Ecodesign preparatory study on mobile phones, smartphones and tablets

Final Task 7 Report

Scenarios

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CONTENT

FIGURES

TABLES

1. GLOSSARY

Term	Definition
BAT	Best Available Technologies
BNAT	Best Not yet Available Technologies
BOM	Bill-of-Materials
CO2	Carbon Dioxide
CPU	Central Processing Unit
DECT	Digital Enhanced Cordless Telecommunications
DRAM	Dynamic Random Access Memory
EN	European Norm
EoL	End of Life
EU	European Union
GaAs	Gallium Arsenide
GB	Gigabyte
GPU	Graphics Processing Unit
HD	High Definition
Hz	Hertz
IC	Integrated Circuit
ICT	Information and Communications Technology
IP	Internet Protocol
IP	Ingress protection
ISO	International Organization for Standardization
JRC	Joint Research Centre
kWh	Kilowatt Hour
LCA	Life Cycle Assessment
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LIB	Lithium-Ion Battery
LLCC	Least Life Cycle Cost
mAh	Milliampere Hour
MEErP	Methodology for the Ecodesign of Energy-related Products
NAND	Not And
NiMH	Nickel-Metal Hydride
OEM	Original Equipment Manufacturer
OLED	Organic Light Emitting Diode
PC	Polycarbonate
PCB	Printed Circuit Board
PCR	Post Consumer Recycled
PoP	Package-on-Package
PSU	Power-Supply Unit
RAM	Random-Access Memory
RF	Radio Frequency
RJ	Registered Jack
SD	Secure Digital
SDHC	Secure Digital High Capacity

Term	Definition
SDRAM	Synchronous Dynamic Random Access Memory
SDXC	Secure Digital Extended Capacity
SMD	Surface Mounted Devices
SME	Small and Medium Enterprise
SoC	System-on-Chip
SOC	State Of Charge
TB	Terrabyte
TWh	Terrawatt Hour
USB	Universal Serial Bus
V	Volt
W	Watt
WEEE	Waste Electrical and Electronic Equipment

2. INTRODUCTION

Preparatory studies aim to assess and specify generic or specific ecodesign measures for improving the environmental performance of a defined product group, sometimes in combination with energy label criteria. The ecodesign preparatory studies therefore provide the scientific foundation for defining these generic and/or specific ecodesign requirements as well as energy labelling criteria. The overall objective is to clearly define the product scope, analyse the current environmental impacts of these products and related systems (extended product scope) and assess the existing improvement potential of any measures. The central element of the MEErP (Kemna 2011; Mudgal et al. 2013), being the underlying assessment methodology, is to prioritise today's possible improvement options from a Least Life Cycle Cost (LLCC) perspective. Identification of the improvement options are based on possible design innovations, Best Available Technologies (BAT) for the short term and Best Not yet Available Technologies (BNAT) for long term, that can help in mitigating the impacts of these products. Policy options are assessed through a scenario analysis and the different outcomes have to be evaluated from the perspective of the EU targets, taking into account potential impacts on the competitiveness of enterprises in the EU and on the consumers.

Objective: This task puts the results of the study in the overall policy context of the Ecodesign and Energy Labelling Directives, summarises the outcomes of previous tasks and derives options for generic and/or specific Ecodesign and Energy label requirements. It looks at suitable policy means to achieve the potential (e.g. implementing "LLCC option" as a minimum and "BAT option" as a promotional target). It draws up scenarios quantifying the improvements that can be achieved compared to a Business-as-Usual scenario. It also compares the outcomes with EU environmental targets and the societal costs if the environmental impact reduction would have to be achieved in another way. It makes an estimate of the impact on consumers (purchasing power) and industry (employment, competitiveness, investment level, etc.) as described in Annex 2 of the Directive, taking into account the typical redesign cycle (platform change) in the product sector.

3. SUBTASK 7.1 – POLICY ANALYSIS

The policy analysis considers the outcomes of all previous tasks and has the objective to outline eco-design requirements including respective framework conditions such as measurement standards. With respect to mobile phones, smartphones and tablets the following policy options seem feasible:

- Option 1: "No action" (i.e. business as usual)
- Option 2: Self-regulation (if proposed by an interested party)
- Option 3: Introduction of mandatory specific and/or generic ecodesign requirements (according to Annex I and/or Annex II of the Ecodesign Directive 2009/125/EC)
- Option 4: Energy Labelling according to the Energy Labelling Regulation 2017/1369
- Option 5: Ecodesign requirements combined with Energy Labelling.

The following analysis uses the term "feature phone" to be consistent with the Base Case terminology. In a legal context it is proposed to use the term "mobile phones other than smartphones" instead, to avoid any products to fall out of the scope unintentionally: All "mobile phones" are in the scope, but depending on product characteristics following definitions in task 1, it is either a "smartphone" or a "mobile phone other than smartphone". "Cordless phones" and "tablets" are further sub-categories, not covered by the term "mobile phone".

3.1. Option 1: "No action"

The “no action” option corresponds to the Base Cases assessment in Task 5 (except for France, see below): The current status quo remains unchanged and as the market for mobile phones, smartphones and tablets is largely saturated, the stock scenario as analysed in Task 2 will be the most like future development.

There are some market trends, which point into the direction of better material efficiency, i.e. longer product lifetimes. These trends are (non-exhaustive lists):

- Mature and partly declining markets, which are characterised by slowed-down replacement cycles
- Trend towards higher smartphone product prices, which results in longer replacement cycles and significant reuse value
- Trend towards higher IP classes, which reduces water ingress related defects (one major reason for product defects) significantly
- Individual efforts by OEMs to foster unbundling, reduce environmental impacts throughout the supply chain, use of recycled materials, advancing recycling technologies, incentivising take back (see Task 4)
- Moore’s Law, which reduces feature size on semiconductors and thus also environmental impacts per transistor

On the other hand there are some trends, which might rather have effects in the opposite direction, towards higher environmental impacts and life cycle costs, which are (non-exhaustive list):

- New product concepts with sophisticated mechanics (in particular: foldable devices), which are likely to result in more defect-prone handsets
- Trend towards higher IP classes, which complicates display (another major reason for product defects) and other repairs
- Enhanced connectivity (5G)
- General shift to what are today high-end devices in terms of specification, thus higher environmental impacts at manufacturing (rebound effect of Moore’s Law)

Given that there are indications (see Task 2) that product lifetimes in this product group are slowly increasing, the positive trends are presumably dominating. Compared to the EU policy goals however these positive effects are apparently not substantial enough.

In France the reparability scoring from January 1, 2021, onwards is expected to influence purchasing behaviour. This affects the market segment of smartphones and feature phones only. The market share of France for these products in the EU27 is 20% (see Task 2, 4.1.1).

3.2. Option 2: Self-regulation

There is no proposed self-regulation for this product group, except for the 2018 industry proposal for a renewed **Memorandum of Understanding on common charger solutions for smartphones** (Apple et al. 2018), signed by Apple, Google, Lenovo, LG Electronics, Motorola Mobility, Samsung, Sony Mobile.

The **EcoRating** system by several telecommunication network operators (see Task 1), being under revision currently, could have a similar effect as a voluntary agreement as it intends to cover mobile phones with a harmonized comprehensive environmental rating approach, covering a range of scoring criteria on

- Durability
- Reparability, reusability and upgradability
- Recyclability and recoverability
- Use of hazardous and restricted substances
- Use of recycled and renewable materials

- Packaging and accessories

and a screening life cycle assessment with parameterized activity data and generic background datasets.

The criteria on hazardous and restricted substances are beyond the scope of the Ecodesign Directive. The EcoRating thus covers a slightly broader range of environmental issues, including and going beyond RoHS and REACh requirements.

Scoring criteria on durability, reparability, reusability and upgradability, recyclability and recoverability, and on use of recycled and renewable materials are aligned with the material efficiency standards EN 45550 to EN 45559.

The EcoRating screening life cycle assessment approach is aligned with the Product Environmental Footprint methodology, and largely relies on a parameterized assessment model, based on generic background data. The final assembly step is supposed to be modelled with primary data on energy consumption. Similarly, transports and distribution are meant to be modelled with actual means of transportation.

Eco Rating fully relies on better transparency and consumer information to yield a change in the market. It does not include any minimum requirement defined as threshold for market entry. In case such a rating score is prominently displayed at the point of sales and easy to understand this is likely to influence a large number of consumers. This assumption is underpinned by the high share of consumers being interested in sustainability of mobile phones (see Task 3).

The revised Eco Rating scoring is planned to be rolled out in Q1 2021 by major telecommunication operators throughout the European Union and globally. The current distribution channel telecommunication operators covers roughly 25-40% of the EU27 market in terms of distributed mobile phones. More Telcos (including North America and Asia) have showed interest to join this initiative. The GSMA Climate Action supports this initiative as well.

As the Eco Rating scores are intended to be prominently communicated, other market actors, such as internet comparison portals, retailers or the OEMs as such, might display these scores as well, resulting in a much broader market coverage.

Eco Rating does not cover cordless phones (e.g., DECT) and tablet computers.

For the sake of clarity, it should be noted, that EcoRating does not meet the requirements of a formal self-regulatory initiative as an alternative to an eco-design regulation:

- EcoRating is led by telecom providers, not by smartphone manufacturers.
- the total market coverage achieved currently is an estimated 25 to maximum 40%. For a Voluntary Agreement to be considered as an alternative under the Ecodesign Directive, the market share achieved should be at least 80% according to the Commission's guidelines for self-regulation measures (C/2016/7770)
- EcoRating does not include design-specific requirements. As such, the market response depends entirely on the provision of information, and this approach does not allow for stringent target setting
- procedures for conformity assessment (e.g. third party verification) still need to be put in place

3.3. *Option 3: Introduction of mandatory specific and/or generic ecodesign requirements*

An eco-design implementing measure can introduce mandatory specific and/or generic requirements.

Based on the analysis provided in Task 6 highest priority is for measures addressing

- Reparability and reusability, including facilitating repair by consumers, but not adversely affecting durability of devices
- OS support
- Battery lifetime (in cycles)
- Battery endurance (per cycle)
- Confidence in data erasure and ease of data transfer
- Unbundling of handset and accessories

Relevant further aspects which are related to LCC savings and environmental benefits include

- Provision of protective shell
- Water and dust ingress protection

Further significant environmental improvements, but with no specific user LCC benefits, can be achieved through

- Reduction of manufacturing impacts through PCB design adaptation and PFC emission reduction in display and IC manufacturing

A set of measures to address these aspects are summarised in Table 1. There is no specific reuse category, but measures on reparability and durability have a positive effect on reusability as well. It is assumed that for the first user, i.e. at the initial purchase decision, reparability and durability are much more important than reusability, and the "reusability aspect" of data erasure and data transfer is addressed by a mandatory data encryption requirement and better information about data erasure and data transfer.
In an earlier version of this study, a combined approach of few specific requirements and a more comprehensive scoring approach to address

- Reparability
- Reliability
- Battery endurance per cycle
- Environmental life cycle performance

has been proposed, but due to stakeholder discussions and to reflect better the requirements of the Ecodesign Directive 2009/125/EC to aim at the life cycle cost minimum to end-users when defining specific thresholds, more emphasize is now put on specific requirements for reparability and reliability. As such there is little room left among current product designs beyond such specific requirements for a scoring scale. The scoring approach on reparability and reliability is seen therefore only as second-best option for implementing eco-design requirements.

Table 1 : Potential material efficiency related potential ecodesign requirements derived from Least Life Cycle Cost analysis (Task 6)

Aspect	Specific requirement	Generic requirement
Reparability (details: 3.3.1)	battery replaceable by laymen according to EN 45554 (with commonly available tools, reversible / reusable fasteners)[1]	OEM guarantees maximum spare parts prices, disclosed with product information
	display screen/display unit replaceable in workshop environment, by generalist	
	Standard size batteries for cordless phones	
	5 years spare parts availability	
	Spare parts delivery time maximum 5 days	
	7 years repair information[2]	
	Joining, fastening or sealing techniques do not prevent the disassembly of priority parts for repair or reuse purposes using commercially available tools	
	Scratch resistance	
Reliability (details: 3.3.2)	5 years OS support[3] (minimum 3 years OS version upgrades, minimum 5 years security updates)	IP class; battery lifetime; tablets: tumble test results
	IP44	
	Fast charging not as default setting	
	Advanced battery management and battery information	
	Battery minimum lifetime[4]	
	200 falls without fatal defects in drop test (tumble test, 1m) (may be tested with protective cover, if shipped with product), and in any case without cover 100 falls without fatal defects	
Battery endurance (per cycle) (details: 3.3.4)	-	energy efficiency index
Confidence in data erasure and ease of data transfer (details: 3.3.3)	data encryption by default	user information

[1] with exemptions, if a similar effect is achieved by other means, such as battery demonstrated to last 1000 cycles @ 80% and IP67 (or higher) rated, or unless OEM provides battery replacement service under reasonable and fair conditions (the latter in practice results in market surveillance issues and is therefore not part of the input to the legislation, see Annex)

[2] Copyright on this information automatically to be waived once OEM decides to withdraw this information

[3] Free of charge

[4] 500 cycles @ 80% remaining charge capacity

Aspect	Specific requirement	Generic requirement
Unbundling	-	user information (and covered by environmental lifecycle data below)
environmental footprint of the product (details: 3.3.6)	-	environmental lifecycle data (incl. recycled content)
CRM and other materials (details: 3.3.7)	-	information

Further specific eco-design requirements apply to cordless phones only (details: 3.3.5):

- Standby power consumption
- Power management: EcoDECT

Regarding the timing to implement measures it is important to respect typical redesign cycles in this product group: Although models are replaced by the next generation in many cases on an annual basis, the development of a new model takes longer and 2-3 years is a more appropriate figure for design cycles. This is however relevant in particular for *specific requirements*, where manufacturers (potentially) need to adapt product designs to meet minimum requirements. *Generic requirements*, i.e. information requirements - or as second-best option scoring approaches - can be introduced faster as this does not require design changes as such, but testing against such criteria before a product is launched on the market can require substantial time upfront before a scoring can take effect. This is particularly the case for battery lifetime testing, for which there is no suitable accelerated test, and which easily takes several months and up to one year or more, if 1000 cycles is the benchmark.

The following sub-chapters discuss details of the eco-design requirements summarised in Table 1. A precise wording as input to a potential legislation is provided in 11 ANNEX: Input to Legislation.

3.3.1. Reparability and reusability

The analysis in Task 6 indicates a positive impact of enhanced reparability and reusability. Facilitating repair by professionals is similarly important as a further step towards better reparability by consumers.

3.3.1.1. Main option: Specific reparability and reusability requirements

Repair by consumers might involve safety issues, if design of numerous devices is not changed drastically. Keeping current slim form factors, making batteries and displays easily replaceable for laymen and with commonly available tools, and featuring high ingress protection classes are not yet widely available.

A mandatory requirement for a user replaceable battery means either returning to typical smartphone designs as of 7 – 8 product generations ago, a slide out battery (as in the LG G5) or modular concepts, or some completely new approach. Besides these design constraints a removable battery requires extra housing compared to embedded batteries and thus tend to have a lower capacity than same-size embedded batteries. This also tends to have an adverse effect on battery endurance per cycle (see below).

Specific requirements derived from the Task 6 analysis are as follows:

1) Availability of spare parts

a) Manufacturers, importers or authorised representatives of the products within the scope of the regulation shall make available to professional repairers at least the following spare parts for a minimum period of five years (mobile phones), six years (tablets) and seven years (cordless phones) after placing the last unit of the model on the market:

Table 2 : Option 3 – Spare parts availability / priority parts

Feature phones	Smartphones	Tablets	Cordless phones
Battery	Battery	Battery	Battery
Display unit	Display assembly	Display unit	Display unit
		Cover glass / digitizer unit	
Charger	Charger	Charger	Charger
Back cover or back cover assembly	Back cover or back cover assembly	Back cover or back cover assembly	Back cover
	Front-facing camera	Front-facing camera	
	Rear-facing camera	Rear-facing camera	
External connectors	External connectors	External connectors	External connectors
Buttons	Buttons	Buttons	Buttons
Microphone	Microphone	Microphone	Microphone
Speaker	Speaker	Speaker	Speaker
	Hinge assembly / mechanical display folding or rolling mechanism		

For smartphones the display assembly may include the cover glass / digitizer components, for all other devices the display assembly may not include the cover / glass.

b) Manufacturers, importers or authorised representatives of the products within the scope of the regulation shall make available to professional repairers and end-users at least the following spare parts for a minimum period of five, six or seven years (see above) after placing the last unit of the model on the market:

Table 3 : Option 3 – Spare parts availability for end-users

Feature phones	Smartphones	Tablets	Cordless phones
Battery	Battery	Battery	Battery
Display unit	Display assembly	Display unit	Display unit
		Cover glass / digitizer unit	
Charger	Charger	Charger	Charger

Batteries with a long battery life might not require replacement within this period, and replaceability for the end-user is thus not required: The battery endurance in cycles must achieve a minimum of 1000 full charge cycles. After 1000 full charge cycles the battery must, in addition, have in a fully charged state, a remaining capacity of at least 80 percent of the rated capacity and the device is at least IP67 rated according to IEC 60529. Another alternative is a convenient replacement service offered by the manufacturer. However, it might not be possible to define a "convenient service" in legal terms.

2) Tools

All priority parts need to be replaceable with commercially available tools

3) Access to repair and maintenance information

a) The manufacturer, importer or authorised representative shall provide access to the repair and maintenance information to professional repairers for a minimum period of five, six or seven years after placing the last unit of the model on the market.

   A professional repairer shall have access to the requested repair and maintenance information within one working day after requesting it. The available repair and maintenance information shall include:
   - the unequivocal appliance identification;
   - a disassembly map or exploded view;
   - wiring and connection diagrams, if required for failure analysis;
   - electronic board diagrams, if required for failure analysis;
   - list of necessary repair and test equipment;
   - technical manual of instructions for repair;
   - diagnostic fault and error codes (including manufacturer-specific codes, where applicable);
   - component and diagnosis information (such as minimum and maximum theoretical values for measurements);
   - instructions for software and firmware (including reset software);
   - information on how to access data records of reported failure incidents stored on the electronic display (where applicable);
   - technical bulletins;
   - software tools, firmware and similar auxiliary means required for full functionality of the spare part and device after repair.

   Copyright on this information automatically to be waived once OEM decides to withdraw this information.

4) Maximum delivery time of spare parts

   a) During the period, for which spare parts availability is required, the manufacturer, importer or authorised representatives shall ensure the delivery of the spare parts within 5 working days after having received the order.

5) Maximum price of spare parts

   a) During the period, for which spare parts availability is required, the manufacturer should indicate a maximum pre-tax price for spare parts, disclosed with the product information.

6) Disassembly requirements

   Manufacturers of the products within the scope of the regulation shall meet the following disassembly requirements according to EN 45554:2020.

   a) Joining, fastening or sealing techniques shall not prevent the disassembly for repair or reuse purposes using commercially available tools of parts listed in 1(a).

   b) The following criteria and classes according to EN 45554:2020 shall apply for the replacement of batteries.

Table 4 : Option 3 - Disassembly requirements for batteries

Criterion	Feature phones	Smartphones	Tablets	Cordless phones
Fasteners and connectors	Removable and reusable	Removable and reusable	Removable and reusable	Removable and reusable
Tools	Feasible with: — the use of no tool, or — a tool or set of tools that is supplied with the product or spare part, or — basic tools as listed in Annex A.4 of EN 45554.	Feasible with: — the use of no tool, or — a tool or set of tools that is supplied with the product or spare part, or — basic tools as listed in Annex A.4 of EN 45554.	Feasible with: — the use of no tool, or — a tool or set of tools that is supplied with the product or spare part, or — basic tools as listed in Annex A.4 of EN 45554.	Feasible with: — the use of no tool, or — a tool or set of tools that is supplied with the product or spare part, or — basic tools as listed in Annex A.4 of EN 45554.
Working environment	Use environment	Use environment	Use environment	Use environment
Skill level	Layman	Layman	Layman	Layman
Exemptions	Battery demonstrated to last 1000 cycles @ 80% and IP67 rated	Battery demonstrated to last 1000 cycles @ 80% and IP67 rated	Battery demonstrated to last 1000 cycles @ 80%	

c) The following criteria and classes according to EN 45554:2020 shall apply for the replacement of displays.

Table 5 : Option 3 - Disassembly requirements for displays

Criterion	Feature phones	Smartphones	Tablets	Cordless phones
Fasteners and connectors	Removable	Removable	Removable	Removable
Tools	Feasible with commercially available tools	Feasible with commercially available tools	Feasible with commercially available tools	Feasible with commercially available tools
Working environment	Workshop environment	Workshop environment	Workshop environment	Workshop environment
Skill level	Generalist	Generalist	Generalist	Generalist

For cordless phones a specific requirement mirroring the findings of Task 6 is:

- User replaceable batteries
- Use of standard size rechargeable batteries (AAA, AA or others defined by IEC 60086-2:2015

As the aforementioned specific requirements are considered ambitious and would ban a significant share of today's products from the market (although rather on the basis of lacking service and testing, not necessarily due to product design features), there is little room for an additional scoring, as initially proposed at the final stakeholder meeting of this preparatory study. A reparability scoring now qualifies as a fall-back option, in case the specific requirements turn out to involve major implementation issues.

3.3.1.2. Alternative option: Generic reparability and reusability scoring requirements

A generic requirement is a reparability scoring, similar to the reparability scoring introduced in France on January 1, 2021 (Table 6).

This approach is aligned with the generic EN 45554:2020, but there is no product specific standard in place.

Table 6 : Smartphone reparability scoring according to upcoming French regulation and correlation with findings of this study

#	Sub-Criterion	Scoring system specifics	Relevancy according to this study
1.1. Commitment to the duration of the provision of technical documentation and advice, free of charge			
1.1.A	The unequivocal identification of the product	Availability in years after placing the last unit of a model on the market to - Repairers - Consumers	Not analysed
1.1.B	A disassembly map or exploded view		Confirmed relevant (DO20 in Task 6)
1.1.C	Wiring and connection diagram		
1.1.D	Electronic boards diagrams		
1.1.E	List of necessary repair and test equipment		
1.1.F	Technical manual of instructions for repair		
1.1.G	Diagnostic fault and error codes		Not analysed, but considered relevant
1.1.H	Component and diagnosis information		Not analysed, but considered relevant
1.1.I	Instructions for software and firmware (including reset software)		Relevant in conjunction with data erasure (DO29)
1.1.J	Information on how to access data records of reported failure incidents stored on the product		Not analysed, but considered relevant for software issues
1.1.K	Technical bulletins		Not analysed
1.1.L	Guidance for self-repair (recommended operations, safety and repair instructions, any implications for the guarantee)	Availability in years[5] after placing the last unit of a model on the market to - Consumers	Confirmed relevant (DO20 in Task 6)
1.1.M	How to get access to professional repairers		Not analysed

[5] scoring would need to be specified as availability in years beyond the minimum regulatory requirement

#	Sub-Criterion	Scoring system specifics	Relevancy according to this study
1.1.N	Failures detection and required action (consumers approach)		Not analysed, but considered relevant
1.1.O	User and maintenance instructions		Not analysed
2.1. Ease of disassembly of spare parts – broken / malfunctioning parts (list 2)			
2.1.A	Battery	Number of steps required to disassemble the spare part[6]	Confirmed relevant (DO17 in Task 6)
2.1.B	Display device (incl. screen/LCD or display panel and touch device)		Confirmed relevant (DO19 in Task 6)
2.1.C	Front-facing camera		Confirmed relevant by failure statistics (Task 3)
2.1.D	Rear-facing camera		
2.1.E	Charger		Not applicable
2.2. Necessary tools to remove spare parts - broken / malfunctioning parts (list 2)			
2.2.A	Battery	Not removable or unitarily accessible with any existing tool Removable only with proprietary tools. Such operation is not feasible with basic or specific tools. These tools are not commercially available Removable only with specific tools. Such operation is not feasible with basic or proprietary tools. These tools include all non-listed tools herein (means all different tools than proprietary and basic tools or tools supplied with the product or the spare part) Removable with no tool, with basic tools or with tools supplied with the product or the spare part	Confirmed relevant (DO17 in Task 6)
2.2.B	Display device (incl. screen/LCD or display panel and touch device)		Confirmed relevant (DO19 in Task 6)
2.2.C	Front-facing camera		Confirmed relevant by failure statistics (Task 3)
2.2.D	Rear-facing camera		
2.2.E	Charger		Not applicable
2.3. Characteristics of fasteners for the assembly of spare parts (lists 1 and 2)			
2.3.A	Charging connector	Removable and Reusable: an original fastening system that can be completely removed without damaging the equipment or leaving residue and can be reused. Removable and non-reusable: an original fastening system that can be	Confirmed relevant (DO23 in Task 6)
2.3.B	Connectors		
2.3.C	Mother board		
2.3.D	Buttons		
2.3.E	Microphone		
2.3.E	Speaker		
2.3.F	Battery		

[6] a product-specific standardisation effort is necessary in order to ensure that disassembly steps are counted in a consistent way between different manufacturers. Moreover, given the large variation in difficulty and time required for specific steps (such as loosening adhesives), the disassembly depth method might need to be complemented with an assessment of the difficulty of certain steps.

#	Sub-Criterion	Scoring system specifics	Relevancy according to this study
2.3.G	Display device (incl. screen/LCD or display panel and touch device)	completely removed without causing damage or leaving residue, but cannot be reused.	
2.3.H	Front-facing camera	Neither removable nor reusable: An original fastening system that cannot be completely removed without causing damage to the equipment or leaving residue and cannot be reused.	
2.3.I	Rear-facing camera		
2.3.J	Charger		Not applicable
3.1. Commitment on the availability over time of spare parts - broken / malfunctioning parts (list 2)			
3.1.A	Battery	Availability in years[7] after placing the last unit of a model on the market to - Producer - Spare parts retailers - Repairers - Consumers	Confirmed relevant (DO20 in Task 6)
3.1.B	Display device (incl. screen/LCD or display panel and touch device)		
3.1.C	Front-facing camera		
3.1.D	Rear-facing camera		
3.1.E	Charger		
3.2. Commitment on the availability over time of spare parts – functional parts (list 1)			
3.2.A	Charging connector	Availability in years[8] after placing the last unit of a model on the market to - Producer - Spare parts retailers - Repairers - Consumers	Confirmed relevant in general (DO23 in Task 6), but mother board replacement is questionable in terms of LCC and environmental impacts
3.2.B	Connectors		
3.2.C	Mother board		
3.2.D	Buttons		
3.2.E	Microphone		
3.2.F	Speaker		
3.3. Commitment on the delivery time of spare parts - broken / malfunctioning parts (list 2)			
3.3.A	Battery	Delivery time in working days to - Producer - Spare parts retailers - Repairers - Consumers	See 3.1
3.3.B	Display device (incl. screen/LCD or display panel and touch device)		
3.3.C	Front-facing camera		
3.3.D	Rear-facing camera		
3.3.E	Charger		
3.4. Commitment on the delivery time of spare parts – functional parts (list 1)			
3.4.A	Charging connector	Delivery time in working days to - Producer - Spare parts retailers - Repairers - Consumers	See 3.2
3.4.B	Connectors		
3.4.C	Mother board		
3.4.D	Buttons		
3.4.E	Microphone		
3.4.F	Speaker		

[7] scoring would need to be specified as availability in years beyond the minimum regulatory requirement
[8] scoring would need to be specified as availability in years beyond the minimum regulatory requirement

#	Sub-Criterion	Scoring system specifics	Relevancy according to this study
4. Price of spare parts			
n.a.	Pre-tax price of the most expensive spare part (list 2)	Compared to manufacturer's price pre-tax of concerned model	Confirmed relevant (DO22 in Task 6)
n.a.	Average pre-tax price of other spare parts (list 2)		
5.1 Information about types of updates			
5.1.A	Information about the different existing updates: corrective updates (bugs, crashes or security shortcomings), upgrades or mixed updates	Absence vs. presence, including reversibility of updates	Confirmed relevant (DO11/13 in Task 6), but focus rather needs to be on extended updates availability
5.2 Free remote assistance			
5.2.A	Type of remote assistance	For repairers - Not available - Up-to-date information on website For consumers - Not available - Remote information - Remote diagnosis assistance - Remote support for repair	Not analysed, but considered relevant
5.3 Possibility to reset softwares			
5.3.A	Operating system reset (including reset with outside buttons)	Possible vs. impossible for - Producer - Repairers - Consumers	Relevant in conjunction with data erasure / encryption key deletion (DO29 in Task 6)
5.3.B	Firmwares reset (including reset with outside button)		Not analysed

Most of the criteria defined for the French reparability index are confirmed to be relevant in light of this study. Not all aspects have been quantified in Task 6 (LCC and environmental assessment of options), and not all criteria can be backed by evidence on repair issues identified in Task 3 – which in no way means, these criteria do not matter.

