on re-use services for EEE, which could compensate negative externalities of WEEE management and EEE manufacturing. This could be done at EU level by including re-use services (e.g. repair) in Annex III of the Council Directive 2006/112/EC ("List of supplies of goods and services to which the reduced rates referred to in article 98 may be applied") for instance, so that a reduced VAT rate applies for re-use services. It should be noted that approval by unanimity by the Council of the European Union is required to adopt such legislative changes at EU level. However, the decision to apply reduced VAT rates remains a competence of each Member States. Member States are therefore considered to be in a leading position for this action by applying reduced VAT rates levels through national legislation.

The pertinence of using the VAT mechanism to promote circular economy activities is in line with the New Circular Economy Action Plan whereby "the Commission will […] continue to encourage the broader application of well-designed economic instruments, such as environmental taxation, including landfill and incineration taxes, and enable Member States to use value added tax (VAT) rates to promote circular economy activities that target final consumers, notably repair services".

Feedback from existing actions:

- In Sweden, repair services for products such as shoes, textiles and bicycles are subject to VAT reductions, set at 12% instead of 25%. In addition, a proposed deduction of 50% (RUT tax deduction) on the labour costs for home repairs and maintenance was applied for products such as white goods and IT-goods. The majority of the interviewees of the bicycle and IT sector observed an increase. However, a definite link between the increase of repairs with the reduced VAT rate and RUT tax deduction implementation could not be confirmed;
- In Belgium, VAT was reduced at a federal level from 21% to 6% in 2000 for all re-use centres with a certification as a social economy enterprise and provided that the collected goods be

[48] Mandatory is understood as implemented through legislation, compared to other policy actions that are more voluntary.

acquired free of charge. Those organisations are certified by the public environment agency (OVAM in Flanders), and gathered in a specific network called Herw!n (formerly KOMOSIE) (Delanoeije *et al.*, 2020).

Proposed implementation (incl. funding):

Actors involved: European Commission, Member States (lead), re-use organisations.

Recommended steps:

1. European Commission: provide for the possibility to apply reduced VAT rates for EEE repair and re-use services through the Commission's right to propose changes to Annex III of the Council Directive 2006/112/EC on a the common system for VAT.
2. Member States: implement reduced VAT rates at national level, and identify which types of organisations are eligible for a tax reduction, for instance certified re-use organisations – see the example from Flanders above.

Financing: Member States.

Synergies with other proposed policy actions:

- Policy #4: Data privacy certification scheme
- Policy #5: Drop-off points databases
- Creating the enabling regulatory framework for re-use: see complementary policy action in Section 4.2.4.

Key success factors:

- Ensure the presence of a certified network of re-use organisations that are eligible for the application of VAT reductions – see the example of Belgium above;
- Facilitate handover for users by linking the certification of re-use organisations with standards on data privacy (e.g. data deletion, transfer service). VAT reduction can alleviate the burden of standard compliance, which is useful to secure consumer personal data, while functioning business models for re-use organisations are necessary for a circular economy. Two effects are foreseen following a VAT reduction: either a reduced price of re-used devices, benefiting the consumer, or an increased margin for re-use organisations, enabling them to potentially invest and enable the re-use of more devices. These effects are not mutually exclusive. They are either directly beneficial to the consumer (through reduced prices) to re-use organisations and more broadly to the environment (reducing waste and increasing re-use), and thus serves the general interest;
- Ensure that re-use organisations have access to quality product streams (e.g. products whose re-use is likely to be profitable).

4.2.3.8 Policy action #8: Deposit-refund systems

Deposit-refund systems (DRS)			
Objective(s) addressed		Maximise value retention of used EEE and WEEE through reverse supply chains: financially incentivise return of used EEE and WEEE	
Barrier(s) addressed		Household storage: data security concerns, backup devices, forgotten about due to their small size…	
Type of instrument(s)		Financial	
Condition of instrument		Voluntary	
Implementation and results		Medium Term	
Actors involved		Member States (lead)	
Product / waste		**Value**	
☐ EEE	☒ WEEE	☒ High	☒ Low

Action working principle:

A deposit-refund system (DRS) has the potential to incentivise the return of devices at the end of their use, so they are harvested for components or prepared for re-use. Careful analysis of a country's cultural specificities, consumer habits and infrastructure is a requirement before implementing this type of system. The success of such a model depends on many factors that need to be carefully taken into account and a unique model is unlikely to fit all Member States.

The decision to implement a DRS at national level should thus be left to the Member States, as is the case for single-use plastic beverage bottles – see the art. 9 of Directive (EU) 2019/904 ("Single-use plastics Directive"). At the EU level, however, feasibility and replicability studies along with sharing of lessons learned and best practices from different Member States can be facilitated in order to encourage Member States to jump-start this type of system.

Fredriksson et al. (2021) investigated, for the case of small electronics, the potential for implementing a deposit-refund system financed by extended producer responsibility schemes and operated by existing collection schemes in Sweden. An expert interview – see section 7.4.1 - highlights the potential challenges of managing the deposit-refund system including the deposit value paid for each equipment and how responsibilities are distributed between different stakeholders (EPR Schemes, producers, distributors etc.).

At this stage, limited data on the impact of a deposit-refund scheme (Uyttenbroek, 2017) does not allow to draw conclusions on the effectiveness of such a policy in the impact assessment of section 5. Overall, expert interviews, literature review and the results of the impact assessment point to the need for further studies at Member State level in order to determine the feasibility of implementation of such systems and to further define success factors and potential challenges.

Feedback from existing actions:

Potential high impact of a DRS:

- In the Netherlands, a study found that a deposit-refund system was one of the most effective strategies to increase mobile phones collection rates. This study highlighted that "*the majority of respondents consisting of students, thus an age-specific group (64%) was willing to accept a depository fee of €11-15, and 53% were willing to return their mobile phones for this fee* [meaning there is a discrepancy between acceptance of a fee and related impact on return rates]. *The highest collection rate (76%) is expected by levying a deposit fee of €25+, however, acceptance of the measure would be low (19%)*." (Uyttenbroek, 2017).
- At a global scale, a study found that a DRS with a high enough deposit fee (a minimum of 10% of the actual price), could increase the collection rate of end-of-life electronic devices to 80-90% (Bordage, 2019).

Feedback on implementation of a viable system:

- The German Green Party suggested a deposit on mobile phones in 2012. However, costs related to barriers (administrative, infrastructure, deposit amount, data security) were considered to outweigh the benefits.[49] The deposit-refund system was rejected by the Federal Government due to the following issues:
    - The return of WEEE would need to be possible at every take-back point, which requires a clearing system that was found to be very expensive and bureaucratic;
    - A specific deposit fee would need to be determined for each mobile phone sold, and should not to exceed the price of the mobile phone itself: this was found to be particularly complex due to the large variety of existing models;
    - A national deposit-refund system would discriminate national producers against producers in other Member States.[50]
- The German manufacturer **Shift** developed a DRS and a complementary repair centre, by introducing a €22 deposit fee on smartphones (more than 5% of the price of their cheapest model), demonstrating the feasibility of the approach (European Commission, 2020b). Each Shiftphone is delivered with a device deposit of €22, which is the minimum amount to be paid out upon returning the phone. For intact devices, the customer receives a higher refund. Shiftphone is a modular smartphone and returned devices are refurbished, resold and some parts are used to repair other devices or separated and handed over to recycling partners. Economic factors are currently being analysed by the MoDeSt research project, funded by the German Ministry of Education and Research (BMBF) (Wilts *et al.*, 2020).
- Anti-theft and security software installed on smartphones poses potential barriers for independent organisations and professionals, since this software can only be removed by the original owner or by the manufacturer (Cordella *et al.*, 2020; Tecchio *et al.*, 2018)[51].

Proposed implementation (incl. funding)[52]:

Actors involved: Member States (lead).

Recommended steps:

[49] Interview with Franhofer IZM

[50] German responses to the questionnaire in the context of this study

[51] Implemented criteria in rating and labelling schemes, and further options identified in the technical analysis in Task 4 (European Commission, 2020b).

[52] Although the impact of a deposit-refund system is assessed in section 5, the proposed implementation steps refer to the need to conduct further studies, as specified in the action working principle above.

1. Member States (Spain, Sweden) are currently carrying out studies to assess the viability of DRS systems - see for example Fredriksson et al. (2021). Financial support could be provided to conduct further studies, in order to answer several challenges to implement an effective deposit-refund system in Member States. Examples of challenges of implementing a DRS system for household EEE are underlined by Frederiksson et al. (2021):
    a. Determining the amount of fee deposit needed for a device – first hypotheses are made in the impact assessment (Section 5.2) of this present study;
    b. Determining the scope of the system: on several groups of products to have an effect on collection rates, or on one product to determine the efficiency of such a system. This is especially relevant as the resources needed to run such a system are important;
    c. Assessing the deposit-refund system effect on re-use, and on the stock of already hoarded devices.
2. European Commission (potential supporting role): share results of studies conducted at national level and best practices on implementation across Member States via policy recommendations.
3. Member States: if it can be substantiated by sufficient data, including from experiments, implement deposit refund systems. The data needed includes the amount of deposit needed, the scope of the DRS system and the effect on re-use and hoarding, taking into account factors such as national cultural specificities, consumer habits and infrastructure.

Financing: Member States make dedicated funds available to finance feasibility studies and experimental tests, to determine if implementing a DRS would be viable at national level.

Synergies with other proposed policy actions:

- Policy #1: Financial Incentives
- Policy #4: Data privacy certification scheme
- Policy #5: Drop-off points databases
- Policy #6: Personalised EoL information
- Product passport: see complementary policy action in Section 4.2.4.

Key success factors:

- Sharing of knowledge and data on past studies is important to determine the right methodologies and metrics to determine the viability of DRS mechanism;
- Studies should pay attention to the economic viability of the DRS;
- Synergies with other actions should be addressed.

4.2.4 Complementary list of policy actions

As mentioned in Section 4.2.2, a list of complementary policy actions is defined, which consist either of cross-cutting or other relevant policy actions suggested by the stakeholders during the two workshops conducted for this study. These actions, described in the following section, have not been included in the impact assessment presented in Section 5.

4.2.4.1 Product passport

Action working principle:

The development of a harmonised EU-wide product passport, for instance under the form of a "digital twin"[53] could be encouraged. It would enable the relevant actors along the value chain (user, repairer, recycler) to receive relevant information about an EEE (e.g. battery's state of health[54], components' functionality, bill of material). The goal of a product passport is that information can be easily passed on from one user to another: producer, end-user, remanufacturer, recycler etc. (Wang *et al.*, 2019) and thus maximise value retention of used EEE through reverse supply chains. It is relevant in the context of a circular economy given the lack of information transfer from one actor to another, which has been mentioned as a challenge by re-use organisations (see Section 3). Making information on a product available can also be useful for companies to fulfil their reporting obligations or for consumer decision-making based on sustainability criteria for instance.

A product passport should include both static information on the EEE and its components, such as its material composition or date of production, but also information that can be updated during its lifecycle, including for example waste/product status, device export or state of health. Regarding the inclusion of up-to-date information in the passport, this proposal would follow the logic provided in Art. 65 of the draft 'Batteries Regulation' proposal[55]

Information could be accessed by the different users of the device, by ensuring the link between the physical product and data via tags such as RFID or QR codes. In the case of mobile phones, the IMEI number (International Mobile Equipment Identity) could be used to link the physical device and data. However, at such an early stage, it is difficult to provide a ranking of the best options to communicate information. It depends among others on the target stakeholder (user, recycler, repair organisation etc.).

It should be noted that information needs to be safe, interoperable and standardised. So far, producers have built proprietary systems, which may not be interoperable, and therefore not compatible with the idea of a standardised product passport.

Feedback can be expected from ongoing studies, such as the UBA project on product passport for EEE "*Product information 4.0 - Further development of the information requirements for products and digital*

[53] "Digital twin" being defined as a real time digital replica of a physical device (Bacchiega et al. 2018).

[54] 'State of health' means a measure of the general condition of a rechargeable battery and its ability to deliver the specified performance compared with its initial condition – as defined in the draft Battery Regulaton (Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning batteries and waste batteries, repealing Directive 2006/66/EC and amending Regulation (EU) No 2019/1020 - COM/2020/798 final).

[55] Ibid. Footnote 54

implementation using the example of energy-related products and textiles" (2021-2024). Various information on product properties such as the origin of raw materials, design, recycled material or hazardous substances[56] content is needed by actors along the product's lifecycle. This above-mentioned study investigates how all the necessary information can be digitally brought together and made available:

- for companies to fulfil their information obligations;
- for sustainable consumer decisions;
- to support re-use; and
- for the treatment of waste products.

Feedback from existing actions:

Existing feedback stems from private initiatives in the Lithium-ion batteries sector:

- **Everledger**: solution to trace the life cycle of Li-ion batteries (portable, EV) using blockchain and Internet of Things (IoT) technologies;
- **Circulor**: software solution that enables batteries manufacturers to track the flow of materials throughout their supply chains, and determine whether the battery is safely reusable.

The product passport is also an emerging idea at EU level, mentioned for instance in the new Circular Economy Action Plan. The new Batteries Regulation proposal for instance requires each industrial and electric-vehicle battery placed on the market in 2026 to have a unique electronic record indicating its basic characteristics. The Impact Assessment study of the Sustainable Product Initiative foresees a specific task on the product passport.

Moreover, reflecting the similar idea of providing access to useful specific information on product category level, the **Information for Recyclers (I4R)** platform is a centralised online platform that provides recyclers and preparation for re-use operators with specific information at product category level for WEEE recycling, in line with the requirements of the WEEE Directive[57].

Key success factors

- Ensure the presence of a clear scope of information in digital twins to define product passport design. This should include data such as commercially sensitive information (on the producer's side), and necessary information (on the remanufacturer's side);
- Guarantee interoperability between existing systems;
- Support relevant stakeholders in the application of the standardised product passport to the device they produce/use/refurbish or remanufacture.

4.2.4.2 Creating the enabling regulatory framework for re-use and preparation for re-use

Action working principle:

According to the Waste Framework Directive, the definition of waste is based on the owner's intention or obligation to discard. If a device is considered as discarded and thus as a WEEE, then only authorised WEEE management operators are allowed to carry out treatment operations. As such, the legal

[56] It can be noted that information related to hazardous substances and notably Substances of Very High Concern (SVHC) could be of interest under the REACh regulation n° 1907/2006, notably for the SCIP database.

[57] I4R Platform, available at: https://i4r-platform.eu/

clarification of the circumstances under which a device is considered as fit for re-use or for preparation for re-use may help to retain device value by promoting EEE re-use before WEEE treatment.

The aim would be to align the regulatory framework with current practices in the re-use sector and maintain the EEE status as long as possible to reach the objective of value retention.

Key success factors:

- The waste status creates a significant cost burden on re-use and preparation for re-use operators (e.g. permit conditions for handling devices). Hence, a review of the regulatory framework on the waste status should be supported by other policy actions aimed at incentivising end-users to return their used devices as products rather than discarding them as waste;
- A favourable regulatory framework should be accompanied by improved design for re-usability.

4.2.4.3 Communication campaigns and educational measures

Action working principle:

Communication campaigns targeted towards consumers are key to raise awareness on the proper handling of used EEE and disposal of WEEE. This recommendation on communication campaigns is in line with the recommendations of the WEEE compliance promotion exercise report on WEEE collection (BiPRO, 2018). EU Member States could benefit from best practices on communication campaigns conducted in other Member States. A more stringent option would be to implement minimum requirements on communication campaigns.

Similarly, virtuous behaviour regarding handling used EEE and WEEE disposal can be taught at school. Awareness-raising at school could include teaching basic repairs, or "e-waste races" (see Section below).

Feedback from existing actions:

- In Germany, the **amendment of the ElektroG** (BMJV, 2015) includes new obligations that require the national register (Stiftung ear) and distributors of EEE to inform end-users of EEE on take-back and disposal requirements and options;
- In December 2019, the German national register launched a consumer information and awareness campaign[58] for the collection and disposal of WEEE, financed by EEE manufacturers;
- A successful nudging campaign in Japan recycled nearly 80,000 tons of cell phones and other electronics to make the medals for the **2021 Tokyo Olympics and Paralympics**. Such symbolic initiatives can be more effective than monetary incentives, in particular when users personally identify with the initiative;
- The UK PRO Material Focus has launched a nationwide campaign called **Recycle Your Electricals** in 2020, combining impactful communication campaigns leveraging the participation of famous figures with a website centralizing the location of re-use and recycling points

[58] "Plan E: E-Schrott einfach und richtig entsorgen" (Plan E: Dispose of e-waste simply and correctly)". Available at: https://e-schrott-entsorgen.org/

throughout the UK. To date, it states that its recycling and re-use locator has been used over 97,000 times[59] since the start of the campaign;

- Regarding school projects, a German NGO has launched "e-waste races" where schools compete to collect the most WEEE from private household over a certain time period[60];
- Similarly, the Spanish **Ecotic** foundation has driven the **R-Ciclojuguetes** initiative, an educational and collection campaign carried out in schools and targeting children to collect electronic toys and small electronic devices. In total, over 165 public schools and 56,000 students participated in the initiative.

4.2.4.4 Separate monitoring and reporting of small WEEE

Action working principle:

One of the issues regarding the collection of smartphones or tablets is the light weight of those devices compared to other heavier household appliances forming the bulk of separately collected WEEE. Furthermore, the six current WEEE categories do not place mobile phones, laptops and tablets in the same category: mobile phones are included in category 6 "small IT and telecommunication equipment" whereas laptops and tablets are reported in category 2 "screens and monitors having a surface greater than 100 cm^2", which includes bulkier items such as televisions and computer monitors. In order to better target small devices for collection, it is suggested to have dedicated monitoring and reporting solutions for specific small WEEE categories: mobile phones, tablets or laptops etc.

As mentioned in section 2.4.2, a study conducted on this topic has already assessed the option of having category specific targets option (European Commission, 2014). In the end, it was not recommended at EU level but only at Member State level on a voluntary basis.

4.2.4.5 Improve the implementation of art. 5 of the WEEE directive on separate collection

Action working principle:

This recommendation does not cover the 1 for 1 and 1 for 0 take back obligations, and tries to address some improvements to reach the objectives of art. 5 of the WEEE Directive. These improvement areas, reviewed below, would address in particular the implementation of art. 5(2)(a) of the WEEE Directive.

In fact, UBA (2019) has shown that easy access to collection points and convenience for the consumer are key to influence the disposal behaviour of the end consumer of WEEE. However, no measures regarding the densification of collection point networks were suggested in the above-mentioned report. The desk research and interviews conducted for the present study have shown that collection points, bins in particular, are vulnerable to theft of potentially valuable devices such as smartphones, tablets and laptops. This analysis is partly confirmed by a cost-benefit analysis performed by UBA (2019) showing that containers and WEEE recycling bins in public spaces perform poorly in terms of acceptance by consumers and theft risk.

[59] Recycle your Electricals website, available at: https://www.recycleyourelectricals.org.uk/about-recycle-your-electricals-campaign/#:~:text=What%20is%20Recycle%20Your%20Electricals%3F%20Recycle%20Your%20Electricals,the%20WEEE%20Fund.%20Find%20out%20about%20Material%20Focus

[60] Das Macht Schule. Available at: https://www.das-macht-schule.net/e-waste-race-info/

In addition to theft, other key factors influencing the effective implementation of art. 5 of the WEEE Directive have been reported by Member States in the framework of this study, including:

- the implementation of collection points in areas with a low population density;
- the visibility and awareness by the public of those collection points; and
- the low compliance of online sellers.

The first two of these factors are in line with the recommendations from the WEEE compliance promotion exercise report conducted for the European Commission, assessing the implementation of the WEEE Directive (BIPRO, 2018). As mentioned in Section 4.2.2, these recommendations included an increase in the density of collection points, extending the distance sellers obligations, where appropriate, and encouraging communication on the existence of the collection points. In addition, to tackle the abovementioned theft issue, BiPRO (2018) also advised that WEEE collected at collection points is protected and secured to protect from theft.

4.2.4.6 Tackling free riding of online sellers not compliant with EU WEEE legislation

Action working principle:

The absence of a level playing field between economic actors[61] placing products on the EU market with physical and online facilities was noted as an important barrier to WEEE collection during stakeholder consultation. This enforcement issue has been reported by PROs (WEEE Forum, 2019), see Table 10. Indeed, "Free-riding" occurs when producers do not comply with the obligations provided by EU legislation, in particular the WEEE Directive, including take-back obligations for distributors, and registration, WEEE collection and treatment for producers.

A study conducted by the French Ministry of Economy (DGCCRF, 2018) showed that 65% of online sellers of EEE do not comply with the 1 for 1 take-back obligation: some invoiced customers for the 1:1 take-back of devices, others provide dissuasive conditions for return (for example by requiring specific return packaging), and the majority simply had no processes in place to take back equipment (45% of sites controlled).

Proposed implementation:

Propose amendment to the WEEE Directive to increase marketplaces' accountability regarding online seller obligations, based on the recently adopted French and German[62] regulation.

This action should be paired with communication campaigns towards producers, online sellers and marketplaces to raise awareness on take-back obligations. Besides, door-to-door and postal services could help distant sellers to comply with their obligations (see Section 0).

Feedback from existing actions:

In France, the "loi AGEC" (Légifrance, 2020) states that marketplaces have to comply with the 1 for 1 and 1 for 0 take-back obligations – as set in art. 5 of the WEEE Directive. Marketplaces, including online sellers, must ensure that information on take-back conditions is delivered by the seller to the buyer before selling. In case the seller does not provide the said information, the marketplace must fulfil the take-back responsibility (Légifrance, 2021).

[61] Art. 3 (1)(f) of the WEEE Directive refers to these actors as „any natural and legal person"

[62] https://www.elektrogesetz.de/wp-content/uploads/ElektroG3-referentenentwurf_09.2020.pdf

A solution would be to adopt similar obligations for online sellers and marketplaces, in order to transfer producer obligations related to the WEEE Directive to the online seller or marketplace in cases where the producer is not compliant.

4.2.4.7 Leasing model

Action working principle:

Measure that support leasing schemes for certain categories of appliances could ensure that devices are properly collected for re-use or recycling. Collected devices would then reach the critical volumes ensuring the economic viability proper treatment (re-use / recycling).

A leasing model would ensure that devices have an appropriate number of re-use cycles (in a "cascade" model) before being recycled. It would also take into account the fact that some consumers are willing to have the latest device model on the market. Beyond environmental considerations, this has been noted to be a driver for leasing models among consumers in a survey conducted in Flanders (Rousseau, 2020).

Besides, such models could help retain value by incentivising producers to make products that last longer. On the other hand, a side effect is that leasing could lead consumers to care less about devices they do not own and therefore may lead to premature damages

Another issue with this solution could be its low acceptability. Rousseau (2020) noted that when consumers are given the choice, leasing is not an option for a majority of respondents because of factors such as the uncertainties to start a lease contract or financial considerations (Rousseau, 2020) - see Task 3 report of the Ecodesign preparatory study on mobile phones, smartphones and tablets (European Commission, 2020b). On the other hand, a consumer survey conducted by Cerulli-Harms et al. (2018) showed that a sizable share of respondents (25%) were willing to lease a smartphone rather than purchase it.

Proposed implementation:

It is proposed to fund consumer insight studies more specifically targeting leasing and "communication as a service" models for an improved comprehension of consumer behaviour for these models and their potential adoption. Given that leasing can be motivated by the consumer's willingness to own the latest available devices, these studies should also include the environmental performance of leasing as a key aspect to consider.

To be successful, leasing models could be associated with specific incentives and kept outside deposit refund systems (if any) in order to lower their costs.

Feedback from existing actions:

The company Refurbed (AT) launched a rental model for smartphones and laptops, whereby devices are insured and consumers have to return them[63]. It allows the company to ensure proper re-use or recycling of devices. The current development of functionality economy could make leasing a growing trend (AFNUM, 2019).

Past experiences with phone leasing have not always proven successful. For instance, the Dutch operator KPN had to end a handset leasing program in 2013, as consumers "prefer more clarity upfront, regarding

[63] Easy Refurbed. Available at: https://easy.refurbed.com/

costs as well as ownership of the handset" (Morris, 2013). However, it is worth noting that leasing enabled to increase the return of the said handsets (KPN, 2013).

5. IMPACT ASSESSMENT OF POLICY ACTIONS

5.1 Methodology

5.1.1 General methodological approach

In the following section, the eight policy actions described in Section 4.2.3 undergo a semi-quantitative analysis of their economic, environmental and social impacts. Potential contribution to EU objectives was also been considered.

Policy actions subjected to semi-quantitative impact assessment
Policy action #1: Financial incentives
Policy action #2: Door-to-door and postal services
Policy action #3: Targets for re-use
Policy action #4: Data privacy certification scheme
Policy action #5: Drop-off points databases
Policy action #6: Personalised EoL information
Policy action #7: Reduced VAT rates on re-use services
Policy action #8: Deposit-refund systems

The quantified impacts of the actions were assessed against a baseline scenario, using quantitative data wherever possible. The impact assessment is based on the following steps:

1. Definition of the scope

Four main categories of products have been studied, as defined in Section 2.2.2:

- mobile phones (smartphones);
- tablets;
- laptops; and their
- chargers.