A major difference is the fact, that this study analysed as a priority part also **glass back covers**, for which however the technical analysis did not show any example, where just the glass can be replaced, which are not addressed in the French repair index.

The scoring under the French legislation applies to **smartphones**, but scoring criteria as listed in Table 6 is basically also applicable to **feature phones** and **tablets**. In theory most of the criteria are also applicable to cordless phones, but given the different characteristics (use patterns, failure modes, software, features) of these devices such a scoring might be partially misleading.

In France, the reparability score will be depicted with coloured icon and score value as shown in Figure 1. A similar way of communicating scoring results of potential Ecodesign requirements needs to be developed, but not only to inform about a reparability score, but also the other aspects, for which a separate scoring is outlined further below.

Figure 1 : Reparability label design, France

3.3.2. Reliability

Besides the reparability related aspects there are several more aspects related to reusability and lifetime extension in general. These aspects are summarised here as reliability aspects.

3.3.2.1. Main option: Specific reliability requirements

Specific requirements derived from the Task 6 analysis are as follows:

1) Resistance to accidental drops
   a) Manufacturers of the products within the scope of the regulation shall ensure that the products pass IEC 60068-2-31:2008 (repeated drop test, 1m) without loss of functionality. Loss of functionality does not refer to just aesthetical impairments, such as scratches, but includes shattered or cracked parts. In case the protective cover is damaged in the test, this does not count as a fatal defect and the test may be continued with a new protective cover.

Table 7: Option 3 – Repeated free fall test requirements

Feature phones	Smartphones	Tablets	Cordless phones
200 falls (may be tested with protective cover, if shipped with product), and in any case 100 falls without cover.	200 falls (may be tested with protective cover, if shipped with product), and in any case 100 falls without cover.	information requirement only	NA

2) Scratch resistance (screen)
   a) Manufacturers of the products within the scope of the regulation shall ensure that the product passes the following hardness level on the Mohs hardness scale.

Table 8 : Option 3 – Scratch resistance requirements

Feature phones	Smartphones	Tablets	Cordless phones
4	4	4	NA

3) Protection from dust and water
   a) Manufacturers of the products within the scope of the regulation shall ensure that the products comply to IEC 60529 with the following minimum requirements for dust ingress protection.

b) Manufacturers of the products within the scope of the regulation shall ensure that the products comply to IEC 60529 with the following minimum requirements for water ingress protection.

Table 9 : Option 3 - Dust and water ingress protection requirements

Feature phones	Smartphones	Tablets	Cordless phones
IP4x	IP4x	IP4x	NA
IPx4	IPx4	IPx4	NA

4) Battery minimum lifetime
   a) Manufacturers of the products within the scope of the regulation shall ensure that the products achieve the following minimum performance according to IEC EN 61960-3:

Table 10 : Option 3 – Battery endurance in cycles requirements

Feature phones	Smartphones	Tablets	Cordless phones
500 cycles @ 80% remaining charge capacity	500 cycles @ 80% remaining charge capacity	500 cycles @ 80% remaining charge capacity	NA

5) Battery management
   a) Manufacturers of the products within the scope of the regulation shall ensure that the battery management of the products records the following data in the system settings or another location accessible for end-users:
      i) Date of manufacturing of the battery;
      ii) Date of first use of the battery;
      iii) Number of full charge/discharge cycles (reference: rated capacity);
      iv) Estimated state of health (full charge capacity relative to the rated capacity in %).

6) Fast charging
   a) Manufacturers of the products within the scope of the regulation shall ensure that fast charging is not set as a default option.

7) Updates
   a) Manufacturers of the products within the scope of the regulation shall provide the following updates free of charge.

Table 11 : Option 3 – Operating system upgrade and update requirements

Feature phones	Smartphones	Tablets	Cordless phones
5 years OS support (minimum 5 years security updates)	5 years OS support (minimum 3 OS version upgrades and at least for 3 years, minimum 5 years security updates)	5 years OS support (minimum 3 OS version upgrades and at least for 3 years, minimum 5 years security updates)	NA

8) Data erasure and ease of data transfer
   a) Manufacturers of the products within the scope of the regulation shall provide the following data erasure and ease of data transfer possibilities.

Table 12 : Option 3 – Data encryption requirements

Feature phones	Smartphones	Tablets	Cordless phones
NA	data encryption by default	data encryption by default	NA

These requirements are based on the following considerations:

Continued support of the **Operating System** with updates removes one of the main barriers for continued device use of smartphones and tablets, but does not solve the problem that third party software developers might not provide software versions being compatible with all maintained OS versions.

OS support depends in most cases on third party support (e.g., by Google in case of Android, but also SoC providers), a very ambitious specific requirement might be in conflict with future third party technologies. However, as Google and Qualcomm just announced a strategy for longer Android OS support (Qualcomm Technologies, Inc. 2021), a mandatory specific requirement of availability of security updates for at least 5 years and the availability of operating system version upgrades for at least 3 years is feasible to meet.

A minimum **battery lifetime** as a specific requirement corresponds with the LCC analysis in Task 6, thus can potentially reduce battery performance triggered obsolescence. Such a baseline is 500 cycles @ 80% remaining charge capacity.

Testing is to be carried out according to EN 61960. The charging profile applied during testing needs to reflect the default charging profile that is applied in practice when a user connects the charger included in the device sales package or is recommended by the manufacturer to its users.

The remaining charge capacity (SOH) is determined using the rated capacity as reference point. The initial capacity, determined in accordance with EN 61960, must be the same as or exceed the rated capacity.

For cordless phones the testing approach needs to be different as full charge/discharge cycles in no way correspond with actual use patterns. Battery lifetime for cordless phones is less critical due to the widespread use of standard AAA batteries.

Given the importance of proper **protection** against accidental drops a specific requirement is a provision of a protective case with the device or the option to obtain a protective case at no additional costs. The latter is preferred as it reduces obsolete cases, if the user wants a specific third party case, or does not want a protective case at all, and to give the user potentially the choice of various case designs. If high robustness against repeated free fall tests can be demonstrated without a protective cover, the requirement to provide one with the product can be waived.

A distinction of protection levels against **water and dust ingress** as listed in Table 13 addresses major differences in protection levels: For dust protection levels up to IP4x are irrelevant due to specified particle sizes. Water protection up to IPx3 is considered to be of low effectiveness (dripping and spraying of water), but to ensure at least a minimum level of water ingress protection IP44 can be considered a specific requirement.

Table 13: IP codes scoring – relevant protection levels and specific requirement (in bold)

Dust ingress protection			Water ingress protection	
Level	Object size		Level	Description of the protection
IP_x			IPx_	
up to 3	(n.a.)		up to 3	
4	**>1 mm**		**4**	**Splashing of water**
5	Dust protected		5	Water jets
6	Dust tight		6	Powerful water jets
			7 and above	Immersion, up to 1 m depth

Battery management can positively influence the performance of batteries by avoiding conditions that are known to accelerate battery degradation, including high C-rates during charging and extended periods of time spent at a high voltage. Therefore, the battery management should implement the following features, contributing to a longer lifespan of batteries.

Gentle charging: The charging rate of the default charging profile does not exceed 0,7C at any point during the charging process. Higher charging rates may be available as option to the user, to be activated by the user, such as through a pop-up message prompting the user upon connecting the device to a charger, or a permanent setting in the settings menu.

If fast charging is permanently selectable in the settings menu, a message shall be displayed notifying the user that fast charging may have a negative impact on battery endurance.

There is currently no clear definition of "fast charging". There are various standards for charging speeds for mobile ICT devices, such as USB Power Delivery that defines five different power profiles in its current version, in addition to industry standards such as Qualcomm's QuickCharge and a range of OEM-specific standards.

The speed of the charging process may be measured in time (hours), power (Watts), or C-rate (charge current relative to battery capacity). The C-rate appears most appropriate, as it includes the battery capacity as a variable (larger batteries may take longer to charge at the same charging current). Commonly, Li-ion batteries are charged using CC-CV profiles and are charged to approx. 80% SOC using constant current (CC), which is gradually decreased in the constant voltage (CV) phase. The C-rate is commonly used to denote the charging current during the CC phase.

Example: The Fairphone 3 applies a charging current of 2A during CC charging of the 3Ah battery (= 0,67C). Due to the slower charging rate during CV charging, the total charging time is approx. 2,5 hours.

The fifteen fastest-charging smartphones released in 2020 have been reported to take between 21 and 74 minutes to be fully charged[9], indicating that charging rates beyond 3C are applied in some cases.

Smart charging: Overnight charging (defined as a reoccurring charging event expected to last 6 hours or longer) should not at once fully charge the battery up to 100% SOC upon connecting the device to a charger (to avoid excess time spent at high voltage). The battery should only be charged to a SOC below 80% (e.g. 60%), and should only be

[9] https://www.androidauthority.com/fastest-charging-phones-1013806/

fully charged to 100% SOC shortly (e.g. finishing no earlier than 1 hour) before the device is expected to be disconnected by the user. This may be implemented by manufacturers through a pop-up message prompting the user upon connecting the device to a charger, or be implemented through software that analyses and predicts the charging habits of individual users automatically in the background.

Overnight charging is defined as a charging event lasting minimum of 6 hours and may occur at any time of the day. Users that regularly charge their devices overnight are likely to connect the charger before going to sleep and disconnect it after waking up, leading to regular patterns in many cases that may be recognized by software. The time at which the charging process completes (100% SOC) may be determined via an alarm that is set by the user in an overnight charging event or by a software that learns user behaviour over time.

Alternatively, the option for the above described smart charging may be opted by the user when connecting the charger.

3.3.2.2. Alternative option: Generic reliability scoring requirements

Given that the comprehensive set of specific requirements above covers a large portion of what could otherwise be addressed with a scoring system, such a scoring system would not yield much added value and information. A reliability scoring now qualifies as a fall-back option, in case the specific requirements turn out to involve major implementation issues.

Similar to the reparability scoring above, introducing a separate reliability scoring provides orientation for the user how robust the device is against technical defects and software obsolescence.

Reparability and general durability could be merged in one combined score, but the analysis in Task 3 showed that some users treat their devices with care whereas others drop them frequently. In that sense, users should have the option to reflect on own device usage and to set different priorities for reparability and other durability aspects.

Table 14 : Option 3a - Mobile phone and tablet reliability scoring criteria

#	Sub-Criterion	Scoring system specifics	Relevance
1. Overload failures (constant probability)			
1.1	Resistance to accidental drops: repeated free fall tests	Survival rate for given test settings and protocol (e.g. drop height, cycles, etc.)	Mobile phones: High Tablets: Medium (due to less outdoor use)
1.2	Resistance to accidental drops: Availability / provision of screen protectors and protective cases	Yes / no	Mobile phones: High Tablets: Medium (due to less outdoor use)
1.3	Scratch resistance (screen, camera, fingerprint sensor, etc.)	Scratch resistance rating	Mobile phones: Currently low, but might change with flexible / bendable displays Tablets: low
1.4	Protection from dust	Compliance with IP codes (up to 4 / 5 / 6)	Mobile phones: Medium Tablets: Medium

#	Sub-Criterion	Scoring system specifics	Relevance
1.5	Protection from water	Compliance with IP codes (up to 3 / 4 / 5 / 6 / 7 and above)	Mobile phones: High Tablets: Medium, due to less outdoor use
2. Degradation failures (rising probability over time)			
2.1	Battery endurance (charging cycles): Minimum number of cycles with a remaining charging capacity of the battery of at least 80%	Minimum number of cycles with functioning remaining charging capacity of the battery of at least 80%	Mobile phones: High Tablet: Medium, due to less frequent charging of tablets on average
2.2	Battery endurance (charging cycles): Pre-installed battery management software for smart charging and provision of state of health data	Yes / no	
2.3	Battery endurance (charging cycles): Information for the correct use of the battery, including fast-charging not as default setting	Yes / no	
2.4	Reliability of ports / connectors	Specified mating / unmating cycles	Mobile phones: Medium Tablets: Medium
2.5	Reliability of other parts (buttons, speakers, etc.)	tbd	Mobile phones: Medium Tablets: Medium
2.6	Operating System updates	Availability of update support for X years and information on impact/reversibility of updates	Mobile phones: High Tablets: Very high, as other lifetime limiting factors are less relevant
2.7	Memory extension: slot for memory card	Yes / no, highly relevant for devices up to 32GB only	Mobile phones: Medium Tablets: Medium
2.8	Dual-SIM	Yes / no	Mobile phones: Low Tablets: Not relevant, single SIM (if SIM at all considered appropriate for almost all users)

3.3.3. Confidence in data erasure and ease of data transfer

The optimal approach to reliable data erasure is data encryption by default plus a factory reset, which deletes the encryption key[10]. This can be a specific requirement to enhance trust in sound data erasure practices across mobile phones and tablets in general.

It is however important, that the user receives information about data erasure once he/she discontinues use of the existing device. Therefore information on data encryption shall be displayed in the course of configuring a new device, and should provide an explanation, that this eases also data erasure and is presumably also available on older devices.

This approach is applicable to **feature phones**, **smartphones** and **tablets**.

For **cordless phones** a mandatory feature to delete call history and address book (by factory reset or similar) is sufficient as erasure of such limited data is much faster than for all the data on a smartphone.

Ease of data transfer can also mean the option of a memory extension card, which can facilitate data transfer from one device to the next, if same memory card format is supported.

3.3.4. Battery endurance (per cycle)

Enhanced battery endurance per cycle has a two-fold effect of reducing energy consumption and increasing battery lifetime (as fewer charging cycles are required). Both aspects are relevant to reduce LCC and environmental impacts.

Typically OEMs provide information on battery endurance, but these values are not measured under same, standardised conditions.

Battery endurance (per cycle) can be addressed with both, a specific requirement, setting a minimum endurance, or by a generic requirement, such as a mandatory information about performance against a battery endurance benchmark. Given the broad range of battery endurance in the field, an information requirement addresses better this full spectrum providing better transparency for the user.

A suitable measure is a benchmark test as used by GSMArena, which comprises a calculated battery endurance for a use scenario reflecting 1 hour of phone calls, 1 hour web browsing, 1 hour playing a video per day. This use scenario represents a lower use intensity, than what Task 3 results for smartphones suggest. The defined activities however correspond well with most typical activities, thus the GSMArena approach allows to make a realistic distinction in device performance, although the then measured endurance times will not correspond with real life experience in terms of battery endurance per full charge.

There are other benchmark approaches, such as going through a defined cycle of operations repeatedly until the battery shuts off, but the overall test philosophy is the same. In that sense, the GSMArena approach is only one option of how to measure and benchmark battery endurance per cycle. The test setting might differ from this approach in the end.

[10] In case the encryption is in place already at end of (first) life, factory reset is a matter of minutes, whereas a full data erasure process (with potentially parts of the storage not being deleted as intended) can take few hours to complete, which is considered a barrier

Settings for each sub-benchmark are as follows, starting with a fully charged battery:

- Making calls
  - close all applications
  - 3G call
  - talk time until phone shuts off (take into account, that screens typically shut off during a call)
- Browsing the web
  - display brightness set to 200 candela per square meter (cd/m^2)
  - 802.11n access point in short distance for full connectivity
  - running an automated script which reloads a webpage every ten seconds; no flash elements on the web pages
- Playing a video
  - display brightness set to 200 candela per square meter (cd/m^2)
  - radios on the device switched off (airplane mode)
  - looping a standard-definition video
  - end-point: battery state of charge at 10%
- Standby

The endurance score is an aggregated and normalised value in hours, as a calculated value derived from the four types of battery endurance tests. The endurance score can be translated into an energy efficiency index as follows:

$$\mathrm{EEI} = \frac{\mathrm{END}_{Device}}{\mathrm{C}_{rated}}$$

Where:

END_{Device} is the calculated battery endurance in hours

C_{rated} is the rated battery capacity in mAh

With this approach there is no incentive for a larger battery, whereas a scoring just relying on the battery endurance per cycle actually incentivizes larger battery capacities. As the analysis in task 4 unveils, such an approach acts slightly in favour of smaller display sizes.

This concept is transferrable to **feature phones** (benchmark to be adapted to making calls and standby only), and to **tablets** (benchmark to be adapted to browsing the web, playing a video, and standby). Although a significant share of tablets feature mobile connectivity this is mainly used for data traffic, not voice calls.

This requirement is not applicable to cordless phones due to major differences in use patterns. Instead, a power consumption requirement as described below is more appropriate for cordless phones.

3.3.5. Power consumption

The analysis in Tasks 4 and 6 shows that a reduced standby power consumption for **cordless phones** is feasible and can contribute to significantly reduced environmental impacts. A target value for a specific requirement is 0,4 W standby power consumption when the fully charged handset is placed in the charging cradle. For cordless phones shipped with a charging cradle only the specific requirement derived from data presented in Task 4 is 0,2 W standby power consumption.

This requirement can be complemented by a mandatory EcoDECT mode, which reduces mainly radiation of the base station.

3.3.6. Reduction of manufacturing impacts

A reduction of manufacturing impacts can be addressed with both, a specific requirement, setting e.g. distinct thresholds for PFC emissions in parts of the supply chain, or by a generic requirement, such as a calculated and communicated Product Environmental Footprint. Given the complexity of the supply chain in this product group and as most of the components and devices originate from outside the EU27 an information requirement incentivising best practice in upstream processes can reduce overall life cycle impacts significantly.

ETSI TR 103 679 (see Task 1) addresses product group specific LCA approaches for products covered by this study and points out elements of a PEFCR for smartphones: "for the time being the best available approach is to apply … the ETSI LCA standard on FLCA [ETSI ES 203 199]. However, that standard is not prescriptive enough and too flexible. Therefore, the smartphone industry could agree on which parameters and which assessment scope FLCAs for smartphones should contain. For example the 20 most important unit processes in the smartphone life cycle can be identified and their assessment scope justified and harmonized. This is especially useful for the main components - and underlying unit processes - such as ICs and PCBs, and the main product parts, such as display, charger and battery. This work might include the most appropriate intensity values for these components and parts."

However, as long as no PEFCR for this product group is in place, environmental life cycle data can build on LCAs following one of the existing standards, or a screening assessment, such as the life cycle scoring as part of the EcoRating approach, or any forthcoming methodology, such as a revised MEErP Ecoreport tool. The actual approach embedded in the eco-design requirements however still needs to be defined.

Given the findings of Task 6 key aspects for implementing environmental footprint requirements are:

- Modelling of semiconductors
  - with appropriate generic background data and models;
  - focus on more sophisticated semiconductors (e.g., those with 12 pins / contacts or more) is acceptable as these largely determine the overall impact of semiconductors;
  - requiring or incentivizing primary data for SoC, RAM, Flash could be an option (fab specific)
  - semiconductors modelled with a generic data model could benefit from a calculated 5% GHG emission reduction, if supplier confirms a high fab specific fluorinated GHG abatement rate of ≥75%[11]
- Modelling of Printed Circuit Boards with appropriate generic background data and models; given that there are typically only 1 or 2 larger PCBs in a mobile phone or tablet, primary data could be an option; data model should include cut-offs, i.e. preferably refer to full processed panel divided by PCBs per panel
- Modelling of displays
  - with appropriate generic background data and models, or primary data (fab specific)
  - displays modelled with a generic data model could benefit from a calculated 5% GHG emission reduction, if supplier confirms a high fab specific fluorinated GHG abatement rate of ≥90%[12]
- Modelling of renewable energy use where suppliers can provide evidence, that a contract on renewable energy supply is in place, not cannibalising the general electricity grid mix and stimulating a capacity increase for the renewable energy sector

[11] Aligned with EPEAT 1680.1 criterion 4.1.10.2
[12] Aligned with EPEAT 1680.1 criterion 4.1.10.1

- Considering mechanical processing of major metal parts and resulting process waste
- Modelling of distribution from final assembly to distribution hubs with actual means of shipping
- Recycled content: As there are OEMs pushing for increased recycled content this should be incentivized through proper environmental accounting of related benefits; calculating the recycled content in alignment with EN 45557:2020

3.3.7. CRM and other material content

Information about material content can provide transparency regarding the use of certain material, which long-term might be relevant for recycling processes, such as distinct rare earth recovery from mobile phones. Among the relevant materials gold, tantalum, neodymium and cobalt are those where significant differences are observed in the market. However, it has to be said, a measure incentivizing reduction of the use of these materials might result in unintended side effects:

- Gold: already covered in environmental footprint requirement detailed in 3.3.6, reduction might yield reliability issues and is in conflict with modularity / reparability
- Tantalum: A general reduction of tantalum also affects material from conflict sources and from artisanal mining done under controlled labour conditions alike
- Cobalt, Neodymium: Reduction might have an adverse effect on performance, functionality

3.4. Option 4: Energy Labelling

The battery endurance based energy efficiency index (see 3.3.4) can be translated in an energy label, having in mind that this metric is not only about actual energy savings in use, but also indirect energy savings through extended product lifetime.

The overall spread in the market regarding benchmark performance is a strong argument for an energy label (see Task 4, 3.1.1.3), to guide the consumer, how a specific device compares to others. The absolute direct energy consumption per device and year of use however is only in the range of roughly 6 to 16 kWh/a[13], which is a much lower level than for any other product group regulated under the Energy Efficiency Labelling Directive (EU) 2017/1369. There is some uncertainty regarding the actual use and charge frequency of these devices, and there are some data points indicating a slightly lower power consumption than what has been taken as modelling approach in this study.

Table 15 : Energy efficiency index (normalised battery endurance) as basis for defining energy efficiency classes for smartphones

Energy efficiency class	Energy efficiency index [in hours / milliAmperehours]	Market coverage smartphones			
		current and historic devices		Products released 2019/2020 (as of June 2020)	
		models	percentage	models	percentage
A	above 0,042 h/mAh	1	0,1%	0	0,0%
B	> 0,037 – 0,042 h/mAh	6	0,9%	0	0,0%
C	> 0,032 – 0,037 h/mAh	26	3,8%	3	2,4%
D	> 0,027 – 0,032 h/mAh	134	19,6%	12	9,8%
E	> 0,022 – 0,027 h/mAh	294	43,0%	79	64,2%
F	> 0,017 – 0,022 h/mAh	189	27,7%	28	22,8%
G	≤ 0,017 h/mAh	33	4,8%	1	0,8%

[13] covering the majority of all mid-range smartphones

A definition of energy efficiency classes targeting at an even spread of classes over a broader range, but "no products are expected to fall into energy class A at the moment of the introduction of the label"[14] results in a class definition as listed in Table 15.

A precise wording as input to a potential legislation is provided in 11 ANNEX: Input to Legislation.

On the label, following information is depicted in this scenario, reflecting the most important and rather easily quantifiable performance aspects identified in Task 6 8including general information depicted on Energy Labels):

- supplier's name or trade mark;
- supplier's model identifier;
- the (energy) efficiency class;
- battery endurance per cycle, active use only in h per full battery charge, rounded to full hours;
- battery endurance in cycles, in ranges ≥500, ≥600, ≥700, ≥800, ≥900, ≥1000, ≥1100, ≥1200, ≥1300, ≥1400;
- ingress protection rating;
- environmental impact score;
- the QR code with access to the product information sheet

Due to only a moderate spread in energy efficiency among **cordless phones** in the market, an energy label for these products is not appropriate.

This approach is applicable to **feature phones**, **smartphones** and **tablets**.

The introduction of an Energy Label for mobile phones and tablets also means a mandatory data provision to the EPREL database, which eases later monitoring of policy implementation.

3.5. Option 5: Ecodesign requirements combined with Energy Labelling

The option of both, eco-design requirements and energy labelling is actually very similar to the eco-design policy option 3: The battery endurance (per cycle) assessed with an energy efficiency index in policy option 3 is instead more prominently translated into an additional Energy Label.

Table 16 : Potential ecodesign requirements and energy label scope derived from product group analysis

Aspect	Eco-design		Energy Label
	Specific requirement	Generic requirement	
Reparability	battery replaceable by laymen according to EN 45554 (with commonly available tools, reversible / reusable fasteners)[15]	OEM guarantees maximum spare parts prices, disclosed with product information	-
	display screen/display unit replaceable in workshop environment, by generalist		-

[14] (EU) 2017/1369, Art. 11, 8

[15] with exemptions, if a similar effect is achieved by other means

Aspect	Eco-design		Energy Label
	Specific requirement	Generic requirement	
	Standard size batteries for cordless phones		-
	5 years spare parts availability		-
	Spare parts delivery time maximum 5 days		-
	7 years repair information[16]		-
	Joining, fastening or sealing techniques do not prevent the disassembly of priority parts for repair or reuse purposes using commercially available tools		-
	Scratch resistance		-
Reliability	5 years OS support[17] (minimum 3 years OS version upgrades, minimum 5 years security updates)	IP class; battery lifetime; tablets: tumble test results	IP class, battery lifetime information on the label
	IP44		-
	Fast charging not as default setting		-
	Advanced battery management and battery information		-
	Battery minimum lifetime[18]		-
	200 falls without fatal defects in drop test (tumble test, 1m) (may be tested with protective cover, if shipped with product), and in any case without cover 100 falls without fatal defects		-
Battery endurance (per cycle)	-	energy efficiency index	Energy Label (Energy efficiency classes)
			Endurance in active use as information on the label
Confidence in data erasure and ease of data transfer	data encryption by default	user information	-
Unbundling	-	user information (and covered by environmental	-

[16] Copyright on this information automatically to be waived once OEM decides to withdraw this information
[17] Free of charge
[18] indicatively : 500 cycles @ 80% remaining charge capacity

Aspect	Eco-design		Energy Label
	Specific requirement	Generic requirement	
		lifecycle data below)	
environmental footprint of the product	-	environmental lifecycle data (incl. recycled content)	information on the label
CRM and other materials	-	information	-
Cordless phones only:			
Standby power	0,4 W / 0,2 W	-	n.a.
Power management	EcoDECT	-	n.a.

For details which set of requirements applies to which product scope see 3.3.

4. SUBTASK 7.2 - SCENARIO ANALYSIS (UNIT STOCK/SALE & ENVIRONMENTAL)

The scenario analysis is based on inputs related to the stock, sales, and replacement and lifetimes in Task 2. Information on energy consumption, product prices and operating costs for each design option are extracted from Tasks 5 and 6.

4.1. Option 1: "No action"

The option 1 "No action", or "business as usual" scenario, assumes no policy measures on the European level.

For France (20% of the EU27 market) the reparability scoring from January 1, 2021, onwards is expected to influence purchasing behaviour and later on lifetime of new devices. In the "No action" scenario this is modelled with 50% of the French smartphone and feature phone market (i.e., 10% of the respective EU27 market) will feature better reparability and better repair practice as reflected by the combined design options DO20/15/20a in the Task 6 analysis. This 10% market share is expected to be reached by 2024, as the effects will materialise not immediately with introduction of the reparability scoring in France but only with the changing reparability practice over time, resulting in longer lifetimes and fewer device replacement purchases.

According to the market analysis in Task 2 and splitting the mobile phone segment in the four Base Cases for smartphones and feature phones defined in Task 5 results in a stock development as shown in Figure 2. The split of the smartphone market into low-end, mid-range and high-end devices mirrors for historic years mainly the introduction of the larger display sizes 6" and 6,5". It is furthermore assumed that the smartphone market sees in future a further trend towards what are high-end devices in terms of today's technology. Corresponding to the stock model developed in Task 2 the overall market is declining due to decreasing forecasted sales for tablet computers and cordless phones and a rather stagnating mobile phone market, plus the effect of the reparability scoring in France.

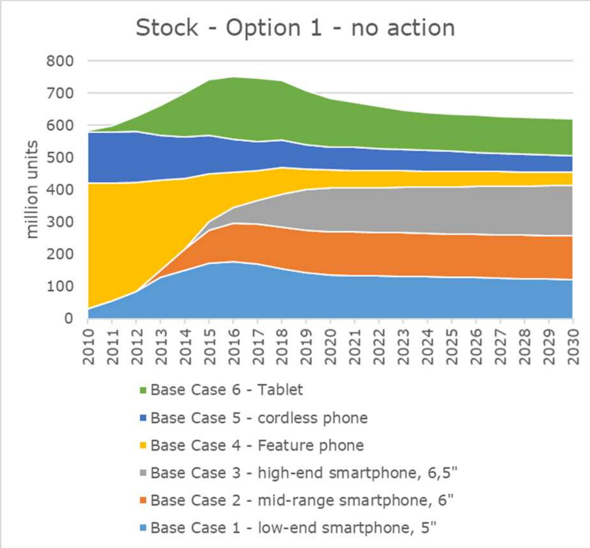

Figure 2 : Option 1 – « no action » - Stock development, EU27, 2010-2030

Sales figures in million units per product type from 2010 to 2030 are documented in Table 17.

The effect of the French reparability score is a decline of sold smartphones by roughly 2 million units annually from 2026 onwards.

Table 17 : Option 1 – « no action » - Sales, EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5" Sales mln. units	Base Case 2 - mid-range smartphone, 6" Sales mln. units	Base Case 3 - high-end smartphone, 6,5" Sales mln. units	Base Case 4 - Feature phone Sales mln. units	Base Case 5 - cordless phone Sales mln. units	Base Case 6 - Tablet Sales mln. units	**Totals Sales mln. units**
2010	12	0	0	130	32	4	**178**
2011	22	0	0	122	32	15	**190**
2012	34	0	0	113	32	28	**207**
2013	52	7	0	93	28	45	**225**
2014	60	22	0	73	26	45	**226**
2015	68	35	8	50	24	42	**225**
2016	71	39	14	36	20	35	**216**
2017	68	41	21	31	18	33	**212**
2018	62	43	29	28	17	31	**210**
2019	57	44	36	22	15	28	**201**
2020	54	45	39	15	14	24	**190**
2021	53	45	39	18	14	24	**194**
2022	53	45	40	18	14	23	**193**
2023	52	45	40	17	13	23	**190**
2024	51	44	40	16	13	23	**188**
2025	51	44	41	16	12	23	**188**
2026	50	44	42	15	12	23	**187**
2027	50	44	42	15	12	23	**186**
2028	49	44	43	15	11	23	**185**
2029	49	44	44	14	11	23	**184**
2030	48	44	44	14	10	23	**184**

In terms of LCC total consumer expenditures are increasing moderately over time, mainly due to the shift towards high-end devices (Table 18).

Table 18 : Option 1 – « no action » - Total consumer expenditure, EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5" mln. €	Base Case 2 - mid-range smartphone, 6" mln. €	Base Case 3 - high-end smartphone, 6,5" mln. €	Base Case 4 - Feature phone mln. €	Base Case 5 - cordless phone mln. €	Base Case 6 - Tablet mln. €	**Totals mln. €**
2010	2.512	-	-	11.530	1.893	1.223	**17.158**
2011	4.665	-	-	10.786	1.893	4.983	**22.326**
2012	7.211	-	-	9.965	1.885	9.634	**28.695**
2013	11.022	3.742	-	8.250	1.656	15.237	**39.907**
2014	12.858	11.225	-	6.494	1.538	15.626	**47.741**
2015	14.610	18.012	7.999	4.383	1.395	14.630	**61.030**
2016	15.161	20.588	14.828	3.223	1.207	12.550	**67.557**
2017	14.542	21.615	21.805	2.716	1.047	11.839	**73.564**
2018	13.309	22.254	30.308	2.471	996	11.183	**80.521**
2019	12.117	23.064	37.196	1.922	892	10.051	**85.242**
2020	11.534	23.494	39.996	1.360	823	8.664	**85.871**
2021	11.419	23.494	40.596	1.611	848	8.506	**86.474**
2022	11.304	23.494	41.205	1.562	818	8.392	**86.775**
2023	11.145	23.424	41.649	1.519	790	8.286	**86.813**
2024	10.989	23.354	42.100	1.477	762	8.181	**86.862**
2025	10.874	23.354	42.731	1.432	736	8.175	**87.303**
2026	10.760	23.354	43.372	1.389	710	8.172	**87.757**
2027	10.645	23.354	44.023	1.348	685	8.170	**88.224**
2028	10.531	23.354	44.683	1.307	661	8.169	**88.704**
2029	10.416	23.354	45.353	1.268	638	8.169	**89.198**
2030	10.302	23.354	46.034	1.230	615	8.169	**89.703**

The costs of societal damages remain stable at a level of 3,5 billion Euros until 2030 (Figure 3). The share of feature phones and cordless phones is and remains to be rather low in comparison to smartphones and tablets.

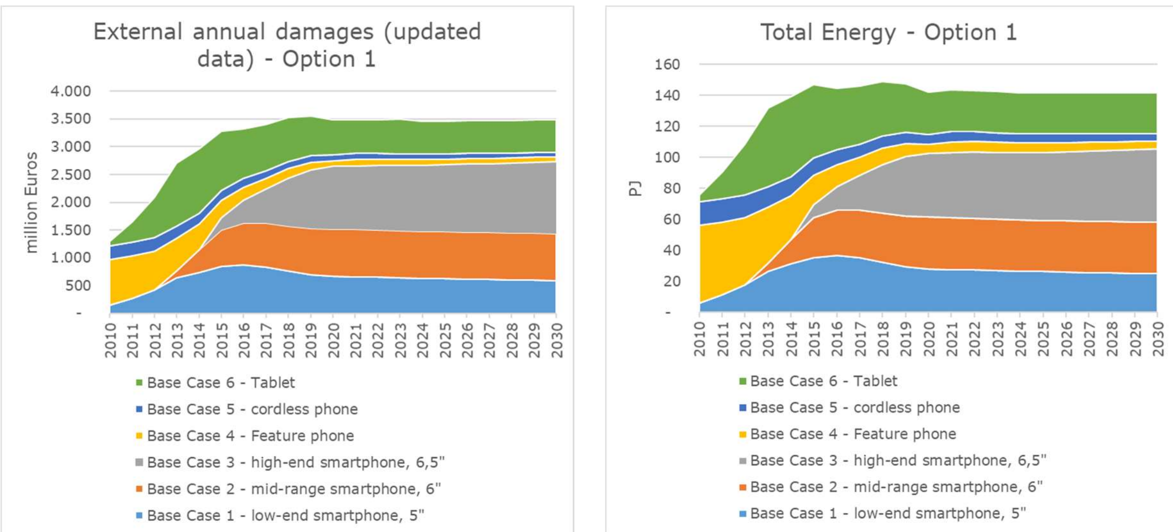

Figure 3 : Option 1 – « no action » - External annual damages (updated societal cost factors) and Total Energy, EU27, 2010-2030

Similarly, Total Energy consumption of the product group is forecasted to remain on a rather stable level of 143 PJ until 2030. Greenhouse gas emissions of the product group remain at 9 million tons CO_2 eq. annually (Figure 4). These emissions are calculated with the EcoReport figures which do not take into account changes in the electricity grid mix over time. Most of the energy consumption depicted above and the greenhouse gas emissions depicted below are related to manufacturing processes, which are largely located outside the EU 27. Still, greenhouse gas emissions are more likely to slightly decline over time due to changes in global electricity generation towards higher share of renewable energy. Largely the same development as for greenhouse gas emissions can be observed for tablets.

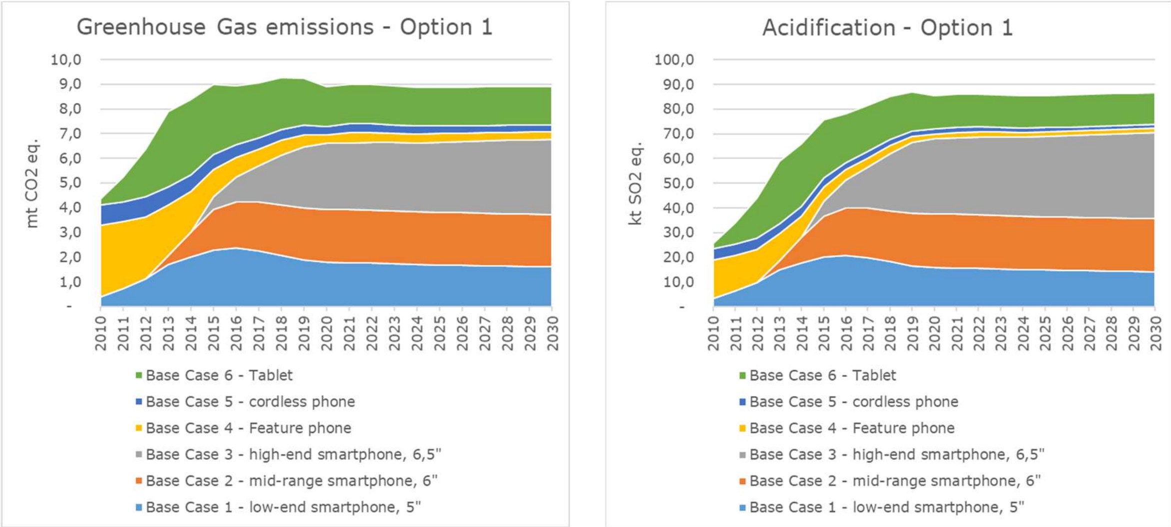

Figure 4 : Option 1 – « no action » - Greenhouse Gas emissions and Acidification, EU27, 2010-2030

4.2. Option 2: EcoRating

In case the EcoRating approach is implemented by large telecommunication network operators across EU27, covering roughly 25% of the market (not all European telecommunication providers being involved, potentially not all vendors providing EcoRating score date), the main effect will be that sustainably conscious consumers are making a better informed choice: For mobile phone purchase decisions, "sustainability of the device" is important to 50% of respondents in a survey in Germany and to 75 – 90% of the respondents in other EU countries (see Task 3, 3.1).

For the scenario analysis it is assumed, that with EcoRating in place half of the 25% market share stated above will choose a device with a significantly better scoring. It is assumed for the scenario analysis that EcoRating is rolled out broadly in 2021 already.

Calculation basis for this scenario is:

- 12,5% of the market (stock) moved towards the point of Least (societal) Life Cycle Costs by 2024, i.e. with some delay as many of the criteria address extended lifetime
- in France, the mandatory reparability score has no additional effect on the market share covered by EcoRating through the telecommunication operators
- Historic effects of prior versions of EcoRating are included in general market figures and not depicted separately in following tables and figures

The lifetime extension stimulus set by EcoRating is forecasted to result in a decrease of sold units by 7 million units from 2027 onwards, under the condition that the stock of devices in use remains the same as without measures, and that the reduction in sales is reached through longer product use lifetime.

This calculation does not account for future evolution of EcoRating: The strategic vision and goals of the EcoRating Consortium includes that other operators as well as other stakeholders in the industry (manufacturers, other retailers, NGOs, public institutions, etc) will also have access to use this methodology, leading to potentially higher impacts than calculated here. The calculation is also based on a "one time effect", but it should be acknowledged, that EcoRating is meant to be revised and updated regularly, leading to a constant evolution of the market towards reduced environmental impacts throughout the life cycle of the products.

Table 19 : Option 2 – EcoRating – Sales total and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	**Sales mln. units**	Sales mln. units	**Sales mln. units**
2010	12	0	0	130	32	4	**178**	*178*	-
2011	22	0	0	122	32	15	**190**	*190*	-
2012	34	0	0	113	32	28	**207**	*207*	-
2013	52	7	0	93	28	45	**225**	*225*	-
2014	60	22	0	73	26	45	**226**	*226*	-
2015	68	35	8	50	24	42	**225**	*225*	-
2016	71	39	14	36	20	35	**216**	*216*	-
2017	68	41	21	31	18	33	**212**	*212*	-
2018	62	43	29	28	17	31	**210**	*210*	-
2019	57	44	36	22	15	28	**201**	*201*	-
2020	54	45	39	15	14	24	**190**	*190*	-
2021	53	44	39	18	14	24	**192**	*194*	- **1,6**
2022	52	44	39	17	14	23	**189**	*193*	- **3,1**
2023	51	43	39	17	13	23	**186**	*190*	- **4,2**
2024	49	43	39	16	13	23	**183**	*188*	- **5,9**
2025	49	43	40	16	12	23	**182**	*188*	- **5,9**
2026	48	43	40	15	12	23	**181**	*187*	- **5,8**
2027	48	43	41	15	12	23	**180**	*186*	- **5,8**
2028	47	43	41	14	11	23	**179**	*185*	- **5,8**
2029	47	43	42	14	11	23	**179**	*184*	- **5,8**
2030	46	43	43	13	10	23	**178**	*184*	- **5,8**

Total consumer expenditure will decline despite slightly increasing product prices (see assumptions in Task 5). This reduction in Life Cycle Costs is due to longer product lifetimes, i.e. longer replacement cycles and to a minor degree also savings in electricity costs. Whereas total purchasing costs go down, the repair costs share of the Life Cycle Costs is increasing significantly (see 5), which is an expected effect: Through better reparability making use of repair services and purchasing spare parts and tools is a growing market.

The development of total consumer expenditure is shown in Table 20: In 2027 total expenditure is 2,6 billion Euros lower than in a "no action" scenario and this level of savings remains stable for the years thereafter.

Table 20 : Option 2 – EcoRating – Total consumer expenditure and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	mln. €	mln. €	mln. €	mln. €	mln. €	mln. €	**mln. €**	mln. €	**mln. €**
2010	2.512	-	-	11.530	1.893	1.223	**17.158**	*17.158*	**-**
2011	4.665	-	-	10.786	1.893	4.983	**22.326**	*22.326*	**-**
2012	7.211	-	-	9.965	1.885	9.634	**28.695**	*28.695*	**-**
2013	11.022	3.742	-	8.250	1.656	15.237	**39.907**	*39.907*	**-**
2014	12.858	11.225	-	6.494	1.538	15.626	**47.741**	*47.741*	**-**
2015	14.610	18.012	7.999	4.383	1.395	14.630	**61.030**	*61.030*	**-**
2016	15.161	20.588	14.828	3.223	1.207	12.550	**67.557**	*67.557*	**-**
2017	14.542	21.615	21.805	2.716	1.047	11.839	**73.564**	*73.564*	**-**
2018	13.309	22.254	30.308	2.471	996	11.183	**80.521**	*80.521*	**-**
2019	12.117	23.064	37.196	1.922	892	10.051	**85.242**	*85.242*	**-**
2020	11.534	23.494	39.996	1.360	823	8.664	**85.871**	*85.871*	**-**
2021	11.322	23.268	40.263	1.608	848	8.506	**85.815**	*86.474*	**- 659**
2022	11.113	23.046	40.535	1.558	818	8.392	**85.463**	*86.775*	**- 1.313**
2023	10.881	22.785	40.703	1.512	790	8.286	**84.957**	*86.813*	**- 1.856**
2024	10.626	22.473	40.760	1.468	762	8.181	**84.270**	*86.862*	**- 2.591**
2025	10.515	22.473	41.372	1.424	736	8.175	**84.695**	*87.303*	**- 2.608**
2026	10.405	22.473	41.992	1.381	710	8.172	**85.133**	*87.757*	**- 2.624**
2027	10.294	22.473	42.622	1.340	685	8.170	**85.584**	*88.224*	**- 2.641**
2028	10.183	22.473	43.262	1.299	661	8.169	**86.047**	*88.704*	**- 2.658**
2029	10.073	22.473	43.911	1.260	638	8.169	**86.523**	*89.198*	**- 2.675**
2030	9.962	22.473	44.569	1.223	615	8.169	**87.011**	*89.703*	**- 2.692**

Total Energy savings to be achieved by EcoRating are 7 PJ in 2027 and following years. This is a savings potential of 4,6%, which materializes only partially within the EU27, and to a significant extend in the global supply chains.

Similar trends can be observed for other environmental indicators: Reduction in carbon emissions is 600.000 tons CO_2 eq. per year from 2027 onwards (and lower savings already much earlier), which corresponds to a reduction by 6,4% compared to the “no action” option.

Table 21 : Option 2 – EcoRating – Total Energy and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	Total Energy PJ	Total Energy PJ	Total Energy PJ	Total Energy PJ	Total Energy PJ	Total Energy PJ	**Total Energy PJ**	Total Energy PJ	**Total Energy PJ**
2010	6	-	-	50	15	4	**76**	*76*	**-**
2011	11	-	-	47	15	17	**90**	*90*	**-**
2012	17	-	-	44	15	32	**108**	*108*	**-**
2013	27	5	-	36	13	51	**132**	*132*	**-**
2014	31	16	-	28	12	51	**139**	*139*	**-**
2015	35	26	8	19	11	47	**147**	*147*	**-**
2016	37	29	15	14	10	40	**145**	*145*	**-**
2017	35	31	22	12	8	37	**146**	*146*	**-**
2018	32	32	31	11	8	35	**149**	*149*	**-**
2019	29	33	38	8	7	32	**148**	*148*	**-**
2020	28	33	41	6	6	27	**142**	*142*	**-**
2021	27	33	41	7	7	27	**142**	*144*	**- 2**
2022	27	32	41	7	6	27	**140**	*143*	**- 3**
2023	26	32	41	6	6	26	**138**	*142*	**- 5**
2024	25	31	41	6	6	26	**135**	*141*	**- 7**
2025	25	31	41	6	6	26	**135**	*141*	**- 7**
2026	25	31	42	6	6	26	**135**	*141*	**- 7**
2027	24	31	43	6	5	26	**135**	*141*	**- 7**
2028	24	31	43	5	5	26	**135**	*141*	**- 7**
2029	24	31	44	5	5	26	**135**	*142*	**- 7**
2030	24	31	45	5	5	26	**135**	*142*	**- 7**

In total figures EcoRating stabilizes the level of annual Greenhouse Gas emissions through mobile phone lifecycles within EU27, but does not reverse the trend, unless EcoRating stimulates continuous innovation towards more sustainable life cycles and/or is broadened to cover larger market segments in the EU27 than only the distribution channels of telecommunication network operators.

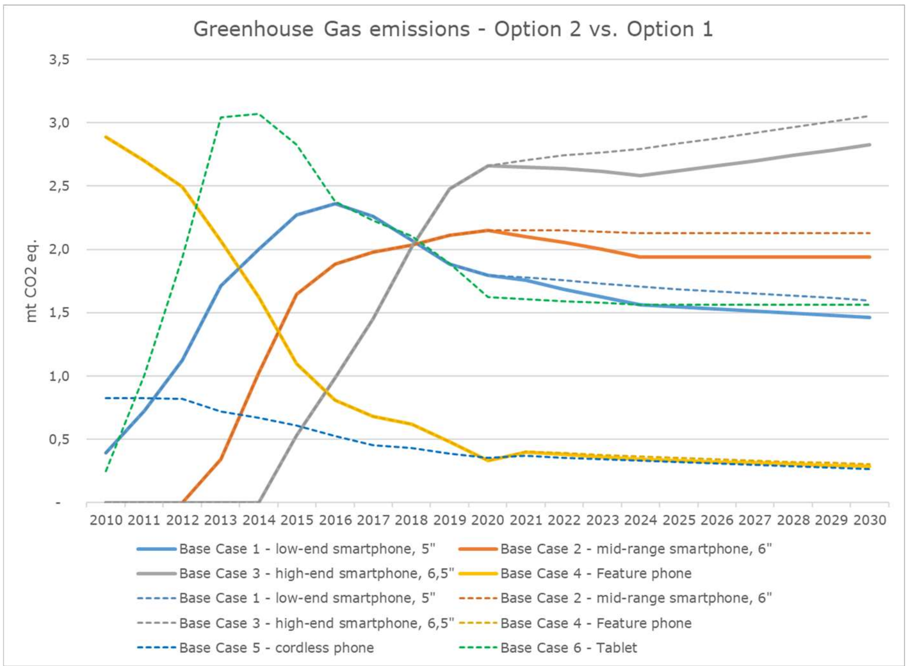

Figure 5 : Option 2 compared to Option 1 – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

Figure 5 depicts to expected trends on Greenhouse Gas emissions initiated by EcoRating.

4.3. Option 3: Introduction of mandatory specific and/or generic ecodesign requirements

The combination of specific and generic eco-design requirements as detailed in 3.3 leads to some mandatory changes in the market and others (i.e., information requirements) stimulate a shift in the market for which the consumer plays a critical role. Both paths analysed in Task 6, the ambitious repair path and the more reliability focussed path, are the potential result of implementing these measures. The reliability focussed path is represents a scenario for achieving a very ambitious battery lifetime of minimum 1000 cycles and high IP rating instead of a focus on user-replaceable batteries, whereas the ambitious reparability path is rather a best-case scenario for implementing the same requirements, but focussing on DIY reparability.

Given that consumers are willing to purchase more sustainable devices (see Task 3), and under the condition that the information requirements provide the needed clarity on sustainability criteria, following assumption is made:

- legislation applies to products put on market from 2023
- 100% of the stock, i.e. devices in use, meets specific requirements by 2027; approximated by following design options according to Task 6:
    - DO20/15/21a,
    - REP scenario only[19]: DO23/17/18/19/21b, but
        - with DO18 referring to the back cover assembly as such, not specifically to glass back cover replacement,
        - with DO19 referring in the design option to display removability by layman (modular, only mechanically fixed display), not the "generalist" level, which is now addressed by the specific requirement – for simplification the same effect is assumed now in this policy scenario, which leads to overestimating the overall REP scenario impact
    - DO49, but increasing battery endurance without increasing battery capacity (no additional impacts due to larger battery size),
    - DO11,
    - DO5/7/8/9, but
        - DUR scenario only: DO5 battery endurance in terms of cycles is 1000@80% instead of the modelled DO5 with 600 cycles@80%, i.e. a further delay of battery replacement need,
    - DO29,
    - DO30,
    - DUR scenario only: DO4
    - DO3/1,
    - DO50
- note: although 100% of the sold products need to be compliant as soon as the legislation applies, the effect of legislation materialises only later, mainly through lifetime extension, as only then replacement sales will go down as intended
- beyond implementation of these specific requirements 50% of the market (stock) moved towards the point of societal Least Life Cycle Costs by 2027
    - **DUR scenario**: DUR path as analysed in Task 6
    - **REP scenario**: REP path as analysed in Task 6

  which means for clarity, e.g.,
    - 50% of devices sold without charger / accessories,

[19] Although some of these design options are specific requirements in the policy scenario the full synergistic effect

  - 50% of devices manufactured with fully optimised processes (PFC abatement), PCB designs, renewable energy for most relevant components and avoidance of air freight
- Further slow increase to 60% market (stock) at point of LLCC by 2030 due to assumed increased environmental awareness

In the REP scenario of implementing Eco-design requirements sales of devices decreases by 42 million units per year in 2030, under the condition that the stock of devices in use remains the same as without measures, and that the reduction in sales is reached through longer product use lifetime.

Table 22 : Option 3 – Eco-design requirements, REP scenario – Sales total and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	**Sales mln. units**	Sales mln. units	**Sales mln. units**
2010	12	0	0	130	32	4	**178**	*178*	-
2011	22	0	0	122	32	15	**190**	*190*	-
2012	34	0	0	113	32	28	**207**	*207*	-
2013	52	7	0	93	28	45	**225**	*225*	-
2014	60	22	0	73	26	45	**226**	*226*	-
2015	68	35	8	50	24	42	**225**	*225*	-
2016	71	39	14	36	20	35	**216**	*216*	-
2017	68	41	21	31	18	33	**212**	*212*	-
2018	62	43	29	28	17	31	**210**	*210*	-
2019	57	44	36	22	15	28	**201**	*201*	-
2020	54	45	39	15	14	24	**190**	*190*	-
2021	53	45	39	18	14	24	**194**	*194*	-
2022	53	45	40	18	14	23	**193**	*193*	-
2023	49	42	38	17	13	23	**181**	*190*	**- 9,4**
2024	45	39	36	15	13	21	**169**	*188*	**- 19,2**
2025	42	36	34	15	12	21	**160**	*188*	**- 27,9**
2026	39	34	33	14	11	20	**151**	*187*	**- 35,7**
2027	37	32	31	13	11	19	**143**	*186*	**- 42,6**
2028	36	32	32	12	10	19	**143**	*185*	**- 42,5**
2029	36	33	33	12	10	19	**143**	*184*	**- 41,1**
2030	36	32	33	12	10	19	**141**	*184*	**- 42,5**

In the DUR scenario the effect is not too different: Sales of devices in total decreases by 37,6 million units in 2030 compared to "no action".

Table 23 : Option 3 – Eco-design requirements, DUR scenario – Sales total and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	**Sales mln. units**	Sales mln. units	**Sales mln. units**
2010	12	0	0	130	32	4	**178**	*178*	-
2011	22	0	0	122	32	15	**190**	*190*	-
2012	34	0	0	113	32	28	**207**	*207*	-
2013	52	7	0	93	28	45	**225**	*225*	-
2014	60	22	0	73	26	45	**226**	*226*	-
2015	68	35	8	50	24	42	**225**	*225*	-
2016	71	39	14	36	20	35	**216**	*216*	-
2017	68	41	21	31	18	33	**212**	*212*	-
2018	62	43	29	28	17	31	**210**	*210*	-
2019	57	44	36	22	15	28	**201**	*201*	-
2020	54	45	39	15	14	24	**190**	*190*	-
2021	53	45	39	18	14	24	**194**	*194*	-
2022	53	45	40	18	14	23	**193**	*193*	-
2023	49	43	38	16	13	23	**183**	*190*	**- 7,8**
2024	45	41	36	15	13	21	**172**	*188*	**- 16,3**
2025	42	39	35	14	12	21	**164**	*188*	**- 23,9**
2026	39	38	34	13	12	20	**156**	*187*	**- 30,8**
2027	37	36	33	13	11	19	**149**	*186*	**- 37,1**
2028	37	36	33	12	11	19	**148**	*185*	**- 37,2**
2029	37	36	34	12	11	19	**148**	*184*	**- 35,9**
2030	36	35	34	12	10	19	**146**	*184*	**- 37,6**

Total consumer expenditure will decline despite slightly increasing product prices (see assumptions in Task 5). This reduction in Life Cycle Costs is due to longer product lifetimes, i.e. longer replacement cycles and to a minor degree also savings in electricity costs. Whereas total purchasing costs go down, the repair costs share of the Life Cycle Costs is increasing significantly (see 5), which is an expected effect: Through better reparability making use of repair services and purchasing spare parts and tools is a growing market.