Material flows have been assessed following the different steps of the EEE and WEEE value chain.

The impact assessment was conducted along the following timeframe:

- 2021: start date;
- 2030: end date of the model, considered as **a long-term horizon** to fully capture the effects of the actions proposed in this study.

2. Definition of a baseline scenario and impact categories

The volumes of each product at each step after end of first active use were modelled in a baseline following a business-as-usual scenario (BAU), i.e. no change with today's legal and policy situation.

The environmental, social and economic indicators related to these volumes were estimated based on studies with the most recent available data. It is assumed that these remain unchanged in the impact assessment unless the policy has a direct, quantifiable influence on these indicators.

The volumes applied to the indicators directly fuel the three types of quantitative impacts analysed in the high-level impact assessment presented in Table 12.

Table 12: Impact categories and associated indicators used in the impact assessment of selected policy actions

Impact category	Indicator
Environmental impacts (quantitative)	• Increase of the collection, recycling, and repair / re-use rates (%) (impact on used EEE and WEEE flows)[64] • Quantities of recycled materials (t) • Carbon emissions avoided (kg CO_2e)
Social impacts (quantitative & qualitative)	• Job creation (# jobs) • Evolution of consumer/customer behaviour (qualitative)
Economic impacts (quantitative)	• Additional recovery capacity needed (t) • Additional costs (€) • Revenue generated (€)

Additionally, the benefits and costs of the selected policy actions on the re-use sector, and other relevant stakeholders (e.g. charities, EPR schemes), were assessed.

3. Data collection

To determine the baseline, data was collected essentially from official reports and databases from the European Commission, the World Bank, industry associations and Producer Responsibility Organisations.

The impacts of the policies were estimated based on the case studies identified, described and quantified in the second phase of the study (see Section 3), the results from the first phase of the study (see Section 2), as well as on relevant academic articles and reports to complete missing data.

4. Assessment of the potential impacts of selected options compared to the baseline scenario

Each policy has a potential impacts on the different flows along the value chain. For instance, products returned instead of stored at home or going to reuse instead of recycling. When applied to the different environmental, social and economic indicators, the policy results in specific environmental, social and economic impacts by 2030 that can then be compared with the baseline scenario.

These estimated impacts were mainly determined by using existing case studies showcasing the influence of the concerned policies on the volumes of small WEEE collected / re-used / recycled. If no case study was available, hypotheses were made based on consumer surveys (including results presented in Section 2), or relevant studies from other sectors. A minimum and maximum scenario were derived from these studies, in order to frame the policy impacts with two limits, expressing the inherent uncertainty of the assessment.

The main hypotheses used for the impact assessment are described in Section 7.5 of the Annex.

5. Impact assessment results and analysis

[64] Assessed in Section 5.2.1.

The estimated environmental, social and economic direct and quantifiable impacts of each selected policy actions were analysed and compared to the baseline scenario. They were also compared between one another to derive comparative impact assessments supporting the final recommendations of this study. Values found in literature (such as the recycling rate of each material, or carbon footprint along the lifecycle of a device) were applied to the volumes of the different streams (collected, recycled, re-used) to calculate their direct impacts.

6. Stakeholders consultation

The feedback collected during the stakeholder consultations with EU Member States and the stakeholder workshop (see Section 7.6) was integrated in the analysis and helped to review the main hypotheses and impact assessment results.

5.1.2 Limits of the chosen approach

The main limits of the approach revolve around data collection, both for the baseline and policy actions.

- **For the baseline scenario**, the overall scarcity of data along with varying estimates of end-of-life flows for small EEE (precisely mobile phones, tablets, laptops and chargers) was levelled by using sources referred to in Section 2. These were complemented by previous European Commission studies and the AFNUM (2019) report when data was lacking for certain products or step in the life-cycle. Nevertheless, estimates made for specific small EEE streams (mobile phone, tablet, laptop and charger) must be taken as proxies of the actual streams considering the difficulty to trace exact end-of-life flows. In addition, at the European level data is reported per category each product is therefore not representative for the total volume reported in their collection category;
- Regarding **illegal waste management practices**, very little data was found to support a robust estimation of this flow. The flow was assumed to be a part of the "unidentified" stream within collection and of the "exports" stream after the devices' end of life. The lack of data also entails that hypotheses regarding the impacts of the different policies on such a stream could not be adequately estimated;
- Each piece of equipment was modelled using an average first lifetime, price, weight, material content and carbon footprint derived from European Commission studies and academic articles. The use of these averages constitutes an inherent limit to the accuracy of the study;
- **For the policies' estimated impacts**, certain values were found by extrapolating impacts of similar and existing initiatives in selected countries to the scale of the European Union. The scalability and replicability of these initiatives is not guaranteed throughout all Member States, so this limit was expressed in a qualitative manner for each scenario;
- The **model itself has inherent limits** as it represents EEE in a simplified way. Indicators are not interdependent and related to each other as they could be. For instance, there is no stock model associated with equipment re-used although this equipment reintegrates the end of life system at the end of its re-used life. Indeed, re-use of equipment is considered as an end-of-life in itself in the model whereas in reality the equipment could be recycled afterwards. The combination of multiple end-of-life options is not explored in our analysis. Similarly, losses may occur at different stages of the model, e.g. separate collection or recycling were not considered as they potentially represent a minor share of the overall model;
- **Policy costs are fixed** and do not consider economies of scale, which might lead to overestimation.

Another important limit is that the impact of each policy action has been assessed separately. However, suggested policy actions are more likely to have a substantial impact on WEEE and used EEE collection

and value retention when implemented together. A combination of policy actions is likely to have a different impact than a mere addition of their effects on e.g. collection rates.

5.1.3 Baseline scenario definition

The baseline, or current, end-of-life flows of small EEE in 2020 are represented in the Sankey diagrams below. More details about baseline scenario definition are provided in Section 7.5.1 of the Annex.

The material flows considered are the following, as already described in Section 5.1.1:

- **placed on the market**;
- **hoarded**: flow of devices kept in drawers by their owners at the end of their lifetime;
- **WEEE collection**:
    - **separate collection**: intentionally discarded EEE (WEEE). This stream includes WEEE treated by EPR schemes and their contractors, including devices that are:
        - prepared for re-use;
        - recycled.
    - **unidentified flows**: linked to the difference between declared collection of waste and effective recycling and re-use in authorised facilities (includes illegal export);
- **WEEE discarded in household bin**: devices which enter the household waste stream and end up landfilled or incinerated;
- **re-used EEE**: includes re-used EEE through private initiatives and C2C sales and donations as well as repaired devices;
- **EEEs exported**.

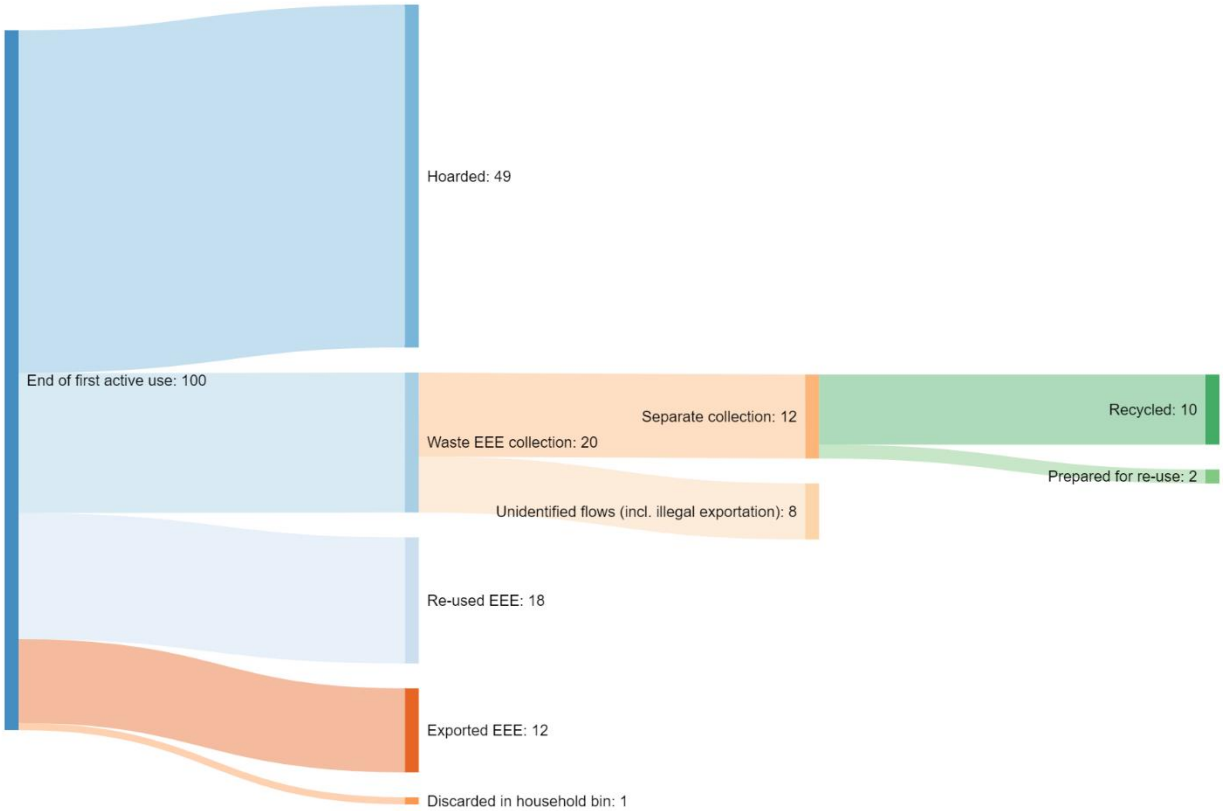
5.1.3.1 Mobile phones & tablets baseline

Equipment placed on the market in 2020 (Eurostat 2020d; Deloitte calculations based on INSEE data, 2019):

- Mobile phones: 137,545,352 units, with an estimated 89% share of private use;
- Tablets: 38,380,000 units, with an estimated 100% share of private use.

Figure 23 illustrates the estimated end of life streams for mobile phones and tablets in 2020.

Figure 23: Mobile phones and tablets baseline end of life streams in 2020 in % (European Commission 2020b; Kantar Worldpanel, 2017; European Commission, 2017; Cordella, 2020; AFNUM, 2019)



The diagram should be read as follows: 49% of devices are hoarded in the end of their first active use, 20% are collected as WEEE, including 12% in separate collection and 8% in unidentified flows.

Mobile phones and tablets characteristics used in the model are estimated in Table 13.

Table 13: Mobile phones & tablets product characteristics used in the model (European Commission, 2020b)

Device	Average weight	Average first lifetime use	Average starting price
Mobile Phone	164 g	2.2 years	395 € (2020 EU-27)
Tablet	530 g	3 years	337 € (2019 Germany)

By 2030, the mobile phones & tablets placed on the market baseline is expected to evolve in the following way (European Commission, 2020b):

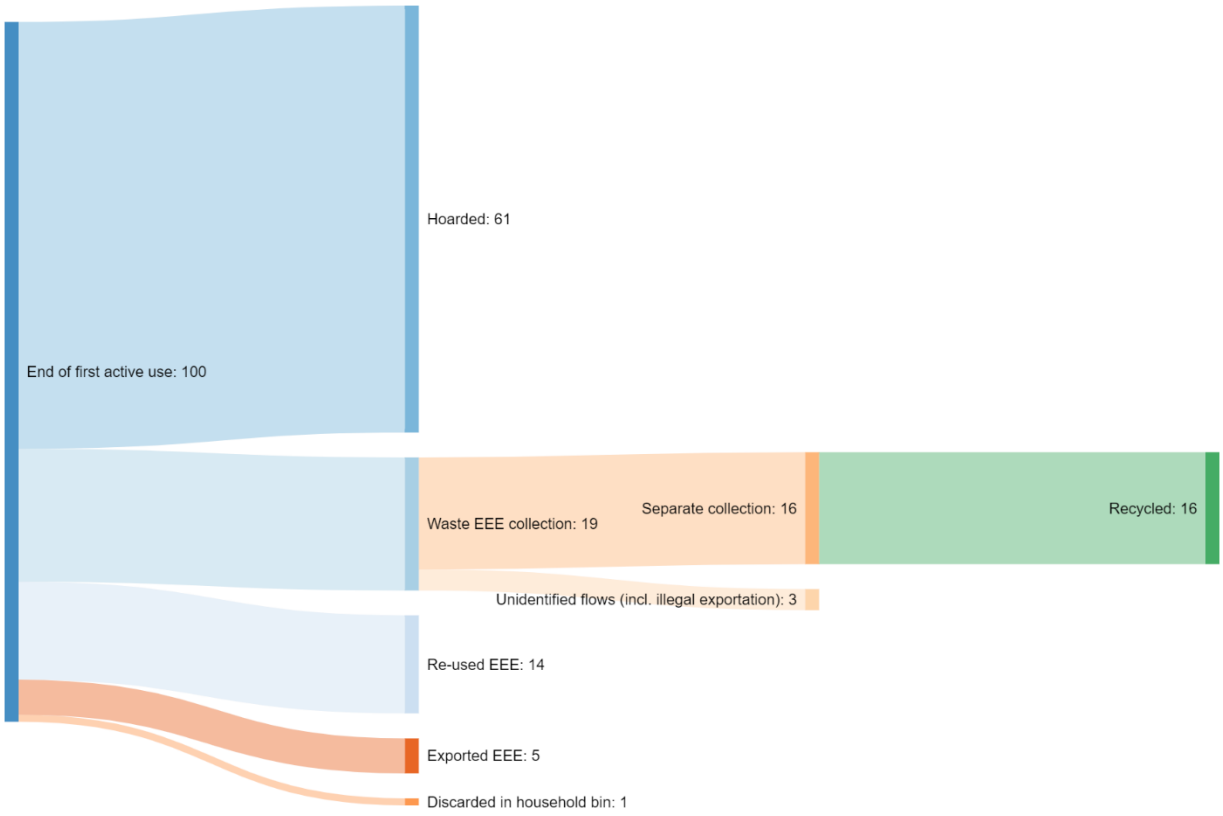
- Mobile phones: -9% (2020), +5% (2021), +3% (2022), +2% (2023), 0% (2024-2030);
- Tablets: -14% (2020), -1% (2021-2024), 0% (2025-2030).

5.1.3.2 Laptops baseline

Equipment placed on the market in 2020: 54,326,623 units, with an estimated 78% share of private use (Eurostat, 2020a; Eurostat 2020c; Deloitte calculations based on INSEE, 2019).

Figure 24 illustrates the estimated end of life streams for laptops in 2020.

Figure 24: Laptops baseline end of life streams in 2020 in % (European Commission, 2017)



Estimated laptops product characteristics used in the model are displayed in Table 14.

Table 14: Laptops product characteristics used in the model (European Commission, 2017)

Device	Average weight	Average first lifetime use	Average starting price
Laptop	1930 g	5 years	1,346 € (2017 average notebook EU consumer price)

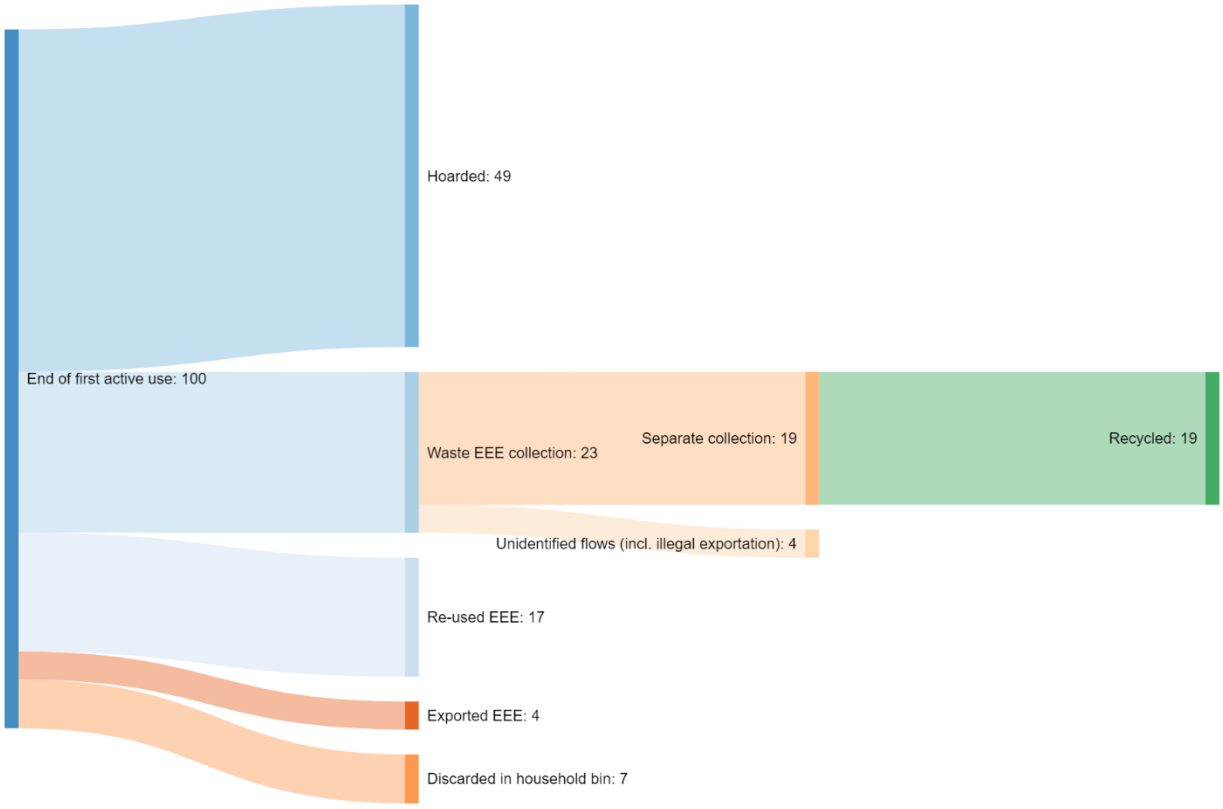
By 2030, the baseline of the laptops placed on the market is expected to evolve in the following way: +6% (2020), 0% (2021-2030) (European Commission, 2017).

5.1.3.3 Chargers baseline

Equipment placed on the market in 2020: 237,273,057 units, with an estimated 100% share of private use[65].

Figure 25 illustrates the estimated end of life streams for chargers in 2020.

Figure 25: Chargers baseline end of life scenarios in 2020 (European Commission, 2019b)



Estimated chargers product characteristics used in the model are displayed in Table 15.

Table 15: Chargers product characteristics used in the model[66]

Device	Average weight	Average first lifetime: use	Average starting price
Chargers	93 g	10 years	37 €

By 2030, the chargers placed on the market baseline is expected to evolve in the following way: -4% (2020), +3% (2021), +2% (2022), +1% (2023), 0% (2024-2030) (European Commission, 2019b; Deloitte calculation based on mobile phones, tablets and laptops volumes).

[65] Based on sum of private Mobile phones, Tablets and Laptops placed on the market estimated in this study: Eurostat 2020a; Eurostat 2020b; Eurostat 2020c; Eurostat 2020d; Deloitte calculations based on INSEE data (2019)

[66] Based on weighted average of mobiles phones, tablets and laptops chargers weights and their volume placed on the market (European Commission, 2019b; Eurostat 2020a; Eurostat 2020b; Eurostat 2020c; Eurostat 2020d; Backmarket, 2021).).).

5.1.4 Policy actions scenarios definition

Table 16: Summary of the estimated associated effects of the policy actions over 10 years

#	Policy action	Summary of expected effects *Values are expressed in points (pts) or percentage (%) depending on the Impact assessment assumptions – see section 7.5.3*
1	***Financial incentives***	- Increased separate collection rate: between +10% and +30% for all devices except chargers - Increased collection comes mainly from the stock of devices in hibernation - Collected devices go mainly to recycling as it is proposed that this action incentivises the collection of low-residual value devices
2	***Door-to-door and postal services***	- Increased separate collection rate: between +7% and +21% for all devices, except laptops (not adapted to policy) - Increased collection comes mainly from the stock of devices in hibernation as well as those that would have otherwise been hoarded by their owners at the end-of-use - From devices collected, it is expected that 60% go to recycling, with, and 40% to re-use, as an average of two initiatives (FR and AT) of varying maturity levels
3	***Re-use targets***	- Increased re-use rate: between +30% and +60% for all devices except chargers (not prepared for re-use). - It is assumed that only re-use rate after collection is impacted (and not WEEE collection rate as a whole) thus that stream will be fuelled by collected WEEE with previously other fate that will be redirected towards preparation for re-use. These flows are recycling flows and unidentified streams. Re-use increase comes from these two streams, the respective share of these two streams staying the same.
4	***Data privacy certification scheme***	- Increased collection rate: between +2 pts and +6 pts for all devices except chargers (not concerned by data privacy) - Increased collection comes mainly from devices that would have otherwise been hoarded by their owners - Collected devices go mainly to recycling, similar to the baseline
5	***Drop-off points databases***	- Increased collection rate: between +2pts and +4pts for all devices - Increased collection comes mainly from the stock of devices in hibernation as well as those that would have otherwise been hoarded by their owners at the end of use - Collected devices go mainly to recycling, similar to the baseline
6	***Personalised EoL information***	- Increased collection rate: between +2pts and +6pts for all devices - Increased collection comes mainly from devices that would have otherwise been hoarded by their owners at the end of use - Collected devices go mainly to recycling, similar to the baseline

#	Policy action	Summary of expected effects *Values are expressed in points (pts) or percentage (%) depending on the Impact assessment assumptions – see section 7.5.3*
7	***Reduced VAT rates on re-use services***	- Increased re-use rate: between +5% and +8% for all devices - Increase in re-use comes mainly from the unidentified (most probably illegal waste exports) stream and from those devices which would otherwise be exported for re-use
8	***Deposit-Refund systems***	- Increased collection rate: between +53% and +71% collection rate for mobile phones and tablets, similar increase expected for laptops and chargers - Increased collection comes mainly from devices that would have otherwise been hoarded by their owners or exported - After collection devices go equally to recycling and re-use, as this policy is expected to incentivise return of both functional and non-functional devices

More information on the hypotheses defined for each policy action can be found in Section 7.5.3 of the Annex.

Table 17: Types of devices impacted by the policy actions

#	Policy action	Mobile phones	Tablets	Laptops	Chargers
1	***Financial incentives***	X	X	X	N/A: not financially valuable enough
2	***Door-to-door and postal services***	X	X	N/A: too large for mail in	X
3	***Re-use targets***	X	X	N/A: not re-used after collection	N/A: assumption that separately collected chargers are only sent to recycling
4	***Data privacy certification scheme***	X	X	X	N/A: no data privacy risk with chargers
5	***Drop-off points databases***	X	X	X	X
6	***Personalised EoL information***	X	X	X	X
7	***Reduced VAT rates on re-use services***	X	X	X	X
8	***Deposit-Refund systems***	X	X	X	X

5.2 Results and analysis of quantitative impact assessments

5.2.1 Policy actions impact on used EEE and WEEE flows

Based on the hypotheses mentioned above and in Section 7.5 of the Annex (hypotheses defining the policy scenario trajectories), each policy generated the following results regarding the end-of-life streams of the devices. Impacts of different policy actions on the current end-of-life streams (collection, hoarding, recycling - see section 5.1.3) are compared and modelled based on the hypotheses detailed in section 7.5.3[67]. Both the current baseline and policy actions scenarios are expressed in percentages. Changes to the share of each end-of-life streams brought about by policy actions are therefore expressed in **percentage points** (pts).

5.2.1.1 Mobile phones & tablets:

Table 18 presents the respective changes in the end-of-life streams of mobile phones and tablets per policy action.

Table 18: Mobile phones & Tablets end-of-life evolution per scenario

#	Policy action	% Equipment that leaves hibernation (pts)		Hoarding rate evolution (pts)		Collection rate evolution (pts)		Recycling rate evolution (pts)		Repair / Re-use rate evolution (pts)	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	Baseline (rates)	**20% after 1.5 yrs**		**49%**		**20%**		**10%**		**20%**	
1	**Financial Incentives**	+3 pts	+9 pts	-1 pt	-2 pts	**+2 pts**	**+6 pts**	+ 2 pts	+5 pts	+0.4 pts	+ 1 pt
2	**Door-to-door and postal services**	+2 pts	+6 pts	-0.4 pts	-1 pt	**+1 pt**	**+4 pts**	+1 pts	+3 pts	+0.6 pts	+2 pts
3	**Re-use targets**	+0 pt	+0 pt	+0 pt	+0 pt	+0 pt	+0 pt	- 3 pts	- 7 pts	**+6 pts**	**+12 pts**
4	**Data privacy certification scheme**	+0 pt	+0 pt	**-1 pt**	**-3 pts**	**+1 pt**	**+3 pts**	+0,6pts	+1,5pt	+0,1 pts	+0,3 pts
5	**Drop-off points databases**	+0 pts	+0 pts	**-1 pts**	**-3 pts**	**+1 pts**	**+3 pts**	+ 1 pts	+ 2 pts	+0,1 pts	+0,3 pts
6	**Personalised EoL information**	+0 pts	+0 pts	**-2 pts**	**-5 pts**	**+2 pts**	**+5 pts**	+ 1 pts	+ 3 pts	+0,2 pts	+0,5 pts

[67] Section 7.5.3 only displays input data and hypotheses. Detailed calculations to calculate the share of each end-of-life stream under each policy action are not described in this report.