The development of total consumer expenditure is shown in Table 24: In 2027 total expenditure is almost 20,2 billion Euros lower, in 2030 20,6 billion Euros lower than in a "no action" scenario. For the DUR scenario of option 3 total savings in 2027 are 15,4 billion Euros and 16,2 billion Euros in 2030 respectively.

Table 24 : Option 3 – Potential ecodesign requirements, REP scenario – Total consumer expenditure and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5" mln. €	Base Case 2 - mid-range smartphone, 6" mln. €	Base Case 3 - high-end smartphone, 6,5" mln. €	Base Case 4 - Feature phone mln. €	Base Case 5 - cordless phone mln. €	Base Case 6 - Tablet mln. €	**Totals mln. €**	Totals - Option 1 mln. €	**Improvement mln. €**
2010	2.512	-	-	11.530	1.893	1.223	**17.158**	*17.158*	**-**
2011	4.665	-	-	10.786	1.893	4.983	**22.326**	*22.326*	**-**
2012	7.211	-	-	9.965	1.885	9.634	**28.695**	*28.695*	**-**
2013	11.022	3.742	-	8.250	1.656	15.237	**39.907**	*39.907*	**-**
2014	12.858	11.225	-	6.494	1.538	15.626	**47.741**	*47.741*	**-**
2015	14.610	18.012	7.999	4.383	1.395	14.630	**61.030**	*61.030*	**-**
2016	15.161	20.588	14.828	3.223	1.207	12.550	**67.557**	*67.557*	**-**
2017	14.542	21.615	21.805	2.716	1.047	11.839	**73.564**	*73.564*	**-**
2018	13.309	22.254	30.308	2.471	996	11.183	**80.521**	*80.521*	**-**
2019	12.117	23.064	37.196	1.922	892	10.051	**85.242**	*85.242*	**-**
2020	11.534	23.494	39.996	1.360	823	8.664	**85.871**	*85.871*	**-**
2021	11.419	23.494	40.596	1.611	848	8.506	**86.474**	*86.474*	**-**
2022	11.304	23.494	41.205	1.562	818	8.392	**86.775**	*86.775*	**-**
2023	10.514	21.926	39.166	1.506	785	8.335	**82.231**	*86.813*	**- 4.581**
2024	9.822	20.571	37.402	1.452	753	7.723	**77.724**	*86.862*	**- 9.138**
2025	9.212	19.388	35.864	1.401	723	7.513	**74.101**	*87.303*	**- 13.202**
2026	8.668	18.348	34.513	1.352	694	7.318	**70.893**	*87.757*	**- 16.864**
2027	8.181	17.425	33.320	1.305	666	7.137	**68.033**	*88.224*	**- 20.191**
2028	8.092	17.419	33.809	1.265	641	7.133	**68.360**	*88.704*	**- 20.345**
2029	8.001	17.412	34.305	1.227	618	7.130	**68.693**	*89.198*	**- 20.505**
2030	7.911	17.405	34.807	1.190	596	7.127	**69.037**	*89.703*	**- 20.667**

Total Energy savings to be achieved by specific and generic eco-design requirements combined are 46 PJ in 2027 and 49 PJ in 2030 (REP scenario). This is a savings potential of almost 35%, which materializes only partially within the EU27, and to a significant extend in the global supply chains. An estimate, which share of the savings will be achieved within EU27 and which share is an effect on the global level, is provided in 4.6, Table 33, Table 38 and Table 40.

In the DUR scenario savings are in the range of 41 PJ (2027) and 44 PJ (2030), i.e. a reduction of 31% in 2030.

Similar trends can be observed for other environmental indicators: Reduction in carbon emissions is 3,6 million tons CO2 eq. in 2030 (REP scenario), which corresponds to a reduction by 40% compared to the "no action" option.

Table 25 : Option 3 – Eco-design requirements, REP scenario – Total Energy and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	Total Energy PJ	Total Energy PJ	Total Energy PJ	Total Energy PJ	Total Energy PJ	Total Energy PJ	**Total Energy PJ**	Total Energy PJ	**Total Energy PJ**
2010	6	-	-	50	15	4	**76**	*76*	-
2011	11	-	-	47	15	17	**90**	*90*	-
2012	17	-	-	44	15	32	**108**	*108*	-
2013	27	5	-	36	13	51	**132**	*132*	-
2014	31	16	-	28	12	51	**139**	*139*	-
2015	35	26	8	19	11	47	**147**	*147*	-
2016	37	29	15	14	10	40	**145**	*145*	-
2017	35	31	22	12	8	37	**146**	*146*	-
2018	32	32	31	11	8	35	**149**	*149*	-
2019	29	33	38	8	7	32	**148**	*148*	-
2020	28	33	41	6	6	27	**142**	*142*	-
2021	28	33	42	7	7	27	**144**	*144*	-
2022	27	33	42	7	6	27	**143**	*143*	-
2023	25	30	39	6	6	26	**133**	*142*	**- 10**
2024	22	28	36	6	6	23	**120**	*141*	**- 21**
2025	20	25	34	5	5	21	**111**	*141*	**- 30**
2026	18	23	31	5	5	20	**103**	*141*	**- 39**
2027	17	21	29	4	4	19	**95**	*141*	**- 46**
2028	16	21	30	4	4	19	**94**	*141*	**- 47**
2029	16	21	30	4	4	19	**94**	*142*	**- 48**
2030	16	20	30	4	4	19	**92**	*142*	**- 49**

Comparing the Greenhouse Gas emissions per product segment unveils some major differences (Figure 6): For feature phones and cordless phones, given the lower overall market share and further declining sales figures the savings potential compared to "no action" is comparing low at 90.000 and 60.000 tons CO2 eq. savings in 2030. For the other market segments savings are 1,27 million tons CO2 eq. for high-end smartphones, 960.000 tons CO2 eq. for mid-range smartphones, 690.000 tons CO2 eq. for low-end smartphones and 530.000 t CO2 eq. for tablets.

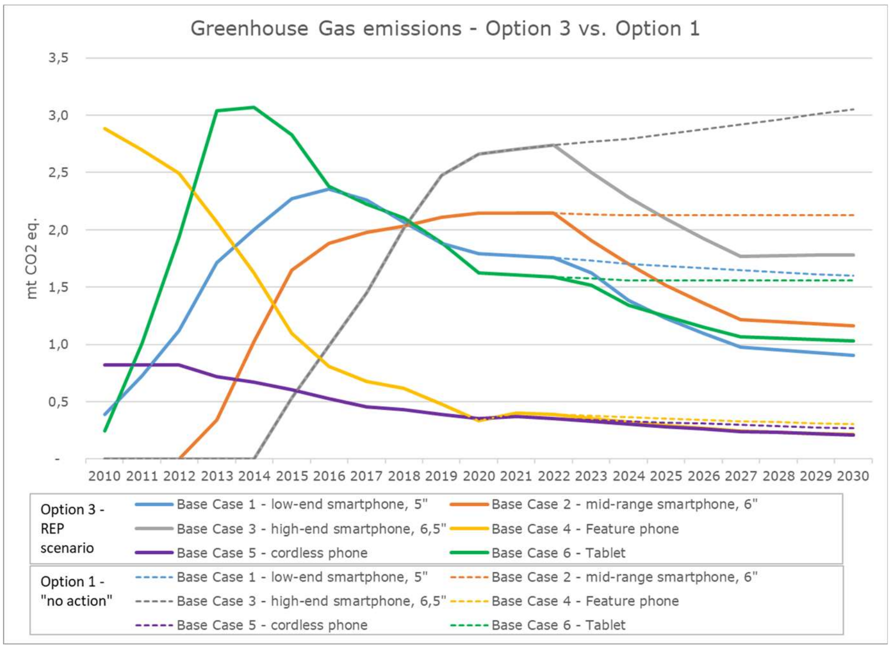

Figure 6 : Option 3 compared to Option 1 – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

The difference between the optimistic and the conservative scenario in terms of Greenhouse Gas emissions seem to be marginal according to the analysis. Figure 7 compares both scenarios and the differences hardly can be distinguished for most of the product segments. Mid-range smartphones is the market segment, where the difference is most notable.

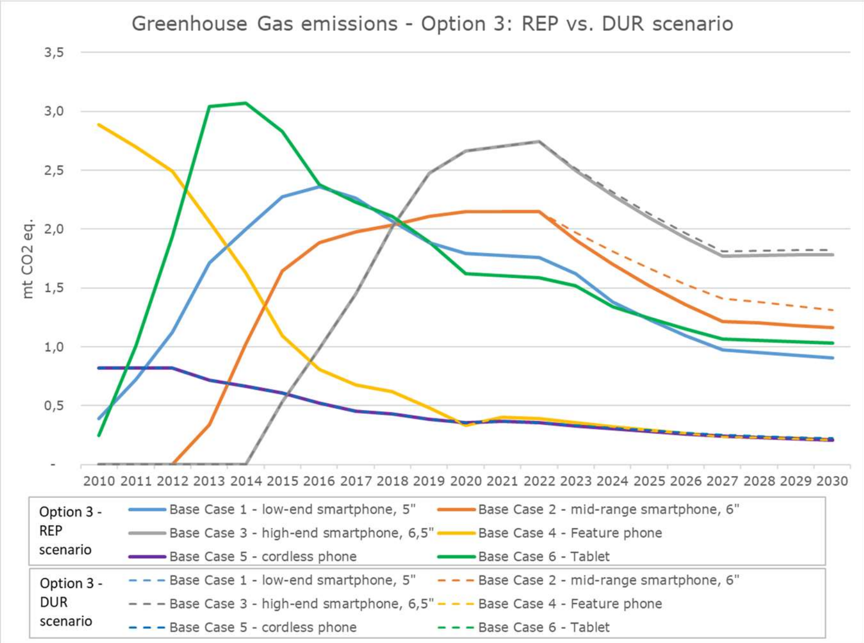

Figure 7 : Option 3 REP vs. DUR scenario – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

4.4. Option 4: Energy Labelling

An Energy Label intends to move a market towards better, more energy efficient products. To which extend the market moves into this direction depends largely on the purchase patterns of consumers. Battery endurance (per cycle) is already a marketing and purchase criterion today, but comparability is hardly given as OEMs test battery endurance in different ways. Given that consumers are willing to purchase more sustainable devices (see Task 3), are used to the Energy Label from other products, and as achieving better labelling classes is also a question of brand image, following assumption is made:

- legislation applies from 2023
- 50% of the market (stock) moved towards 30% better battery endurance (per cycle) by 2027
- 90% of the market (stock) in average moved towards 30% better battery endurance (per cycle) by 2030 (still, the average energy efficiency class is D then)

Compared to the “No action” scenario (Option 1) the Energy Label leads to slowly declining sales figures – due to the anticipated longer battery life. In 2030 a sales volume 6,4 million units lower than in a business-as-usual scenario is expected, due to lower sales figures across the smartphones, feature phone and tablet market segment. Total sales of products covered by this product study is expected to be 177 million units in 2030 in EU27.

Table 26 : Option 4 – Energy Label – Sales total and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	**Sales mln. units**	Sales mln. units	**Sales mln. units**
2010	12	0	0	130	32	4	**178**	*178*	-
2011	22	0	0	122	32	15	**190**	*190*	-
2012	34	0	0	113	32	28	**207**	*207*	-
2013	52	7	0	93	28	45	**225**	*225*	-
2014	60	22	0	73	26	45	**226**	*226*	-
2015	68	35	8	50	24	42	**225**	*225*	-
2016	71	39	14	36	20	35	**216**	*216*	-
2017	68	41	21	31	18	33	**212**	*212*	-
2018	62	43	29	28	17	31	**210**	*210*	-
2019	57	44	36	22	15	28	**201**	*201*	-
2020	54	45	39	15	14	24	**190**	*190*	-
2021	53	45	39	18	14	24	**194**	*194*	-
2022	53	45	40	18	14	23	**193**	*193*	-
2023	52	45	40	17	13	23	**190**	*190*	-
2024	51	44	40	16	13	23	**188**	*188*	- **0,4**
2025	50	44	41	16	12	23	**186**	*188*	- **1,1**
2026	50	44	41	15	12	23	**185**	*187*	- **2,2**
2027	49	43	41	15	12	23	**182**	*186*	- **3,6**
2028	48	43	41	14	11	23	**180**	*185*	- **5,0**
2029	47	43	41	13	11	23	**178**	*184*	- **6,4**
2030	47	43	42	13	10	22	**177**	*184*	- **6,4**

Total consumer expenditure will decline despite slightly increasing product prices (see assumptions in Task 5 for DO49). This reduction in Life Cycle Costs is due to longer product lifetimes, i.e. longer replacement cycles and savings in electricity costs.

The development of total consumer expenditure is shown in Table 27: In 2027 total expenditure is 2,1 billion Euros lower, in 2030 3,85 billion Euros lower than in a "no action" scenario.

Table 27 : Option 4 – Energy Label – Total consumer expenditure and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	mln. €	mln. €	mln. €	mln. €	mln. €	mln. €	**mln. €**	mln. €	**mln. €**
2010	2.512	-	-	11.530	1.893	1.223	**17.158**	*17.158*	**-**
2011	4.665	-	-	10.786	1.893	4.983	**22.326**	*22.326*	**-**
2012	7.211	-	-	9.965	1.885	9.634	**28.695**	*28.695*	**-**
2013	11.022	3.742	-	8.250	1.656	15.237	**39.907**	*39.907*	**-**
2014	12.858	11.225	-	6.494	1.538	15.626	**47.741**	*47.741*	**-**
2015	14.610	18.012	7.999	4.383	1.395	14.630	**61.030**	*61.030*	**-**
2016	15.161	20.588	14.828	3.223	1.207	12.550	**67.557**	*67.557*	**-**
2017	14.542	21.615	21.805	2.716	1.047	11.839	**73.564**	*73.564*	**-**
2018	13.309	22.254	30.308	2.471	996	11.183	**80.521**	*80.521*	**-**
2019	12.117	23.064	37.196	1.922	892	10.051	**85.242**	*85.242*	**-**
2020	11.534	23.494	39.996	1.360	823	8.664	**85.871**	*85.871*	**-**
2021	11.419	23.494	40.596	1.611	848	8.506	**86.474**	*86.474*	**-**
2022	11.304	23.494	41.205	1.562	818	8.392	**86.775**	*86.775*	**-**
2023	11.145	23.424	41.649	1.519	790	8.286	**86.813**	*86.813*	**-**
2024	10.969	23.299	41.975	1.474	762	8.170	**86.649**	*86.862*	**- 212**
2025	10.817	23.191	42.353	1.423	736	8.145	**86.664**	*87.303*	**- 638**
2026	10.647	23.031	42.610	1.372	710	8.111	**86.481**	*87.757*	**- 1.276**
2027	10.460	22.820	42.748	1.320	685	8.069	**86.102**	*88.224*	**- 2.122**
2028	10.276	22.613	42.892	1.270	661	8.028	**85.740**	*88.704*	**- 2.965**
2029	10.094	22.410	43.042	1.222	638	7.989	**85.394**	*89.198*	**- 3.804**
2030	9.983	22.410	43.687	1.185	615	7.969	**85.850**	*89.703*	**- 3.854**

Besides the cost benefits for the consumers in EU27 an Energy Label reduces the external societal costs of this product group by 217 million Euros in 2030 (Table 28). This corresponds to 6% of the aggregated external societal costs in 2030.

Total Energy savings to be achieved by an Energy Label are 8 PJ in 2027 and 15 PJ in 2030. This is a savings potential of 10,5%, which materializes only partially within the EU27, and to a significant extend in the global supply chains.

Whereas the introduction of an Energy Label for other product groups resulted in major energy efficiency gains for e.g. household appliances, this will be less game changing for this product group: Energy efficiency in terms of battery endurance already matters as a performance criterion, but lack of transparency and comparability is missing yet to allow a fully transparent purchase decision for the best performing devices in terms of energy efficiency.

An estimate, which share of the savings will be achieved within EU27 and which share is an effect on the global level, is provided in 4.6, Table 33 and Table 40.

Table 28 : Option 4 – Energy Label – Total External annual damages (updated societal cost factors) and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5" external annual damages (updated data) mln. €	Base Case 2 - mid-range smartphone, 6" external annual damages (updated data) mln. €	Base Case 3 - high-end smartphone, 6,5" external annual damages (updated data) mln. €	Base Case 4 - Feature phone external annual damages (updated data) mln. €	Base Case 5 - cordless phone external annual damages (updated data) mln. €	Base Case 6 - Tablet external annual damages (updated data) mln. €	**Totals external annual damages (updated data) mln. €**	Totals - Option 1 external annual damages (updated data) mln. €	**Improvement external annual damages (updated data) mln. €**
2010	144	0	0	817	249	93	**1.303**	*1.303*	-
2011	268	0	0	764	249	377	**1.658**	*1.658*	-
2012	414	0	0	706	248	725	**2.092**	*2.092*	-
2013	633	136	0	584	218	1139	**2.710**	*2.710*	-
2014	738	409	0	460	202	1151	**2.960**	*2.960*	-
2015	839	656	226	310	183	1060	**3.273**	*3.273*	-
2016	870	749	418	228	159	891	**3.316**	*3.316*	-
2017	835	787	615	192	138	834	**3.401**	*3.401*	-
2018	764	810	855	175	131	789	**3.524**	*3.524*	-
2019	695	840	1049	136	117	709	**3.547**	*3.547*	-
2020	662	855	1128	100	109	637	**3.491**	*3.491*	-
2021	655	855	1145	114	112	601	**3.483**	*3.483*	-
2022	649	855	1163	111	108	596	**3.481**	*3.481*	-
2023	639	851	1174	107	104	621	**3.497**	*3.497*	-
2024	628	845	1181	103	100	595	**3.451**	*3.464*	- **12**
2025	618	838	1188	100	97	586	**3.427**	*3.463*	- **36**
2026	606	829	1191	96	93	578	**3.393**	*3.465*	- **72**
2027	592	817	1188	93	90	569	**3.349**	*3.468*	- **119**
2028	578	805	1185	89	87	562	**3.307**	*3.473*	- **166**
2029	565	794	1183	86	84	555	**3.267**	*3.480*	- **213**
2030	559	794	1201	83	81	552	**3.270**	*3.487*	- **217**

Table 29 : Option 4 – Energy Label – Total Energy and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5" Total Energy PJ	Base Case 2 - mid-range smartphone, 6" Total Energy PJ	Base Case 3 - high-end smartphone, 6,5" Total Energy PJ	Base Case 4 - Feature phone Total Energy PJ	Base Case 5 - cordless phone Total Energy PJ	Base Case 6 - Tablet Total Energy PJ	**Totals Total Energy PJ**	Totals - Option 1 Total Energy PJ	**Improvement Total Energy PJ**
2010	6	-	-	50	15	4	**76**	*76*	-
2011	11	-	-	47	15	17	**90**	*90*	-
2012	17	-	-	44	15	32	**108**	*108*	-
2013	27	5	-	36	13	51	**132**	*132*	-
2014	31	16	-	28	12	51	**139**	*139*	-
2015	35	26	8	19	11	47	**147**	*147*	-
2016	37	29	15	14	10	40	**145**	*145*	-
2017	35	31	22	12	8	37	**146**	*146*	-
2018	32	32	31	11	8	35	**149**	*149*	-
2019	29	33	38	8	7	32	**148**	*148*	-
2020	28	33	41	6	6	27	**142**	*142*	-
2021	28	33	42	7	7	27	**144**	*144*	-
2022	27	33	42	7	6	27	**143**	*143*	-
2023	27	33	43	7	6	26	**142**	*142*	**0**
2024	26	33	43	6	6	26	**141**	*141*	- **1**
2025	26	33	43	6	6	26	**139**	*141*	- **2**
2026	25	32	43	6	6	25	**136**	*141*	- **5**
2027	24	31	42	6	5	25	**133**	*141*	- **8**
2028	24	30	41	5	5	24	**130**	*141*	- **11**
2029	23	30	41	5	5	23	**127**	*142*	- **15**
2030	23	30	41	5	5	23	**127**	*142*	- **15**

The savings potential for Greenhouse Gas emissions is 0,7 million tons CO2 eq., or 8,4% compared to "no action" in 2030.

These trends in Greenhouse Gas emissions until 2030 are depicted in Figure 8.

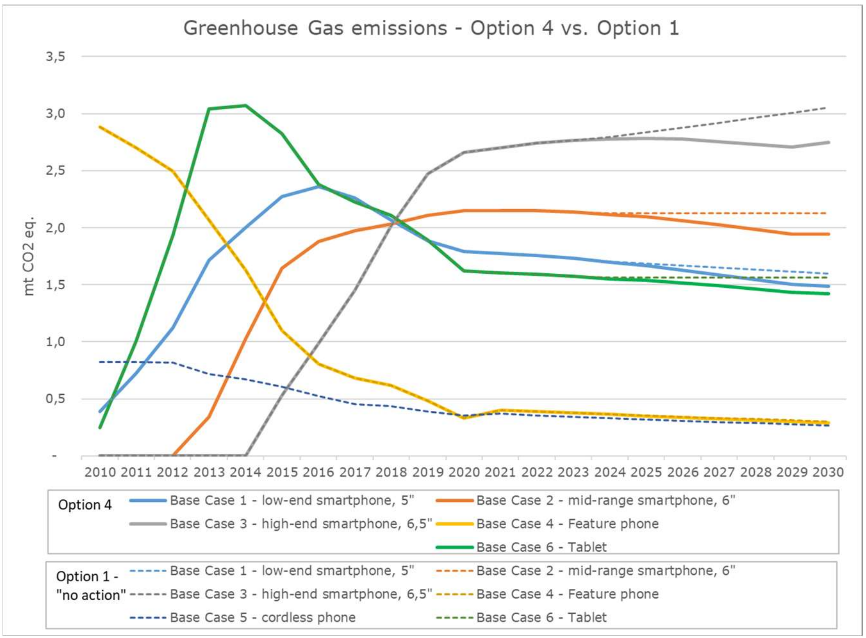

Figure 8 : Option 4 compared to Option 1 – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

4.5. Option 5: Ecodesign requirements combined with Energy Labelling

The effect of introducing a potential Energy Label combined with potential Ecodesign requirements compared to Ecodesign requirements only, can hardly be quantified: The regulated aspect, battery endurance (per cycle), is covered by both measures, but with slightly different approaches: The Energy Label would be introduced as a rather widely known graphical indication of energy efficiency whereas incorporating a battery endurance rating through some Ecodesign benchmark indicator would be a new kind of information. Therefore it can be assumed, that a distinct Energy Label besides other Ecodesign information requirements might lead to a faster shift in the market towards devices with a better battery endurance. An Energy Label would also mean, that products have to be entered in the EPREL database and as such transparency on overall device performance in the market will be enhanced. These are arguments in favour of a combined approach.

Given the general popularity of the Energy Label for purchase decisions a – speculative – scenario for a combined approach is, that changes in the market occur faster than with a new type of Eco-design information. This scenario is based on the Ecodesign requirements scenario (option 3), but 50% of products just meeting the specific requirements and the other 50% of the market reaches the point of Least Life Cycle costs already one year earlier, i.e. in 2026. In 2030 65% instead of 60% is assumed to reach the point of Least Life Cycle Costs. This development is also based on the rationale, that the Energy Label puts more emphasize on aspects, which materialise right from market introduction and not (only) over an extended lifetime: These are material efficiency, and production related environmental impacts as a score value on the label.

Compared to the "No action" scenario (Option 1) the combination of both, Ecodesign requirements and Energy Label leads to declining sales figures. In 2029 and 2030 a sales volume 42,5 million units lower than in a business-as-usual scenario is expected. Total sales of products covered by this product study is expected to be 141 million units in 2030 in EU27.

Table 30 : Option 5 – Ecodesign requirements and Energy Label – Sales total and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	**Sales mln. units**	Sales mln. units	**Sales mln. units**
2010	12	0	0	130	32	4	**178**	*178*	-
2011	22	0	0	122	32	15	**190**	*190*	-
2012	34	0	0	113	32	28	**207**	*207*	-
2013	52	7	0	93	28	45	**225**	*225*	-
2014	60	22	0	73	26	45	**226**	*226*	-
2015	68	35	8	50	24	42	**225**	*225*	-
2016	71	39	14	36	20	35	**216**	*216*	-
2017	68	41	21	31	18	33	**212**	*212*	-
2018	62	43	29	28	17	31	**210**	*210*	-
2019	57	44	36	22	15	28	**201**	*201*	-
2020	54	45	39	15	14	24	**190**	*190*	-
2021	53	45	39	18	14	24	**194**	*194*	-
2022	53	45	40	18	14	23	**193**	*193*	-
2023	47	40	36	16	13	23	**176**	*190*	**- 14,1**
2024	43	36	34	15	12	21	**160**	*188*	**- 28,0**
2025	40	34	32	14	12	20	**152**	*188*	**- 35,7**
2026	37	32	31	13	11	19	**144**	*187*	**- 42,7**
2027	37	32	31	13	11	19	**143**	*186*	**- 42,6**
2028	37	33	32	13	11	19	**144**	*185*	**- 41,1**
2029	36	32	32	12	10	19	**142**	*184*	**- 42,5**
2030	36	32	33	12	10	19	**141**	*184*	**- 42,5**

Compared to requirements under the Ecodesign Directive only, the combination with an Energy Label results in very similar total savings, but reductions will be achieved earlier, due to the modelling approach chosen here. Figure 10 depicts this trend for Greenhouse Gas emissions until 2030.

Total consumer expenditure will decline despite slightly increasing product prices (see assumptions in Task 5). This reduction in Life Cycle Costs is due to longer product lifetimes, i.e. longer replacement cycles and to a minor degree also savings in electricity costs. Whereas total purchasing costs go down, the repair costs share of the Life Cycle Costs is increasing significantly (see chapter 5), which is an expected effect: Through better reparability making use of repair services and purchasing spare parts and tools is a growing market.

The development of total consumer expenditure is shown in Table 27: In 2027 total expenditure is 20,2 billion Euros lower, in 2030 20,7 billion Euros lower than in a "no action" scenario.

Table 31 : Option 5 – Ecodesign requirements and Energy Label – Total consumer expenditure and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5" mln. €	Base Case 2 - mid-range smartphone, 6" mln. €	Base Case 3 - high-end smartphone, 6,5" mln. €	Base Case 4 - Feature phone mln. €	Base Case 5 - cordless phone mln. €	Base Case 6 - Tablet mln. €	**Totals mln. €**	Totals - Option 1 mln. €	**Improvement mln. €**
2010	2.512	-	-	11.530	1.893	1.223	**17.158**	*17.158*	-
2011	4.665	-	-	10.786	1.893	4.983	**22.326**	*22.326*	-
2012	7.211	-	-	9.965	1.885	9.634	**28.695**	*28.695*	-
2013	11.022	3.742	-	8.250	1.656	15.237	**39.907**	*39.907*	-
2014	12.858	11.225	-	6.494	1.538	15.626	**47.741**	*47.741*	-
2015	14.610	18.012	7.999	4.383	1.395	14.630	**61.030**	*61.030*	-
2016	15.161	20.588	14.828	3.223	1.207	12.550	**67.557**	*67.557*	-
2017	14.542	21.615	21.805	2.716	1.047	11.839	**73.564**	*73.564*	-
2018	13.309	22.254	30.308	2.471	996	11.183	**80.521**	*80.521*	-
2019	12.117	23.064	37.196	1.922	892	10.051	**85.242**	*85.242*	-
2020	11.534	23.494	39.996	1.360	823	8.664	**85.871**	*85.871*	-
2021	11.419	23.494	40.596	1.611	848	8.506	**86.474**	*86.474*	-
2022	11.304	23.494	41.205	1.562	818	8.392	**86.775**	*86.775*	-
2023	10.209	21.224	37.969	1.501	783	8.359	**80.046**	*86.813*	**- 6.767**
2024	9.309	19.388	35.334	1.444	749	7.519	**73.743**	*86.862*	**- 13.119**
2025	8.761	18.348	34.003	1.394	719	7.322	**70.546**	*87.303*	**- 16.757**
2026	8.269	17.425	32.827	1.345	690	7.140	**67.696**	*87.757*	**- 20.061**
2027	8.180	17.419	33.310	1.305	665	7.134	**68.012**	*88.224*	**- 20.212**
2028	8.089	17.412	33.798	1.265	641	7.130	**68.334**	*88.704*	**- 20.370**
2029	7.999	17.405	34.293	1.227	618	7.127	**68.669**	*89.198*	**- 20.529**
2030	7.908	17.395	34.790	1.190	595	7.123	**69.001**	*89.703*	**- 20.703**

The costs of societal damages decrease from a current level of 3,5 billion Euros down to approximately 2,4 billion Euros (Figure 9).

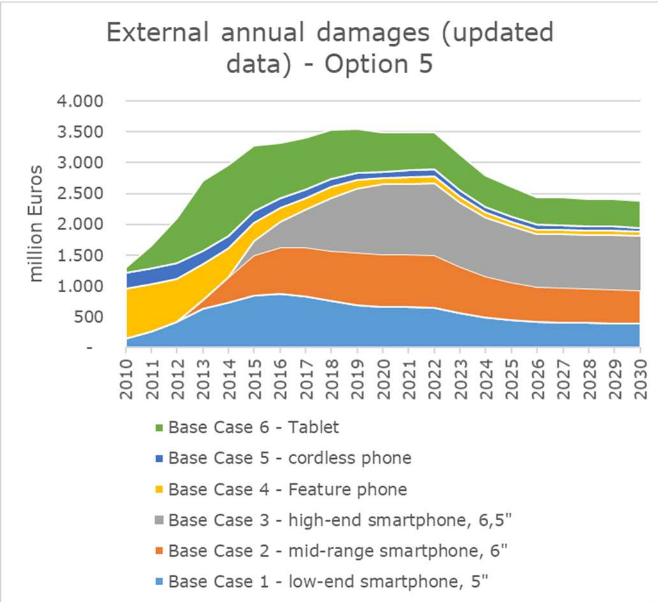

Figure 9 : Option 5 – Ecodesign requirements and Energy Label – External annual damages (updated societal cost factors), EU27, 2010-2030

Total Energy savings to be achieved by specific and generic eco-design requirements in combination with an Energy Label are 47 PJ in 2027 and 50 PJ in 2030 (Table 32). This is a savings potential of 35%, which materializes only partially within the EU27, and to a significant extend in the global supply chains.

Similar trends can be observed for other environmental indicators: Reduction in carbon emissions is 3,7 million tons CO2 eq. in 2030, which corresponds to a reduction by 41,6% compared to the "no action" option.

Table 32 : Option 5 – Eco-design requirements and Energy Label – Total Energy and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	Total Energy	Total Energy	Total Energy	Total Energy	Total Energy	Total Energy	**Total Energy**	Total Energy	**Total Energy**
	PJ	PJ	PJ	PJ	PJ	PJ	**PJ**	PJ	**PJ**
2010	6	-	-	50	15	4	**76**	*76*	-
2011	11	-	-	47	15	17	**90**	*90*	-
2012	17	-	-	44	15	32	**108**	*108*	-
2013	27	5	-	36	13	51	**132**	*132*	-
2014	31	16	-	28	12	51	**139**	*139*	-
2015	35	26	8	19	11	47	**147**	*147*	-
2016	37	29	15	14	10	40	**145**	*145*	-
2017	35	31	22	12	8	37	**146**	*146*	-
2018	32	32	31	11	8	35	**149**	*149*	-
2019	29	33	38	8	7	32	**148**	*148*	-
2020	28	33	41	6	6	27	**142**	*142*	-
2021	28	33	42	7	7	27	**144**	*144*	-
2022	27	33	42	7	6	27	**143**	*143*	-
2023	24	29	37	6	6	25	**128**	*142*	**- 14**
2024	20	25	33	5	5	21	**111**	*141*	**- 30**
2025	19	23	31	5	5	20	**103**	*141*	**- 39**
2026	17	21	29	5	5	19	**95**	*141*	**- 46**
2027	17	21	29	4	4	19	**94**	*141*	**- 47**
2028	16	21	29	4	4	19	**94**	*141*	**- 48**
2029	16	21	30	4	4	19	**93**	*142*	**- 49**
2030	15	20	30	4	4	19	**91**	*142*	**- 50**

Greenhouse Gas emissions decline more rapidly from 2023 onwards than with the Eco-design requirements only (Figure 10), given the modelling approach, but this "Energy Label" advantage is not expected to last for long. Towards 2030 the emission trends merge again.

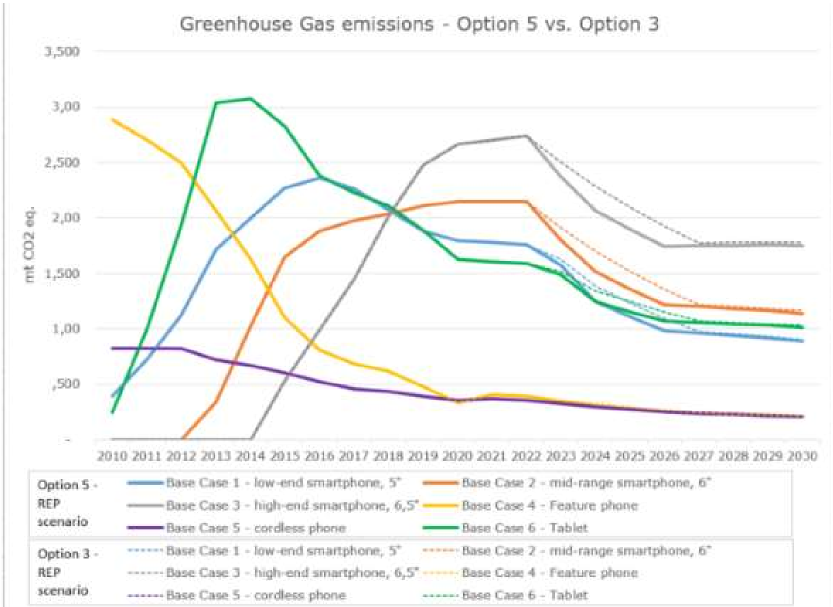

Figure 10 : Option 5 compared to Option 3 (REP scenario) – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

4.6. Comparison of options

The following sub-chapters compare the outcome of the scenario analysis, now individually for the market segments

- smartphones, aggregating results for Base Cases 1-3
- feature phones (i.e., "mobile phones other than smartphones"), representing results for Base Case 4
- cordless phones, representing results for Base Case 5
- tablets, representing results for Base Case 6

4.6.1. Smartphones

The implementation of potential Ecodesign requirements as detailed in the policy options is expected to have a major impact on sales figures, due to extended replacement cycles. Consequently, also the combination of potential Ecodesign requirements and a potential Energy Label reduces the number of sold units by 36 million phones per year on the EU27 market in 2030, which is 26% less devices put on the market (Figure 11).

Smartphones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units
2010	12	12	12	12	12
2011	22	22	22	22	22
2012	34	34	34	34	34
2013	59	59	59	59	59
2014	82	82	82	82	82
2015	111	111	111	111	111
2016	125	125	125	125	125
2017	131	131	131	131	131
2018	134	134	134	134	134
2019	137	137	137	137	137
2020	138	138	138	138	138
2021	138	136	138	138	138
2022	138	135	138	138	138
2023	137	133	128	137	124
2024	136	131	120	136	113
2025	136	131	113	135	106
2026	136	131	106	135	100
2027	136	131	100	133	100
2028	136	131	100	132	101
2029	137	131	102	131	101
2030	137	131	101	131	101

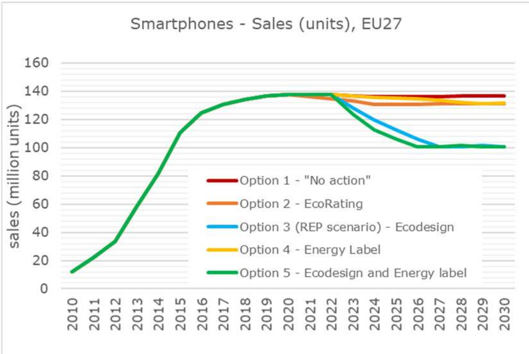

Figure 11 : Smartphones – Sales per policy scenario, EU27, 2010-2030

Total annual consumer expenditure slightly grows in coming years for options 1 ("no action"), 2 (EcoRating), and 4 (Energy Label), due to a limited effect on lifetime extension across the EU27 market and the ongoing trend towards more high-price devices. The significantly declining total annual consumer expenditures for options 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) mirror the declining sales of new devices.

Total annual consumer expenditure does not include costs for mobile and data subscriptions (see Task 2 for related cost details), or software (apps) and software based services.

Smartphones	Option 1 - "No action" total annual consumer expenditure mln. €	Option 2 - EcoRating total annual consumer expenditure mln. €	Option 3 (REP scenario) - Ecodesign total annual consumer expenditure mln. €	Option 4 - Energy Label total annual consumer expenditure mln. €	Option 5 - Ecodesign and Energy label total annual consumer expenditure mln. €
2010	2.512	2.512	2.512	2.512	2.512
2011	4.665	4.665	4.665	4.665	4.665
2012	7.211	7.211	7.211	7.211	7.211
2013	14.763	14.763	14.763	14.763	14.763
2014	24.084	24.084	24.084	24.084	24.084
2015	40.622	40.622	40.622	40.622	40.622
2016	50.577	50.577	50.577	50.577	50.577
2017	57.962	57.962	57.962	57.962	57.962
2018	65.872	65.872	65.872	65.872	65.872
2019	72.377	72.377	72.377	72.377	72.377
2020	75.025	75.025	75.025	75.025	75.025
2021	75.509	74.852	75.509	75.509	75.509
2022	76.003	74.694	76.003	76.003	76.003
2023	76.218	74.369	71.675	76.218	69.501
2024	76.442	73.859	67.919	76.243	64.196
2025	76.959	74.360	64.630	76.360	61.309
2026	77.486	74.870	61.728	76.287	58.746
2027	78.022	75.389	59.152	76.028	59.148
2028	78.568	75.918	59.561	75.781	59.556
2029	79.123	76.456	59.977	75.545	59.972
2030	79.689	77.004	60.401	76.080	60.394

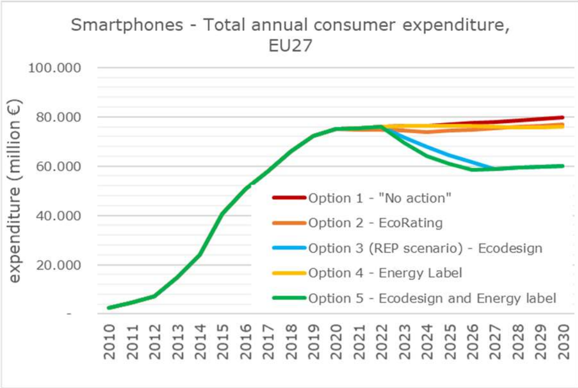

Figure 12 : Smartphones – Total annual consumer expenditure per policy scenario, EU27, 2010-2030

For the specific aspect of repair costs, which show a fundamentally different trend, see chapter 5, Figure 38, p. 86.

These cost effects of the scenarios involving Ecodesign requirements are even more apparent for the external annual damages, based on the updated cost figures introduced in Task 5. With options 2 (EcoRating) and 4 (Energy Label) external damages will be reduced by 2030, but a major reduction in external damages is achieved only with option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label). These two options reduce societal costs by almost 950 million Euros in 2030 (Figure 13).

Smartphones	Option 1 - "No action" external annual damages (updated data) mln. €	Option 2 - EcoRating external annual damages (updated data) mln. €	Option 3 (REP scenario) - Ecodesign external annual damages (updated data) mln. €	Option 4 - Energy Label external annual damages (updated data) mln. €	Option 5 - Ecodesign and Energy label external annual damages (updated data) mln. €
2010	144	144	144	144	144
2011	268	268	268	268	268
2012	414	414	414	414	414
2013	769	769	769	769	769
2014	1.147	1.147	1.147	1.147	1.147
2015	1.720	1.720	1.720	1.720	1.720
2016	2.038	2.038	2.038	2.038	2.038
2017	2.237	2.237	2.237	2.237	2.237
2018	2.429	2.429	2.429	2.429	2.429
2019	2.584	2.584	2.584	2.584	2.584
2020	2.646	2.646	2.646	2.646	2.646
2021	2.656	2.615	2.656	2.656	2.656
2022	2.667	2.585	2.667	2.667	2.667
2023	2.665	2.548	2.457	2.665	2.357
2024	2.663	2.502	2.274	2.653	2.104
2025	2.675	2.513	2.114	2.644	1.963
2026	2.686	2.524	1.972	2.625	1.836
2027	2.698	2.535	1.845	2.597	1.834
2028	2.710	2.546	1.842	2.569	1.829
2029	2.722	2.558	1.837	2.542	1.824
2030	2.735	2.570	1.833	2.553	1.814

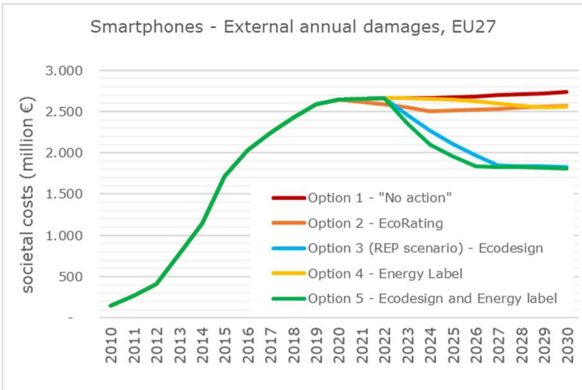

Figure 13 : Smartphones – External annual damages (updated data) per policy scenario, EU27, 2010-2030

Option 2 (EcoRating) is the one, which can have an immediate effect, if being implemented broadly by telecommunications providers already in 2021. The calculated effect could equal 80 million Euros reduced societal damages in 2022 already.

Similar to sales and costs Total Energy consumption for the product segment of smartphones is reduced significantly on the EU27 market only with options involving Ecodesign requirements (Figure 38).

Smartphones	Option 1 - "No action" Total Energy PJ	Option 2 - EcoRating Total Energy PJ	Option 3 (REP scenario) - Ecodesign Total Energy PJ	Option 4 - Energy Label Total Energy PJ	Option 5 - Ecodesign and Energy label Total Energy PJ
2010	6	6	6	6	6
2011	11	11	11	11	11
2012	17	17	17	17	17
2013	32	32	32	32	32
2014	47	47	47	47	47
2015	69	69	69	69	69
2016	81	81	81	81	81
2017	88	88	88	88	88
2018	95	95	95	95	95
2019	101	101	101	101	101
2020	103	103	103	103	103
2021	103	101	103	103	103
2022	103	100	103	103	103
2023	103	99	95	103	91
2024	103	97	86	102	79
2025	103	97	79	101	73
2026	104	97	73	100	67
2027	104	98	67	98	67
2028	104	98	67	95	67
2029	105	98	67	93	66
2030	105	99	66	94	65

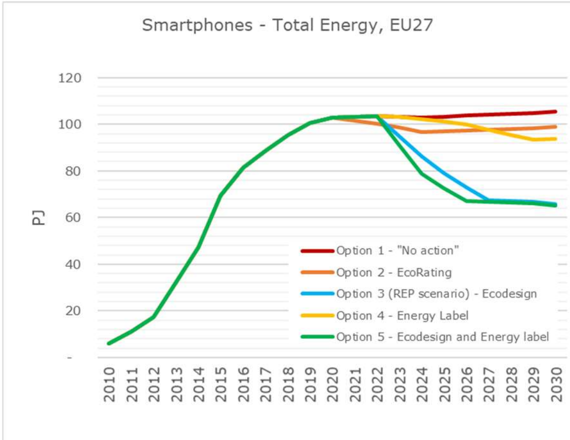

Figure 14 : Smartphones – Total Energy per policy scenario, EU27, 2010-2030

The effect of option 2 (EcoRating) on immediate Greenhouse Gas emission reduction is obvious from the scenario analysis (Figure 15): As Life Cycle Assessment results are part of the EcoRating score, there is some transparency on manufacturing and other life cycle impacts and consequently for consumers the possibility to make an informed decision.

Smartphones	Option 1 - "No action" Greenhouse Gas emissions mt CO2 eq.	Option 2 - EcoRating Greenhouse Gas emissions mt CO2 eq.	Option 3 (REP scenario) - Ecodesign Greenhouse Gas emissions mt CO2 eq.	Option 4 - Energy Label Greenhouse Gas emissions mt CO2 eq.	Option 5 - Ecodesign and Energy label Greenhouse Gas emissions mt CO2 eq.
2010	0,4	0,4	0,4	0,4	0,4
2011	0,7	0,7	0,7	0,7	0,7
2012	1,1	1,1	1,1	1,1	1,1
2013	2,1	2,1	2,1	2,1	2,1
2014	3,0	3,0	3,0	3,0	3,0
2015	4,5	4,5	4,5	4,5	4,5
2016	5,2	5,2	5,2	5,2	5,2
2017	5,7	5,7	5,7	5,7	5,7
2018	6,1	6,1	6,1	6,1	6,1
2019	6,5	6,5	6,5	6,5	6,5
2020	6,6	6,6	6,6	6,6	6,6
2021	6,6	6,5	6,6	6,6	6,6
2022	6,6	6,4	6,6	6,6	6,6
2023	6,6	6,2	6,0	6,6	5,7
2024	6,6	6,1	5,4	6,6	4,8
2025	6,6	6,1	4,8	6,5	4,4
2026	6,7	6,1	4,4	6,5	3,9
2027	6,7	6,1	4,0	6,4	3,9
2028	6,7	6,2	3,9	6,3	3,9
2029	6,7	6,2	3,9	6,2	3,8
2030	6,8	6,2	3,9	6,2	3,8

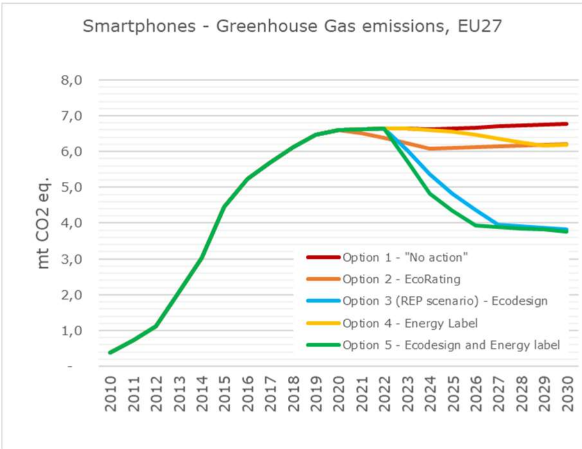

Figure 15 : Smartphones – Greenhouse Gas emissions per policy scenario, EU27, 2010-2030

With option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) the Greenhouse Gas emissions drop significantly from 2023 onwards. For both scenarios the related emissions are 3 million t CO2 eq. lower in 2030 than with "no action".

The same trends for the various policy scenarios are confirmed for other environmental indicators as well. As an example, Figure 16 provides the scenario results for acidification: Options 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) result in significant reductions in SO_2 and other emissions contributing to acidification. Roughly 21 kt SO2 eq. less in 2030 is the calculated effect of both options for the year 2030. Actually, a similarly high savings potential is achieved already from 2027 onwards in these scenarios. Option 2 (EcoRating) and 4 (Energy Label) result in less emissions reductions.

Smartphones	Option 1 - "No action" Acidification kt SO2 eq.	Option 2 - EcoRating Acidification kt SO2 eq.	Option 3 (REP scenario) - Ecodesign Acidification kt SO2 eq.	Option 4 - Energy Label Acidification kt SO2 eq.	Option 5 - Ecodesign and Energy label Acidification kt SO2 eq.
2010	3,4	3,4	3,4	3,4	3,4
2011	6,4	6,4	6,4	6,4	6,4
2012	9,9	9,9	9,9	9,9	9,9
2013	18,6	18,6	18,6	18,6	18,6
2014	28,0	28,0	28,0	28,0	28,0
2015	42,8	42,8	42,8	42,8	42,8
2016	51,2	51,2	51,2	51,2	51,2
2017	56,6	56,6	56,6	56,6	56,6
2018	62,0	62,0	62,0	62,0	62,0
2019	66,4	66,4	66,4	66,4	66,4
2020	68,1	68,1	68,1	68,1	68,1
2021	68,4	67,6	68,4	68,4	68,4
2022	68,7	67,0	68,7	68,7	68,7
2023	68,6	66,3	63,9	68,6	61,6
2024	68,6	65,3	59,4	68,3	55,3
2025	68,9	65,6	55,6	68,2	51,9
2026	69,2	65,9	52,2	67,8	48,9
2027	69,6	66,2	49,2	67,1	49,1
2028	69,9	66,6	49,3	66,5	49,2
2029	70,3	66,9	49,5	65,9	49,4
2030	70,6	67,2	49,6	66,2	49,5

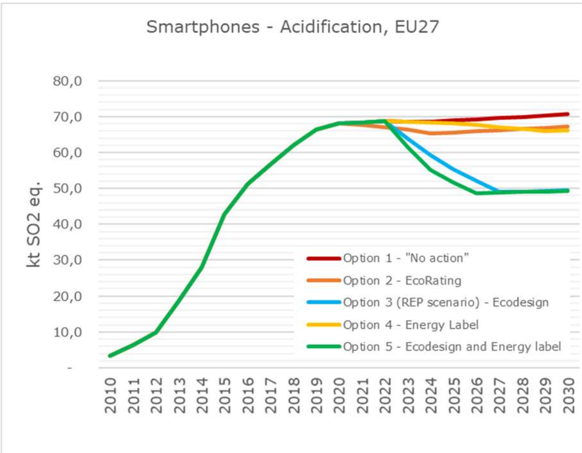

Figure 16 : Smartphones – Acidification per policy scenario, EU27, 2010-2030

Coming back to the impacts on Total Energy and Greenhouse Gas emissions, a rough estimate if savings materialise in the EU27 or outside can be made on the basis of the life cycle phase, to which the savings can be attributed: As almost all of the supply chain is located outside EU27 impacts related to production can be considered as occurring outside the EU27. The distribution phase partly can be allocated to EU27, partly to non-EU countries. Changes in use phase related impacts clearly can be attributed to EU27. Table 33 provides data for these 3 life cycle phases (end of life being excluded here) for devices sold in 2030: As the stock is not affected by any of the policy scenarios but only the number of sold units, energy consumption in use and Greenhouse Gas emissions from use are not as much subject to reductions as the production phase: Option 2 (EcoRating) reduces Total Energy consumption in the use phase of devices by 1,5 PJ but 2,5 PJ in the production phase. Option 3 (Ecodesign requirements) results in 8,3 PJ use phase related Total Energy savings, but 15 PJ production related Total Energy savings. Option 4 (Energy Label) is the only scenario where savings stemming from the use phase are significantly larger than those related to production, despite the positive effect on product lifetimes.

Table 33 : Smartphones – Total Energy and Greenhouse Gas emissions per policy scenario, per life cycle phase, EU27, all units sold in 2030

2030: smartphones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scen.) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Total Energy (PJ)					
Production	56,40	53,85	41,28	54,73	41,16
Distribution	16,27	13,98	6,05	15,79	5,54
Use	39,93	38,47	31,58	32,15	31,47
Totals	**112,61**	**106,30**	**78,91**	**102,67**	**78,17**
Greenhouse Gas emissions (mt CO2 eq.)					
Production	4,25	3,94	2,67	4,13	2,63
Distribution	1,26	1,08	0,47	1,22	0,43
Use	1,72	1,66	1,36	1,39	1,35
Totals	**7,24**	**6,68**	**4,50**	**6,74**	**4,41**

In the "no action" scenario the overall amount of material, of which smartphones, accessories and packaging are made in 2030 is calculated to be roughly 77.900 t[20], thereof 17.300 t electronics and 16.400 t metals other than those in the electronics parts (Table 34). Total material consumption is reduced with option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) down to roughly 47.000 t, which is a 40% reduction. These figures include already spare parts, which will be used for repairs of these units over their lifetime.

Table 34 : Smartphones – Material consumption per policy option, EU27, all units sold in 2030

2030: smartphones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scen.) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Material categories					
Bulk Plastics (t)	2.188,97	2.038,69	1.387,44	2.103,71	1.368,24
TecPlastics (t)	6.842,55	6.184,70	3.647,44	6.579,87	3.528,88
Ferro metals (t)	2.336,11	2.223,45	1.658,15	2.246,10	1.652,50
Non-ferro metals (t)	14.109,75	13.433,33	9.997,12	13.502,95	9.956,65
Electronics (t)	17.313,97	16.355,24	11.810,95	16.626,93	11.728,37
Miscellaneous, mainly paper, cardboard (t)	35.126,72	31.874,05	19.111,38	33.713,58	18.540,86
Totals materials (t)	**77.918,08**	**72.109,47**	**47.612,49**	**74.773,15**	**46.775,51**
thereof, Critical Raw Materials (t)					
Tantalum (Ta)	2,73	2,62	2,02	2,63	2,02
Indium (In)	1,37	1,31	1,01	1,31	1,01
Platinum Group metals (PGM)	1,37	1,31	1,01	1,31	1,01
Gallium (Ga)	0,05	0,05	0,04	0,05	0,04
Rare earth elements (Sc, Y, Nd)	13,67	13,12	10,11	13,14	10,11
Cobalt (Co)	820,35	787,39	606,31	788,40	606,31
Magnesium (Mg)	757,46	727,03	559,83	727,95	559,83

The same data for major material categories is depicted in Figure 17.

The consumption of Critical Raw Materials, provided that the composition of smartphones does not change fundamentally, is reduced along with the declining sales of phones (Table 34): The amount of Tantalum is reduced from 2,7 t in the "no action" scenario to 2,0 t with option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label). Same trends can be observed for the other Critical Raw Materials Indium, Gallium, Platinum Group Metals, Rare Earth Elements and Magnesium. Consumption of Cobalt declines by close to 200 t with potential Ecodesign requirements, unless better battery endurance comes at the expense of increasing the amount of Cobalt per battery.