7	**Reduced VAT rates on re-use services**	+0 pt	+0 pt	+0 pt	+0 pt	+0 pt	+0 pt	-0.01 pt	-0.02 pts	**+1 pt***	**+2 pts***
8	**Deposit-Refund systems**	+27 pts	+80 pts	-28 pts	-43 pts	**+33 pts**	**+51 pts**	+17 pts	+26 pts	+17 pts	+26 pts

* Growth stemming from re-used EEE only (not re-used from separate collection)

5.2.1.2 Laptops

Table 19 presents the end-of-life evolution of laptops per scenario.

Table 19: Laptops end of life evolution per scenario

#	Policy action	% Equipment that leaves hibernation (pts)		Hoarding rate evolution (pts)		Collection rate evolution (pts)		Recycling rate evolution (pts)		Repair / Re-use rate evolution (pts)	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	Baseline (rates)	**20% after 1.5 yrs**		**61%**		**33%**		**16%**		**14%**	
1	**Financial Incentives**	+2 pts	+7 pts	-1 pts	-2 pts	**+2 pts**	**+6 pts**	+2 pts	+5 pts	+0.4 pts	+ 1 pt
2	**Door-to-door and postal services**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	**Re-use targets**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	**Data privacy certification scheme**	+0 pts	+0 pts	**-1 pt**	**-2 pts**	**+1 pts**	**+2 pts**	+1 pt	+2 pts	+0 pts	+ 0 pts
5	**Drop-off points databases**	+0 pts	+0 pts	**-3 pts**	**-7 pts**	**+3 pts**	**+7 pts**	+2 pts	+6 pts	+0 pts	+ 0 pts
6	**Personalised EoL information**	+0 pts	+0 pts	**-5 pts**	**-14 pts**	**+5 pts**	**+14 pts**	+4 pts	+11 pts	+0 pts	+ 0 pts
7	**Reduced VAT rates on re-use services**	+0 pts	+0 pts	+0 pt	+0 pt	+0 pt	+0 pt	+0 pt	+0 pt	**+0.8 pts***	**+1.3 pts***
8	**Deposit-Refund systems**	+16 pts	+42 pts	-27 pts	-41 pts	**+31 pts**	**+48 pts**	+16 pts	+24 pts	+16 pts	+24 pts

* Growth stemming from re-used EEE only (not re-used from separate collection)

5.2.1.3 Chargers

Table 20 presents the end-of-life evolution of chargers per scenario.

Table 20: Chargers end of life evolution per scenario

#	Policy action	% Equipment that leaves hibernation (pts)		Hoarding rate evolution (pts)		Collection rate evolution (pts)		Recycling rate evolution (pts)		Repair / Re-use rate evolution (pts)	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	Baseline (rates)	**20% after 1.5 yrs**		**49%**		**40%**		**19%**		**17%**	
1	**Financial Incentives**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	**Door-to-door and postal services**	+2 pts	+6 pts	-0.5 pts	-1.4 pt	**+2pts**	**+5 pts**	+ 1 pt	+ 3 pts	+1 pt	+ 2 pts
3	**Re-use targets**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	**Data privacy certification scheme**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	**Drop-off points databases**	+0 pts	+0 pts	**-1 pts**	**-3 pts**	**+1 pts**	**+3 pts**	+1 pts	+3 pts	+0 pt	+0 pt
6	**Personalised EoL information**	+0 pts	+0 pts	**-2 pts**	**-5 pts**	**+2 pts**	**+5 pts**	+1 pt	+4 pts	+0 pt	+0 pt
7	**Reduced VAT rates on re-use services**	+0 pts	+0 pts	+0 pts	+0 pts	+0 pts	+0 pts	-0.01 pts	-0.02 pts	**+1pt***	**+2pts***
8	**Deposit-Refund systems**	+27 pts	+80 pts	-28 pts	-43 pts	**+33 pts**	**+51 pts**	+17 pts	+26 pts	+17 pts	+26 pts

* Growth stemming from re-used EEE only (not re-used from separate collection)

5.2.2 Environmental, Social and Economic Impacts

5.2.2.1 Overview of the impact assessment results

For each policy scenario, the environmental, social and economic impacts were modelled using estimated parameters (see Section 7.5.2 in the Annex), which translated the end-of-life trajectories brought on by the policy actions into quantified impacts:

- **Increase of the collection, recycling, and repair / re-use rates (%):** end-of-life evolution of the devices in scope per scenario; assessed in Section 5.2.1;
- **Cumulated quantity of recycled materials (t):** difference between the weights of material recycled (thus including the different recycling rates per material) in the policy scenario vs. the baseline over a period of 10 years. This corresponds to the weight of materials effectively recycled and not to the amount available for recycling;
- **GHG emissions avoided (tCO_2eq):** difference between the tons of GHG emissions avoided in the policy scenario vs. the baseline over 10 years;
- **Jobs created:** difference between the number of jobs required in the policy scenario vs. the business as usual scenario until 2030;
- **Evolution of consumers/customers behaviour:** qualitative description of consumer behaviour change induced by the policy action;
- **Quantity of material recycled for the year 2030 (t):** difference between the weight of devices sent to recycling in the policy scenario vs. the baseline projected scenario in the year 2030;
- **Additional costs of policy (€):** additional cumulative costs over ten years estimated for the main stakeholders concerned by the policy action in its design and operationalisation as described in Section 4.2;
- **Additional revenue generated (€):** difference between the revenue generated from the resale of used devices and the revenue of the devices recycled in the policy scenario vs. the baseline over a period of 10 years. This revenue impacts mainly re-use organisations and recyclers.

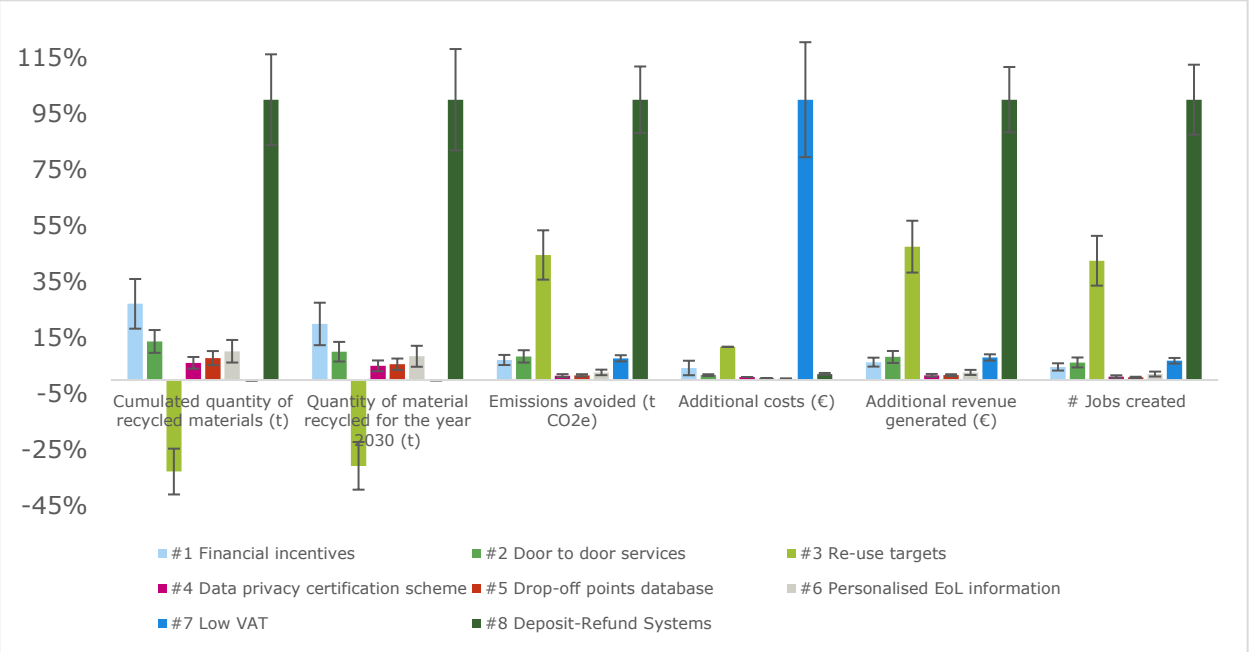
To be noted:

- The additional costs incurred correspond to the costs required for the implementation and operationalisation of each policy action. It is considered they are borne by the stakeholder organisations (PROs, national authorities, consumers, recyclers etc.) in charge of deploying the specific policy action. The level of detail on implementation costs depends on available data[68];
- The additional revenue generated corresponds to the resale and recycling revenue of devices. They are considered to be earned by the vendors and recyclers.

Figures Figure 26 to Figure 29 present the impact assessment summary of each one of the proposed policy actions for **mobile phones, tablets, laptops and chargers**.

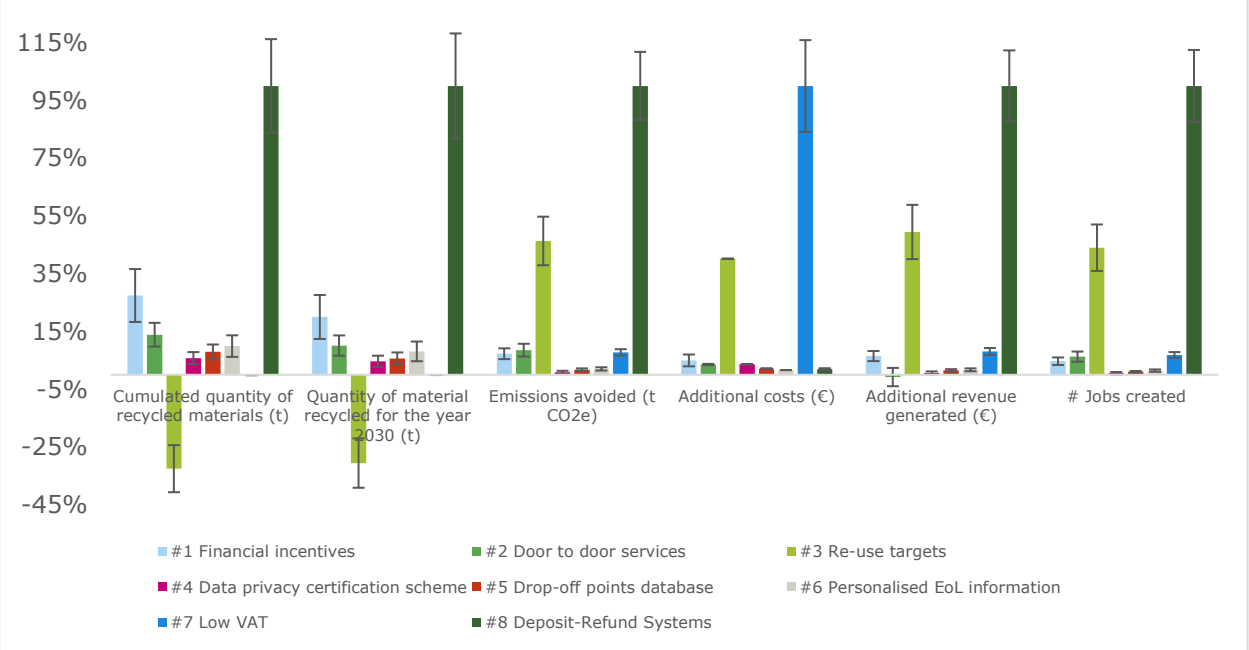
[68] No implementation cost data was found for policy action #4 data privacy certification scheme

Figure 26: Impact Assessment Summary for Mobile Phones



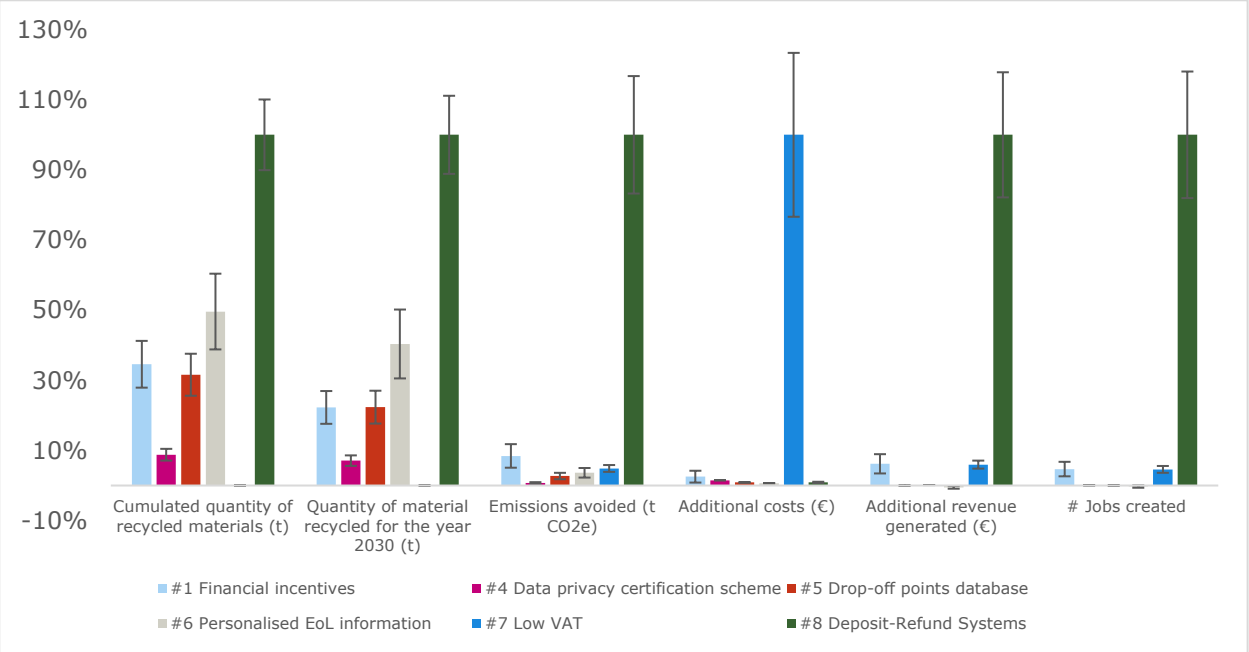
Error bars: indicate the min and max of each scenario.

Figure 27: Impact Assessment Summary for Tablets



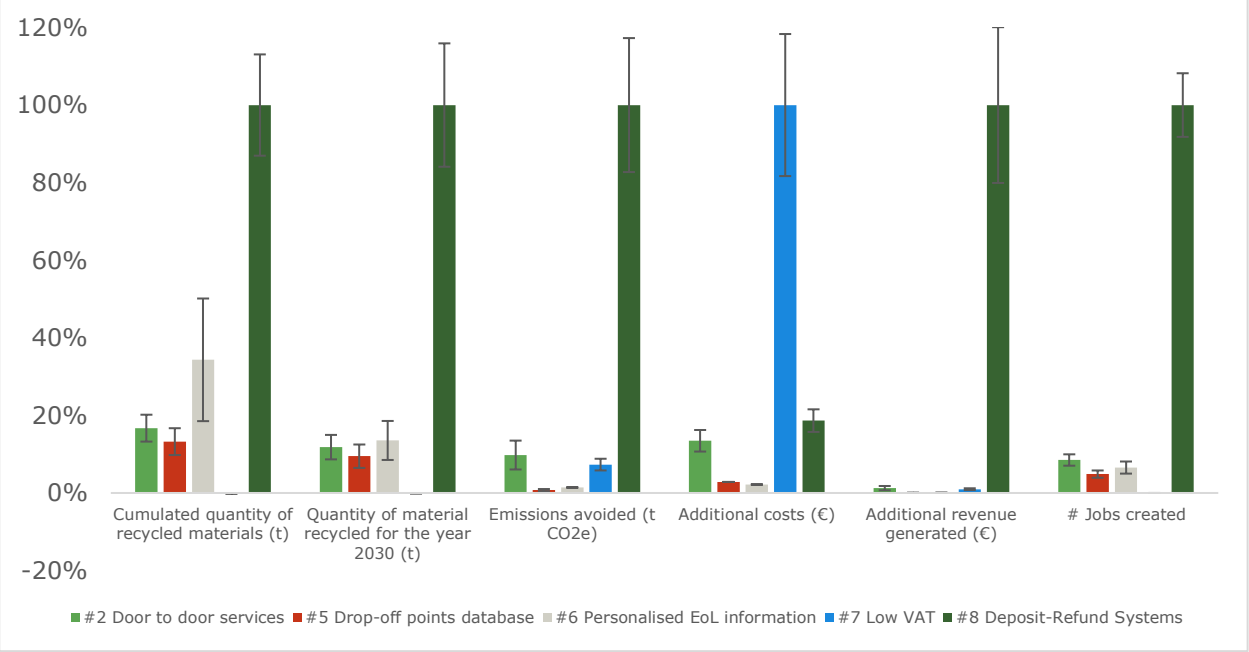
Error bars: indicate the min and max of each scenario.

Figure 28: Impact Assessment Summary for Laptops



Error bars: indicate the min and max of each scenario.

Figure 29: Impact Assessment Summary for Chargers



Error bars: indicate the min and max of each scenario.

The main observation is that policies targeting and incentivising reuse i.e. the extension of active lifetimes have the strongest impacts in terms of emissions avoided, revenues generated and job creation.

Notably, policy action #8 "Deposit-refund systems" achieves overall the highest impacts across the board: in line with its high recycling and re-use rates estimated, it brings about the most significant

quantity of recycled materials, emissions avoided (most notably due to the high incidence of re-use), revenue generated and jobs created.

Policy action #3 "Targets for re-use", whose focus is increasing re-use, also showcases positive results regarding emissions avoided, revenue generated, and jobs created.

5.2.2.2 Discussion: impact assessment analysis by policy action

In the following paragraphs, the results of the impact assessment are discussed and analysed by policy action. Some of the policies are mentioned here as having an 'indirect effect' on the impact of the other policy actions. This is due to the fact that the impact of these actions is not considered significant by itself, but the policy action would play a role in enabling and supporting other initiatives assessed in the study. This indirect effect has been assessed qualitatively.

5.2.2.2.1 Policy action #1: Financial incentives

Impact overview:

One of the most efficient policies regarding the quantity of recycled materials accumulated over the course of ten years compared to current practice assessed in the baseline (19.6 kt for mobile phones, 9.8 kt for tablets, and 19.1 kt for laptops) with however relatively high costs compared to the other policies due to the minimum financial reward set for each device returned, which is higher than their estimated recycling value usually estimated at about 1.6 euros (see Annex, Table 34).

It addresses the issue of "household storage" by encouraging users to empty their drawers thanks to financial incentives, irrespective of the equipment's' value.

Collection, re-use and recycling performance:

This punctual and short-term action aims at rapidly incentivising the collection of phones currently in hibernation or that would otherwise have been hoarded at their end of life: the majority of the impacts are seen during the 3-year period of the policy implementation, generating a +20% increase in the collection of devices, of which an estimated 20% are re-usable and 80% are to be recycled. The high proportion of recycled devices is due to the inherent goal of this policy action to "empty the drawers" which contain older phones with low residual value.

GHG emissions avoided:

This policy action ranks lower in terms of GHG emissions avoided among the different policies assessed, as it mostly impacts recycling rather than re-use, which is the main driver of emissions reduction.

Additional costs of the policy action:

The additional costs, estimated to be high relative to the other policies, mostly stems from the financial reward guaranteed for the returned devices, combined with a national communication campaign to increase the visibility of this short-term policy action. These costs would be borne by the PROs, all the while positively impacting the consumers who will have received financial rewards in exchange for their devices, and an increased activity for recyclers and resellers (including charities).

Additional revenues:

The increase in revenues, at mid-range compared to the other policies, will mostly benefit (1) PROs and/or associated resellers implementing the policy action (including charities) and (2) recyclers. This policy action is the only one that will directly and positively impact consumers financially.

Job creation:

The increase in jobs is in the lower mid-range among the different policies, as greater volumes of devices collected generate more jobs. However, a higher proportion of devices goes towards recycling which is less job-intensive than the re-use sector.

Consumer behaviour change:

Limited consumer behaviour change is expected in the long term as this policy action is punctual and focused on monetary incentive: consumers may be less likely to continue returning their mobile phones once the reward or financial incentive stops.

Limits identified:

Setting the financial reward has to be further refined with respect to the values estimated in this study: between 5€ and 22€ (see Annex 7.5.3.1 for more information). For each geographic region, additional consumer behaviour studies need to be undertaken in order to provide adapted amounts to favour the return of both reusable devices and non-reusable ones (that have too low of a residual value in the re-use market to incentivise consumers to bring them back). It is also important to avoid an overpayment for the devices that would render this policy action less financially sound.

Replicability and scalability (as mentioned in Section 3.3.4):

This policy action is identified as a reward system. The growing market for second-hand and repaired small EEE can be considered an important driver for the replicability and scalability of an action which focuses on functional devices with high value. To a lesser extent, differences in environmental awareness in certain Member States could impact the success of such an action if it works as a stand-alone.

Reward systems exist and operate in multiple Member States, which might intensify competition. Relevant infrastructure, technology and certifications need to be in place in the Member State for the action to be replicated viably. Commercial and regulatory considerations (e.g. requirements under the Waste Shipments Regulation[69]) may hinder scalability of reward initiatives by dissuading systems from collecting small WEEE, regardless of its reparability, and may limit the full collection potential for small EEE and WEEE.

Subsidiarity and proportionality:

The implementation of this policy action at EU level would not allow to take into account variations in the implementation and organisation of EPR schemes in different Member States, as well as the local cultural and market context. The most appropriate level to implement the incentive is therefore at Member State level by EPR schemes.

Overall feasibility:

Moderate feasibility due to the potential cost burden for producers when the financial incentive to buy back exceeds revenues from the recycling of low value devices.

[69] Regulation (EC) No 1013/2006 on shipments of waste.

5.2.2.2.2 Policy action #2: Door-to-door and postal services

Impact overview:

One of the most efficient policies regarding the quantity of recycled materials accumulated over the course of ten years compared to current practice assessed in the baseline (average 17.5 kt for mobile phones, 8.7 kt for tablets, and 1.7 kt for chargers), and overall potential in terms of average emissions avoided, revenues generated and jobs created as it is estimated to increases re-use rates over time.

However, it should be noted that the impact depends on several other factors, such as effective communication campaigns, partnerships with postal collection services, as well as the level of costs and complexity of logistics associated with setting up such systems.

Collection, re-use and recycling performance:

This action aims at facilitating the collection of phones, tablets and chargers currently in hibernation or devices reaching end-of-life that would otherwise be hoarded: over a ten year period projected for the policy implementation, collection increases by 14% with an average of 40% of devices going to re-use and 60% to recycling based on the collection levels of two existing schemes: "Je donne mon téléphone" by Ecosystem and "Ö3-Wundertüte" in Austria. This high fraction of re-use is due to the length of the policy action: the first years of door–to-door collection see a lower fraction of re-usable phones as mostly older phones in hibernation are sent by consumers (for example, Ecosystem's "Je donne mon telephone" initiative[70] with 20% going to re-use and 80% to recycling). But as the policy action matures, the greater the fraction of more recent, re-usable phones reaching their end-of-life, which would otherwise be hoarded, are returned through postal services(as seen in the Ö3-Wundertüte initiative[71] in Austria, reaching 60% going to re-use and 40% to recycling after more than 10 years of operation).

GHG emissions avoided:

The GHG emissions avoided stand at the higher range among the different policies assessed, as this policy action impacts more significantly re-use, which is the main driver of emissions reduction.

Additional costs of the policy action:

The additional costs, in the mid-range among the different policies assessed, are due to the costs of the envelopes negotiated at preferential rates and for each device to be returned, combined with a yearly communication campaign to ensure the visibility of such an initiative, which represents a significant share of the costs. These costs would be borne by the PROs throughout the duration of the policy action. The costs linked to door-to-door collection was not part of this assessment.

Additional revenues:

The increase in revenues, standing in the higher range compared the policies assessed due to the stronger increase in re-usable phones being collected, will mostly benefit (1) PROs and/or associated resellers implementing the policy action (including charities) and (2) recyclers.

Job creation:

The increase in jobs is in the higher mid-range among the different policies assessed, notably due to the slightly higher proportion of devices going into re-use which is more job-intensive than the recycling sector.

[70] See section 3.3

[71] See section 3.3.

Consumer behaviour change:

Associated with a recurrent annual communication campaign towards consumers, this policy action is expected to drive consumer behaviour change towards a more permanent habit of returning devices at their end of life, as is observed in the Ö3-Wundertüte initiative.

Limits identified:

As this policy action aims to improve convenience of returning devices, the communication campaign should be adequately fine-tuned in order to reach a maximum number of consumers. The costs of such a communication campaign can thus vary from what was estimated in this impact assessment.

Replicability and scalability (as mentioned in Section 3.3.4):

In general, the replicability of convenience systems may not fully benefit from the growing market for second-hand and repaired small EEE, as most systems direct their collected small EEE and WEEE to recycling operations. However, increased attention for re-use and repair and the growing market in the future may benefit door-to-door and postal services. Furthermore, the extent to which convenience systems can scale up may correlate to what relevant donors are willing to provide in terms of necessary funding.