[20] This also includes part of the metal production waste from machining housing parts, see Base Case data in Task 5

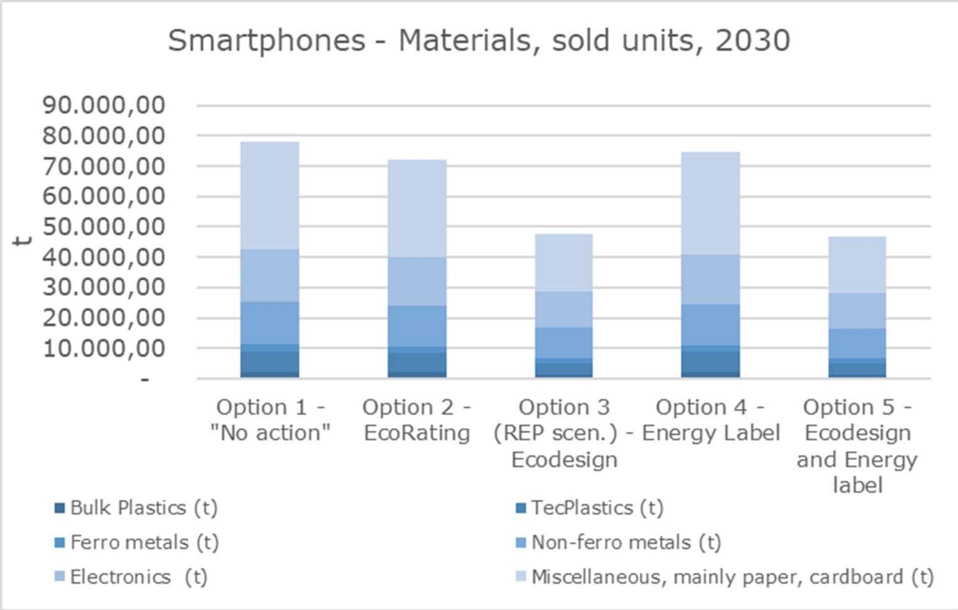

Figure 17 : Smartphones – Material consumption per policy option, EU27, all units sold in 2030

4.6.2. Feature phones

The implementation of Ecodesign requirements as detailed in the policy options is expected to have a major impact on sales figures, due to extended replacement cycles, in any anyway declining market of feature phones. Consequently, also the combination of potential Ecodesign requirements and a potential Energy Label reduces the number of sold units by 2 million feature phones per year on the EU27 market in 2030, which is 15% less devices put on the market (Figure 18).

Feature phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units
2010	130	130	130	130	130
2011	122	122	122	122	122
2012	113	113	113	113	113
2013	93	93	93	93	93
2014	73	73	73	73	73
2015	50	50	50	50	50
2016	36	36	36	36	36
2017	31	31	31	31	31
2018	28	28	28	28	28
2019	22	22	22	22	22
2020	15	15	15	15	15
2021	18	18	18	18	18
2022	18	17	18	18	18
2023	17	17	17	17	16
2024	16	16	15	16	15
2025	16	16	15	16	14
2026	15	15	14	15	13
2027	15	15	13	15	13
2028	15	14	12	14	13
2029	14	14	12	13	12
2030	14	13	12	13	12

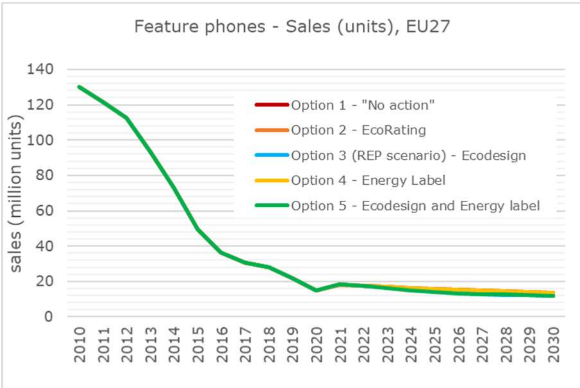

Figure 18 : Feature phones – Sales per policy scenario, EU27, 2010-2030

With the declining market for feature phones total annual consumer expenditure goes down in coming years for all options. The total annual consumer expenditures for options 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) decrease by 40 million Euros in 2030 compared to "no action".

Total annual consumer expenditure does not include costs for mobile subscriptions (see Task 2 for related cost details).

Feature phones	Option 1 - "No action" total annual consumer expenditure mln. €	Option 2 - EcoRating total annual consumer expenditure mln. €	Option 3 (REP scenario) - Ecodesign total annual consumer expenditure mln. €	Option 4 - Energy Label total annual consumer expenditure mln. €	Option 5 - Ecodesign and Energy label total annual consumer expenditure mln. €
2010	11.530	11.530	11.530	11.530	11.530
2011	10.786	10.786	10.786	10.786	10.786
2012	9.965	9.965	9.965	9.965	9.965
2013	8.250	8.250	8.250	8.250	8.250
2014	6.494	6.494	6.494	6.494	6.494
2015	4.383	4.383	4.383	4.383	4.383
2016	3.223	3.223	3.223	3.223	3.223
2017	2.716	2.716	2.716	2.716	2.716
2018	2.471	2.471	2.471	2.471	2.471
2019	1.922	1.922	1.922	1.922	1.922
2020	1.360	1.360	1.360	1.360	1.360
2021	1.611	1.608	1.611	1.611	1.611
2022	1.562	1.558	1.562	1.562	1.562
2023	1.519	1.512	1.506	1.519	1.501
2024	1.477	1.468	1.451	1.473	1.443
2025	1.432	1.424	1.400	1.422	1.392
2026	1.389	1.381	1.350	1.369	1.344
2027	1.348	1.340	1.303	1.316	1.303
2028	1.307	1.299	1.264	1.264	1.263
2029	1.268	1.260	1.225	1.215	1.225
2030	1.230	1.223	1.188	1.178	1.188

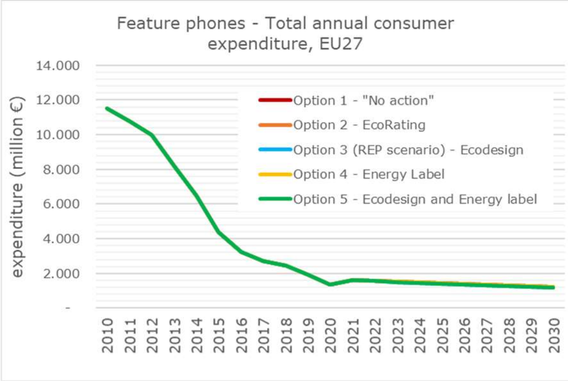

Figure 19 : Feature phones – Total annual consumer expenditure per policy scenario, EU27, 2010-2030

For the specific aspect of repair costs, which show a fundamentally different trend, see chapter 5, Figure 38, p. 86.

These cost effects of the scenarios involving Ecodesign requirements are even more apparent for the external annual damages, based on the updated cost figures introduced in Task 5. With options 2 (EcoRating) and 4 (Energy Label) external damages will be reduced by 2030, but a major reduction in external damages is achieved only with option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label). These two options reduce societal costs by 24 million Euros in 2030 (Figure 20).

Feature phones	Option 1 - "No action" external annual damages (updated data) mln. €	Option 2 - EcoRating external annual damages (updated data) mln. €	Option 3 (REP scenario) - Ecodesign external annual damages (updated data) mln. €	Option 4 - Energy Label external annual damages (updated data) mln. €	Option 5 - Ecodesign and Energy label external annual damages (updated data) mln. €
2010	817	817	817	817	817
2011	764	764	764	764	764
2012	706	706	706	706	706
2013	584	584	584	584	584
2014	460	460	460	460	460
2015	310	310	310	310	310
2016	228	228	228	228	228
2017	192	192	192	192	192
2018	175	175	175	175	175
2019	136	136	136	136	136
2020	100	100	100	100	100
2021	114	113	114	114	114
2022	111	108	111	111	111
2023	107	103	101	107	99
2024	103	98	93	103	88
2025	100	95	85	99	81
2026	97	92	78	95	74
2027	94	90	72	91	71
2028	91	87	69	87	68
2029	89	84	66	83	65
2030	86	82	63	80	62

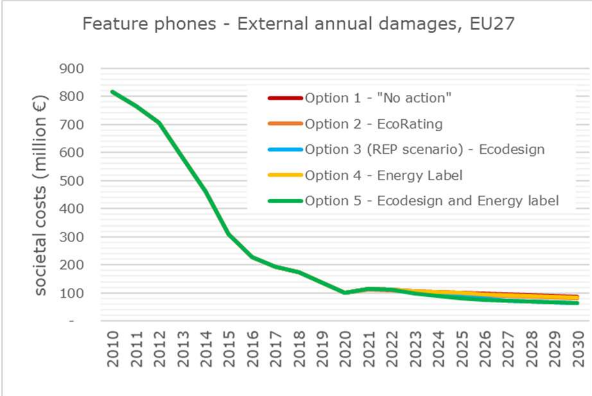

Figure 20 : Feature phones – External annual damages (updated data) per policy scenario, EU27, 2010-2030

Similar to sales and costs Total Energy consumption for the product segment of feature phones is reduced significantly on the EU27 market only with options involving Ecodesign requirements (Figure 21).

Feature phones	Option 1 - "No action" Total Energy PJ	Option 2 - EcoRating Total Energy PJ	Option 3 (REP scenario) - Ecodesign Total Energy PJ	Option 4 - Energy Label Total Energy PJ	Option 5 - Ecodesign and Energy label Total Energy PJ
2010	50,4	50,4	50,4	50,4	50,4
2011	47,1	47,1	47,1	47,1	47,1
2012	43,5	43,5	43,5	43,5	43,5
2013	36,0	36,0	36,0	36,0	36,0
2014	28,4	28,4	28,4	28,4	28,4
2015	19,1	19,1	19,1	19,1	19,1
2016	14,1	14,1	14,1	14,1	14,1
2017	11,9	11,9	11,9	11,9	11,9
2018	10,8	10,8	10,8	10,8	10,8
2019	8,4	8,4	8,4	8,4	8,4
2020	5,8	5,8	5,8	5,8	5,8
2021	7,0	6,9	7,0	7,0	7,0
2022	6,8	6,7	6,8	6,8	6,8
2023	6,6	6,3	6,2	6,6	6,0
2024	6,3	6,0	5,7	6,3	5,3
2025	6,2	5,9	5,1	6,0	4,8
2026	6,0	5,7	4,7	5,8	4,4
2027	5,8	5,5	4,3	5,4	4,2
2028	5,6	5,3	4,1	5,2	4,0
2029	5,5	5,2	3,9	4,9	3,9
2030	5,3	5,0	3,8	4,7	3,7

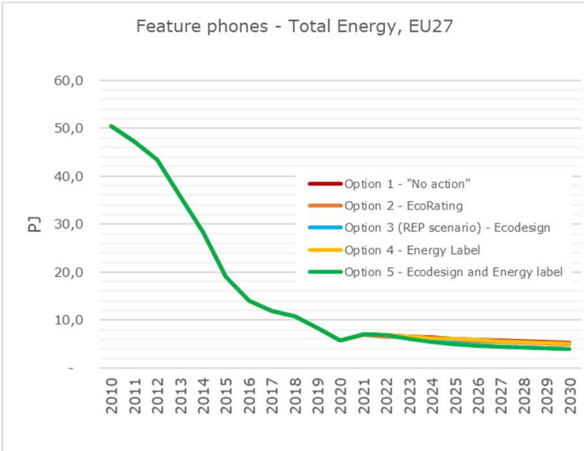

Figure 21 : Feature phones – Total Energy per policy scenario, EU27, 2010-2030

Just as with smartphones, the effect of option 2 (EcoRating) on immediate Greenhouse Gas emission reduction is obvious from the scenario analysis (Figure 22): As Life Cycle Assessment results are part of the EcoRating score, there is some transparency on manufacturing and other life cycle impacts and consequently for consumers the possibility to make an informed decision.

Feature phones	Option 1 - "No action" Greenhouse Gas emissions mt CO2 eq.	Option 2 - EcoRating Greenhouse Gas emissions mt CO2 eq.	Option 3 (REP scenario) - Ecodesign Greenhouse Gas emissions mt CO2 eq.	Option 4 - Energy Label Greenhouse Gas emissions mt CO2 eq.	Option 5 - Ecodesign and Energy label Greenhouse Gas emissions mt CO2 eq.
2010	2,89	2,89	2,89	2,89	2,89
2011	2,70	2,70	2,70	2,70	2,70
2012	2,49	2,49	2,49	2,49	2,49
2013	2,07	2,07	2,07	2,07	2,07
2014	1,63	1,63	1,63	1,63	1,63
2015	1,10	1,10	1,10	1,10	1,10
2016	0,81	0,81	0,81	0,81	0,81
2017	0,68	0,68	0,68	0,68	0,68
2018	0,62	0,62	0,62	0,62	0,62
2019	0,48	0,48	0,48	0,48	0,48
2020	0,33	0,33	0,33	0,33	0,33
2021	0,40	0,40	0,40	0,40	0,40
2022	0,39	0,38	0,39	0,39	0,39
2023	0,38	0,36	0,35	0,38	0,34
2024	0,36	0,34	0,32	0,36	0,30
2025	0,35	0,33	0,29	0,35	0,27
2026	0,34	0,32	0,26	0,33	0,24
2027	0,33	0,31	0,24	0,32	0,23
2028	0,32	0,30	0,23	0,30	0,22
2029	0,31	0,29	0,21	0,28	0,21
2030	0,30	0,28	0,21	0,28	0,20

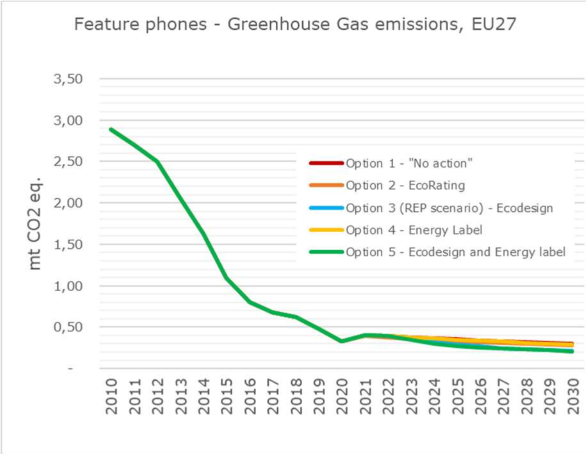

Figure 22 : Feature phones – Greenhouse Gas emissions per policy scenario, EU27, 2010-2030

With option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) the Greenhouse Gas emissions drop significantly from 2023 onwards. For both scenarios the related emissions are 90.000 t CO2 eq. lower in 2030 than with “no action”.

The same trends for the various policy scenarios are confirmed for other environmental indicators as well. As an example, Figure 23 provides the scenario results for acidification: Options 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) result in significant reductions in SO_2 and other emissions contributing to acidification. Roughly 0,4 kt SO2 eq. less in 2030 is the calculated effect of both options.

Feature phones	Option 1 - "No action" Acidification kt SO2 eq.	Option 2 - EcoRating Acidification kt SO2 eq.	Option 3 (REP scenario) - Ecodesign Acidification kt SO2 eq.	Option 4 - Energy Label Acidification kt SO2 eq.	Option 5 - Ecodesign and Energy label Acidification kt SO2 eq.
2010	15,4	15,4	15,4	15,4	15,4
2011	14,4	14,4	14,4	14,4	14,4
2012	13,3	13,3	13,3	13,3	13,3
2013	11,0	11,0	11,0	11,0	11,0
2014	8,7	8,7	8,7	8,7	8,7
2015	5,9	5,9	5,9	5,9	5,9
2016	4,3	4,3	4,3	4,3	4,3
2017	3,6	3,6	3,6	3,6	3,6
2018	3,3	3,3	3,3	3,3	3,3
2019	2,6	2,6	2,6	2,6	2,6
2020	1,8	1,8	1,8	1,8	1,8
2021	2,2	2,1	2,2	2,2	2,2
2022	2,1	2,0	2,1	2,1	2,1
2023	2,0	2,0	1,9	2,0	1,9
2024	1,9	1,9	1,8	1,9	1,7
2025	1,9	1,8	1,6	1,9	1,5
2026	1,8	1,7	1,5	1,8	1,4
2027	1,8	1,7	1,4	1,7	1,4
2028	1,7	1,6	1,3	1,6	1,3
2029	1,7	1,6	1,3	1,5	1,3
2030	1,6	1,5	1,2	1,5	1,2

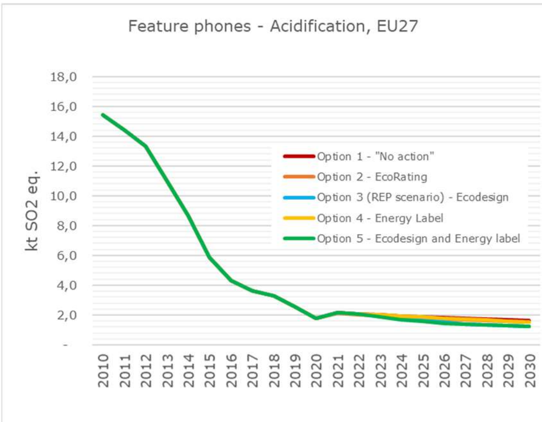

Figure 23 : Feature phones – Acidification per policy scenario, EU27, 2010-2030

Coming back to the impacts on Total Energy and Greenhouse Gas emissions, a rough estimate if savings materialise in the EU27 or outside can be made on the basis of the life cycle phase, to which the savings can be attributed: As almost all of the supply chain is located outside EU27 – but be reminded that in the case of feature phones significant final assembly still takes place in EU27 - impacts related to production can be considered as occurring in their majority outside the EU27. The distribution phase partly can be allocated to EU27, partly to non-EU countries. Changes in use phase related impacts clearly can be attributed to EU27. Table 35 provides data for these 3 life cycle phases (end of life being excluded here) for devices sold in 2030: Option 3 (Ecodesign requirements) result in almost the same savings for use and production phase. Option 4 (Energy Label) is the only scenario where savings stemming from the use phase are significantly larger than those related to production, despite the positive effect on product lifetimes.

Table 35 : Feature phones – Total Energy and Greenhouse Gas emissions per policy scenario, per life cycle phase, EU27, all units sold in 2030

2030: feature phone	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scen.) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Total Energy (PJ)					
Production	1,35	1,29	1,05	1,30	1,04
Distribution	1,53	1,39	0,85	1,47	0,81
Use	1,95	1,89	1,72	1,66	1,71
Totals	**4,83**	**4,57**	**3,62**	**4,43**	**3,56**
Greenhouse Gas emissions (mt CO2 eq.)					
Production	0,08	0,08	0,06	0,08	0,06
Distribution	0,12	0,11	0,07	0,11	0,06
Use	0,08	0,08	0,07	0,07	0,07
Totals	**0,28**	**0,27**	**0,20**	**0,26**	**0,19**

In the "no action" scenario the overall amount of material, of which feature phones, accessories and packaging are made in 2030 is calculated to be roughly 22.600 t[21], thereof 3.600 t electronics and 1.300 t metals other than those in the electronics parts, but 3.000 t plastics (Table 36). Total material consumption is reduced with option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) down to roughly 13.000 t, which is a 42% reduction. These figures include already spare parts, which will be used for repairs of these units over their lifetime.

Table 36 : Feature phones – Material consumption per policy option, EU27, all units sold in 2030

2030: feature phone	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scen.) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Material categories					
Bulk Plastics (t)	286,93	271,97	211,01	274,91	208,04
TecPlastics (t)	773,47	726,12	540,23	741,06	529,63
Ferro metals (t)	90,14	86,21	69,57	86,36	68,91
Non-ferro metals (t)	288,71	268,59	190,92	276,61	186,15
Electronics (t)	1.011,49	961,19	754,18	969,10	744,59
Miscellaneous, mainly paper, cardboard (t)	3.974,18	3.683,46	2.570,10	3.807,62	2.499,69
Totals materials (t)	**6.424,91**	**5.997,54**	**4.336,00**	**6.155,65**	**4.237,01**
thereof, Critical Raw Materials (t)					
Tantalum (Ta)	1,23	1,20	1,06	1,18	1,06
Indium (In)	0,14	0,13	0,12	0,13	0,12
Platinum Group metals (PGM)	0,27	0,27	0,23	0,26	0,23
Gallium (Ga)	0,07	0,07	0,06	0,07	0,06
Rare earth elements (Sc, Y, Nd)	1,37	1,33	1,17	1,31	1,17
Cobalt (Co)	40,97	40,04	35,21	39,25	35,21
Magnesium (Mg)	-	-	-	-	-

[21] This also includes part of the metal production waste from machining housing parts, see Base Case data in Task 5

The same data for major material categories is depicted in Figure 24.

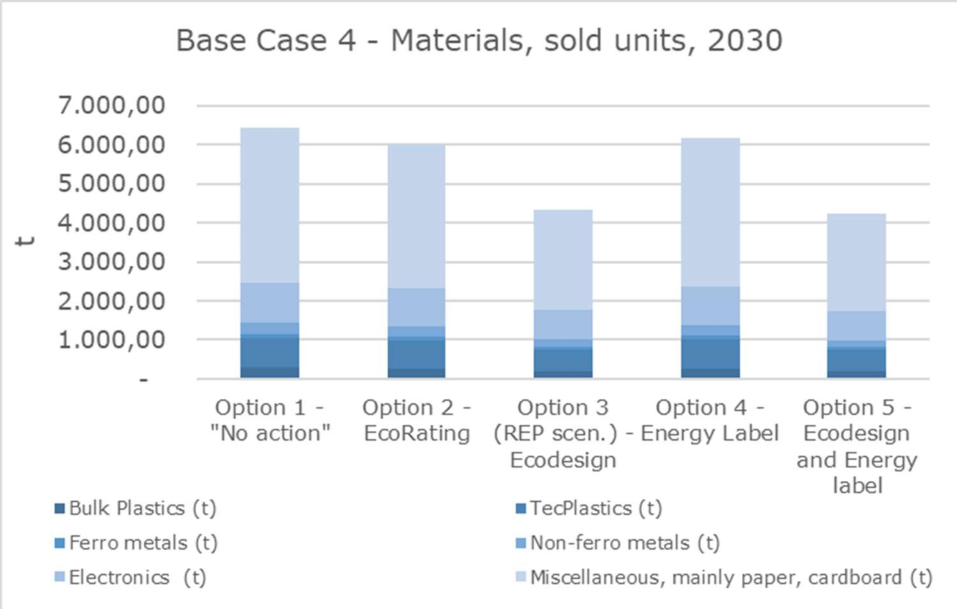

Figure 24 : Feature phones – Material consumption per policy option, EU27, all units sold in 2030

The consumption of Critical Raw Materials, provided that the composition of feature phones does not change fundamentally, is reduced along with the declining sales of phones (Table 36): The amount of Tantalum is reduced from 4,3 t in the "no action" scenario to 3,2 t with option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label). Same trends can be observed for the other Critical Raw Materials Indium, Gallium, Platinum Group Metals and Rare Earth Elements. Consumption of Cobalt declines by 37 t with Ecodesign requirements, unless better battery endurance comes at the expense of increasing the amount of Cobalt per battery.

4.6.3. Cordless phones

For cordless phones the comparison of policy options is much simpler: As neither EcoRating covers this product segment nor has been the need for an Energy Label been identified in the course of this study, the only two remaining options to be compared are

- Option 1: "no action"
- Option 2: Ecodesign requirements, which are partly different from those defined for smartphones, feature phones, and tablets

The implementation of Ecodesign requirements as detailed in the policy option 3 is expected to have a minor impact on sales figure (Figure 25): In a steadily declining market Ecodesign requirements as detailed in option 3 will reduce sales by another 400.000 units in 2030 – or 4% of the market.

It is worthwhile noticing, that the market for cordless phones exceeds the indicated 200.000 units, which serve as orientation for possible requirements under the Ecodesign Directive, are still exceeded by a factor 50 in 2030.

Cordless phones	Option 1 - "No action" Sales mln. units	Option 2 - EcoRating Sales mln. units	Option 3 (REP scenario) - Ecodesign Sales mln. units	Option 4 - Energy Label Sales mln. units	Option 5 - Ecodesign and Energy label Sales mln. units
2010	32,0		32,0		
2011	32,0		32,0		
2012	31,9		31,9		
2013	28,0		28,0		
2014	26,0		26,0		
2015	23,6		23,6		
2016	20,4		20,4		
2017	17,7		17,7		
2018	16,8		16,8		
2019	15,1		15,1		
2020	13,8		13,8		
2021	14,3		14,3		
2022	13,8		13,8		
2023	13,4		13,2		
2024	12,9		12,5		
2025	12,4		11,9		
2026	12,0		11,4		
2027	11,6		10,8		
2028	11,2		10,4		
2029	10,8		10,2		
2030	10,4		9,7		

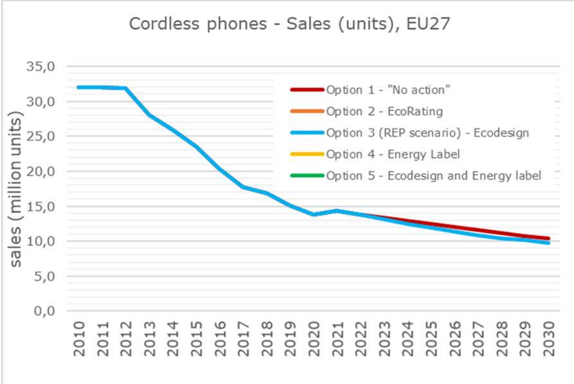

Figure 25 : Cordless phones – Sales per policy scenario, EU27, 2010-2030

Total annual consumer expenditure further declines in coming years for options 1 ("no action") with a shrinking market. Total annual consumer expenditures for option 3 (Ecodesign requirements) are not significantly different. In 2030 consumers in total might safe 25 million Euros due to the policy measures detailed in option 3.

Total annual consumer expenditure does not include costs for landline subscriptions (see Task 2 for related cost details).

Cordless phones	Option 1 - "No action" total annual consumer expenditure mln. €	Option 2 - EcoRating total annual consumer expenditure mln. €	Option 3 (REP scenario) - Ecodesign total annual consumer expenditure mln. €	Option 4 - Energy Label total annual consumer expenditure mln. €	Option 5 - Ecodesign and Energy label total annual consumer expenditure mln. €
2010	1.893		1.893		
2011	1.893		1.893		
2012	1.885		1.885		
2013	1.656		1.656		
2014	1.538		1.538		
2015	1.395		1.395		
2016	1.207		1.207		
2017	1.047		1.047		
2018	996		996		
2019	892		892		
2020	823		823		
2021	848		848		
2022	818		818		
2023	790		785		
2024	762		753		
2025	736		723		
2026	710		694		
2027	685		666		
2028	661		641		
2029	638		618		
2030	615		596		

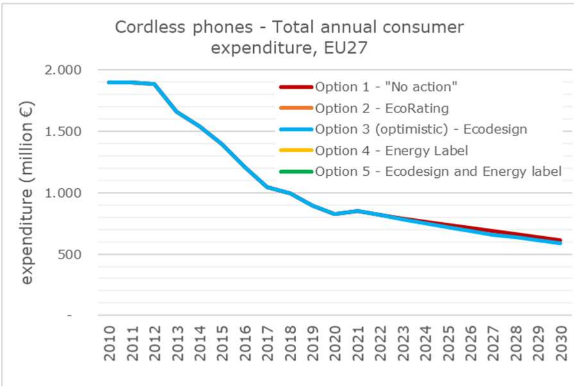

Figure 26 : Cordless phones – Total annual consumer expenditure per policy scenario, EU27, 2010-2030

Despite the marginal changes in consumer expenditure, societal damages show a greater savings potential through option 3. With this option (Ecodesign requirements) external damages will be reduced by 2030 by 15 million Euros, compared to 81 million Euros in a "no action" scenario (Figure 27).