The reliance on supporting networks, such as the postal, transport and waste collection networks, implies a considerable level of location and context-dependency. As such, convenience systems such as door-to-door and postal services which are successful in one region or Member State may be less replicable and scalable in others, if supporting networks are less available and/or accessible. Differences in levels of environmental awareness from one Member State to another can also impact the success of this action.

If used devices were collected as WEEE by door-to-door services and sent to another Member State for preparation for re-use or recycling, applicable measures under the Waste Shipment Regulation could also represent a barrier for the scalability of this action.

Subsidiarity and proportionality:

This policy action should be implemented at national level, as it depends on contractual agreements with local postal systems and actors operating EPR schemes for example.

As costs of implementation are considered negligible, the proposed measure does not go beyond what is necessary to maximize value retention and increase WEEE collection rates.

Overall feasibility:

Moderate feasibility is estimated for this policy action. The use of postal systems for the collection of EEE and WEEE has been adopted in the EU, as they are observed in several of the initiatives surveyed in this study ("jedonnemontelephone.fr", "Ö3-wundertute", etc.). However, the fire risk related to EEE and WEEE containing lithium-ion batteries can represent an issue for mailing operations.

5.2.2.2.3 Policy action #3: Targets for re-use

Impact overview:

One of the most efficient policies regarding the cumulative emissions avoided over ten years (2 $ktCO_2$ for mobile phones and 0,8 $ktCO_2$ for tablets) and for additional revenue generated over ten years (18 € billion for mobile phones and 25 € billion for tablets).

The policy action has a highly significant impact since such a target could encourage the implementation of measures that incentivise re-use also of EEE whose market value is low, incentivise users to donate them and have a push impact on repair schemes.

Collection, re-use and recycling performance:

This action is a long-term policy, aiming for a permanent increase of the re-use rate of devices. Indeed, as it is designed in this report, it enables a real impact on re-use by focusing on equipment that is returned through take-back schemes and can still be used, and thus does not impact collection rates per se but rather the distribution between the different streams after collection. It is assumed that a collateral impact of this action could be the temporary shift of collection for recycling, in favour of repair and re-use.

GHG emissions avoided:

The GHG emissions avoided are expected to be quite high as they reflect the shift from recycling to re-use, which is much more impactful in terms of emission reduction.

Additional costs of the policy action:

The additional costs of this policy action are linked to the implementation and monitoring. The costs of policy design are considered negligible here.

The costs to create additional re-use facilities are not considered in this assessment, as there was no consistent source to provide an estimate of these costs.

Additional revenues:

The increase in revenues, distinguishing itself from other policies by its significant value, mostly benefits re-use actors (mostly re-use operators contracting with EPR schemes) by providing them with a larger pool of devices to resell.

Job creation:

The increase in jobs is at the higher end compared to other policies, as greater volumes of devices collected generate more jobs, but also due to the higher proportion of devices going towards re-use which is more job-intensive than the recycling sector.

Consumer behaviour change:

As this policy action focuses on the re-use of collected devices, it entails promoting re-use behaviour for end-users via different measures such as financial incentives, communication campaigns, etc.

Limits identified:

The policy action has to be associated with policies aiming at increasing the collection rate of devices, such as door to door postal collection (policy #2). The association of two such policies could have a significant impact on all the indicators.

Replicability and scalability (as mentioned in Section 3.3.4):

The reliance on re-use networks implies a considerable level of location- and context-dependency. As such, measures to achieve re-use targets can be successful in one region or Member State but less successful in others, if supporting networks are less available or developed. Differences in levels of environmental awareness and of resources allocated to these measures from one Member State to another can also impact the success of this action.

Subsidiarity and proportionality:

As for the collection and recovery targets set in the WEEE Directive and re-use measurement methodologies set in the Implementing Decision (EU) 2021/19, this policy action should be implemented at EU level, and further measures specified at national level to reach the targets and fit local conditions.

As costs of implementation in the way this policy action is designed are considered low, the proposed measure does not go beyond is the objective of maximising value retention. However, it can be assumed that implementation and monitoring of such targets could come at a high cost.

Overall feasibility:

Moderate feasibility as monitoring of re-use is being developed at EU level, but to measure re-use and determine specific targets could be challenging. Feasibility could also be hampered by data security concerns.

5.2.2.2.4 Policy action #4: Data privacy certification scheme

Impact overview:

Under the impact assessment assumptions, this policy option has moderate impacts, all ranking lower compared to the other policies. The potential of this policy action lies in the quantity of recycled materials and avoided emissions.

This policy action has a less significant impact, but highly significant indirect effects. Multiple stakeholders mentioned the importance of data privacy concerns during the workshops. Studies and feedback from second-hand actors have identified the need for such standards (see Section 3). Direct impacts may be difficult to assess, but this action is considered a key enabler for other suggested policy actions.

Collection, re-use and recycling performance:

This action is implementable in the mid-term and aims to increasing collection and thus enabling further re-use and recycling. However, its impacts are quite mitigated since, in the absence of sources stating otherwise, it is estimated that current recycling and reuse practices would not be directly impacted by this policy and therefore the distribution of devices ending up in these different streams would remain the same. While the collection rate increases, the proportion going to recycling and re-use is expected to be the same as the estimated for the baseline.

GHG emissions avoided:

The GHG emissions avoided are quite low, as the impact to re-use and recycling rates, as compared to the baselines is limited.

Additional costs of the policy action:

Additional costs were not taken into account in this assessment as there was no consistent source to provide an estimate of these costs.

Additional revenues:

The increase in revenues is limited as the increase is similar for re-use and recycling with no tendencies leaning towards re-use, which is the main revenue pool. The additional revenues will mostly profit resellers (including charities), certified by this data protection scheme as they respond to the consumer barrier (concerns over data privacy) tackled here.

Consumer behaviour:

This policy action relies on the modification of consumer behaviour, especially consumers with high concerns for data privacy protection. This standard will modify this consumer segment by providing a guarantee for that of data protection and deletion for collected devices.

Job creation:

The increase in jobs is quite limited due to the limited increase of re-use and recycling rates.

Limits identified:

The policy action has to be associated with the development of either re-use or recycling streams to allow the proper management of the additional collected devices.

Replicability and scalability (as mentioned in Section 3.3.4):

The reliance on supporting networks such as reuse networks implies a considerable level of location and context-dependency. As such, data privacy standards which are successful in one region or Member State may be less replicable and scalable in others, if supporting networks are less available and/or accessible. Differences in levels of environmental awareness from one Member State to another can also impact the success of this action.

Subsidiarity and proportionality:

The implementation of this policy action only at national level would lead to a divergence in the requirements for economic operators and market distortions. The EU level is the most appropriate to implement it.

The proposed measure does not go beyond what is necessary to maximize value retention and increase WEEE collection rates.

Overall feasibility:

High feasibility as existing standards developed at country-level can be leveraged for application at European-level.

5.2.2.2.5 Policy action #5: Drop-off points database

Impact overview: Moderate impacts, all ranking lower compared to the other policies. The potential of this policy action lies in the quantity of recycled materials.

The direct impact of this policy action is less significant, but it has a highly significant indirect effect. Consumer studies carried out on WEEE flows list a lack of awareness on appropriate disposal practices. During the workshop with the WEEE Forum, stakeholders agreed that improving awareness on collection points is important and appropriate communication tools and campaigns are crucial.

Collection, re-use and recycling performance:

This action is a medium-term policy aiming at increasing collection and thus, through this increase, enable further re-use and recycling. Yet, the impacts are quite moderate as in the absence of sources stating otherwise, it was considered that the collected devices distribution between streams was identical to current practice assessed in the baseline. Thus, the impact of the policy action is limited by the low recycling and re-use rates considered in the baseline.

GHG emissions avoided:

The GHG emissions avoided are quite low, as the amount of GHG emissions avoided by recycling and re-use is assessed as low, considering the low re-use and recycling rates of the baseline.

Additional costs of the policy action:

Additional costs are linked to data gathering for available collection and repair facilities and to update this database annually. The advertising campaign needed to raise awareness on this database would represent the main cost source. These will be borne by the PROs or Member States depending on the implementation of the policy action.

Additional revenues:

The increase in revenues is limited as the increase of devices sent towards re-use and recycling is similar, with no tendencies leaning towards re-use which is the main revenue pool. The additional revenues mostly benefit recyclers and resellers (including charities), linked to the PROs as they emanate from a separate collection increase.

Job creation:

The increase in jobs is quite limited due to the limited increase of re-use and recycling rates.

Consumer behaviour:

This policy action is expected to change consumer behaviour for some citizens, especially those without prior knowledge of drop-off locations. It will permanently modify behaviour for this consumer segment by ensuring that people can easily access information.

Limits identified:

The policy action has to be associated with the development of either re-use or recycling streams to allow the management of the additional collected devices.

Replicability and scalability (as mentioned in Section 3.3.4):

Databases on drop-off points have been implemented in most Member States. However, the impact of the action relies on the existing network of drop-off points, which might differ from one Member State to another and thus impact the replicability and scalability of the action. Differences in levels of environmental awareness from one MS to another can also impact the success of this action.

Subsidiarity and proportionality:

Given the better knowledge that national authorities have of existing databases and market conditions for WEEE and EEE, this policy action should be implemented at national level.

As costs of implementation are considered low, the proposed measure does not guarantee that WEEE collection rates is increased and value retention is maximised, however, its implementation will facilitate the process.

Overall feasibility:

Moderate to high feasibility based on the research and workshops which proved that the use of relevant data and platforms in many Member States already exist. Asking relevant stakeholders to update these platforms appears feasible. Depending on the chosen approach (best practices guidelines or minimum requirements), feasibility would vary from moderate to high.

5.2.2.2.6 Policy action #6: Personalised EoL information

Impact overview: Moderate impacts, all ranking in the lower range among policies. The potential of this policy action lies in the quantity of recycled materials and avoided emissions.

The impact of this policy action is less significant, but it has a highly significant indirect effect. Push notifications have been found to be successful in changing consumer habits. Combining these notifications with relevant information from the 'product passport' is promising (see Section 4.2.4.1).

Collection, re-use and recycling performance:

This action is a mid-term policy aiming at increasing collection and thus, through this increase, enabling further re-use and recycling. Yet, the impacts are quite mitigated as, in the absence of sources stating otherwise, it was considered that the collected devices repartition between streams is identical to current practice assessed in the baseline. Thus, the impact of the policy action is limited by the low recycling and re-use rates considered in the baseline.

GHG emissions avoided:

The GHG emissions avoided are quite low, as they are limited by the re-use and recycling rates of the baseline.

Additional costs of the policy action:

Additional costs are linked to the information gathering regarding available disposal options and the update of this base. The main costs would be linked to the development of websites and/or apps that calculate the value of devices and that provide direct information to the user.

Additional revenues:

The increase in revenues is limited as the increase is similar for re-use and recycling with no tendencies leaning towards re-use, which is the main revenue pool. The additional revenues mostly benefit recyclers and resellers (including charities) linked to the PROs as they emanate from a separate collection increase.

Job creation:

The increase in jobs is quite limited due to the limited increase of re-use and recycling rates.

Consumer behaviour:

This policy action is expected to have a significant impact on consumer behaviour as the aim is to provide information to the directly consumer. It has therefore a higher chance of impacting consumers' habits on the long term.

Limits identified:

The policy action has to be associated with the development of either re-use or recycling streams to allow the management of the additional collected devices.

Replicability and scalability (as mentioned in Section 3):

This policy action relies on existing collection and take-back networks. Therefore, it implies a considerable level of location and context-dependency. As such, actions which are successful in one region or Member State may be less replicable and scalable in others, if supporting networks are less available. Differences in levels of environmental awareness from one Member State to another can also impact the success of this action.

Subsidiarity and proportionality:

The implementation of this policy action only at national level would lead to a divergence in the requirements for economic operators, and market distortions. The EU level is the most appropriate to implement it.

Overall feasibility:

Moderate feasibility as the information retrieved thanks to the product passport combined with the artificial intelligence already used by operators and manufacturers can render this action feasible. Data protection issues could though be an important barrier to the feasibility of this policy action.

5.2.2.2.7 Policy action #7: Reduced VAT rates on re-use services

Impact overview: This policy action only impacts re-use services, with a relatively high increase in the re-use rate expected, but a slight reduction of devices going to recycling compared to the current situation. The associated costs are the highest, as they reflect the loss of revenue from decreased VAT on re-use services.

The impact of this policy action is rated as significant, based on the price-elasticity of demand theory applied in this study. However, no empirical evidence or modelling has proven the efficiency of reduced VAT rates on re-used small EEE specifically.

Collection, re-use and recycling performance:

This action is specifically aimed at increasing re-use activities, with preferential fiscal measures to effectively reduce prices of the devices and consequently increase demand. The private/marketplace re-use sector would directly benefit with a +1.3 pts increase in re-use rates compared to the baseline. It is also assumed that separate collection would remain stable, but with re-use from collection (charities linked to such separate collection) that would marginally benefit with a +0.1 pts increase.

GHG emissions avoided:

The GHG emissions avoided stand at the mid-higher range among the different policies assessed as this action targets and increases specifically re-use, which is the main driver of emissions reduction.

Additional costs of the policy action:

The additional costs are the highest among all the policies assessed: they reflect the loss in revenue for national budgets from the reduced VAT. These costs are directly borne by Member States. In this impact assessment it is estimated that these losses in fiscal revenue are more significant than the increase in revenue for re-use organisations and potential benefit for consumers.

Additional revenues:

The increase in revenues, standing in the mid-higher range among the policies assessed due to the higher volume of second-hand devices being sold, will in majority benefit private re-sellers, including marketplaces.

Job creation:

The increase in jobs is in the higher mid-range among the different policies, specifically due to the increased number of devices going into re-use which is more job-intensive than the recycling sector.

Consumer behaviour change:

Based on price-elasticity of demand theory, if the benefits of a VAT reduction is passed on to the consumer as assumed in the impact assessment, this policy action is assumed to drive consumer behaviour towards an increased demand for second-hand devices.

Limits identified:

The increase in re-use rate was estimated from a price-elasticity of demand study (European Commission, 2007b), which possesses inherent limits as it was not specifically designed for the devices and at the scale analysed here. Moreover, reducing the VAT on certain repair services is undertaken by certain EU countries (Sweden, Belgium) but its concrete effects remain unknown and are difficult to correlate back to the policy action (Dalhammar *et al.*, 2020).

Replicability and scalability (as mentioned in Section 3.3.4):

The growing market for second-hand and repaired small WEEE can be considered as an important driver for the replicability and scalability of this action. However, costly and complicated infrastructure, technology and certifications need to be in place in the Member for the action to be replicated viably, which is not always the case. In fact, the VAT reduction might not be high enough to have a strong effect on the financials of the re-use sector nor be passed on to the consumer, especially when considering low-value EEE, which may hinder the scalability of this action.

Subsidiarity and proportionality:

A common system for Value Added Tax (VAT) is harmonized at EU level, however the application of reduced rates on specific goods and services is a Member State competence.

VAT reduction can incur a significant cost burden for local authorities, therefore the proportionality of the measure to ensure value retention maximization and increase of WEEE collection rates to the objectives is not optimal.

Overall feasibility:

Low feasibility. Negotiations to amend Annex III of Directive 2006/112/EC which currently frames the use of reduced VAT rates is ongoing, and requires an unanimous vote from Member States. Applying reduced VAT to repair and re-use activities remains ay decision to be made by each Member State.

5.2.2.2.8 Policy action #8: Deposit-Refund Systems

Impact overview:

The most efficient policy action regarding almost every impact indicator assessed, with strong collection, recycling and re-use potential, avoiding overall the most GHG emissions, the most revenue generated and the most jobs created.

The impact for this policy action is rated as highly significant, based on two studies that have shown high willingness by respondents to return devices for an 11 -15 € deposit - over 50% in one example (Uyttenbroek, 2017) and estimated increase in collection rates to over 80% for a fee representing 10% of the price of the device (Bordage, 2019) - especially if it is mandatory or if the deposit fee is persuasive enough.

Collection, re-use and recycling performance:

This action is estimated to impact every device subject to the deposit return scheme reaching their first end of life, based on an estimation from one case study that an average of about 62%[72] of consumers will return their devices to retrieve their deposit, with 50% of the collected devices going to re-use and 50% to recycling.

GHG emissions avoided:

Highest GHG emissions avoided as this policy action generates the highest volume of re-used devices which is the main driver of GHG emissions reduction.

Additional costs of the policy action:

[72] Average between 53% and 71% based on (Uyttenbroek, 2017) - see section 7.5.3.5

The additional costs of this initiative are in the mid-range compared the different policies, inducing a very low cost per emissions avoided as the latter are the most significant by far. The costs will be borne by the producers throughout the duration of the policy action.

Additional revenues:

The highest increase in revenues will mostly benefit (1) resellers associated with the PROs implementing the policy action (mostly charities) and (2) recyclers.

Job creation:

The increase in jobs is the highest among the different policies, as greater volumes of devices collected generate more jobs, but also due to the higher proportion of devices going towards re-use which is more job-intensive than the recycling sector.

Consumer behaviour change:

Considered to be very impactful on consumer behaviour, as it is expected to incentivise them very effectively, through a loss aversion mechanism, to return their devices right at the purchasing step.

Limits identified:

- The costs are based on the projections[73] made in the EU Ecodesign Preparatory study (European Commission, 2020b) as no nation-wide examples exist to date[74];
- The increase in collection rate was estimated based on a consumer behaviour study, which could be further substantiated with more empirical evidence (none identified to date).

Replicability and scalability (as mentioned in Section 3.3.4):

The growing market for second-hand and repaired small EEE is an important driver for the replicability and scalability of this action. However, differences in environmental awareness in certain Member States and lack of awareness of the residual value of small EEE could impact its replicability and scalability if it works as a stand-alone.

Further, complicated infrastructure, technology and certifications need to be in place in the Member States for the action to be replicated viably, which is not always the case.

Subsidiarity and proportionality:

Member States are more efficient in setting a system fitting local conditions to increase WEEE collection rates. Therefore, the implementation of a deposit-refund system should be made at local scale.

As detailed in section 4.2.3.8 and in the current knowledge gap, the implementation of a DRS cannot be considered as proportional to the objectives of value retention maximization and WEEE collection rates increase.

Overall feasibility:

Low feasibility as feasibility studies have demonstrated the numerous barriers that need to be addressed for this policy action to work. For instance, the German federal government decided not to implement such a scheme at national level due to administrative, infrastructure, deposit amount, data security

[73] Costs per unit returned is 0.5 €

[74] As mentioned in section 4.2.3.8, proposals have been published by the German Green Party but not taken up due to implementation difficulties. Source : https://newseu.cgtn.com/news/2020-01-09/Anti-waste-plan-could-see-German-smartphone-buyers-pay-deposit-N5TG7yXOcE/index.html ; https://www.euronews.com/2020/01/07/german-greens-propose-25-euro-deposit-to-encourage-phone-recycling ;

barriers. Member State-specific studies need to be conducted to determine the economic model that would ensure a viable system.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The study highlights the drivers behind the low return rates of small used EEE and WEEE based on an analysis of the current situation for used and waste mobile phones, laptops, tablets and their chargers. Overall, the **main characteristics** of small EEE and WEEE that **result in low collection and household storage** include:

- **their weight**: it is easier to meet collection targets by collecting heavier devices, which can result in less of an incentive for authorities, PROs and waste management operators to improve and increase the collection of smaller and lighter devices;
- **their size**: small devices are more easily forgotten in household drawers, or disposed of via mixed household waste;
- **their lifetime**: the most recent predictions point to the increasing service life due to product design developments and a lower replacement rate as prices for new devices increase and the second-hand market grows;
- **their perceived value**: in some cases, consumers believe their used devices are worth more than their actual market value; These devices are kept and deemed valuable to consumers as back-up and for data storage;
- **their complex design**: the relatively high costs of recycling small WEEE due to increasing complexity in product design can hinder demand from recyclers and impact the ease of reparability for actors involved in repair and refurbishment activities.

Some of the identified **challenges regarding return rates and collection** are lack of awareness on collection and appropriate disposal practices, presence of illegal collectors and scavengers due to inefficient law enforcement by local authorities and challenges related to the organisation and financing of take-back operations.

Household storage is also identified as a main challenge driven by some of the abovementioned characteristics of the devices analysed, such as their small size and their perceived value. Consumer tendency to store and forget their old small devices in household drawers is to a large extent driven by data security concerns, lack of trust in the recycling or collection process and lack of access or awareness of proper take-back options, which can lead to for example the improper disposal of such devices via the mixed municipal household waste.

The research and stakeholder consultations conducted during the study highlighted **four main areas of improvement** to address the abovementioned challenges and to incentivise consumers to return their devices.

Firstly, further clarification of options distinguishing between used EEE and waste EEE for consumers and collection operators could prevent significant amounts of functional devices from being sent to waste recycling operations. Data reporting on exports of used devices for the second-hand market, the monitoring of export flows outside the EU, and law enforcement of illegal waste exports by local authorities would allow for a more accurate and transparent understanding of the amount of waste generated and available for collection. Furthermore, incentivising consumer behaviour through improvements of existing collection networks and increasing consumer awareness on available options to return their old devices would improve return and collection rates. Ultimately, improving the collaboration and interaction of all actors across the value chain would help create more efficient business models and potentially increase the return rate of small devices.

The **analysis and categorisation of existing return systems** in the EU revealed the main barriers and opportunities for the replication and scaling up of the different systems. The conclusions of the analysis were used for the selection of the final list of policy actions and the evaluation of their feasibility. Taking all elements into account, take-back schemes based on rewards present relatively limited barriers for replicability and scalability in comparison with convenience and charity systems, mainly due to their potential to benefit from the growing market for second-hand and repaired small EEE and the relative ease of scalability beyond the initial investments. From a technical point of view, convenience and charity systems appear to be easier to replicate in comparison with reward systems, due to their reliance on more accessible methods and tools, such as large networks of existing collection bins. Reward systems require more specialised infrastructure than simple collection points in order to assess the value of EEE and then provide the appropriate reward. However, the reliance on funding and the dependence on a local or Member State- specific network of supporting actors might hamper their replicability of convenience and charity systems in other Member States.

Table 21 below presents a comparative overview of the qualitatively estimated **feasibility**, including scalability and replicability, and quantitatively estimated **impacts** of each policy action to incentivise the return of small EEE and WEEE. The identified impacts aim at giving a comparative overview of the different policies. Consequently, if all policy actions are deemed impactful compared with the baseline, impacts can however be considered as more or less significant when actions are compared to one another. Two scales are therefore used in Table 21:

- **Feasibility** is rated from low to high;
- **Impact** is rated from less significant to highly significant. Some policies are complementary and supporting of other policies and are thus mentioned as having an 'indirect effect' on the impact of the other policy rather than a direct impact.

Two final points are worth noting. Firstly, the general impact score is estimated by aggregating different indicators of very different nature (economic, social and environmental ones). It thus may reflect a simplification bias. Secondly, in the absence of tangible feedback, the most conservative hypothesis was always chosen.

Table 21: Conclusions on the feasibility and impact of each policy action

Nr.	Policy action	Feasibility	Impact	Conclusions
1	**Financial incentives**	Moderate	Significant	This instrument is expected to have a significant punctual impact during implementation, with a limited long-term effect on consumer behaviour. The moderate feasibility is due to the costs required for its implementation. The recommended implementation of this action is at MS level.
2	**Door-to-door and postal services**	Moderate	Significant	The conclusions of the impact assessment point to a significant impact with short and long-term benefits and an increase in re-use collections as the action matures. The feasibility and scalability are also moderate as examples of functioning postal collection systems exist in some MS, but fire-risks due to the li-ion batteries is a barrier. Costs linked to door-to-door collection were not directly assessed in this study. The recommended implementation of this action is at MS level.

Nr.	Policy action	Feasibility	Impact	Conclusions
3	**Targets for re-use**	Moderate	Highly Significant	The conclusions of the impact assessment point to a highly significant impact on re-use rates due to supporting measures put in place to meet targets and thus on emissions avoided and jobs created. Costs of additional re-use facilities were not considered which could impact the feasibility of the action. Furthermore, contracts with reuse organisations are expected to improve implementation. Feasibility could be hampered by data security concerns. The recommended implementation of this action is at MS level.
4	**Data privacy certification scheme**	High	Not possible to be determined due to absence of data…	The action impact was measured as being lower than anticipated, in part due to testing limitations stemming from limited data availability. As this action increases collection, it must be coupled with developments of re-use or recycling streams in order to ensure the adequate recovery of the collected devices.
			…but highly significant indirect effect	Though displaying limited impacts on its own, a data privacy certification scheme is still considered a key enabler for most policy actions. Its indirect effect could therefore be deemed high.
5	**Drop-off points database**	Moderate to High	Not possible to be determined due to absence of data…	The action impact was measured as being lower than anticipated due in part to limited data availability. In fact, the flow of the collected devices estimated in the impact assessment is considered identical to the current situation. To have a real impact, there should be some feedback on increasing re-use and recycling of these additional devices collected.
			…but highly significant indirect effect	Though displaying limited impacts on re-use and recycling on their own (it all depends on the quality and extent of the collection scheme and subsequent operations), implementing a drop-off points database is considered key in enduringly and sustainably increasing the collection of devices. Its indirect effect is thus quite high when coupled with other actions. The recommended implementation of this action is at MS level.
6	**Personalised EoL information**	Moderate	Not possible to be determined due to absence of data…	The action impact was measured as being lower than anticipated due in part to limited data availability.

Nr.	Policy action	Feasibility	Impact	Conclusions
			… but highly significant indirect effect	Though displaying limited impacts on its own, personalised EoL information is still considered as a key enabler for most policy actions, since it could directly and favourably change consumer behaviour. Its indirect effect could therefore be deemed high. The recommended implementation of this action is at MS level.
7	**Reduced VAT rates on re-use services**	Low	Significant	Relatively high impact on re-use rates alone was observed during the impact assessment. The high costs of the policy reflect the loss of revenue, a cost borne by national governments alone that negatively impact the feasibility of the policy action. The impact of this policy action is rated as significant, based on the assumptions made in this study. However, no empirical piece of evidence or other modelling has proven the efficiency of reduced VAT rates on re-used small EEE specifically. The recommended implementation of this action is at MS level.
8	**Deposit-refund systems**	Low	Estimated as highly significant but more data needed to substantiate	The results of the impact assessment are aligned with anticipated results, with a high impact regarding almost every impact indicator assessed. However, numerous barriers to entry need to be addressed for this solution to work. More studies are recommended to assess the impact of a deposit-refund system. The recommended implementation of this action is at MS level.

6.2 Recommendations

By combining the results of the impact assessment with the qualitative evaluations made from the workshops and desk research, the policy actions "Financial incentives" and "Door-to-door and postal services" have been considered as **quick wins**. They are considered as quick wins due to their significant impact and are implementable with expected results in the short term. Both action build on the implementation of existing actions in some Member States.

The recommendations on financial incentives and on door-to-door and postal services are also in line with the recommendations of the WEEE compliance promotion exercise (BIPRO, 2018) on improving WEEE collection infrastructure. The implementation of financial incentives was also recommended in Frederiksson *et al.* (2021), as a conclusion of the study of the efficiency of the deposit-return scheme.

It is important to note that some actions not considered as quick wins can still be considered as **key enablers** to incentivize the return of used devices for other policy actions:

- Data privacy certification schemes – see Section 4.2.3.4;
- Drop-off points databases – see Section 4.2.3.5;
- Personalised End-of-Life information – see Section 4.2.3.6.

Their impacts have been individually assessed as less significant, but data privacy is for instance a major concern for consumers when returning their devices. Therefore, these actions must be considered when setting up return schemes.

These policy actions could also offer better traceability of the existing waste flows, the extent of which is currently not fully understood by stakeholders and presents many grey zones. In fact, various stakeholders highlighted that a lack of traceability of WEEE and EEE streams (e.g. unreported flows and illegal WEEE exports) hinders the creation of pertinent policy actions.

A number of the policy actions assessed above would require implementation at Member State level, considering the subsidiarity principle. They also imply best practices to be shared with and between Member States, for instance through the TAIEX - Technical Assistance and Information Exchange - instrument. A list of policy actions which could be implemented by Member States is displayed in Table 22.

Table 22: Policy actions to be implemented at Member State level

Policy action	Recommendation for EU Member States
Financial incentives	A minimum 'guaranteed' financial reward would incentivise the return of devices, irrespective of their recycling value. The financial incentive targeting the stock of hoarded devices could be funded in the framework of EPR schemes legislation, and should be limited in time in order to be cost effective. It should be noted that existing examples show that EPR schemes can support re-use, there are currently no examples of EPR schemes funding directly the return of used devices through a financial reward as described.
Door-to-door and postal services	National authorities should promote partnership between re-use organisations, EPR schemes and postal collection systems.
Reduced VAT rates on re-use services	While at the EU level, common aspects of the VAT framewok legislation are agreed on applying reduced VAT rates

	specifically on re-use services for electronics remains a Member States competence.
Targets for re-use	The implementation of dedicated re-use targets, set either overall or by EEE category, could be a solution to encourage and maximise value retention of used EEE. Pending assessment and possible legislative proposals for targets under waste legislation at EU level, Member States should set targets for re-use at national level, and re-use operations should be supported in the framework of EPR schemes.
Drop-off points databases	Member States should implement or update drop-off points databases based on best practices for the design and maintenance of databases observed in other Member States.
Personalised EoL information	At national level, telecom operators and distributors can make information available to their customers regarding take-back options.
Deposit-refund scheme	A deposit-refund system has the potential to incentivise the return of devices at the end of use .The implementation of this type of system should be preceded by a careful analysis of a country's cultural specificities, consumer habits and infrastructure. However, based on literature review and interviews conducted in the framework of this study, the feasibility of a deposit-refund scheme is deemed to be low.

7. ANNEX – SUPPORTING TECHNICAL INFORMATION

7.1 Approach and methodology of problem definition

The first part of the study is further divided into specific steps as reflected in the following Table.

Table 23: Overview of steps for problem definition

Step	Description
1.1 Scope definition	• Scope of small used EEE/WEEE to be assessed • Identification and establishment of key terms and definitions • Main parameters to be covered in the problem definition
1.2 Data collection	• Desk research and literature review • Stakeholder consultation
1.3. Overview of current situation & Problem definition	• Sector mapping (product flows and key stakeholders) • Estimations on household storage of **small used EEE** and collection of **small WEEE** • Estimation of potential losses to the circular economy • Underlying drivers and causes; including barriers and opportunities • Magnitude and scale of the problem

7.1.1 Approach for scope definition

7.1.1.1 Selection of key terms and definitions

Following an assessment of the above factors,

Table 24 summarises **the key identified terms** and their **relevance** to the current study. The key terms have been grouped into four categories according to the principal areas and issues addressed:

- Terms related to the **characteristics** of devices covered and distinguishing between different life-cycle phases;
- Terms related to defining the **key factors** that influence the use and EOL of devices;
- Terms related to the **EOL practices defined in existing legislation**; and
- Terms related to **EOL practices not specifically defined in existing legislation.**

In order to establish definitions for the key identified terms, an in-depth review of existing definitions was carried out and prioritised by type of source in the following order:

(1) Official definitions laid out in EU legislation, notably the WEEE Directive and Waste Framework Directive (2008/98/EC)
(2) Definitions used in official EU and national publications
(3) Definitions from existing literature and stakeholder consultation (in cases where no official definition is provided in existing EU / national legislation or publications)

Table 24: Selection of key terms and relevance to study

Category	Key terms	Relevance to study
Characteristics of devices covered and distinguishing between different life-cycle phases	• Electrical & electronic equipment (EEE) • Small EEE/WEEE (vs. larger EEE)	**Distinction between small EEE/WEEE and other EEE/WEEE:** Only small used and waste EEE are covered by the study.[75] As such, it is important to clearly define the technical characteristics of small EEE/WEEE as opposed to other i.e. larger-sized EEE categories.
	• Used EEE • Waste EEE (WEEE) • WEEE from private households'	**Distinction between (used) EEE and waste EEE**: In order to identify key factors allowing for the distinction between used and waste EEE; and WEEE from private households in regard to relevant requirements and legal status in accordance with the WEEE Directive and other existing legislation, particular the Waste Shipment Regulation (WSR) (see Box 1 in Section 7.2) to ensure applicability and overall coherence of possible solutions developed in Section 3.
Key factors that influence the use and EOL of devices	• Households • Producers • Distributors	**Clear designation of the main roles and responsibilities of key actors at EOL phase:** These actors play an important role in regard to how devices are managed at their end-of-life (EoL) i.e. awareness of end-users of designated collection points, responsibility of distributors to ensure collection points at retail shops, etc. As such, this can provide important insights on whether possible future options should target specific audiences in order to increase collection rates; reduce household storage, increase re-use, etc.
EOL practices defined in existing legislation	• Collection • Separate collection • Re-use • Recovery • Preparing for re-use • Recycling	**Clear understanding of the end-of-life practices covered by existing legislation and related requirements:** The WEEE Directive lays out specific requirements and targets in relation to specific EoL practice, as well as associated European standards for the collection and treatment of WEEE, as mandated

[75] The main focus of the study is on small used and waste EEE due to the key factors surrounding their end-of-life management. For example, due to the smaller size of the devices concerned, consumer behaviour in relation to end-of-life (EOL) practices of a mobile phone will not be the same compared to larger EEE such as a fridge or television (it is much easier to store a phone after use in homes compared to a television). As such, it will be important to establish distinguishing factors between the different categories of devices concerned.

Category	Key terms	Relevance to study
		by the European Commission in 2013 following the adoption of the WEEE Directive.[76]
EOL practices not specifically defined in existing legislation	• Repair • Refurbishment • Remanufacturing • Household storage • Obsolescence	**Clear understanding of the key terms associated with more "informal" EOL practices**, which are not officially defined in existing legislation nor subject to specific reporting requirements in official statistics, therefore the data and results obtained from existing studies must be analysed carefully. Application and interpretation of such terms can vary across MS / industry. As such, it will be important to establish clear definitions for each of the different disposal and treatment routes of small WEEE.

[76] EC (2013) Mandate to the European Standardisation Organisations for Standardisation in the Field of Waste Electrical and Electronic Equipment (Directive 2012/19/EU). Available at: https://ec.europa.eu/environment/waste/weee/pdf/m518%20EN.pdf

7.1.1.2 Selection of devices

In regard to the selection of devices covered by the study, the approach considered the following factors:

- Devices that correspond to those:
  - Subject to relevant separate collection requirements under the WEEE Directive (see Table 27 in Annex 7.3); and
  - Specifically mentioned in the Terms of Reference of the project (mobile phones, tablets, laptops and chargers) in relation to household storage (see Table 28, Table 29 and Figure 30) and low collection (see Table 30).
- Devices that represent relatively high market volumes as well as potential substantial losses / missed opportunities in regard to the economic value of recoverable materials.
- Applicability and relevance of possible policy measures.
- Availability of recent and robust data (including quantitative where possible).

7.1.2 Approach for problem definition

The focus of the problem definition includes the household storage of small used EEE and low collection of small WEEE. The assessment resulted in an overview of the key issues that need to be addressed.As such, the problem definition has been established separately for each of thedevices covered: mobile phones (including feature phones and smartphones), laptops (including tablets) and their chargers with the aim of determining whether the same problem definition could apply to other small EEE. Examples of some of the aspects that have been evaluated include product specific elements e.g. technical characteristics, size and dimensions of product categories, comparisons between the market size for other small WEEE devices, consumer behaviour factors, existence of dedicated collection, return, repair, and recycling schemes, etc.

The approach for the establishment of the problem definition has closely followed the European Commission's Better Regulation Guidelines, particularly toolbox #14 on "*How to Analyse Problems*" (European Commission, 2017a). Based on the main focus areas of the problem definition as described previously and key guidance from the Better Regulation Guidelines, Table 25 below summarises the relevant areas and topics that have been addressed in the problem definition.

Key findings from the problem definition contributed to ensure a solid understanding of the issues at stake and corresponding challenges and served as key inputs for the development of policy measures. Finally, relevant qualitative and quantitative findings on past, current and future trends have also contributed to establishing a robust baseline scenario for the assessment of the potential impacts of the identified policy actions.

Table 25: Overview of main areas covered in problem definition

Main areas	Rational	Description of elements to be covered

A. Establish what the problem is and why it is problematic	To identify the issues that might have to be addressed atatat EU level, including the information needed for decision makers to decide whether a policy response is warranted	• Overview of the current situation i.e. the status quo:
		  ○ Summary of relevant policy objectives
		  ○ Key market trends
		  ○ Collection rates and household storage of used EEE
		  ○ Value of EEE materials and components in re-use, recovery and recycling markets.
		• Determine the main negative consequences of the problem in relation to household storage and low collection rates:
		  ○ Environmental consequences: accumulation of potentially hazardous e-waste, extraction of raw materials, etc.
		  ○ Economic consequences: potential losses to the circular economy, impacts on the recycling sector, etc.
		• Determine whether there may be additional (or related) problems linked to the pursuit of general objectives and principles such as international issues (international regulatory or market changes, international agreements or competitiveness disadvantages), etc.

B. Assess the magnitude and EU dimension of the problem	To show whether a problem is relevant or not.	• Where possible, quantification of the problem e.g. economic value of potentially recoverable materials, trends in collection rate, etc. • Relevance of possible cross-border effects or fragmentation of internal market.
C. Establish the causes ("drivers") and assess their relative importance	To help identify policy actions which address the problem.	• Map the main underlying causes (drivers) of the problem to determine what drives the behaviour that would have to change to address the problem. • Highlight the key drivers that play a major role in the problem and distinguish those that may stem from other initiatives to determine any relevant interactions among drivers.
D. Identify who the relevant stakeholders are	To have a targeted stakeholder consultation, analysis of drivers and distribution of impacts for each group	• Identification of the main stakeholders affected by the problem and whose behaviour causes it e.g. consumers (households), producers, waste management operators, public authorities, etc.
E. Describe how the problem is likely to evolve with no new EU intervention	To verify if the need for a possible policy initiative is going to persist.	• Assess the likelihood that the problem will persist in the absence of EU policy intervention. In other words, the likely evolution of the identified problem drivers and the extent that this could affect the existence and magnitude of the problem based on assessment of recent trends and implementation of existing policy at all relevant levels (MS, EU, international). • Highlight any other aspects including potential opportunities to be considered for development of policy actions.

7.2 List of key terms and definitions

Table 26: Definitions of key terms for purposes of the study

Key terms	Proposed definition / description	Source(s)
Electrical & electronic equipment (EEE)	Electrical and electronic equipment are devices that are dependent on electric currents or electromagnetic fields to work properly for generating, transferring and measuring these currents and fields designed for use with a voltage rating of 1,000 volts or less for alternating current and 1,500 volts or less for direct current.	WEEE Directive (2012/19/EU): Article 3(1)(a)
Waste EEE (WEEE) **(the term e-waste is also used instead of WEEE)**	Article 3(1) (e) of the WEEE Directive defines waste electrical and electronic equipment as EEE which is waste in accordance with Article 3(1) of the Waste Framework Directive (WFD): "*any substance or object, which the holder discards or intends or is required to discard, including all components, sub-assemblies and consumables which are part of the product at the time of discarding.*"	WEEE Directive (2012/19/EU): Article 3(1)(e) WFD (2008/98/EC): Article 3(1)
	Distinction between EEE and WEEE: EEE becomes WEEE if its holder discards it, or intends or is required to discard it. To make this judgement it may be necessary to examine all circumstances including the history of an item on a case by case basis. However, there are characteristics of used EEE that are likely to indicate whether it is waste or not (see Box 1, Annex 7.2).	Waste Shipment Regulation (WSR) (European Commission, 2019a)
Used EEE	Used electrical and electronic equipment is any EEE that is not considered as being WEEE although it is no longer being actively used by its holder. It corresponds to the end of service life (or first active use life) described in the Section 2.3.1.1.	Nordic Council of Ministers (2015)
Small EEE/WEEE	Annex III of the WEEE Directive lists the categories of EEE covered by the Directive, and provides technical specifications to distinguish between small and large EEE devices as follows: • Large equipment: any external dimension more than 50 cm • Small equipment, including small IT and telecommunication devices: no external dimension more than 50 cm	WEEE Directive (2012/19/EU): Annex III (5)(6)

Key terms	Proposed definition / description	Source(s)
	Small EEE are devices with no external dimension larger than 50cm, without part accessories (e.g. hoses, tubes, power cables) and wrapped to its minimal size if it has fixed retractile or foldable parts.	EWRN (2018)
WEEE from private households'	WEEE which comes from private households and WEEE which comes from commercial, industrial, institutional and other sources which, because of its nature and quantity, is similar to that from private households. Waste from EEE likely to be used by both private households and users other than private households shall in any event be considered to be WEEE from private households.	WEEE Directive (2012/19/EU): Article 3(1)(h))
Households	A household includes either one person living alone or a group of people, not necessarily related, living at the same address with common housekeeping, i.e. sharing at least one meal per day or sharing a living or sitting room.	Eurostat (2020f)
Producers	Any natural or legal person who, irrespective of the selling technique used, is established in a MS and[77]: (i) manufactures EEE under his own name or trademark, or has EEE designed or manufactured and markets it under his name or trademark within the territory of that MS; (ii) resells within the territory of that MS, under his own name or trademark, equipment produced by other suppliers, a reseller not being regarded as the 'producer' if the brand of the producer appears on the equipment, as provided for in point (i); (iii) places on the market of that MS, on a professional basis, EEE from a third country or from another MS; or (iv) sells EEE by means of distance communication directly to private households or to users other than private households in a MS and is established in another MS or in a third country.	WEEE Directive (2012/19/EU): Article 3(1)(f)

[77] Including distance communication in accordance with Directive 97/7/EC of the European Parliament and of the Council of 20 May 1997 on the protection of consumers in respect of distance contracts.

Key terms	Proposed definition / description	Source(s)
Distributors	Any natural or legal person in the supply chain, who makes an EEE available on the market. This definition does not prevent a distributor from being, at the same time, a producer as defined in accordance with the WEEE Directive, Article 3(1) (f).	WEEE Directive (2012/19/EU): Article 3(1)(g)
	For WEEE from private households, MS shall ensure that when supplying a new product, distributors: • Are responsible for ensuring that such waste can be returned free of charge on a one-to-one basis as long as the equipment is of equivalent type and has fulfilled the same functions as the supplied equipment; and • Provide for the collection, at retail shops with sales areas relating to EEE of at least 400 m^2 of very small WEEE (no external dimension more than 25 cm) free of charge to end-users and with no obligation to buy EEE of an equivalent type, unless an assessment shows that alternative existing collection schemes are likely to be at least as effective.	WEEE Directive (2012/19/EU): Article 4(2)(c)(d)
Collection	The gathering of waste, including the preliminary sorting and storage of waste for the purposes of transport to a waste treatment facility.	WFD (2008/98/EC): Article 3(10)
Separate collection	Collection of a waste stream that is kept separately by type and nature so as to facilitate a specific treatment.	WFD (2008/98/EC): Article 3(11)
Re-use	Any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.	WFD (2008/98/EC): Article 3(14)
Recovery	Any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy.	WFD (2008/98/EC): Article 3(15)
Preparing for re-use	Checking, cleaning or repairing recovery operations, by which products or components of products that have become waste	WFD (2008/98/EC): Article 3(16)

Key terms	Proposed definition / description	Source(s)
	are prepared so that they can be re-used without any other pre-processing.	
Recycling	Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.	WFD (2008/98/EC): Article 3(17)
Household storage	Refers to when consumers keep (or store) a device at home, which is no longer actively used by the holder. Rather than re-selling it on the second-hand market or handing it over for collection and recycling, consumers may choose to keep such devices as back-ups, due to for example data security concerns or due to lack of awareness of designated collection schemes.	Baldé et al. (2017) BBC (2019)
Repair	Repair aims to extend the duration of the product's service life through modifications of the equipment (e.g. to change of a spare part, disassemble the equipment, etc.) and generally refers to specialised repair of professional goods produced in the manufacturing sector with the aim of restoring machinery, equipment and other products to working order.	EC (2016a) IMCO (2016)
	A process in B2C or B2B[78] of fixing a specified defect (or series of faults) of a product. Repair ensures the quality and functionality and renders the product/component available for re-use.	DigitalEurope (2017)
Refurbishment	A process that may be used in B2B or B2C that renders the product available for re-use through part removal and upgrades/ replacements, and testing. Unlike remanufactured products, refurbished products do not necessarily perform better than a newly manufactured	DigitalEurope (2017)

[78] B2B or "business to business" refers to when refers to interactions between businesses, for example when businesses sell products and services directly to other businesses. B2C or "business to consumer" refers to when businesses sell products and services to customers for personal use.

Key terms	Proposed definition / description	Source(s)
	product and may include some small defects (such as a lower battery capacity), which do not have major impact on the use of the product.	
Remanufacturing	A process primarily in B2B that refers to returning a used, non-functional, discarded or traded-in product "to at least its original performance with a warranty that is equivalent or better than of the newly manufactured product".	DigitalEurope (2017)
Obsolescence	Refers to when products reach the end of their lifespan and become obsolete, which can occur in various ways, sometimes also due to impossibility of repair.	European Parliament (2016)

Box 1: Distinction between used EEE and WEEE – Annex VI of the WEEE Directive and Waste Shipment Regulation

In order to distinguish between EEE and WEEE, where the holder of the object claims that he intends to ship or is shipping used EEE and not WEEE, Member States shall require the holder to have available the following to substantiate this claim:

(a) a copy of the invoice and contract relating to the sale and/or transfer of ownership of the EEE which states that the equipment is destined for direct re-use and that it is fully functional;

(b) evidence of evaluation or testing in the form of a copy of the records (certificate of testing, proof of functionality) on every item within the consignment and a protocol containing all record information according to point 3;

(c) a declaration made by the holder who arranges the transport of the EEE that none of the material or equipment within the consignment is waste as defined by Article 3(1) of Directive 2008/98/EC; and

(d) appropriate protection against damage during transportation, loading and unloading in particular through sufficient packaging and appropriate stacking of the load.

2. By way of derogation, point 1(a) and (b) and point 3 do not apply where it is documented by conclusive proof that the shipment is taking place in the framework of a business-to-business transfer agreement and that:

(a) the EEE is sent back to the producer or a third party acting on his behalf as defective for repair under warranty with the intention of re-use; or

(b) the used EEE for professional use is sent to the producer or a third party acting on his behalf or a third-party facility in countries to which Decision C(2001)107/Final of the OECD Council concerning the revision of Decision C(92)39/Final on control of transboundary movements of wastes destined for recovery operations applies, for refurbishment or repair under a valid contract with the intention of re-use; or

(c) the defective used EEE for professional use, such as medical devices or their parts, is sent to the producer or a third party acting on his behalf for root cause analysis under a valid contract,

in cases where such an analysis can only be conducted by the producer or third parties acting on his behalf.

3. In order to demonstrate that the items being shipped constitute used EEE rather than WEEE, Member States shall require the following steps for testing and record keeping for used EEE to be carried out:

Step 1: Testing

(a) Functionality shall be tested and the presence of hazardous substances shall be evaluated. The tests to be conducted depend on the kind of EEE. For most of the used EEE a functionality test of the key functions is sufficient.

(b) Results of evaluation and testing shall be recorded.

Step 2: Record

(a) The record shall be fixed securely but not permanently on either the EEE itself (if not packed) or on the packaging so it can be read without unpacking the equipment.

(b) The record shall contain the following information:

— name of item (name of the equipment if listed in Annex II or Annex IV, as appropriate, and category set out in Annex I or Annex III, as appropriate),

— identification number of the item (type No) where applicable,

— year of production (if available),

— name and address of the company responsible for evidence of functionality,

— result of tests as described in step 1 (including date of the functionality test),

— kind of tests performed.

4. In addition to the documentation requested in points 1, 2 and 3, every load (e.g. shipping container, lorry) of used EEE shall be accompanied by:

(a) a relevant transport document, e.g. CMR or waybill;

(b) a declaration by the liable person on its responsibility.

5. In the absence of proof that an object is used EEE and not WEEE through the appropriate documentation require in points 1, 2, 3 and 4 and of appropriate protection against damage during transportation, loading and unloading in particular through sufficient packaging and appropriate stacking of the load, which are the obligations of the holder who arranges the transport, Member State authorities shall consider that an item is WEEE and presume that the load comprises an illegal shipment. In these circumstances the load will be dealt with in accordance with Articles 24 and 25 of Regulation (EC) No 1013/2006.

In addition to the provisions laid out in the WEEE Directive, the Waste Shipment Regulation also provides additional clarifications on the important elements allowing for enabling distinction between EEE and WEEE. The following summarises some of the key elements included in the European Commission's Correspondents' Guidelines on Shipments of WEEE and of used EEE suspected to be WEEE (European Commission, 2019a):

Distinction between EEE and WEEE: EEE becomes WEEE if its holder discards it or intends or is required to discard it. To make this judgement it may be necessary to examine all circumstances including the history of an item on a case-by-case basis. However, there are characteristics of used EEE that are likely to indicate whether it is waste or not:

- **Situations where used EEE should normally be considered WEEE:**
  - The EEE is destined for disposal or recycling, instead of root cause analysis or re-use, or its fate is uncertain;

- The EEE is not complete - essential parts are missing and the EEE cannot perform its key functions;
- The EEE shows a defect that materially affects its functionality and fails relevant functionality tests; The EEE shows physical damage that impairs its functionality or safety, as defined in relevant standards, and cannot be repaired at a reasonable cost;
- The protection against damage during transport, loading and unloading operations is inappropriate, e.g. the packaging or stacking of the load is insufficient;
- The EEE is particularly worn or damaged or damaged in appearance and its appearance reduces its marketability;
- The EEE has among its constituent part(s) a hazardous component that contains hazardous substances to an extent that the EEE is required to be disposed of, is prohibited to be exported or is prohibited for use in such EEE under European Union or national legislation
- The EEE is destined for disassembly and cannibalisation (to gain spare parts) or
- The price paid for the items is significantly lower than would be expected from fully functional EEE for re-use.