Cordless phones	Option 1 - "No action" external annual damages (updated data) mln. €	Option 2 - EcoRating external annual damages (updated data) mln. €	Option 3 (REP scenario) - Ecodesign external annual damages (updated data) mln. €	Option 4 - Energy Label external annual damages (updated data) mln. €	Option 5 - Ecodesign and Energy label external annual damages (updated data) mln. €
2010	249		249		
2011	249		249		
2012	248		248		
2013	218		218		
2014	202		202		
2015	183		183		
2016	159		159		
2017	138		138		
2018	131		131		
2019	117		117		
2020	109		109		
2021	112		112		
2022	108		108		
2023	104		100		
2024	100		94		
2025	97		87		
2026	93		81		
2027	90		76		
2028	87		73		
2029	84		69		
2030	81		66		

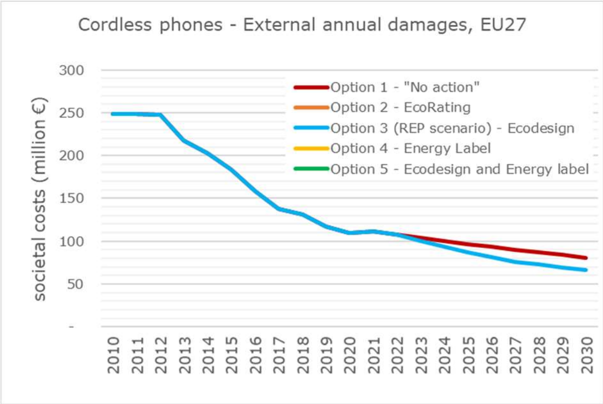

Figure 27 : Cordless phones – External annual damages (updated data) per policy scenario, EU27, 2010-2030

Given that the policy option mainly addressed standby power consumption and as the embedded energy of the phone itself (and its base station) is lower than for the other phones, there is a significant reduction in Total Energy consumption through this option: More than 25% or 1,3 PJ Total Energy can be saved from 2027 onwards (Figure 28).

Cordless phones	Option 1 - "No action" Total Energy PJ	Option 2 - EcoRating Total Energy PJ	Option 3 (REP scenario) - Ecodesign Total Energy PJ	Option 4 - Energy Label Total Energy PJ	Option 5 - Ecodesign and Energy label Total Energy PJ
2010	15,0		15,0		
2011	15,0		15,0		
2012	15,0		15,0		
2013	13,2		13,2		
2014	12,2		12,2		
2015	11,1		11,1		
2016	9,6		9,6		
2017	8,3		8,3		
2018	7,9		7,9		
2019	7,1		7,1		
2020	6,5		6,5		
2021	6,7		6,7		
2022	6,5		6,5		
2023	6,3		6,0		
2024	6,1		5,6		
2025	5,8		5,2		
2026	5,6		4,8		
2027	5,4		4,4		
2028	5,2		4,2		
2029	5,1		4,0		
2030	4,9		3,8		

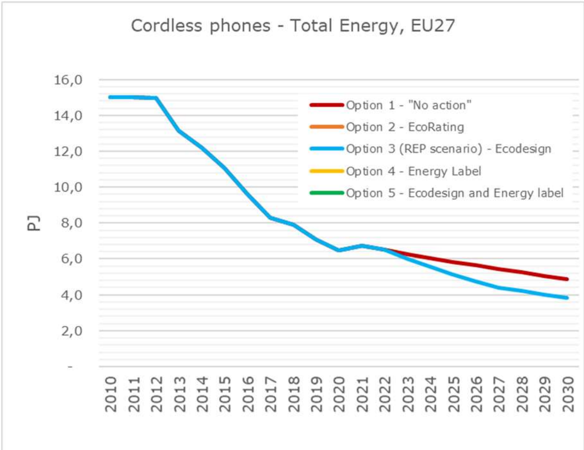

Figure 28 : Cordless phones – Total Energy per policy scenario, EU27, 2010-2030

Greenhouse Gas emission reductions mirror the scenario analysis for Total Energy (Figure 29): Savings potential for the cordless phones market in EU27 is 60.000 tons CO2 eq. from 2027 onwards, compared to the "no action" scenario.

Cordless phones	Option 1 - "No action" Greenhouse Gas emissions mt CO2 eq.	Option 2 - EcoRating Greenhouse Gas emissions mt CO2 eq.	Option 3 (REP scenario) - Ecodesign Greenhouse Gas emissions mt CO2 eq.	Option 4 - Energy Label Greenhouse Gas emissions mt CO2 eq.	Option 5 - Ecodesign and Energy label Greenhouse Gas emissions mt CO2 eq.
2010	0,82		0,82		
2011	0,82		0,82		
2012	0,82		0,82		
2013	0,72		0,72		
2014	0,67		0,67		
2015	0,61		0,61		
2016	0,52		0,52		
2017	0,45		0,45		
2018	0,43		0,43		
2019	0,39		0,39		
2020	0,35		0,35		
2021	0,37		0,37		
2022	0,36		0,36		
2023	0,34		0,33		
2024	0,33		0,30		
2025	0,32		0,28		
2026	0,31		0,26		
2027	0,30		0,24		
2028	0,29		0,23		
2029	0,28		0,22		
2030	0,27		0,21		

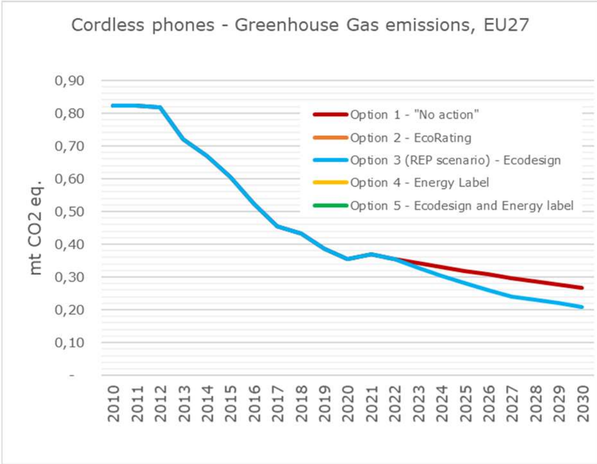

Figure 29 : Cordless phones – Greenhouse Gas emissions per policy scenario, EU27, 2010-2030

Results for the environmental indicator acidification – as an example for other environmental impacts - are in no way different: Option 3 (Ecodesign requirements) results in 300 t SO2 eq. reduction compared to “no action”. This is the case for years 2027 and after (Figure 30).

Smartphones, Feature phones	Option 1 - "No action" Acidification kt SO2 eq.	Option 2 - EcoRating Acidification kt SO2 eq.	Option 3 (REP scenario) - Ecodesign Acidification kt SO2 eq.	Option 4 - Energy Label Acidification kt SO2 eq.	Option 5 - Ecodesign and Energy label Acidification kt SO2 eq.
2010	4,6		4,6		
2011	4,6		4,6		
2012	4,6		4,6		
2013	4,0		4,0		
2014	3,7		3,7		
2015	3,4		3,4		
2016	2,9		2,9		
2017	2,5		2,5		
2018	2,4		2,4		
2019	2,2		2,2		
2020	2,0		2,0		
2021	2,1		2,1		
2022	2,0		2,0		
2023	1,9		1,9		
2024	1,9		1,7		
2025	1,8		1,6		
2026	1,7		1,5		
2027	1,7		1,4		
2028	1,6		1,4		
2029	1,6		1,3		
2030	1,5		1,2		

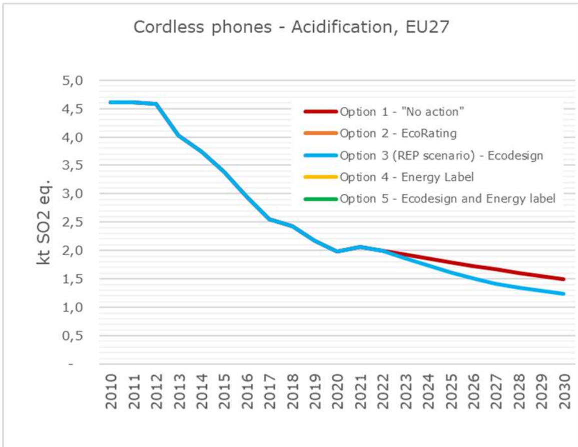

Figure 30 : Cordless phones – Acidification per policy scenario, EU27, 2010-2030

Coming back to the impacts on Total Energy and Greenhouse Gas emissions, a rough estimate if savings materialise in the EU27 or outside can be made in a similar way as for smartphones and feature phones by distinguishing effects related to production, distribution and use respectively. The correlation of production with non-EU27 impacts however is not fully accurate as there is still a relevant market share of cordless phones at least assembled in Europe. Major components however even for these devices assembled in EU27 stem typically from global supply chains.

Option 3 (Ecodesign requirements) results in 0,9 PJ use phase related Total Energy savings, and 0,2 PJ production related Total Energy savings (Table 37).

Table 37 : Cordless phones – Total Energy and Greenhouse Gas emissions per policy scenario, per life cycle phase, EU27, all units sold in 2030

2030: cordless phone	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scen.) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Total Energy (PJ)					
Production	1,03		0,85		
Distribution	1,23		1,01		
Use	2,50		1,64		
Totals	**4,76**		**3,50**		
Greenhouse Gas emissions (mt CO2 eq.)					
Production	0,06		0,05		
Distribution	0,10		0,08		
Use	0,11		0,07		
Totals	**0,26**		**0,20**		

In the "no action" scenario the overall amount of material, of which cordless phones, accessories (including base station) and packaging are made in 2030 is calculated to be roughly 4.600 t, thereof 765 t electronics and 330 t metals other than those in the electronics parts (Table 38). Total material consumption is reduced with option 3 (Ecodesign requirements) by almost 1.000 t.

Table 38 : Cordless phones – Material consumption per policy option, EU27, all units sold in 2030

2030: cordless phone	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scen.) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Material categories					
Bulk Plastics (t)	1.757,95		1.361,43		
TecPlastics (t)	506,67		424,14		
Ferro metals (t)	83,08		72,52		
Non-ferro metals (t)	244,88		166,35		
Electronics (t)	765,06		633,11		
Miscellaneous, mainly paper, cardboard (t)	1.264,09		1.006,57		
Totals materials (t)	**4.621,73**		**3.664,12**		
thereof, Critical Raw Materials (t)					
Tantalum (Ta)	0,0052		0,0049		
Indium (In)	-		-		
Platinum Group metals (PGM)	0,21		0,19		
Gallium (Ga)	-		-		
Rare earth elements (Sc, Y, Nd)	2,18		2,04		
Cobalt (Co)	7,28		6,81		
Magnesium (Mg)	-		-		

The consumption of Critical Raw Materials, provided that the composition of cordless phones does not change fundamentally, is reduced along with the declining sales of phones.

4.6.4. Tablets

For tablets all policy options detailed in 3. Subtask 7.1 – Policy analysis apply except for option 2 (EcoRating).

The implementation of Ecodesign requirements as detailed in the policy options is expected to have a major impact on sales figures, due to extended replacement cycles. This effect applies not only to smartphones and feature phones, but is less apparent for tablets. However, both, option 3 (Ecodesign requirements) and 5 (combination of Ecodesign requirements and Energy Label) reduces the number of sold units by 3,8 million units on the EU27 market in the years 2027 to 2030, which is 16% less devices put on the market (Figure 31).

Tablets	Option 1 - "No action" Sales mln. units	Option 2 - EcoRating Sales mln. units	Option 3 (REP scenario) - Ecodesign Sales mln. units	Option 4 - Energy Label Sales mln. units	Option 5 - Ecodesign and Energy label Sales mln. units
2010	3,7		3,7	3,7	3,7
2011	14,8		14,8	14,8	14,8
2012	28,5		28,5	28,5	28,5
2013	44,7		44,7	44,7	44,7
2014	45,2		45,2	45,2	45,2
2015	41,6		41,6	41,6	41,6
2016	35,0		35,0	35,0	35,0
2017	32,8		32,8	32,8	32,8
2018	31,0		31,0	31,0	31,0
2019	27,8		27,8	27,8	27,8
2020	23,9		23,9	23,9	23,9
2021	23,6		23,6	23,6	23,6
2022	23,4		23,4	23,4	23,4
2023	23,2		23,2	23,2	23,2
2024	23,0		21,3	22,9	20,6
2025	23,0		20,6	22,9	19,9
2026	23,0		19,9	22,8	19,2
2027	23,0		19,2	22,7	19,2
2028	23,0		19,2	22,6	19,4
2029	23,0		19,4	22,5	19,2
2030	23,0		19,2	22,5	19,2

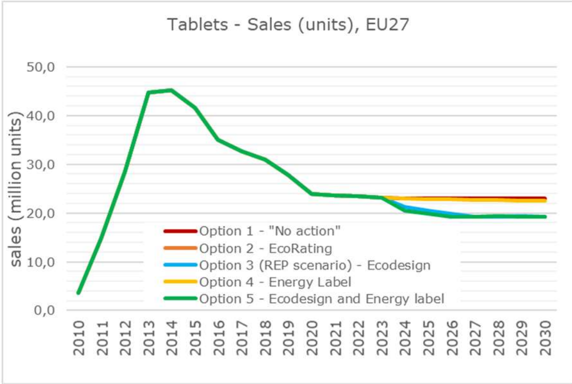

Figure 31 : Tablets – Sales per policy scenario, EU27, 2010-2030

Total annual consumer expenditure remains stable in coming years for actually all options. The cost decrease for consumers for option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) totals above 1 billon Euros towards the end of the decade. The cost savings effect of option 4 (Energy Label) is calculated with 200 million Euros.

Tablets	Option 1 - "No action" total annual consumer expenditure mln. €	Option 2 - EcoRating total annual consumer expenditure mln. €	Option 3 (REP scenario) - Ecodesign total annual consumer expenditure mln. €	Option 4 - Energy Label total annual consumer expenditure mln. €	Option 5 - Ecodesign and Energy label total annual consumer expenditure mln. €
2010	1.223		1.223	1.223	1.223
2011	4.983		4.983	4.983	4.983
2012	9.634		9.634	9.634	9.634
2013	15.237		15.237	15.237	15.237
2014	15.626		15.626	15.626	15.626
2015	14.630		14.630	14.630	14.630
2016	12.550		12.550	12.550	12.550
2017	11.839		11.839	11.839	11.839
2018	11.183		11.183	11.183	11.183
2019	10.051		10.051	10.051	10.051
2020	8.664		8.664	8.664	8.664
2021	8.506		8.506	8.506	8.506
2022	8.392		8.392	8.392	8.392
2023	8.286		8.335	8.286	8.359
2024	8.181		7.728	8.170	7.526
2025	8.175		7.520	8.145	7.331
2026	8.172		7.327	8.111	7.150
2027	8.170		7.147	8.069	7.145
2028	8.169		7.144	8.028	7.142
2029	8.169		7.142	7.989	7.140
2030	8.169		7.140	7.969	7.136

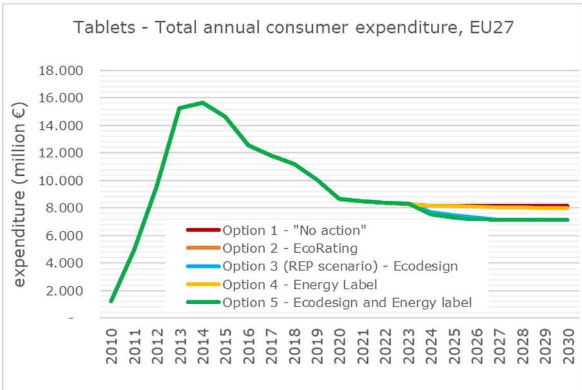

Figure 32 : Tablets – Total annual consumer expenditure per policy scenario, EU27, 2010-2030

Total annual consumer expenditure does not include costs for mobile and data subscriptions (see Task 2 for related cost details), or software (apps) and software based services.

For the specific aspect of repair costs, which show a fundamentally different trend, see chapter 5, Figure 39, p. 86.

These cost effects of the scenarios involving Ecodesign requirements are more apparent for the external annual damages. With option 4 (Energy Label) external damages will be reduced by 2030, but a major reduction in external damages is achieved only with option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label). These two options reduce societal costs by almost 150 million Euros in 2030 (Figure 33).

Tablets	Option 1 - "No action" external annual damages (updated data) mln. €	Option 2 - EcoRating external annual damages (updated data) mln. €	Option 3 (REP scenario) - Ecodesign external annual damages (updated data) mln. €	Option 4 - Energy Label external annual damages (updated data) mln. €	Option 5 - Ecodesign and Energy label external annual damages (updated data) mln. €
2010	93		93	93	93
2011	377		377	377	377
2012	725		725	725	725
2013	1.139		1.139	1.139	1.139
2014	1.151		1.151	1.151	1.151
2015	1.060		1.060	1.060	1.060
2016	891		891	891	891
2017	834		834	834	834
2018	789		789	789	789
2019	709		709	709	709
2020	637		637	637	637
2021	601		601	601	601
2022	596		596	596	596
2023	621		588	621	573
2024	597		535	595	508
2025	591		504	586	478
2026	588		476	578	452
2027	586		450	569	448
2028	585		447	562	444
2029	585		444	555	441
2030	585		441	552	436

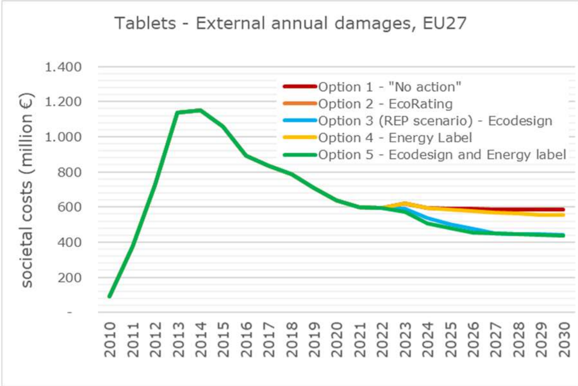

Figure 33 : Tablets – External annual damages (updated data) per policy scenario, EU27, 2010-2030

Energy consumption for the product segment of tablets is reduced significantly on the EU27 market with options involving Ecodesign requirements (Figure 34). The savings potential of these options 3 and 5 is 7 PJ by 2030. For option 4 (Energy Label) still half of this potential materialises.

Tablets	Option 1 - "No action" Total Energy PJ	Option 2 - EcoRating Total Energy PJ	Option 3 (REP scenario) - Ecodesign Total Energy PJ	Option 4 - Energy Label Total Energy PJ	Option 5 - Ecodesign and Energy label Total Energy PJ
2010	4		4	4	4
2011	17		17	17	17
2012	32		32	32	32
2013	51		51	51	51
2014	51		51	51	51
2015	47		47	47	47
2016	40		40	40	40
2017	37		37	37	37
2018	35		35	35	35
2019	32		32	32	32
2020	27		27	27	27
2021	27		27	27	27
2022	27		27	27	27
2023	26		26	26	25
2024	26		23	26	21
2025	26		22	26	20
2026	26		20	25	19
2027	26		19	25	19
2028	26		19	24	19
2029	26		19	23	19
2030	26		19	23	19

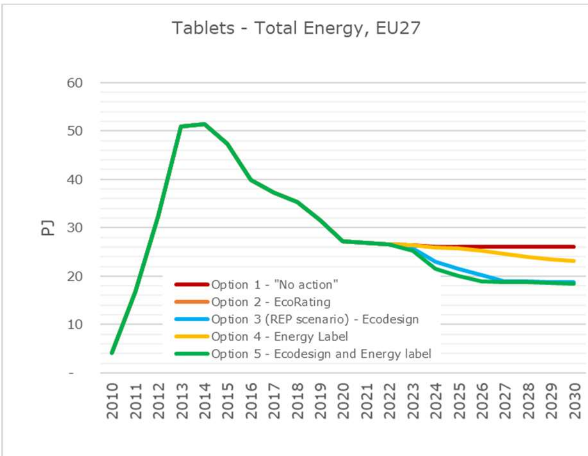

Figure 34 : Tablets – Total Energy per policy scenario, EU27, 2010-2030

With option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) the Greenhouse Gas emissions drop significantly from 2023 onwards. For both scenarios the related emissions are 0,6 million t CO2 eq. lower in 2030 than with “no action”. Compared to this savings potential an Energy Label only (i.e., option 4) yields a significantly lower savings potential, but still 0,2 million t CO2 eq.

Tablets	Option 1 - "No action" Greenhouse Gas emissions mt CO2 eq.	Option 2 - EcoRating Greenhouse Gas emissions mt CO2 eq.	Option 3 (REP scenario) - Ecodesign Greenhouse Gas emissions mt CO2 eq.	Option 4 - Energy Label Greenhouse Gas emissions mt CO2 eq.	Option 5 - Ecodesign and Energy label Greenhouse Gas emissions mt CO2 eq.
2010	0,2		0,2	0,2	0,2
2011	1,0		1,0	1,0	1,0
2012	1,9		1,9	1,9	1,9
2013	3,0		3,0	3,0	3,0
2014	3,1		3,1	3,1	3,1
2015	2,8		2,8	2,8	2,8
2016	2,4		2,4	2,4	2,4
2017	2,2		2,2	2,2	2,2
2018	2,1		2,1	2,1	2,1
2019	1,9		1,9	1,9	1,9
2020	1,6		1,6	1,6	1,6
2021	1,6		1,6	1,6	1,6
2022	1,6		1,6	1,6	1,6
2023	1,6		1,5	1,6	1,5
2024	1,6		1,3	1,6	1,2
2025	1,6		1,2	1,5	1,2
2026	1,6		1,2	1,5	1,1
2027	1,6		1,1	1,5	1,1
2028	1,6		1,1	1,5	1,0
2029	1,6		1,0	1,4	1,0
2030	1,6		1,0	1,4	1,0

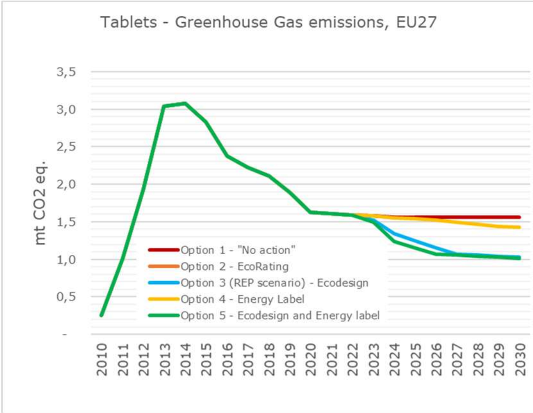

Figure 35 : Tablets – Greenhouse Gas emissions per policy scenario, EU27, 2010-2030

The same trends for the various policy scenarios are confirmed for other environmental indicators as well. As an example, Figure 36 provides the scenario results for acidification: Options 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) result in significant reductions in SO_2 and other emissions contributing to acidification. 2,8 kt SO2 eq. less in 2030 is the calculated effect of both options for the year 2030. Actually, a similarly high savings potential is achieved already from 2027 onwards in these scenarios. Option 4 (Energy Label) results in less emissions reductions.

Tablets	Option 1 - "No action" Acidification kt SO2 eq.	Option 2 - EcoRating Acidification kt SO2 eq.	Option 3 (REP scenario) - Ecodesign Acidification kt SO2 eq.	Option 4 - Energy Label Acidification kt SO2 eq.	Option 5 - Ecodesign and Energy label Acidification kt SO2 eq.
2010	2,1		2,1	2,1	2,1
2011	8,4		8,4	8,4	8,4
2012	16,1		16,1	16,1	16,1
2013	25,3		25,3	25,3	25,3
2014	25,6		25,6	25,6	25,6
2015	23,5		23,5	23,5	23,5
2016	19,8		19,8	19,8	19,8
2017	18,5		18,5	18,5	18,5
2018	17,5		17,5	17,5	17,5
2019	15,7		15,7	15,7	15,7
2020	13,5		13,5	13,5	13,5
2021	13,3		13,3	13,3	13,3
2022	13,2		13,2	13,2	13,2
2023	13,1		13,0	13,1	12,9
2024	13,0		11,8	12,9	11,3
2025	13,0		11,3	12,9	10,8
2026	13,0		10,8	12,8	10,3
2027	13,0		10,3	12,6	10,3
2028	13,0		10,3	12,5	10,3
2029	13,0		10,3	12,3	10,3
2030	13,0		10,3	12,2	10,2

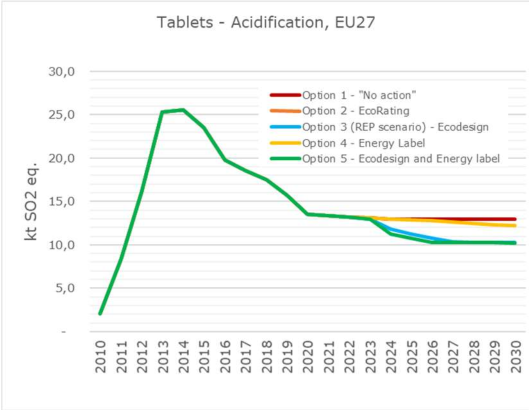

Figure 36 : Tablets – Acidification per policy scenario, EU27, 2010-2030

Coming back to the impacts on Total Energy and Greenhouse Gas emissions, a rough estimate if savings materialise in the EU27 or outside can be made on the basis of the life cycle phase, to which the savings can be attributed, similar to the approach for smartphones and feature phones suggested above: Production related impacts largely occur outside EU27, use phase impacts relate to energy consumption in EU27. Table 39 provides data for the 3 life cycle phases production, distribution, use (end of life being excluded here) for devices sold in 2030: As the stock is not affected by any of the policy scenarios but only the number of sold units, energy consumption in use and Greenhouse Gas emissions from use are not as much subject to reductions as the production phase: Option 3 (Ecodesign requirements) results in 1,6 PJ use phase related Total Energy savings, and 1,5 PJ production related Total Energy savings.

Table 39 : Tablets – Total Energy and Greenhouse Gas emissions per policy scenario, per life cycle phase, EU27, all units sold in 2030

2030: Tablet	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scen.) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Total Energy (PJ)					
Production	11,90		9,90	11,64	9,87
Distribution	2,70		1,23	2,64	1,15
Use	9,16		7,57	7,15	7,51
Totals	**23,75**		**18,71**	**21,42**	**18,53**
Greenhouse Gas emissions (mt CO2 eq.)					
Production	0,86		0,61	0,84	0,60
Distribution	0,21		0,10	0,20	0,09
Use	0,39		0,32	0,31	0,32
Totals	**1,46**		**1,03**	**1,35**	**1,01**

In the "no action" scenario the overall amount of material, of which tablets, accessories and packaging are made in 2030 is calculated to be roughly 30.400 t[22], thereof 5.500 t electronics and 6.400 t metals other than those in the electronics parts (Table 45). Total material consumption is reduced with option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) down to roughly 22.000 t. These figures

[22] This also includes part of the metal production waste from machining housing parts, see Base Case data in Task 5

include already spare parts, which will be used for repairs of these units over their lifetime.