- **Situations where used EEE suspected to be WEEE should normally not be considered WEEE:"**
  - Where the holder of the object claims that he intends to ship or is shipping used EEE and not WEEE, the holder must have available the following to substantiate this claim (Annex VI, WEEE Directive):
    - A copy of the invoice and contract relating to the sale and/or transfer of ownership of the EEE which states that the EEE is destined for direct re-use and that it is fully functional;
    - Evidence of evaluation or testing
    - A declaration made by the holder who arranges the transport of the EEE that none of the material or equipment within the consignment is waste as defined by Article 3(1) of the Waste Framework Directive;
    - The EEE is sent back to the producer or a third party acting on his behalf as defective for repair under warranty with the intention of re-use; or the used EEE for professional use is sent to the producer or a third party acting on his behalf or a third-party facility.

Box 2: Case law on the distinction between used EEE and WEEE

At EU level, several sources can be considered with regard to the interpretation and application of the definition of "waste" as laid down in Article 3(1) of the Waste Framework Directive 2008/98/EC. As the definition of "WEEE" is tied to this general definition of waste, such guidance is relevant for the distinction between "EEE" and "WEEE" as well.

Firstly, it should be noted that the Court of Justice of the European Union (CJEU) has handed down a considerable line of case law concerning the definition of waste. The most recent case law with

a direct focus on WEEE is the CJEU´s 2019 *Tronex B.V.* judgment[79], which concerned the status of a consignment of "electrical or electronic appliances" to a destination outside the EU. In order to establish whether obligations under Regulation No 1013/2006 on shipments of waste had been infringed, the CJEU was asked preliminary questions by the Court of Appeal concerning the status of the appliances in question as either waste (WEEE) or products (EEE).[80]

The CJEU concluded that the relevant shipment to a third country of a consignment of electrical and electronic appliances, which had been initially intended for retail sale but which were returned by the consumer or which, for various reasons, were sent back by the retailer to its supplier, is to be regarded as a "shipment of waste" as opposed to used EEE where that consignment:

- contains appliances lacking a certification of good working condition; or
- which are not adequately protected from transport damage.

Such goods which have become redundant in the seller's product range and which are in their unopened original packaging, on the other hand, must not, without indications to the contrary, be regarded as waste.

While the *Tronex B.V.* judgment clearly concerns appliances sent back to suppliers by consumers, various considerations by the CJEU should be taken into consideration when assessing suitable criteria for the distinction between used EEE and waste EEE. Furthermore, any EU guidance which already existed before the judgment (such as the relevant Correspondent's Guidelines for the shipment of waste) should be read and interpreted in the light of the judgment. It is also relevant to note that the CJEU´s conclusions and considerations in the *Tronex B.V.* judgment should be read within the context of previous case law, such as the *Inter-Environnement Wallonie*[81], Arco *Chemie*[82]*, Zanetti*[83] *Niselli*[84]*, and Shell*[85] cases.

Based on Annex VI of the WEEE Directive, the main parameters for distinguishing used EEE from waste EEE taken into consideration by the CJEU are the level of packaging of devices (unopened packages that efficiently protect devices from transport damage) and the existence of a certificate of good working conditions for those devices.

[79] Openbaar Ministerie v Tronex BV, Case C-624/17, ECLI:EU:C:2019:564

[80] As highlighted in the judgment "the appliances were mainly packed in their original boxes, but some were unpacked. The consignment comprised, on the one hand, appliances returned by consumers under the relevant product guarantee and, on the other hand, articles which, for example, had left the product range following a change in that range. Some appliances were defective. The shipment took place without the notification or consent referred to in Regulation No 1013/2006"; Openbaar Ministerie v Tronex BV, Case C-624/17, ECLI:EU:C:2019:564, Par 10

[81] Inter-Environnement Wallonie ASBL v Région Wallonne, C-129/96, [1997] ECR I-7411

[82] ARCO Chemie Nederland Ltd v Minister van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, Joined Cases C-418/97 and C-419/97, [2000] ECR I-04475

[83] Zanetti and Others, C-359/88, 1990 I-01509

[84] Niselli, C-457/02, 2004 I-10853

[85] Shell Nederland Verkoopmaatschappij BV, Joined Cases C-241/12 and C-242/12, ECLI:EU:C:2013:821

Box 3: Repair versus refurbishment and remanufacturing

A clear understanding of the terms: **repair**, **refurbishment** and **remanufacturing** is essential in order to establish an exhaustive and accurate overview of the different activities aimed at extending product lifetime i.e. extension of the duration of its use and overall lifespan and identify certain factors that facilitate the decision on whether devices should be re-directed to 1) re-use e.g. repairs and refurbishment 2) remanufacturing or 3) recovery e.g. energy recovery and recycling.

- **Repair** generally refers to any operations, which restore products to working order by fixing specific defects or faults that made it inoperable e.g. fixing a dysfunctional keypad or replacing a broken screen and thereby extending the duration of the product's service life. Repairing a device may also include some refurbishment activities, however, does not necessarily imply that there is a change in ownership or that the device is being placed back on the market.
- **Refurbishment** (or reconditioning[86]) refers to any operations by which the product is restored to its essential working functions, before going back on the market. As such, refurbishment can also include repairs, however, usually involve a lengthier process so that the device can be re-sold / placed back on the market, and in most cases imply a change in ownership. Depending on the condition of the device when received, refurbishment can include a range of activities such as cleaning of equipment, testing procedures, factory resets, firmware updates, cosmetic improvements, replacement and/or upgrading of components, erasing of data and removing the identification of the previous owner and repackaging for resale.[87]
- **Remanufacturing** refers to the comprehensive disassembly and reassembly process required to restore a used, non-functional, discarded or traded-in product "to at least its original performance with a warranty that is equivalent or better than of the newly manufactured product" (DigitalEurope, 2017) In other words, remanufacturing can be understood as the process under which products are reverted to a quality and functionality that is **equivalent or better than a newly manufactured product**. In most cases, remanufactured products reflect the latest Original Equipment Manufacturer (OEM) specifications and can include improvements or upgrades that have occurred since the product was originally made and placed on the market. In practical terms, this means that remanufactured products are both cosmetically and functionally equivalent to newly manufactured products and fulfil all relevant product specifications.

In light of the above, some of the key factors that can be considered to differentiate between repair, refurbishment and remanufacturing include:

- Repaired devices are those that have had problems fixed so that it is operable, however they are not necessarily under warranty and may or may not have been cleaned up. Contrary to refurbished or remanufactured products, repaired devices does not imply that

[86] The term reconditioning can be understood as a synonym for refurbishment and can be used interchangeably.
[87] French national waste management legislation Article L541-1-1 (2020). Available at : www.legifrance.gouv.fr/affichCodeArticle.do;jsessionid=F68F9FC63D3FBFF9CDA200D12CDD3B08.tplgfr24s_2?idArticle=LEGIARTI000041598665&cidTexte=LEGITEXT000006074220&dateTexte=20200406

it is being re-sold or placed back on the market and as such can be continued be used by the original owner.

- Refurbished devices include those that are returned shortly after sale i.e. little or no use by the end-user or used items that undergo maintenance before being placed back on the market and re-sold. In many cases, refurbished devices also include a new product warranty, however this practice varies from seller to seller.[88]
- Remanufacturing is generally undertaken by the original product manufacturers (OECD, 2018), whereas refurbishment can be carried out by other actors, such as licensed Refurbishers, who are not necessarily the original product manufacturer. An important distinguishing factor between remanufactured and refurbished devices is that refurbished products are usually relaunched on the market under the same product ID/registration, whereas remanufactured devices are placed on the market under a new ID/registration.

Box 4: Re-use versus preparing for re-use

The distinction between "re-use" and "preparing for re-use" is important due to the legal implications associated with whether or not the device is **considered as waste**.

- **Re-use** as defined in Article 3(13) of the WFD, includes "any operation by which products or components that are **not waste** are used again for the same purpose for which they were conceived". In other words, in most cases re-using refers to using an item again after it has been used, for its original or for similar purposes, without significantly changing its physical status. This can include activities related to further trading and change in ownership, for example through the re-sale of used products (before it becomes waste) through channels such as online or second-hand markets or as donations to charities, etc.
- **Preparation for re-use** is defined in Article 3(16) of the WFD as "checking, cleaning or repairing and recovery operations, by which products or components of products that have **become waste** are prepared so that they can be re-used without any other pre-processing". Preparing for re-use refers to activities that are undertaken on devices that are considered waste e.g. discarded or collected at designated sites. As such, preparation for re-use is therefore a waste management activity and subject to relevant waste management requirements. Furthermore, preparing for re-use operations are subject to the European standard: EN 50614 on requirements for the preparing for re-use of waste electrical and electronic equipment (European Commission, 2013b). As such, preparing for re-use activities are often executed by specialised treatment centres. EN 50614 is applicable to the processes relating to the preparing for re-use of WEEE listed in Annex I and Annex III of the WEEE Directive and does not cover activities connected with used or second-hand equipment that have not become waste.

Considering the above, a key factor to distinguish between "re-use" and "preparing for re-use" is whether the item is classed as waste or non-waste. This can be determined by the certainty that the item will be re-used even if some repair or refurbishment is required (SEPA, 2017). Re-use is only applicable and relevant in the case of products that are not considered waste. In other words, the intent of the original holder is not to discard the final product as waste. For example, where there is no change of ownership of the item, and there is certainty that the item will be re-used for its original purpose, then the item has not been discarded, and is not waste. Some practical examples include repair and refurbishment services (including those carried out under warranty)

[88] Ifixit website, Gordon, Whitson, 8 July 2019 "What's the Difference Between New, Used, and Refurbished?" www.ifixit.com/News/30756/whats-the-difference-between-new-used-and-refurbished

on the item, which is returned to its original owner to be re-used for its original purpose. In cases where there is change of ownership, re-use would apply for example when the item in question is given or sold to a friend or colleague or are repaired or refurbished and sent back to the original holder or re-sold to a new owner (as there is certainty that it will be re-used for its original purpose). Preparing for re-use on the other hand, refers to related activities once the product has been discarded by the final user and becomes waste e.g. WEEE retrieved from collection schemes.

Box 5: Understanding the concept of obsolescence

A thorough understanding of **obsolescence** is important due to the differences in interpretation and the influence it can have on the use and end-of-life of products. A summary of some of the key elements behind the concept of **obsolescence** to consider is summarised below (European Parliament, 2016):

- **Planned or built-in obsolescence:** refers to products which are deliberately designed to fail after a certain period or number of uses. This practice is used by some producers to ensure long-term sales volumes by reducing the time between repeat purchases. One example might be producing an appliance which is deliberately designed to no longer function within five years of its purchase, pushing consumers to replace it within five years.
- **Technical obsolescence:** when a new product or technology supersedes the old one, and it is preferred to use the new technology instead. Historical examples of new technologies superseding old ones include bronze replacing flint in hand-tools, DVDs replacing videocassettes, and the telephone replacing the telegraph.
- **Indirect obsolescence:** components required for repair cannot be obtained, or it is not practical or cost-effective to repair the product. Manufacturers and repair companies will typically cease support for products once they become obsolete as keeping production lines in place and parts in storage for a shrinking user base becomes unprofitable.
- **Incompatibility obsolescence:** products no longer work properly once an operating system is updated.
- **Style obsolescence:** leading consumers to believe that their products are out of date or old-fashioned, although they may still be fully functional.

7.3 Supporting information for the selection of final devices

Table 27: Descriptions of relevant product categories covered by WEEE Directive (Annex III & IV)[89]

WEEE category	Example of devices
Category 2: Screens and monitors *(S > 100cm²)* **Screens and monitors are EEE intended to provide images and information on an electronic display - regardless of its dimension – such as cathode ray tubes (CRT), liquid crystal displays (LCD), light-emitting diode displays (LED) or other kind of electronic displays.**	▪ **Laptops** ▪ **Tablets** ▪ E-readers ▪ Notebooks ▪ Screens ▪ Televisions ▪ LCD photo frame ▪ Monitors
Category 5: Small equipment *(L < 50 cm)* **If the largest outer dimension is 50 cm or less and it is not considered to be an IT or telecommunication equipment it meets the definition of category 5.**	▪ Video cameras ▪ Video recorders ▪ Equipment reproducing sound and image ▪ Clocks and watches ▪ Hi-fi equipment
Category 6: Small IT and telecom devices *(L < 50cm)* **Information equipment is equipment that can be used for collecting, transmitting, processing, storing and showing information. Telecommunication equipment is equipment designed to transmit signals – voice, video and data – electronically over a certain distance. The largest outer dimension must 50cm or less.**	▪ **Mobile phone** (e.g. smartphone and feature phone) ▪ Telephones ▪ GPS ▪ Pocket calculator ▪ Routers ▪ **Personal computers** ▪ Printers

Table 28: Drivers behind household storage and low collection and examples of devices (Anthesis, 2020)

Key drivers		Examples of devices concerned
Household storage	• Data security concerns • Emotional attachment • Kept as backup devices • Lack of awareness of proper disposal options • Size makes it convenient to store in a forgotten location	**Small used EEE:** • Mobile phones (e.g. feature phones and smartphones) • Hard drives • Game consoles • Chargers • Headphones • Video cameras and recorders
Low collection	• Lack of awareness of dedicated collection / return schemes • Inefficient collection schemes • Costs for setting up collection points • Economic and technical challenges for recovery / recycling	**Small waste EEE:** • Mobile phones • Chargers • Tablets • Laptops • Phablets

Figure 30: Drivers behind household storage and low collection of small used EEE/WEEE

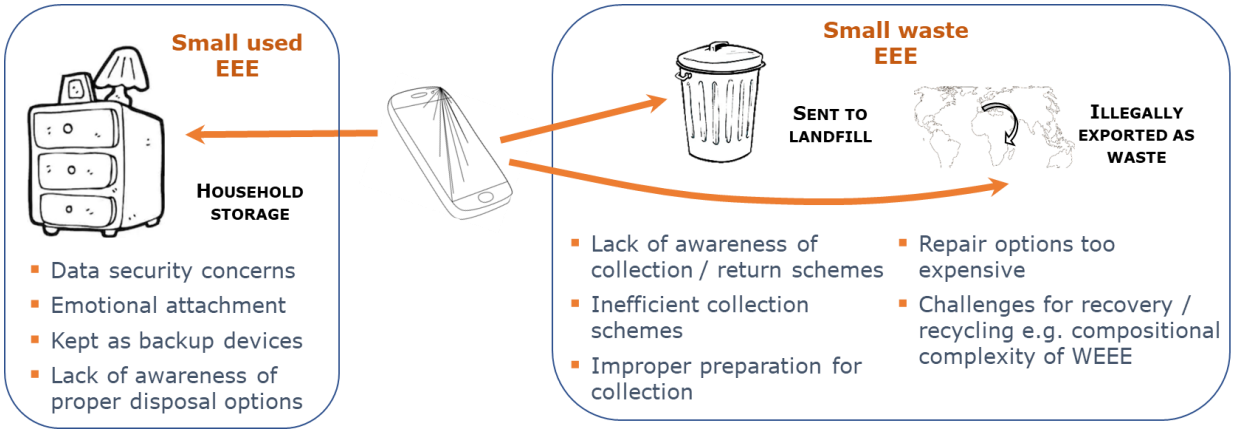


Table 29: Consumer survey: what consumers did with previous mobile phones after last upgrade (Deloitte, 2016)

Country	Saved it	Shared it	Collected & recycled	Sold it	Lost it
Australia	47%	28%	13%	10%	21%
UK	48%	20%	9%	22%	1%
Japan	49%	5%	14%	31%	1%
Canada	49%	15%	19%	15%	2%
Global	49%	23%	10%	15%	3%

Table 30: Collection rates of WEEE in Europe (2017), (Eurostat, 2020a)

Category of WEEE	Reported collection rate (2017)[90]
Large household appliances	46%
Small household appliances	49%
IT and telecom equipment	60%
Consumer equipment and photovoltaic panels	82%

[90] Collection rate calculated as prescribed by the WEEE Directive : $Collection\ rate = \frac{Collected\ devices}{Average\ of\ devices\ put\ on\ the\ market\ during\ the\ three\ last\ years}$

Table 31: List of materials in a feature phone (Basel convention, 2010)

Material	Share
Plastics	40%
Glass and ceramics	20%
Copper and compounds	10%
Nickel and compounds	10%
Potassium hydroxide	4%
Cobalt	5%
Carbon	4%
Aluminium	3%
Steel, ferrous metal	3%
Tin	1%
Minor constituent (Br, Cd, Cr, Li, Pb, Mn, Ag, Ta, Ti, W, Zn)	<1%
Microconstituents (Sb, As, Ba, Be, Bi, Ca, F, Ga, Au, Mg, Pd, Ru, Sr, S, Y, Zr)	<0.1%

7.4 Methodology to establish a list of the most relevant policy actions

The methodology to establish a list of the most relevant policy actions is based on several steps, including:

- a critical review of the results from the problem definition (Section 2);
- the identification of existing return system (Section 3);
- a desk research; and
- stakeholder interviews (Section 7.6).

Relevant policy actions were selected and sorted depending on criteria described in Section 7.4.2.

7.4.1 Desk research and interviews for the identification of possible further action at EU level

Firstly, desk research was conducted to identify and review the recommendations of several studies performed at EU and/or national level, with the goal to increase the circularity (collection, repair or recycling rates) of targeted appliances. This list of reviewed studies is presented in Section 8. The outcome of this meta-analysis is a comprehensive list of possible policy actions to increase collection for re-use, repair and recycling.

A list of public policy areas set out in a recent report from the European Environment Agency (EEA, 2020) was also identified to help provide an inventory of existing incentives.

Secondly, recommendations were assessed, improved and sorted, notably thanks to stakeholders' expertise. Interviews were therefore conducted with various stakeholders to collect feedbacks from both experts in the domain of waste collection (PROs, circular economy experts) and experts in other sectors (digital, ICT market experts, social sciences expert). The general approach was to present the objectives of the study, and a list of pre-selected actions adapted to the interviewed experts' domain. The list of interviewed stakeholders and main outcomes of the interviews are presented in Table 32. They are not meant to reflect the authors' own point of view but to provide transparent information to the reader about stakeholders' analysis of the issue at stake.

These interviews therefore complemented the discussions held within the project team, capitalising on the experience gained during the establishment of the problem definition and the identification and typology of existing return and reward systems.

Table 32: List of interviews conducted for the identification of possible further action at EU level

Organisation / Function	Topics discussed	Main findings
GS1 in Europe **GS1 France**	Data / Digital twin / Blockchain	Traceability of products is based on a model where every part of the value chain (manufacturer, repairer, user…) should add and update information to the products' "passport", or digital twin to make it available for all parties Standardised information on products (e.g., on a digital form) are therefore needed and depends on what manufacturers are willing to disclose. A limit to standardised and interoperable data are proprietary architectures, which may be different from one brand to another.
WEEE Forum	Data / Blockchain / general approach	Online sellers not registered and not undertaking take back, or not paying for collection and reprocessing, impose an unfair cost on other producers and retailers, distort the market, make compliant companies less competitive and result in an overstatement of WEEE collection rate. Various initiatives geared towards nudging people to return their small WEEE need to be investigated.
Closing the Loop	Waste compensation / illegal shipments / global EPR	Increasing collection for material extraction and increasing collection for re-use are two different issues with different solutions. Taking in used devices for repair, refurbishing or resale are propositions that are supported by the market. They're backed by profitable business models (see example the exponential growth of re-commerce websites). However, collecting and recycling electronic waste does not come with a profitable business model. As a result, it makes sense for governments to actively support the collection of non-usable waste (or set requirements for this), while the governmental role for increasing the collection of usable devices could be limited to incentivising or tax breaks. There is a world-scale take-back process to be put in place (or a 'global EPR'), since EEE in majority have a second life in Asia or Africa. A solution would be to support, promote and/or require collection and importation of waste devices in countries lacking recycling infrastructures, as preventing the export of used EEE to developing countries will have strong negative side-effects (e.g. increased demand for new, lower quality devices in those markets). One way to reward the collection of waste devices in countries lacking recycling infrastructures is to allow those collection results to contribute to European recycling targets/rates (for EU countries and/or EU producers).

Organisation / Function	Topics discussed	Main findings
Lecturer in social psychology in IUT Sénart Fontainebleau (UPEC – Université Paris Est Créteil)	Impact of information and incentives / behavioural approach	Efforts to change consumer behaviour have to be paired with a functioning collection infrastructure. Malfunctioning or too complex infrastructures or processes may lead to 'good intention littering'. Temporary incentives may not trigger long term behavioural changes. Finally, and contrary to other types of household waste (packaging, etc.), users expect a 'contract' type relation with the waste manager, from whom they expect reassurance as regards safe data handling for instance. This more individual relation implies that valuable devices, such as recent laptops, tablets or mobile phones cannot easily be collected using bins or equivalent types of solutions.
Ecosystem	Donation / take back systems / general approach	Low efficiency of collection bins for valuable products. Importance of donation systems to collect used items. There is also an information deficit on Consumer-to-consumer re-use of phones. On deposit system, the minimum deposit fee to incentivise return of phones would be around 30-40€ minimum and would cost 1bn€ to consumers (based on an incentive deposit of 30-40€ minimum per device and about 25 million phones sold in France each year).
Fraunhofer IZM	Deposit-refund systems / ecodesign actions / general approach	Fraunhofer IZM is conducting the Ecodesign preparatory study on mobile phones, smartphones and tablets. At the end of life of the devices, several consumer-related issues remain to be solved. First, there is a need to incentivise users to properly return their current devices at the end of their useful life (after repair, re-use, etc.) and not to hoard them at home (prevents further material degradation). Second, an incentive mechanism is required to bring back devices that have already been hoarded in the past. Deposit schemes for mobile phones and other small electronic devices have been a topic of discussion for many years. As an example, the German Green Party suggested a deposit on mobile phones already in 2012[91]. So far, it was considered that the costs related to barriers such as the administrative burden, setting up the infrastructure, fixing the deposit amount, data security issues or the question on distributive issues (who bears the burden?) would outweigh the benefits. An interesting example that nudged consumers to bring back their old hoarded devices can be found in Japan. Japan recycled nearly 80,000 tons of cell phones and other electronics

[91] Note of the authors: information was reported during the interview. Additional proposals have been published since: https://newseu.cgtn.com/news/2020-01-09/Anti-waste-plan-could-see-German-smartphone-buyers-pay-deposit-N5TG7yXOcE/index.html. https://www.euronews.com/2020/01/07/german-greens-propose-25-euro-deposit-to-encourage-phone-recycling.

Organisation / Function	Topics discussed	Main findings
		to make the medals for the 2021 Tokyo Olympics and Paralympics. Such symbolic initiatives can be more effective than monetary incentives, in particular when users personally identify with the initiative. Different OEMs started to incentivise the take back of devices through own systems. Some manufacturers not only take back their own models, but also devices from other companies. However, credit is often only granted if the phone is not damaged (e.g. no cracked display, etc.).
Orange	Private take-back systems/re-use markets	Orange has a 30% collection rate target by 2025. Currently, collection rate is at 17%, and is made of "citizen collection" (40%) and buy-back programs (60%) "Citizen collection" is carried out thanks to secure collection points, and donated phones are traceable by IMEI. Personal data deletion being a major concern for users. Re-use of phones (10% of "citizen collection") is economically constrained - resale value vs. refurbishing cost driven e.g. by data deletion processes; Buy-back of phones is carried out at retail stores. Phones are valued depending on their market value on the re-use market. If phones are valueless, they are sent to the "citizen collection" stream.

7.4.2 Criteria for an impactful list of actions

The insights gained from the desk research and interviews helped formalise a set of actions, to answer the specific objective of increasing the collection of small EEE and WEEE at their end-of-use.

The selection was based on the following criteria:

- the **innovative character** of the action;
- the potential to **address the issues identified** in Section 2;
- the potential to be replicated and scaled up at the EU level (Section 3); and
- the classification as **'push-action'.**

'Push-actions' were prioritised because their aim is to directly address barriers for take-back and collection. These type of actions address the 'consumer behaviour' barriers identified within the problem definition. They usually do not encompass ecodesign type of actions as the latter are covered by other studies and initiatives.

As such, 'push-actions' differentiate from 'pull-actions' (e.g. compulsory recycled content) that work towards developing the ecosystem of collection and repair activities more generally and improve the profitability of collecting small EEE and WEEE as a whole. They are of the utmost importance to a well-functioning and balanced commodity market. With a few exceptions however (e.g. "reduced VAT rates for re-use services", and "targets for re-use"), these 'pull-actions' were not prioritised.

Combining different types of actions will allow improving collection of EEE and WEEE in a most efficient way. In fact, such a complex problem cannot be solved with an all-encompassing solution and must be approached from multiple perspectives. Consequently, building an 'EU wide return scheme' should not be understood as implementing a single solution or system, but rather as the combination of several solutions at EU level.

Figure 31 below maps out the different stakeholders and actions involved in the treatment of EEE/WEEE throughout the value chain. The actions target in priority the extension of product life and collection phases. In order to reach the overall objectives of value retention and increased collection rates, actions involving other steps of the lifecycle of EEE and WEEE such as the use phase of devices ('Product passport' and 'personalised EoL information') have also been considered.

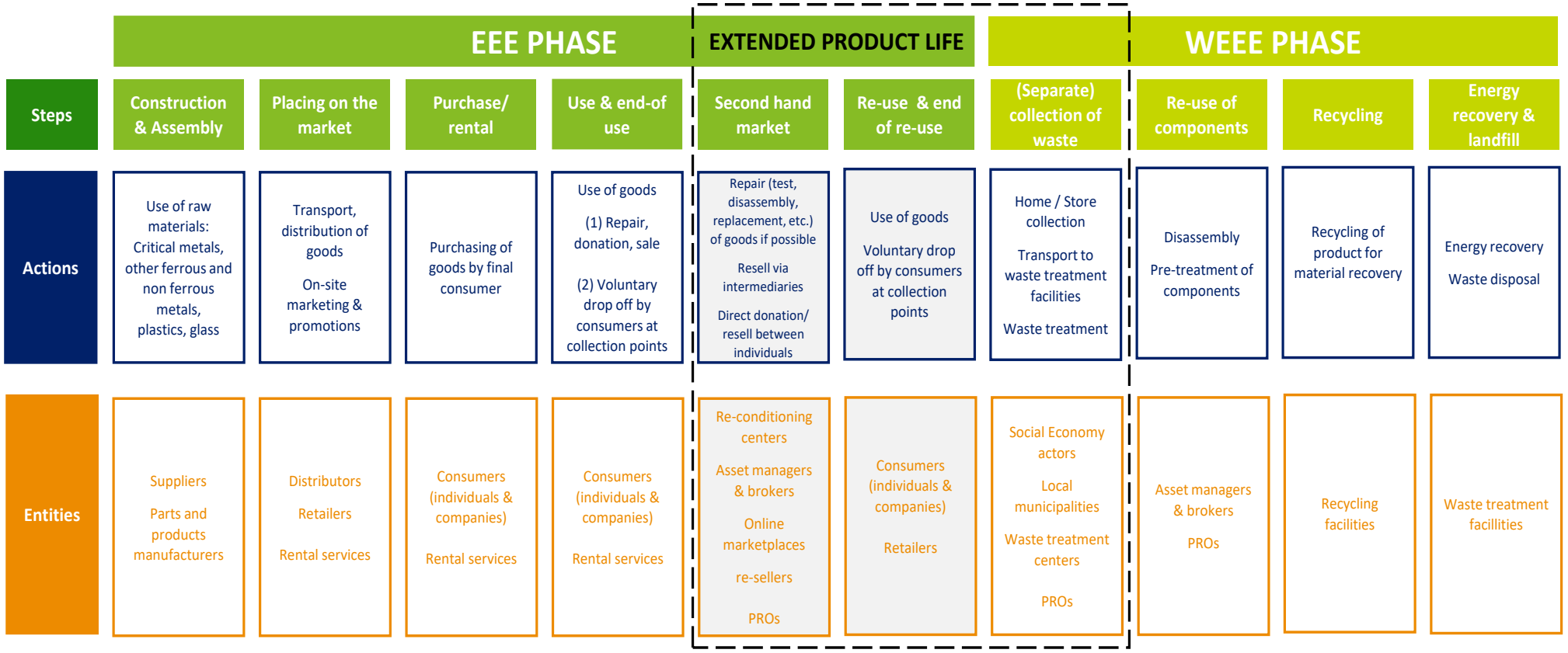


Figure 31: Different stakeholders/entities and actions involved in the treatment of EEE/WEEE throughout the value chain

7.5 Preliminary impact assessment hypotheses

7.5.1 Baseline hypotheses

The table below reports the main estimated values that have been used for baseline calculations, together with their respective sources.

Table 33: Main values used for the baseline

Product / value chain step	Baseline Value	Source
EEE placed on the market		
Mobile phones placed on the market	137,545,352	Eurostat (2018) PRODCOM data on mobile phones
Tablets placed on the market	38,380,000	European Commission (2020b). Ecodesign preparatory study on mobile phones, smartphones and tablets - Task 4
Laptop computers placed on the market	54,326,823	Eurostat (2018) PRODCOM data on laptop computers
Chargers placed on the market	267,092,523	Deloitte calculation based on Mobile phones, Tablets and Laptops volumes
EEE repaired over lifetime		
Mobile phones repaired	2%	European Commission (2020b), Ecodesign preparatory study on mobile phones, smartphones and tablets - Task 5
Tablets repaired	2%	European Commission (2020b), Ecodesign preparatory study on mobile phones, smartphones and tablets - Task 5
Laptop computers repaired	9%	European Commission (2017), Preparatory Study on the Review of Regulation 617/2013 for Computers, Task 5-6
Chargers repaired	0%	Teqcycle interview (2020)
EEE hoarded (as a percentage of devices reaching end of first lifetime: PoM + average first lifetime) :		
Mobile phones in hibernation	49%	Cordella et al. (2020), JRC Technical Report: Guidance for the Assessment of Material Efficiency: Application to Smartphones
Tablets in hibernation	49%	Same as mobile phones
Laptop computers in hibernation	61%	European Commission (2017), Preparatory Study on the Review of Regulation 617/2013 for Computers, Task 3
Chargers in hibernation	49%	European Commission (2019b), Impact assessment study on common chargers of portable devices.
Waste EEE collection (as a percentage of devices reaching end of first lifetime: PoM + average first lifetime)		
Mobile phones waste collection	20%	Average between EMF (2020) and European Commission (2020) Ecodesign Task 3 values, verified by AFNUM (2019) range
Tablets waste collection	20%	Same as mobile phones
Laptop computers waste collection	19%	European Commission (2017), Preparatory Study on the Review of Regulation 617/2013 for Computers, Task 3
Chargers waste collection	23%	European Commission (2019b), Impact assessment study on common chargers of portable devices p.171

Product / value chain step	Baseline Value	Source
Waste EEE collection: WEEE separate collection (as a percentage of devices reaching end of first lifetime: PoM + average first lifetime)		
Mobile phones separate collection	12%	Sum of recycled and prepared for re-use mobile phones (see below)
Tablets separate collection	12%	Sum of recycled and prepared for re-use tablets (see below)
Laptop computers separate collection	16%	Sum of recycled and prepared for re-use laptops (see below)
Chargers separate collection	19%	Sum of recycled and prepared for re-use chargers (see below)
WEEE separate collection: WEEE recycled (as a percentage of devices reaching end of first lifetime: PoM + average first lifetime)		
Mobile phones recycled	10%	Circle economy (2020), Exploring the global environmental and socio-economic effects of pursuing a circular economy, cross-checked with AFNUM (2019)
Tablets recycled	10%	Same as mobile phones
Laptop computers recycled	16%	Ratio based on Eurostat WEEE Collected / Recycled: tab Data_Eurostat (2018)
Chargers recycled	19%	European Commission (2019), Impact assessment study on common chargers of portable device
WEEE separate collection: WEEE prepared for re-use (as a percentage of devices reaching end of first lifetime: PoM + average first lifetime)		
Mobile phones prepared for re-use	2%	Ecosystem website: https://telephone-portable.ecosystem.eco/ (2020)
Tablets prepared for re -use	2%	Same as mobile phones
Laptop computers prepared for re-use	0%	Deloitte assumption (2020)
Chargers prepared for re-use	0%	Teqcycle interview (2020)
Waste EEE collection: WEEE unidentified (incl. illegal export) (as a percentage of devices reaching end of first lifetime: PoM + average first lifetime)		
WEEE collection: Mobile phones unidentified (most probably illegal export)	8%	Subtraction, validated with AFNUM (2019) and Circle Economy (2020) ranges
WEEE collection: Tablets unidentified (most probably illegal export)	8%	Subtraction
WEEE collection: Laptop computers unidentified (most probably illegal export)	3%	Subtraction
WEEE collection: Chargers unidentified (most probably illegal export)	4%	Subtraction
EEE re-used (from EEE stream only, not prepared for re-use) (as a percentage of devices reaching end of first lifetime: PoM + average first lifetime)		
Mobile phones re-used (from EEE stream only, not prepared for re-use)	18%	AFNUM (2019), Étude du marché et parc de téléphones portables français en vue d'augmenter durablement leur taux de collecte

Product / value chain step	Baseline Value	Source
Tablets re-used (from EEE stream only, not prepared for re-use)	18%	Same as mobile phones
Laptop computers re-used (from EEE stream only, not prepared for re-use)	14%	European Commission (2017), Preparatory Study on the Review of Regulation 617/2013 for Computers and Computer Servers
Chargers re-used (from EEE stream only, not prepared for re-use)	17%	European Commission (2019b), Impact assessment study on common chargers of portable devices p.171
WEEE discarded in household bin (as a percentage of devices reaching end of first lifetime: PoM + average first lifetime)		
Mobile phones discarded in household bin	1%	AFNUM (2019), Étude du marché et parc de téléphones portables français en vue d'augmenter durablement leur taux de collecte
Tablets discarded in household bin	1%	AFNUM (2019), Étude du marché et parc de téléphones portables français en vue d'augmenter durablement leur taux de collecte
Laptop computers discarded in household bin	1%	European Commission (2017), Preparatory Study on the Review of Regulation 617/2013 for Computers
Chargers discarded in household bin	7%	European Commission (2019b), Impact assessment study on common chargers of portable devices
EEE exported (as a percentage of devices reaching end of first lifetime: PoM + average first lifetime)		
Mobile phones exported	12%	Subtraction, verified by AFNUM (2019) and Circle Economy (2020) studies
Tablets exported	12%	Subtraction
Laptop computers exported	5.5%	Subtraction
Chargers exported	4%	Subtraction

Estimated hoarding time (median)	1.5 years	Anthesis (2020) Electrical Waste - challenges and opportunities
% equipment that leaves hoarding at end of avg hoarding time	20%	Deloitte assumption (2020)

Devices characteristics:		
Average first lifetime of a mobile phone[92]	2.2 years	Kantar Worldpanel (2017) "An Incredible Decade for the Smartphone: What's Next?''
Average first lifetime of a tablet[93]	3 years	European Commission (2017), Preparatory Study on the Review of Regulation 617/2013 for Computers and Computer Servers, Task 3

[92] Average first lifetime of a mobile phone equates to the average replacement cycle estimated in five European countries (France, Germany, UK, Italy and Spain)

[93] Average first lifetime of tablet, laptops and chargers are assumed to correspond to the average replacement cycle, stemming from the EC Preparatory Study on the Review of Regulation 617/2013 for Computers and Computer Servers, as they are lower than the average replacement cycles in the US estimated by Statista (2020), Personal electronics devices replacement cycle lengths forecast in the United States from 2019 to 2024.

Devices characteristics:		
Average first lifetime of a laptop computer	5 years	European Commission (2017), Preparatory Study on the Review of Regulation 617/2013 for Computers and Computer Servers, Task 3
Average first lifetime of a charger	10 years	European Commission (2019b), Impact assessment study on common chargers of portable devices

Mobile phone weight	164 g	European Commission (2020), Ecodesign preparatory study, Task 4
Tablet weight	530 g	European Commission (2020), Ecodesign preparatory study, Task 4
Laptop computer weight	1930 g	Tecchio et al. (2018) , JRC Technical Report: Analysis of material efficiency aspects of personal computers product group
Charger weight	93 g	Weighted average of mobile phones, tablets and laptops chargers weights (based on PoM data): European Commission (2019b), Impact assessment study on common chargers of portable devices,

7.5.2 Environmental, Economic and Social impacts hypotheses

Main hypotheses:

- Recycled quantities generated (kg/unit):
  - Average material composition of the devices[94] times the recycling rate (in %) of each material determined from various sources:
    - 80-99% recovery rate for gold, palladium, silver, copper, nickel, lead, antimony, and tin (Navazo *et al.*, 2014)
    - 90% recovery rate for Cobalt (~14% of Li-ion battery) (European Commission, 2016)
    - 98% recycling rate for aluminium (European Commission, 2016)
    - 50% zinc, plastics recycled (European Commission, 2016)
    - 0% recovery rates for Magnesium, Iron, Glass (European Commission, 2016)
- Revenue generated:
  - Re-use revenue (€/unit): determined using average device price (€) identified in the baseline, to which is applied the average % resell reduction estimated using Backmarket data (2021). It is applied to all devices resold for re-use (including refurbishment and remanufacturing).
  - Recycling revenue (€/unit): determined by multiplying average metals price (sources: average 20 years price (€/kg) for Al, Fe, Cu, Pb, Sn, Ni, Zn, Au, Pt, Ag from the World Bank Commodity Markets database (2020) and average price (€/kg) for Pd, Co, Li from the EESC (2019), Identifying the impact of the circular economy on the Fast-Moving Consumer Goods Industry) by the estimated quantities of metals recycled by unit.
- GHG emissions ($kgCO_2eq$/unit):
  - It was assumed that for each re-used equipment, the emissions saved equated to the CO_2e emissions of Production – (CO_2e emissions of the battery + of the screen production) of each device along its lifecycle to reflect the repair activity often associated with re-use (corresponding sources listed in Table 33 alongside each device and value chain step).
  - For each recycled equipment, the emissions saved corresponded to the difference between the CO_2e emissions of the primary material production and of the secondary material production, applied to the amount of each material effectively recycled in each device (corresponding sources listed in Table 33 alongside each device and value chain step).
- Jobs creation:
  - Collection jobs created (#Jobs/t collected): determined using the number of jobs in the French WEEE collection & treatment sector applied to the tons collected and treated per year (Ecologie.gouv, 2021) The % share of jobs dedicated to collection is then applied (Ecologic, 2013).
  - Repair & re-use jobs created (€Jobs/units repaired): estimation of the number of jobs required per units refurbished per year determined from the sources indicated in the table below

[94] Mobile phones: EESC, 2019; Tablets: European Commission (2020b), Eco-Design Task 4;; Laptops: Tecchio *et al.* (2018))(2018) cross-checked with Park et al, Evaluation of Recycling Resources in Discarded Information and Communication Technology Devices (Smartphones, Laptop computers), Chargers: European Commission (2019b))

- Recycling jobs created (#Jobs/t collected): determined using the number of jobs in the French WEEE collection & treatment sector applied to the tons collected and treated per year (Ecologie.gouv, 2021) The % share of jobs dedicated to recycling is then applied (Ecologic, 2013)

Table 34: Main indicators used to quantify the environmental, social and economic impacts of each policy scenario

Relevant indicators	Sub-indicator (value chain step)	Sub-indicator (type of equipment)	Data	Unit	Data source
• Revenue generated	Re-use revenue generated	Phone	194.7	€/unit	European Commission (2020), Ecodesign Preparatory Study Task 2 + Backmarket data (2021)
		Tablet	209.5	€/unit	European Commission (2020), Ecodesign Preparatory Study Task 2 + Backmarket data (2021)
		Laptop	576.7	€/unit	European Commission (2017), Preparatory Study on the Review of Regulation 617/2013 for Computers, Task 2 + Backmarket data (2021)
		Chargers	24.7	€/unit	Backmarket data (2021)
	Recycling revenue generated	Phone	1.6	€/unit	World Bank (2020), EESC (2019), Identifying the impact of the circular economy on the Fast-Moving Consumer Goods Industry
		Tablet	2.1	€/unit	World Bank (2020), EESC (2019), Identifying the impact of the circular economy on the Fast-Moving Consumer Goods Industry
		Laptop	4.5	€/unit	World Bank (2020), EESC (2019), Identifying the impact of the circular economy on the Fast-Moving Consumer Goods Industry
		Charger	0.8	€/unit	World Bank (2020), EESC (2019), Identifying the impact of the circular economy on the Fast-Moving Consumer Goods Industry
• Quantities of recycled materials (plastics and metals)	Recycled material	Phone	0.08	kg/unit	EESC (2019), Identifying the impact of the circular economy on the Fast-Moving Consumer Goods Industry
		Tablet	0.12	kg/unit	European Commission (2020b), Ecodesign preparatory study on mobile phones, smartphones and tablets , Ecodesign Task 4 (from Manhart et al. (2016))
		Laptop	0.85	kg/unit	Tecchio et al. (Tecchio et al. (2018), JRC Technical Report:

Relevant indicators	Sub-indicator (value chain step)	Sub-indicator (type of equipment)	Data	Unit	Data source
					Analysis of material efficiency aspects of personal computers product group + Cross checked with Park et al (2018), Evaluation of Recycling Resources in Discarded Information and Communication Technology Devices (Smartphones, Laptop computers)
		Charger	0.029	kg/unit	European Commission (2019b), Impact assessment study on common chargers of portable devices
• Greenhouse Gas (GHG) emissions	Mobile phone GHG emissions	Mobile phone production	27.7	$kgCO_2e$/unit	European Commission (2020), Ecodesign Preparatory Study Task 5: Mid-range smartphone
		Mobile phone distribution	8.7	$kgCO_2e$/unit	
		Mobile phone use	11.3	$kgCO_2e$/unit	
		Mobile phone disposal	0.1	$kgCO_2$ /unit	
		Mobile Phone re-use	-24.5	$kgCO_2e$/unit	Estimate based on (1) %GHG emissions linked to battery and screen production (Ercan (2016), Life Cycle Assessment of a Smartphone) applied to the (2) production emissions determined in EC (2020), Ecodesign Preparatory Study Task 5: Mid-range smartphone
		Mobile phone recycling	-1.22	$kgCO_2e$/unit	Estimate based on virgin vs. recycled kgCO2e of the different materials from: European Commission (2014), Study on collection rates of waste electrical and electronic equipment (WEEE) and BIR (2008), CO2 report
	Tablet GHG emissions	Tablet production	37.2	$kgCO_2e$/unit	European Commission (2020), Ecodesign Preparatory Study Task 5: Tablet
		Tablet distribution	9.1	$kgCO_2e$/unit	
		Tablet use	17.2	$kgCO_2e$/unit	
		Tablet disposal	0.2	$kgCO_2e$/unit	
		Tablet re-use	-32.9	$kgCO_2e$/unit	Estimate based on (1) %GHG emissions linked to battery and screen production (Ercan (2016) Life Cycle Assessment of a Smartphone) applied to the (2) production emissions determined in EC, Ecodesign Preparatory Study Task 5: Tablet p.70 (2020)
		Tablet recycling	-1.74	$kgCO_2e$/unit	Estimate based on virgin vs. recycled kgCO2e of the different materials from: European Commission (2014), Study on collection rates of waste electrical and electronic

Relevant indicators	Sub-indicator (value chain step)	Sub-indicator (type of equipment)	Data	Unit	Data source
					equipment (WEEE) and BIR (2008), CO2 report
	Laptop GHG emissions	Laptop production	64.2	kgCO_2e/unit	Based on total Laptop embodied GHG emissions (from EC Preparatory Study on the Review of Regulation 617/2013 for Computers, Task 5-6), calculated along the value chain according to the Tablet LCA
		Laptop distribution	15.7	kgCO_2e/unit	
		Laptop use	29.7	kgCO_2e/unit	
		Laptop disposal	0.4	kgCO_2e/unit	
		Laptop re-use	-56.8	kgCO_2e/unit	Estimate based on (1) %GHG emissions linked to battery and screen production (Ercan (2016) Life Cycle Assessment of a Smartphone) applied to the (2) production emissions determined above
		Laptop recycling	-6.8	kgCO_2e/unit	Estimate based on virgin vs. recycled kgCO2e of the different materials from: European Commission (2014), Study on collection rates of waste electrical and electronic equipment (WEEE) and BIR (2008), CO2 report
	Charger GHG emissions	Charger production	1.93	kgCO_2e/unit	European Commission (2019b), Impact assessment study on common chargers of portable devices
		Charger distribution	1.39	kgCO_2e/unit	
		Charger disposal	0.02	kgCO_2e/unit	
		Charger disposal	-1.7	kgCO_2e/unit	Estimate based on (1) %GHG emissions linked to battery and screen production (Ercan (2016) Life Cycle Assessment of a Smartphone) applied to the (2) production emissions determined in European Commission (2019b), Impact assessment study on common chargers of portable devices
		Charger re-use	-0.11	kgCO_2e/unit	Estimate based on virgin vs. recycled kgCO_2e of the different materials from: European Commission (2014), Study on collection rates of waste electrical and electronic equipment (WEEE) and BIR (2008), CO_2 report
• Job creation	Collection jobs	All	1.80E-03	jobs/t collected	Ecologie.gouv (2021), Déchets d'équipements électriques et électroniques Ecologic (2013), Une filière créatrice d'emplois
	Repair & re-use jobs	Phone	0.0008	jobs/unit	EESC (2019), Identifying the impact of the circular economy on the Fast-Moving Consumer Goods Industry
		Tablet	0.0008	jobs/unit	EESC (2019), Identifying the impact of the circular economy on the Fast-Moving Consumer Goods Industry

7.5.3 Policy actions scenarios hypotheses

For each policy action for which a quantitative impact assessment is conducted, modelling hypotheses are presented in separate tables regarding:

- Policy action timeline and resulting flows, including the decrease of existing flows (hoarding, devices sent to household bi…), and the increase in other flows (re-use, recycling, etc.) resulting from the policy action;
- Policy action costs.

N.B. Precision in the definitions:

- Hoarded: **flow** of devices which is 'in drawers' (i.e. kept dormant, unused in households) by their owners at the end of their lifetime;
- In hibernation: **stock** of devices accumulated in hibernation (i.e. kept dormant, unused in households) at a given time.

While devices 'in hibernation' refers to the total stock of devices accumulated after several years, 'hoarded' devices refers to devices sent to this stock at each modelled period of time in the impact assessment.

7.5.3.1 Financial Incentives

Policy timeline & resulting flows				
	Min	**Hypothesis source (min)**	**Max**	**Hypothesis source (max)**
# years for policy to be effective	2	Deloitte assumption	2	Deloitte assumption
# years policy will last	3	Deloitte assumption	3	Deloitte assumption
Mobile phone separate collection rate increase	+10%	Proximus "Don't miss the call" initiative[95] (2020): Collection target is 100k devices /year at national scale (PoM in Belgium is 2m devices /year): +5pts collection rate in 2020 = +20% collection rate at EU level Min: +10% collection rate increase	+30%	Proximus "Don't miss the call" initiative (2020): Collection target is 100k devices /year at national scale (PoM in Belgium is 2m devices /year): +5pts collection rate in 2020 = +20% collection rate at EU level Max: +30% collection rate increase
Tablet separate collection rate increase	+10%	Same as mobile phones	+30%	Same as mobile phones

[95] See section 3.3

Policy timeline & resulting flows				
Laptop separate collection rate increase	+10%	Same as mobile phones	+30%	Same as mobile phones
Charger separate collection rate increase	-	*Not impacted by policy*	-	*Not impacted by policy*

	Total In hibernation (already in stock)	**End of Life**		
		Hoarded (in coming flow)	**Discarded in Household bin**	**Exported**
Separate collection rate increase comes from[96]	50%	30%	10%	10%

	Recycled	**Preparation for re-use**	
		Prepared for re-use	**Source of hypothesis**
Separate collection stream goes to	80%	20%	Ecosystem "Je donne mon téléphone" initiative[97] (2020). Average 20% re-use: level at beginning of policy implementation

Policy additional costs				
	Min	**Source**	**Max**	**Source**
Financial reward per mobile phone & tablet (€/unit collected)	5	Proximus "Don't miss the call" initiative[98] (2020): Minimum Financial reward of 5€ for mobile phones	22	Shift GmbH initiative (2018) from European Commission (2020b), Ecodesign preparatory study on mobile phones, smartphones and tablets: Financial reward of 22 € for mobile phones
Financial reward per laptop (€/unit collected)	17	Extrapolation based on mobile phones Financial reward (min), the average mobile phone price and the average laptop price	75	Extrapolation based on mobile phones Financial reward (max), the average mobile phone price and the average laptop price
National communication campaign (€/year)	11,194,030	AFNUM (2019): National communication campaign: 1m€/year	11,194,030	AFNUM (2019):

[96] Ecosystem "Je donne mon téléphone" initiative from section 3.3., Deloitte assumption (2021)

[97] See section 3.3.

[98] See section 3.3

		in France extrapolated to the EU population		National communication campaign: 1m €/year in France extrapolated to the EU population

7.5.3.2 Door-to-door and postal services

Policy timeline & resulting flows				
	Min	**Hypothesis source (min)**	**Max**	**Hypothesis source (max)**
# years for policy to be effective	2	Deloitte assumption	2	Deloitte assumption
# years policy will last	10	Max numbers of years in modelling	10	Max numbers of years in modelling
Mobile phone separate collection rate increase	+7%	Ecosystem "Je donne mon téléphone" initiative (2020): Target: 57k phones/yr. collected vs. 400k /yr. currently collected by approved collection (AFNUM, 2019) = +14.2% collection increase Min: +7% collection increase	+21%	Ecosystem "Je donne mon téléphone" initiative (2020): Target: 57k phones/yr. collected vs. 400k /yr. currently collected by approved collection (AFNUM, 2019) = +14.2% collection increase Max: +21% collection increase
Tablet separate collection rate increase	+7%	Same as mobile phones	+21%	Same as mobile phones
Laptop separate collection rate increase	-	Not impacted by policy	-	Not impacted by policy
Charger separate collection rate increase	+7%	Same as mobile phones	+21%	Same as mobile phones

	Total In hibernation (already in stock)	**End of life**		
		Hoarded (in coming flow)	**Discarded in Household bin**	**Exported**
Separate collection rate increase comes from[99]	50%	30%	10%	10%

	Recycled	**Preparation for re-use**	
		Prepared for re-use	**Source of hypothesis**

[99] Ecosystem "Je donne mon téléphone" initiative from section 3.3., Deloitte assumption (2021)

Separate collection stream goes to	80%	20%	Ecosystem "Je donne mon téléphone" initiative (2020). Average 20% re-use: level at beginning of policy implementation
Separate collection stream goes to	40%	60%	O3-Wundertüte initiative (2020): Level reached upon policy maturity
AVERAGE	**60%**	**40%**	

Policy additional costs				
	Min	**Source**	**Max**	**Source**
Prepaid postal (€/unit sent for collection)	2	AFNUM (2019): Simplified collection system via La Poste: 2€ negotiated price for prepaid envelopes N.B. This is a lower bound estimation, as the Seiffi Service Finnish initiative indicates a price of 4.9€ per prepaid envelope[100]	2	AFNUM (2019): Simplified collection system via La Poste: 2 € negotiated price for prepaid envelopes N.B. This is a lower bound estimation, as the Seiffi Service Finnish initiative indicates a price of 4.9 € per prepaid envelope[101]
National communication campaign (€/year)	11,194,030	AFNUM (2019): National communication campaign: 1m€/year in France extrapolated to the EU population	11,194,030	AFNUM (2019): National communication campaign: 1m €/year in France extrapolated to the EU population

7.5.3.3 Targets for re-use

Policy timeline & resulting flows				
	Min	**Hypothesis source (min)**	**Max**	**Hypothesis source (max)**
# years for policy to be effective	6	Delanoeije J., Bachus K. (2020), *Re-use. The understudied circular economy strategy*: Time allocated to reach the target	6	Delanoeije J., Bachus K. (2020), *Re-use. The understudied circular economy strategy:* Time allocated to reach the target
Mobile phone re-use rate increase	+6 pts	Delanoeije J., Bachus K. (2020): Re-use rate increases by 40%. Minimum: 30%.	+12 pts	Delanoeije J., Bachus K. (2020): Re-use rate augments by 40%. Maximum: 60%.

[100] SEIFFI - Datalaitteiden tietoturvallinen kierrätyspalvelu. Available at : https://seiffi.fi/

[101] SEIFFI - Datalaitteiden tietoturvallinen kierrätyspalvelu. Available at : https://seiffi.fi/

Tablet re-use rate increase	+6 pts	Delanoeije J., Bachus K. (2020): Re-use rate increases by 40%. Minimum: 30%.	+12 pts	Delanoeije J., Bachus K. (2020): Re-use rate increases by 40%. Maximum: 60%.
Laptop re-use rate increase	-	Not impacted by policy as laptops are not re-used from collection	-	Not impacted by policy as laptops are not re-used from collection
Charger re-use rate increase	-	Not impacted by policy as chargers are not re-used from collection	-	Not impacted by policy as chargers are not re-used from collection

	Total In hibernation (already in stock)	**End of life**		
		Hoarded (in coming flow)	**Discarded in Household bin**	**Exported**
Re-use rate increase comes from[102]	0%	56%	0%	44%

	Recycling[103]	**Preparation for re-use**
Separate collection stream goes to	17% to 33%	40% to 70%

Policy additional costs				
	Min	**Source**	**Max**	**Source**
Policy design	negligible	Deloitte assumption	negligible	Deloitte assumption
Administrative costs	15 full time equivalent staff per country for transposition of Directive, supporting materials, staff training and communication activities	IEEP et al. (2015) Study to analyse differences in costs of implementing EU policy	15 full time equivalent staff per country for transposition of Directive, supporting materials, staff training and communication activities	IEEP et al. (2015) Study to analyse differences in costs of implementing EU policy

[102] Deloitte assumption

[103] The recycling stream is temporally cannibalised as reusing a device only shifts in time the recycling process.

Funding from EPR schemes	Approx. 80 M € / year	Assuming that 5% of visible fees are directed to help achieving re-use targets[104], and based on the EPR fees received in France for household WEEE 243 M€ in 2019 by ecosystem (ecosystem, 2019), extrapolated at EU level based on population	Approx. 80 M € / year	Assuming that 5% of visible fees are directed to help achieving re-use targets[105], and based on the EPR fees received in France for household WEEE 243 M€ in 2019 by ecosystem (Ecosystem, 2019), extrapolated at EU level based on population

7.5.3.4 Reduced VAT rates on re-use services

Policy timeline & resulting flows				
	Min	**Hypothesis source (min)**	**Max**	**Hypothesis source (max)**
# years for policy to be effective	4	Deloitte assumption	4	Deloitte assumption
# years policy will last	10	Max numbers of years in modelling	10	Max numbers of years in modelling
Device separate collection rate increase	+6%	Dalhammar et al. (2020) and Deloitte assumption: We assume the increase in re-use rate from collection will source from existing streams (most notably the unidentified (most probably illegal export) and exported streams) rather than expanding separate collection as a whole	+9%	Dalhammar et al. (2020) and Deloitte assumption: We assume the increase in re-use rate from collection will source from existing streams (most notably the unidentified (most probably illegal export) and exported streams) rather than expanding separate collection as a whole
Mobile phone re-use rate increase: both re-use from EEE and re-use from collection	+6%	European Commission (2007b), Study on reduced VAT applied to goods and services in the Member States of the European Union: Using -0.6 price elasticity of demand for audio-visual,	+9%	European Commission (2007b), Study on reduced VAT applied to goods and services in the Member States of the European Union: Using -0.6 price elasticity of demand for audio-visual, photographic and information product segment and assuming a 100% pass-through rate of the VAT on a 15.5% reduction of the VAT from 21.5% to 6%

[104] As set in th French loi AGEC : *article L541-10-5 du code de l'environnement* (Légifrance, 2021)

[105] As set in th French loi AGEC : *article L541-10-5 du code de l'environnement* (Légifrance, 2021)

		photographic and information product segment and assuming a 100% pass-through rate of the VAT on a 9.5% reduction of the VAT from 21.5% to 12%		
Tablet re-use rate increase	+6%	Similar to mobile phones	+9%	Similar to mobile phones
Laptop re-use rate increase	+6%	Similar to mobile phones	+9%	Similar to mobile phones
Charger re-use rate increase	+6%	Similar to mobile phones	+9%	Similar to mobile phones

Repartition of streams to separate collection:

	Total In hibernation (already in stock)	**End of life**		
		Hoarded (in coming flow)	**Discarded in Household bin**	**Exported**
Separate collection rate increase comes from[106]	Same as baseline	Same as baseline	Same as baseline	Same as baseline

Repartition of streams to re-use from collection:

	Recycled	**Unidentified streams (most probably illegal export)**
Preparation for re-use rate increase comes from[107]	10%	90%

Repartition of streams to re-use from EEE:

	Hoarded	**Exported**	**Household bin**
Re-use from EEE rate increase comes from[108]	10%	90%	0%

Policy additional costs				
	Min	**Source**	**Max**	**Source**
Loss of VAT per device re-used (€/unit collected)	(21.5% – 12%)* price of repaired	N.B. Borne by national governments	(21.5% – 6%)* price of repaired /re-used device	N.B. Borne by national governments

[106] Deloitte assumption (2021)

[107] Deloitte assumption (2021)

[108] Deloitte assumption (2021)

	/re-used device			

7.5.3.5 Deposit-refund systems

Policy timeline & resulting flows				
	Min	**Hypothesis source (min)**	**Max**	**Hypothesis source (max)**
# years for policy to be effective	3	Deloitte estimation: Typical DRS take 2-3 years to be implemented (e.g. case of Europe: Scotland announced in May 2019 for implementation in April 2021 (though delayed to 2022 due to Covid), UK announced in 2019 for implementation in 2023…)	3	Deloitte estimation: Typical DRS take 2-3 years to be implemented (e.g. case of Europe: Scotland announced in May 2019 for implementation in April 2021 (though delayed to 2022 due to Covid), UK announced in 2019 for implementation in 2023…)
# years policy will last	10	Max numbers of years in modelling	10	Max numbers of years in modelling
Deposit on mobile phone	15€	Uyttenbroek (2017) The majority of the respondents (64%) are willing to accept a depository fee of €11-15 for mobile phones	22€	Shift GmbH initiative (2018) from European Commission (2020b), Ecodesign preparatory study on mobile phones, smartphones and tablets: Deposit price of 22€ for mobile phones
Mobile phone separate collection rate increase	53% return rate	Uyttenbroek (2017) €11-€15 deposit, 53% respondents would return their mobile phones	71% return rate	Uyttenbroek (2017) €21-€25 deposit, 71% respondents would return their mobile phones
Tablet separate collection rate increase	Like mobile	Deloitte assumption	Like mobile	Deloitte assumption
Laptop separate collection rate increase	Like mobile	Deloitte assumption	Like mobile	Deloitte assumption
Charger separate collection rate increase	Like mobile	Deloitte assumption	Like mobile	Deloitte assumption

	Total In hibernation (stock)	**End of life**		
		Hoarded	**Discarded in Household bin**	**Exported**
Collection rate increase comes from (European	0%	85%	1%	14%

Commission, 2020b)				

	Recycled	**Prepared for re-use**
Separate collection stream goes to (European Commission, 2020b)	50%	50%

Policy additional costs				
	Min	**Source**	**Max**	**Source**
Costs per unit returned (€/ unit returned)	0.5	European Commission (2020b), Ecodesign preparatory study on mobile phones, smartphones and tablets – Task 6	0.5	European Commission (2020b), Ecodesign preparatory study on mobile phones, smartphones and tablets – Task 6

7.5.3.6 Data privacy certification scheme

Policy timeline & resulting flows				
	Min	**Hypothesis source (min)**	**Max**	**Hypothesis source (max)**
# years for policy to be effective	4	Deloitte assumption: development and application of a standard	4	Deloitte assumption: development and application of a standard
% of consumers receptive to the policy	20%	Deloitte assumption	50%	Deloitte assumption
Mobile phone separate collection rate increase (after policy time)	+1pts	AFNUM (2019), Étude téléphones portables – supplementary information p55 consumer survey: 12% of consumers assert that such a standard will convince them to give their equipment away	+3pts	AFNUM (2019), Étude téléphones portables – supplementary information p55 consumer survey: 12% of consumers assert that such a standard will convince them to give their equipment away
Tablet separate collection rate increase	+1pts	AFNUM (2019), Étude téléphones portables	+3pts	AFNUM (2019), Étude téléphones portables
Laptop separate collection rate increase	+1pts	Kiyo Kurisu & al. (2020) Hibernating behaviour for household personal computers	+30%	Kurisu, K. & al. (2020) Hibernating behaviour for household personal computers

Charger separate collection rate increase	0pts	Not impacted as there is no data privacy concerns with chargers	0pts	Not impacted as there is no data privacy concerns with chargers

	Total In hibernation (already in stock)	**End of life**		
		Hoarded (in coming flow)	**Discarded in Household bin**	**Exported**
Separate collection rate increase comes from	The ratio of equipment exiting hibernation augments by the same percentage as collection as people receptive to the policy will be inclined to get their equipment out of hibernation	100%	0%	0%

	Recycled	**Preparation for re-use**
Separate collection stream goes to	*Same as baseline*	*Same as baseline*

Policy additional costs				
	Min	**Source**	**Max**	**Source**
Standard development cost	N/A	No credible estimate could be determined on standard development cost	N/A	No credible estimate could be determined on standard development cost
Standard implementation cost	8.4 M€ / year	Extrapolation at EU level based on the cost for 27 re-use centers in Flanders (Delanoije et Bachus, 2020), and the resources needed for implementing the certification scheme per year, approximately 20 days/year (Deloitte assumption), At an average labour cost in the EU: 28,5 € / h (Eurostat, 2020f), or 228 €/day assuming an 8h workday. Flanders population is 6,6 M hab. and EU is 450 M hab.	8.4 M€ / year	Extrapolation at EU level based on the cost for 27 re-use centers in Flanders (Delanoije et Bachus, 2020), and the resources needed for implementing the certification scheme per year, approximately 20 days/year (Deloitte assumption), At an average labour cost in the EU: 28,5 € / h (Eurostat, 2020f), or 228 €/day assuming an 8h workday. Flanders population is 6,6 M hab. and EU is 450 M hab.

Regarding laptops, in the absence of credible feedback on the augmentation of preparation for re-use, we considered, to remain consistent with the baseline that no re-use stream was created from separate collection for laptops.

7.5.3.7 Drop-off points databases

Policy timeline & resulting flows				
	Min	**Hypothesis source (min)**	**Max**	**Hypothesis source (max)**
# years for policy to be effective	2	Deloitte assumption: Duration of a consulting mission + time to raise awareness	2	Deloitte assumption: Duration of a consulting mission + time to raise awareness
% of consumers receptive to the policy	20%	Deloitte assumption	50%	Deloitte assumption
Mobile phone separate collection rate increase (after policy time)	+1pts	AFNUM (2019), Étude du marché et parc de téléphones portables français en vue d'augmenter durablement leur taux de collecte: Supplementary information p55 consumer survey: 12% of consumers assert that such a standard will convince them to give their equipment away	+3pts	AFNUM (2019): AFNUM (2019):Supplementary information p55 consumer survey: 12% of consumers assert that such a standard will convince them to give their equipment away
Tablet separate collection rate increase	+1pts	AFNUM (2019)	+3pts	AFNUM (2019)
Laptop separate collection rate increase	+3pts	Kiyo Kurisu & al. (2020): Hibernating behaviour for household personal computers	+7pts	Kiyo Kurisu & al. (2020): Hibernating behaviour for household personal computers
Charger separate collection rate increase	+1pts	AFNUM (2019), Étude téléphones portables	+3pts	AFNUM (2019)

	Total In hibernation (already in stock)	**End of life**		
		Hoarded (in coming flow)	**Discarded in household bin**	**Exported**
Separate collection rate increase comes from	The ratio of equipment exiting hibernation augments by the same percentage as collection as people	100%	0%	0%

	receptive to the policy will be inclined to get their equipment out of hibernation			

	Recycled	**Re-use from Collection**
Separate collection stream goes to	*Same as baseline*	*Same as baseline*

Policy additional costs				
	Min	**Source**	**Max**	**Source**
Cost of creating database (€)	100 000	Deloitte estimation: Cost of a consulting mission	120 000	Deloitte estimation: Cost of a consulting mission
Cost of updating database (€/year)	50 000	Deloitte estimation	60 000	Deloitte estimation
National communication campaign (€/year)	11,194,030	AFNUM (2019): National communication campaign: 1m€/year in France extrapolated to the EU population	11,194,030	AFNUM (2019): National communication campaign: 1m€/year in France extrapolated to the EU population

Regarding laptops, in the absence of credible feedback on the increase of preparation from re-use we decided to remain consistent with the baseline and considered that no re-use stream was created from the separate collection of laptops.

7.5.3.8 Personalised EoL information

Policy timeline & resulting flows				
	Min	**Hypothesis source (min)**	**Max**	**Hypothesis source (max)**
# years for policy to be effective	4	Deloitte assumption	4	Deloitte assumption
% of consumers receptive to the policy	25%	Deloitte assumption	75%	Deloitte assumption
Mobile phone separate collection rate increase	+2pts	AFNUM (2019), Étude du marché et parc de téléphones portables français en vue d'augmenter durablement leur taux de collecte: Supplementary information p.55 consumer survey: 14% of consumers assert that such a standard will convince them to give their equipment away	+5pts	AFNUM (2019): AFNUM (2019): Supplementary information p.55

Tablet separate collection rate increase	+2pts	AFNUM (2019): Supplementary information p.55	+5pts	AFNUM (2019)
Laptop separate collection rate increase	+5pts	Kiyo Kurisu & al. (2020): Hibernating behaviour for household personal computers	+14pts	Kurisu, K.al. (2020): Hibernating behaviour for household personal computers
Charger separate collection rate increase	+2pts	AFNUM (2019): Supplementary information p.55 (Deloitte assumption: can be extended to chargers)	+5pts	AFNUM (2019): Supplementary information p.55 (Deloitte assumption: can be extended to chargers)

	Total In hibernation (already in stock)	**End of life**		
		Hoarded (in coming flow)	**Discarded in household bin**	**Exported**
Separate collection rate increase comes from	The ratio of equipment exiting hibernation augments by the same percentage as collection as people receptive to the policy will be inclined to get their equipment out of hibernation	100%	0%	0%

	Recycled	**Re-use from Collection**
Separate collection stream goes to	*Same as baseline*	*Same as baseline*

Policy additional costs				
	Min	**Source**	**Max**	**Source**
Cost of creating database (€)	100 000	Deloitte estimation: Cost of a consulting mission	120 000	Deloitte estimation: Cost of a consulting mission
Cost of updating database (€/year)	50 000	Deloitte estimation	60 000	Deloitte estimation
National communication campaign (€/year)	11,194,030	AFNUM (2019): National communication campaign: 1m€/year in France extrapolated to the EU population	11,194,030	AFNUM (2019): National communication campaign: 1m€/year in France extrapolated to the EU population

Technical information gathering from equipment (€/year)	130 000	AFNUM (2019): French OPEX multiplied by population ratio	130 000	AFNUM (2019): French OPEX multiplied by population ratio

Regarding laptops, in the absence of credible feedback on the increase of preparation for re-use, we decided to remain consistent with the baseline and considered that no re-use stream was created from the separate of collection of laptops.

7.6 Stakeholder consultation

The following paragraphs provide information regarding the organisation and implementation of the stakeholder consultation activities. The results of these consultations are directly provided under the relevant section of the report, in line with their main aim as indicated in Table 35 below.

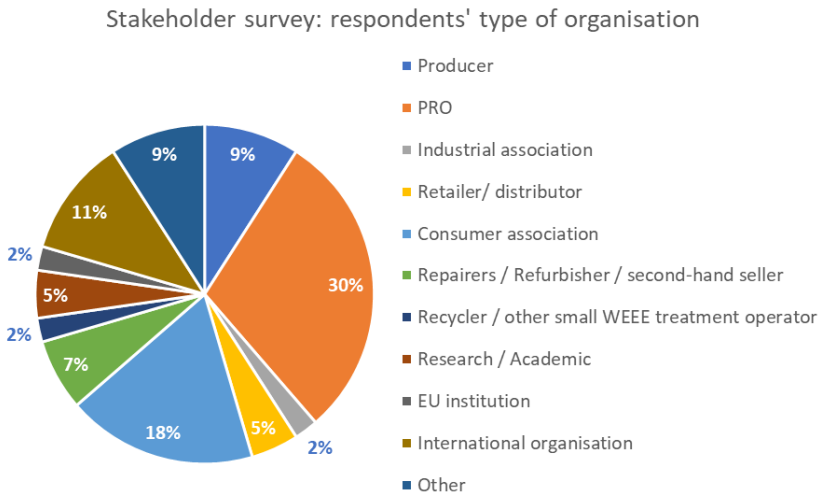
Table 35: Stakeholder consultation activities carried out throughout the study

SH consultation	Type	Timeframe	Main aim of consultation	Categories of stakeholders consulted
Online survey for problem definition	Online survey	November 2020	• To address data gaps on problem definition • To gather data on relevant separate collection systems	Producers, Producer Responsibility Organisations (PROs), industrial associations, Retailers/distributors, consumer associations, Refurbishers/second-hand sellers, recyclers / other small WEEE treatment operators, research/academic, EU institutions, international organisations
Focus group with Producer Responsibility Organisations (PROs)	Online meeting	3 December 2020	• To address data gaps on problem definition • To gather data on relevant separate collection systems • To gather information on potential EU-level measures	Producer Responsibility Organisations (PROs)
Interviews for in-depth assessment of identified initiatives	Telephonic interviews	November-December 2020	• To gather data for factsheets on selected collection systems • To gather data on replicability and scalability of selected collection systems	Organisations managing return systems for small WEEE/EEE in EU, including e.g. refurbishers/second-hand sellers, recyclers, charities/NGOs, service providers etc.
Interviews with experts for possible further actions at EU level	Telephonic interviews	November-December 2020	• To gather information on potential EU-level measures • To address data gaps concerning impacts of identified potential EU-level measures	Experts in the domain of collection (PROs, circular economy experts), and in other sectors (digital, ICT market experts, social science expert).
Workshop with EU Member States	Online workshop	26 February 2021		EU Member States representatives
Final Stakeholder Workshop	Online workshop	19 March 2021		Producers, Producer Responsibility Organisations (PROs), industrial associations, Retailers/distributors, consumer associations, Refurbishers/second-hand sellers, recyclers / other small WEEE treatment operators, research/academic, EU institutions, international organisations

7.6.1 First stakeholder consultation: online survey

During the first stage of the study, 121 stakeholders were selected and invited to participate to an online survey.

Although around 60% of the stakeholders invited started to fill in the questionnaire, the survey was finally submitted by 35% of the invited stakeholders. Most of the stakeholders that completed the survey represent a Producer Responsibility Organisation (PRO) (30% of the stakeholders), followed by consumer associations (18%), international organisations (11%) and producers (9%). 50% of the respondents that completed the survey are active in one EU Member State, while the other 50% has indicated a wider geographical coverage, corresponding to multiple EU Member States, extra-EU countries and in some cases other continents (e.g. Africa, Australia, US).



7.6.2 Focus group with Producer Responsibility Organisations

As part of the stakeholder consultation strategy, on 3 December 2020 a dedicated online focus group took place within the annual Operations Committee Meeting of WEEE Forum. The aim of the focus group was to collect feedback and information from different PROs with regard to the different phases of the study. Around 20 participants/ PROs, all members of WEEE Forum, took part in the meeting.

7.6.3 Interviews for in-depth assessment of identified initiatives

As described in Section 3.3, a number of exemplary return schemes in the countries in scope were selected for further analysis.

7.6.4 Workshop with EU Member States

An online workshop with WEEE experts from EU Member States was organised on 26 February 2021, with the aim of presenting the first results of the study and gather the participants' feedback on the actions proposed, based on their specific experience. In total, 20 Member States attended the workshop.

As a preparatory activity for the workshop, the Member States representatives were asked to fill in a questionnaire. All inputs collected during the workshop and via the received questionnaires were taken into consideration for the definition of proposed policy actions.

Of the presented actions, "drop-off points database" was the one selected by the participants as the most implemented in the various Member States. A detailed combined overview of the actions selected by the stakeholders during the Stakeholder workshop and the Member States workshop is provided in Section 4.2.1.

The Member States indicated the actions "creating the enabling regulatory framework for re-use", "data privacy certification scheme" and "Reduced VAT rates on re-use services" as particularly promising to implement at EU level.

As additional actions to be considered, the participants' input was quite varied, and included e.g. proposals for better collection networks, collection and awareness campaigns, uniform labelling of collection points and product as a service.

Finally, the main challenges highlighted by the Member States for the effective implementation of the take-back obligation as laid down in Article 5(2) of the WEEE Directive, especially with the objective to increase collection of small WEEE, related mostly related to free-riding, in relation to the difference in obligations between brick-and-mortar and online sales.

7.6.5 Stakeholder Workshop

As a final consultation activity, an online stakeholder workshop was organised on 19 March 2021. The aim of the workshop was to provide the stakeholders with further details on the study including the background and the methodology used for the different phases, and to gather their feedback on the proposed list of actions.

In total, 88 stakeholders belonging to collection and recycling organisations, refurbishers and repairers, producers, industry associations, online platforms, retail associations, producer responsibility organisations, Member States representatives, research and academia participated in the workshop.

The stakeholders were invited to select the policy actions which they considered as most feasible and/or more likely to have the greatest impact on the collection of small WEEE/used EEE and to discuss on several aspects such as the expected difficulties of implementation, the impacts, the key success factors and potential synergies with other policy actions. Furthermore, the participants were invited to explore additional options not included in the list proposed by the project team.

Actions selected as most relevant

The proposed policy actions selected as more relevant by the workshop's participants were the following:

- Targets for re-use;
- Creating the enabling regulatory framework for re-use;
- Financial incentives;
- Product passport;
- Drop-off points database;
- Door-to-door and postal services.

A detailed combined overview of the actions selected by the stakeholders during the Stakeholder workshop and the Member States workshop is provided in Section 4.2.1.

Proposed additional actions

The participants identified a number of additional actions as potentially relevant to improve the collection rates of small WEEE, or increase the re-use rate of EEE:

- Extension of the legal guarantee and right to repair: action aimed at increasing the repair rate of devices, to be potentially implemented in combination with the use of the digital receipt;

- Repair funds: to increase repair rates over recycling;
- New or expanded regulation to address the topic of 5G: action aimed at tackling the possibility of an increase of WEEE following the implementation of 5G
- Encourage EU Member States to look into levies and taxes: action aimed at supporting smaller initiatives;
- Addressing legal and economic barriers for transboundary shipments of waste: action aimed at enabling global programmes;
- Ensuring that refurbishment companies also consider low value equipment: action aimed at strengthening the recycling component and addressing both valuable and non-valuable products;
- Leasing/ renting model: to facilitate the collection of EoL devices and incentivise producers to make long lasting products;
- Market intelligence actions such as 1)Targets focusing on specific products: action aimed at encouraging more fit for purpose approaches, focused on products that need to be supported and excluding those that already flow on the market; 2) Gather a clearer understanding of the WEEE/EEE flows to identify areas where to act as a priority;
- New calculation for the amount of waste generated, taking into account exported devices as not being waste generated in Europe and household storage of EEE.

The specific stakeholders' feedback and inputs gathered during the workshop have been of high importance for the definition of the proposals for further action at EU level and are described in the relevant parts of Section 4.

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