Table 40 : Tablets – Material consumption per policy option, EU27, all units sold in 2030

2030: Tablet	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scen.) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Material categories					
Bulk Plastics (t)	1.125,17		732,90	1.100,52	715,39
TecPlastics (t)	1.690,40		1.034,08	1.653,36	1.001,70
Ferro metals (t)	486,71		373,74	476,05	370,89
Non-ferro metals (t)	5.916,05		4.891,78	5.786,43	4.882,54
Electronics (t)	5.478,93		4.271,79	5.358,89	4.245,02
Miscellaneous, mainly paper, cardboard (t)	15.726,23		10.871,29	15.381,68	10.678,88
Totals materials (t)	**30.423,48**		**22.175,58**	**29.756,93**	**21.894,41**
thereof, Critical Raw Materials (t)					
Tantalum (Ta)	0,92		0,77	0,90	0,77
Indium (In)	0,46		0,38	0,45	0,38
Platinum Group metals (PGM)	0,23		0,19	0,22	0,19
Gallium (Ga)	0,05		0,04	0,04	0,04
Rare earth elements (Sc, Y, Nd)	17,22		14,43	16,84	14,43
Cobalt (Co)	344,37		288,62	336,83	288,62
Magnesium (Mg)	459,16		384,82	449,10	384,82

The same data for major material categories is depicted in Figure 37.

The consumption of Critical Raw Materials, provided that the composition of tablets does not change fundamentally, is reduced along with the declining sales of devices (Table 40): The amount of Tantalum is reduced from 0,9 t in the "no action" scenario to 0,8 t with option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label). Same trends can be observed for the other Critical Raw Materials Indium, Gallium, Platinum Group Metals, Rare Earth Elements and Magnesium. Consumption of Cobalt declines by 55 t with Ecodesign requirements.

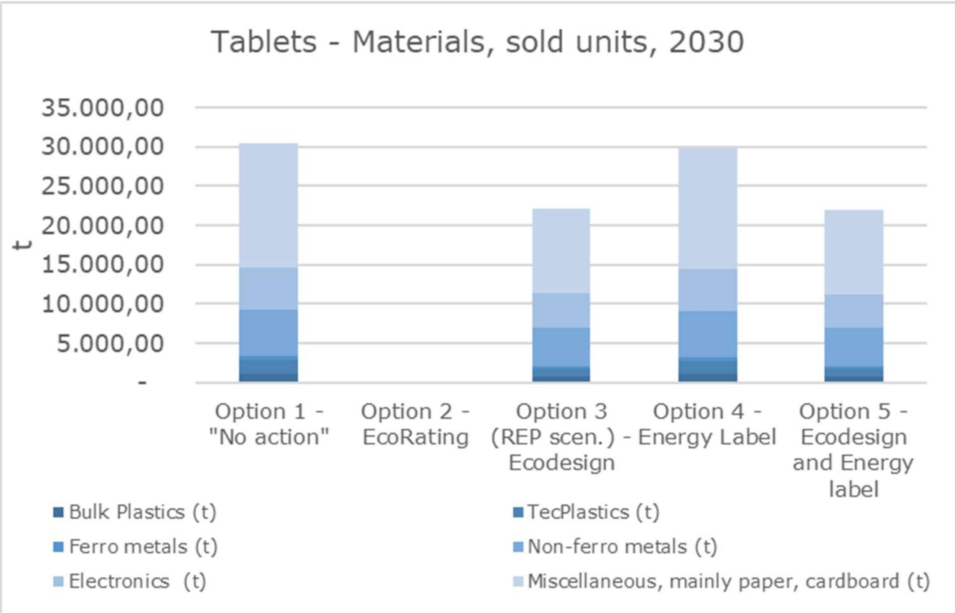

Figure 37 : Tablets – Material consumption per policy option, EU27, all units sold in 2030

5. SUBTASK 7.3 – SOCIO-ECONOMIC IMPACT ANALYSIS

The Ecodesign Directive states that ecodesign requirements should not entail excessive costs, nor undermine the competitiveness of enterprises and should not have a significant negative impact on consumers or other users. This will be studied in detail in an Impact Assessment which can be commissioned by the European Commission at a later stage in the policy-making process.

However, major impacts that are likely to occur as a consequence of introducing Ecodesign measures are identified in a preliminary step of the analysis. In particular, this preliminary assessment addresses impacts on manufacturers and consumers of mobile phones, smartphones and tablets as well as impacts on innovation and development.

Overall it is likely and intended that customers will benefit from ecodesign measures, since higher robustness, modularity (exchange of batteries), and better support for updates and repair tackles major lifetime limiting factors of their product and safe money. Saving on new device purchases is apparently the most effective option to bring life cycle costs down.

Selling less devices however has huge impacts on the whole manufacturing industry and OEMs.

5.1. Consumer costs

The additional costs, cost savings and potential energy savings calculated in the policy and impact analysis will need to be interpreted as estimates for average values, keeping in mind that specific cost reductions will vary from one product to another and from one user to another (e.g., being in need of a repair or not).

From the perspective of individual consumers potential Ecodesign requirements lead to higher per-product costs, but due to extended lifetimes the costs per year of use are lower than with the status quo. The "status quo" is not the same as the "no action" scenario (option 1) above: The "no action" scenario already anticipates the coming reparability scoring in France, i.e. already a shift towards the impacts of EU-wide Ecodesign requirements. As of now, it can only be speculated how the French reparability scoring affects the EU27 market outside France: Will OEMs change product portfolios and repair support EU-wide, or will the main effects be achieved through changed purchase decisions within France, but basically the same product portfolio. As the following analysis of individual consumer expenditures refers to EU27 averages, the effect of the French reparability scoring is not taken into account due to the given uncertainties. For the same reason the scenario with EcoRating is not reflected in the analysis below.
The purchase prices of low-end smartphones will increase up to 5% with Ecodesign options implemented in response to potential Ecodesign requirements (Table 41). The purchase costs in the more reliability focussed design approach increases most as higher IP classes and more robust components are not yet widely implemented in low-end devices and product designs changed in these directions are more costly to manufacture. The effect of an Energy Label on product prices is minor. Electricity costs go down in average with the Energy Label in place, but overall energy costs are far from being a crucial issue for consumers in this whole product group. With potential Ecodesign requirements electricity costs go up, because product lifetime is longer.
Calculating product use costs per year of use shows a significant cost decrease: Total consumer expenditure goes down from 85,44 Euros to the range of 65,32 Euros to 67,41 Euros with potential Ecodesign requirements in place.

Table 41 : Average Product Life Cycle costs - Low-end smartphone, 5" – Status quo, Ecodesign Requirements, Energy Label

low-end smartphone, 5"	Status quo	Ecodesign requirements		Energy Label
		REP scenario	DUR scenario	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	*DO49 (see Task 6)*
product use lifetime (years)	2,50	3,40	3,40	2,59
per product				
electricity costs	3,94 €	4,24 €	4,24 €	3,23 €
repair costs	9,66 €	12,06 €	13,50 €	9,66 €
Totals consumer expenditure	**13,60 €**	**16,30 €**	**17,74 €**	**12,89 €**
external societal damages (MEErP 2011)	3,58 €	3,43 €	3,43 €	3,51 €
external societal damages (updated data)	12,26 €	9,80 €	9,80 €	11,93 €
per year of use				
purchase price	80,00 €	60,52 €	62,19 €	77,49 €
electricity costs	1,57 €	1,25 €	1,25 €	1,25 €
repair costs	3,86 €	3,55 €	3,97 €	3,74 €
Totals consumer expenditure	**85,44 €**	**65,32 €**	**67,41 €**	**82,48 €**
external societal damages (MEErP 2011)	1,43 €	1,01 €	1,01 €	1,36 €
external societal damages (updated data)	4,90 €	2,89 €	2,89 €	4,61 €

Individual product purchase prices for mid-range smartphones increase as well with the various policy options, but compared to the low-end devices less so for the reliability focussed implementation of design options (Table 42). This is due to the reason, that such features are already implemented to a larger extend in this product segment and the average price increase therefore is lower.
Repair costs increase significantly, but less in the reparability focussed implementation of design options than in the reliability focussed path: Although the more reliable design requires less repairs the assumption that with a high level of reparability consumers get engaged in do-it-yourself repairs and only the tools, spare parts purchase and logistics price is taken into account, and labour costs of professional repair staff is saved in a significant share of repair cases. The repair time of the consumer comes "for free" in this calculation.

For a mid-range smartphone with a 6" display the total consumer expenditure per year of use decreases from 174,03 Euros to about calculated 129,25 Euros to 132,96 Euros with potential Ecodesign requirements in place which lead to the implementation of design features mirroring the point of Least Life Cycle Costs.

Table 42 : Average Product Life Cycle costs – Mid-range smartphone, 6" – Status quo, Ecodesign Requirements, Energy Label

mid-range smartphone, 6"	Status quo	Ecodesign requirements		Energy Label
		REP scenario	DUR scenario	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	*DO49 (see Task 6)*
product use lifetime (years)	3,00	4,17	4,14	3,14
per product				
purchase price	500,00 €	503,53 €	508,33 €	500,00 €
electricity costs	6,10 €	6,53 €	6,49 €	4,92 €
repair costs	16,00 €	28,58 €	35,35 €	16,00 €
Totals consumer expenditure	**522,10 €**	**538,64 €**	**550,17 €**	**520,92 €**
external societal damages (MEErP 2011)	5,86 €	5,75 €	5,74 €	5,75 €
external societal damages (updated data)	19,01 €	15,58 €	15,51 €	18,45 €
per year of use				
purchase price	166,67 €	120,82 €	122,85 €	159,49 €
electricity costs	2,03 €	1,57 €	1,57 €	1,57 €
repair costs	5,33 €	6,86 €	8,54 €	5,10 €
Totals consumer expenditure	**174,03 €**	**129,25 €**	**132,96 €**	**166,16 €**
external societal damages (MEErP 2011)	1,95 €	1,38 €	1,39 €	1,83 €
external societal damages (updated data)	6,34 €	3,74 €	3,75 €	5,89 €

High-end smartphones will likely face only a marginal further price increase in average. Total consumer expenditure per unit of product will slightly go down with an Energy Label in place. With potential Ecodesign requirements total consumer expenditures increase by 30 to 42 Euros, mainly due to increased spending on repairs (Table 43).
As the average device lifetime (use lifetime) increases from 3,5 years to 4,60 to 4,77 years if potential Ecodesign requirements are effective, the consumer expenditure per year of use is significantly lower with measures in place: Annual costs decline from calculated 296,27 Euros to 223,13 Euros to 234,02 Euros, depending on which design path OEMs will follow. With an Energy Label only, costs per year of use go down as well to an expected value just below 280,- Euros.

Table 43 : Average Product Life Cycle costs – High-end smartphone, 6,5" – Status quo, Ecodesign Requirements, Energy Label

high-end smartphone, 6,5"	Status quo	Ecodesign requirements		Energy Label
		REP scenario	DUR scenario	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	*DO49 (see Task 6)*
product use lifetime (years)	3,50	4,77	4,60	3,71
per product				
purchase price	1.000,00 €	1.004,20 €	1.004,65 €	1.000,00 €
electricity costs	9,10 €	9,36 €	9,03 €	7,28 €
repair costs	27,84 €	49,88 €	62,10 €	27,84 €
Totals consumer expenditure	**1.036,94 €**	**1.063,45 €**	**1.075,78 €**	**1.035,12 €**
external societal damages (MEErP 2011)	9,44 €	9,30 €	9,23 €	9,27 €
external societal damages (updated data)	29,25 €	25,13 €	24,81 €	28,41 €
per year of use				
purchase price	285,71 €	210,70 €	218,55 €	269,91 €
electricity costs	2,60 €	1,96 €	1,96 €	1,96 €
repair costs	7,95 €	10,47 €	13,51 €	7,51 €
Totals consumer expenditure	**296,27 €**	**223,13 €**	**234,02 €**	**279,38 €**
external societal damages (MEErP 2011)	2,70 €	1,95 €	2,01 €	2,50 €
external societal damages (updated data)	8,36 €	5,27 €	5,40 €	7,67 €

The relative increase in purchase price is higher for feature phones than for the other mobile phones. Affordability of access to mobile telecommunication services might become an issue here, if a price increase of 5 Euros is seen as a relevant barrier.
Over the extended product lifetime here as with the other product segments the costs go down: As the lifetime is expected to increase from 3 to 3,53 or 3,60 years the annual total consumer expenditures decrease from 29,52 Euros towards 28,43 Euros and 28,53 Euros respectively, depending on the chosen design path (Table 44). In total, potential Ecodesign requirements will not change consumer expenditures much, but societal damages will be reduced by roughly one third on an annual basis.

Table 44 : Average Product Life Cycle costs – Feature phone – Status quo, Ecodesign Requirements, Energy Label

feature phone	Status quo	Ecodesign requirements		Energy Label
		REP scenario	DUR scenario	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	*DO49 (see Task 6)*
product use lifetime (years)	3,00	3,53	3,60	3,15
per product				
purchase price	80,00 €	82,70 €	85,70 €	80,40 €
electricity costs	3,30 €	3,26 €	3,97 €	2,90 €
repair costs	5,25 €	14,88 €	12,79 €	5,25 €
Totals consumer expenditure	**88,55 €**	**100,84 €**	**102,46 €**	**88,55 €**
external societal damages (MEErP 2011)	1,49 €	1,40 €	1,47 €	1,45 €
external societal damages (updated data)	6,27 €	4,56 €	4,88 €	6,08 €
per year of use				
purchase price	26,67 €	23,40 €	23,78 €	25,54 €
electricity costs	1,10 €	0,92 €	1,10 €	0,92 €
repair costs	1,75 €	4,21 €	3,55 €	1,67 €
Totals consumer expenditure	**29,52 €**	**28,53 €**	**28,43 €**	**28,13 €**
external societal damages (MEErP 2011)	0,50 €	0,40 €	0,41 €	0,46 €
external societal damages (updated data)	2,09 €	1,29 €	1,35 €	1,93 €

The Energy Label scenario does not apply for cordless phones. Potential Ecodesign requirements are calculated to keep total consumer expenditures on roughly the same level: With the reparability focussed design track, which actually means the use of replaceable standard size batteries for all cordless phones, costs go slightly up – as batteries have to be purchased for replacing failing ones; without this particular design option of standard size batteries for all phones the savings the electricity costs savings are dominating and lead to slightly lower average consumer expenditures even on a per product basis.
Factoring in the extended use lifetime leads to slightly decreasing costs per year of use, but in the Euro-cent-range (Table 45).
External societal damages drop more significantly by roughly 25% taking year of use as the calculation basis.

Table 45 : Average Product Life Cycle costs – Cordless phone – Status quo, Ecodesign Requirements, Energy Label

cordless phone (incl. base station)	Status quo	Ecodesign requirements		Energy Label
		REP scenario	DUR scenario	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	
product use lifetime (years)	5,00	5,35	5,09	n.a.
per product				
purchase price	50,00 €	51,76 €	51,20 €	
electricity costs	5,65 €	4,08 €	3,88 €	
repair costs	3,50 €	4,55 €	3,50 €	
Totals consumer expenditure	**59,15 €**	**60,39 €**	**58,58 €**	
external societal damages (MEErP 2011)	1,91 €	1,63 €	1,60 €	
external societal damages (updated data)	7,78 €	6,06 €	6,03 €	
per year of use				
purchase price	10,00 €	9,68 €	10,05 €	
electricity costs	1,13 €	0,76 €	0,76 €	
repair costs	0,70 €	0,85 €	0,69 €	
Totals consumer expenditure	**11,83 €**	**11,29 €**	**11,50 €**	
external societal damages (MEErP 2011)	0,38 €	0,30 €	0,31 €	
external societal damages (updated data)	1,56 €	1,13 €	1,18 €	

Tablet purchase prices in average will increase by less than 3% in average with the implementation of design options in response to potential Ecodesign requirements. As with mobile phones the repair costs increase significantly due to more repairs being undertaken, resulting in almost one year lifetime extension compared to the status quo (Table 46).

Table 46 : Average Product Life Cycle costs – Tablet – Status quo, Ecodesign Requirements, Energy Label

cordless phone (incl. base station)	Status quo	Ecodesign requirements		Energy Label
		REP scenario	DUR scenario	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	
product use lifetime (years)	5,00	5,35	5,09	n.a.
per product				
purchase price	50,00 €	51,76 €	51,20 €	
electricity costs	5,65 €	4,08 €	3,88 €	
repair costs	3,50 €	4,55 €	3,50 €	
Totals consumer expenditure	**59,15 €**	**60,39 €**	**58,58 €**	
external societal damages (MEErP 2011)	1,91 €	1,63 €	1,60 €	
external societal damages (updated data)	7,78 €	6,06 €	6,03 €	
per year of use				
purchase price	10,00 €	9,68 €	10,05 €	
electricity costs	1,13 €	0,76 €	0,76 €	
repair costs	0,70 €	0,85 €	0,69 €	
Totals consumer expenditure	**11,83 €**	**11,29 €**	**11,50 €**	
external societal damages (MEErP 2011)	0,38 €	0,30 €	0,31 €	
external societal damages (updated data)	1,56 €	1,13 €	1,18 €	

Calculating product use costs per year of use shows a significant cost decrease: Total consumer expenditure goes down from 71,16 Euros to the range of 61,97 Euros to 64,18 Euros with potential Ecodesign requirements in place.

The issue of affordability due to slightly increased prices for new devices is less an issue, if the reuse market on the other side is growing in response to the potential Ecodesign requirements on new devices. With a growing number of devices available for reuse, the prices on the reuse market are likely to go down, being a low-cost option for access to telecommunication services.

5.2. Impact on OEMs

Those options involving potential Ecodesign requirements are largely based on generic requirements and to some extend on specific requirements. Putting emphasize on information requirements and scoring systems leaves it to the OEMs how they respond with their product designs and as such leaves room for innovations to reach high scoring values.

In case the lifetime of devices is extended as calculated in the policy scenarios the number of new sold units will go down significantly, but only with a delay of several years once the devices covered by potential Ecodesign requirements approach their by now typical end of life.

According to 2018 PRODCOM figures (see Task 2) almost 180 million mobile phones are imported into the EU27, and only 2 million phones produced in EU27 member countries[23]. This indicates that the effect of extended lifetime and decreasing sales will be on non-EU industry mainly.

For cordless phones the EU27 industry plays a more important role: According to 2018 PRODCOM figures 6 million units are produced in EU27, and 9.4 million units imported[24].

Similar to smartphones there are only few rather small tablet assembling companies in EU27. The market is dominated by far by brands from the U.S. and Asia. Consequently, dropping sales figures will affect mainly these non-EU vendors.

The market for mobile phones, cordless phones and tablets is relatively concentrated, but through the complex supply chain most likely tens of thousands of manufacturing companies are affected by any policy measure and in particular if these lead to significantly declining sales of new devices.

Due to the massive size of the mobile phone market smartphones have been a driver for many technologies, from a broad range of semiconductors, sensors, printed circuit board technologies, display technologies and mobile batteries. This technology progress, leading also to more efficient processes, has been fuelled by smartphone sales globally. Shrinking the market of this product group by incentivizing longer product use lifetime will inevitably also have a slow-down effect on innovation in these core technologies. As a side effect, less semiconductor production for mobile devices globally will have an effect on semiconductor manufacturing equipment providers, which is an industry with some leading European high-tech machinery builders.

Already in recent years some OEMs put more emphasize on revenues through services running on their devices, thus keeping in use devices with their own software ecosystem

[23] Another 26,6 million units are exported, which are apparently to a large extend devices, which have been imported before and/or reuse devices.

[24] Another 1,7 million units are exported.

is in their interest. Some also fostered refurbishment activity, bringing back used devices to the same or other markets. This works predominantly for high-end devices, which after few years still meet performance expectations of relevant market segments. These tendencies show, that OEMs find to a certain extend ways to deal with a stagnating or declining market.

The costs for implementing design options as detailed in Task 6 in average is on a very moderate level. For models sold in larger numbers this cost increase will be even less relevant, for those models where fewer units are sold the redesign costs and costs for tests and logistics (e.g., to meet information requirements or to guarantee spare parts availability) might become rather an issue.

Spare parts availability in general might become a risk for OEMs as they have to plan how many spare parts might be required over a given period. As these parts are typically sourced from suppliers OEMs depend on the continued availability of spare parts or have to put spare parts on stock, which in the case of batteries faces the issue of calendric ageing. Both, putting too few spare parts on stock an running out of parts before the claimed support period ends and putting too many spare parts on stock, which are not needed in the end and result in theoretically avoidable costs and environmental impacts, are non-optimal scenarios.

The tests required to be compliant with the reliability requirements outlined in 3.3.2 are only a fraction of those typically applied by OEMs – with some modifications. The major challenge is the extended testing for battery lifetime, which is a question of testing time as these test cannot be accelerated without having an adverse impact on test results.

Ecodesign and Energy Label policy options involve administrative and logistics costs for OEMs, e.g. for providing labels.

5.3. Retailers

Less products to be sold will have also an impact on retailers, for whom smartphones and tablets frequently represent a significant share of their business. On the positive side, the design changes related to the packaging through unbundling reduce logistics costs for retailers.

Energy Label policy options involve administrative and logistics costs for retailers, e.g. for presenting the labels at the point of sales and/or at online platforms.

5.4. Repair business

For all policy options the scenario analysis shows a clear trend towards increasing costs for repairs. Although at first glance this appears to be counter-intuitive, this is actually the intended effect of the reparability measures: Devices, which have been discarded by now or are going into hibernation after a defect undergo a repair, thus the amount of repairs is likely to increase significantly to extend the lifetime of broken devices (Figure 38). Related repair costs include spare parts costs for DIY repairs (where applicable to a scenario), spare parts and labour costs for professional repairs, but also repairs undertaken as preparation for reuse.

Smartphones, Feature phones	Option 1 - "No action" repair and maintenance costs mln. €	Option 2 - EcoRating repair and maintenance costs mln. €	Option 3 (REP scenario) - Ecodesign repair and maintenance costs mln. €	Option 4 - Energy Label repair and maintenance costs mln. €	Option 5 - Ecodesign and Energy label repair and maintenance costs mln. €
2010	797	797	797	797	797
2011	850	850	850	850	850
2012	917	917	917	917	917
2013	1.102	1.102	1.102	1.102	1.102
2014	1.311	1.311	1.311	1.311	1.311
2015	1.687	1.687	1.687	1.687	1.687
2016	1.906	1.906	1.906	1.906	1.906
2017	2.066	2.066	2.066	2.066	2.066
2018	2.244	2.244	2.244	2.244	2.244
2019	2.367	2.367	2.367	2.367	2.367
2020	2.414	2.414	2.414	2.414	2.414
2021	2.422	2.473	2.422	2.422	2.422
2022	2.430	2.533	2.430	2.430	2.430
2023	2.612	2.706	2.600	2.612	2.674
2024	2.794	2.950	2.753	2.788	2.879
2025	2.805	2.962	2.890	2.785	3.004
2026	2.816	2.974	3.016	2.775	3.119
2027	2.828	2.987	3.131	2.760	3.131
2028	2.840	3.000	3.144	2.745	3.144
2029	2.852	3.014	3.158	2.731	3.158
2030	2.865	3.028	3.172	2.743	3.172

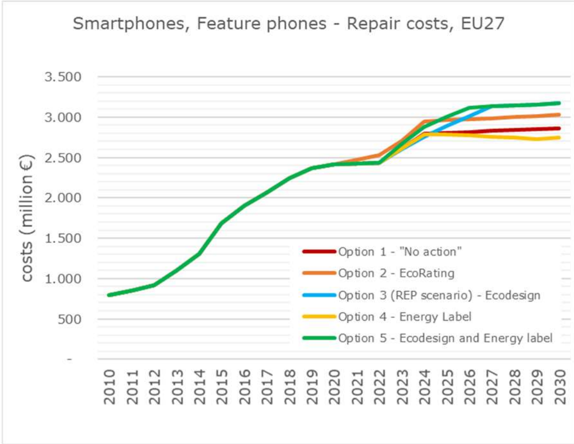

Figure 38 : Smartphones, Feature phones – Repair costs per policy scenario, EU27, 2010-2030

A similar effect is observed for the policy scenarios involving Ecodesign requirements for tablets (Figure 39): Expenditures for repairs almost double, this is what results in lifetime extension and brings down overall Life Cycle Costs for the consumer in average.

Tablets	Option 1 - "No action" repair and maintenance costs mln. €	Option 2 - EcoRating repair and maintenance costs mln. €	Option 3 (REP scenario) - Ecodesign repair and maintenance costs mln. €	Option 4 - Energy Label repair and maintenance costs mln. €	Option 5 - Ecodesign and Energy label repair and maintenance costs mln. €
2010	12		12	12	12
2011	61		61	61	61
2012	155		155	155	155
2013	302		302	302	302
2014	452		452	452	452
2015	577		577	577	577
2016	643		643	643	643
2017	658		658	658	658
2018	612		612	612	612
2019	555		555	555	555
2020	497		497	497	497
2021	459		459	459	459
2022	428		428	428	428
2023	403		442	403	461
2024	386		460	386	493
2025	383		488	382	519
2026	381		516	379	544
2027	380		542	375	542
2028	379		541	373	541
2029	379		541	371	541
2030	379		541	371	541

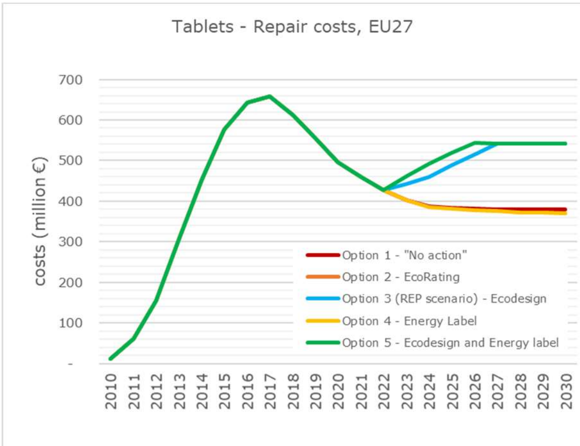

Figure 39 : Tablets – Repair costs per policy scenario, EU27, 2010-2030

Under these conditions massive positive effects are expected for

- Professional repair services
- (where applicable) third party spare parts provision
- Providers of repair tools

Professional repair services are expected to benefit more, if repairs are simplified, but beyond the typical DIY level. Users are likely to consult professional repair shops more frequently, if spare parts availability is given and repair costs go down due to tool availability and repair-friendly designs[25]. There are also indications from the repair business, that some of the design options detailed in Task 6 (spare parts availability and prices in particular) would strengthen the sector significantly.

Even if battery lifetime is extended by some of the design options, if other measures are implemented as well the overall effect is likely significantly more repairs than nowadays.

In case OEMs respond to the potential Ecodesign requirements with more progressive solutions towards reparability, this is likely to result in a significant increase in DIY repairs and might have a negative effect on professional repair shops. Providers of repair tools and (where applicable) third party spare parts would benefit with their business model.

Strengthening the repair business has a positive effect on employment within the EU27. Almost all repairs, including in-warranty repairs, are done within EU27 member countries. For some types of repairs, including in-warranty repairs, there are significant intra-EU shipments.

5.5. Reuse market

Just as the repair business the re-commerce and refurbishment business benefits from better reparability: More products can be refurbished with appropriate effort and in general the hibernation effect is countered by some of the measures (data erasure and transfer, enhanced timely collection and takeback).

There are some mid-size refurbishment and re-commerce companies in the EU27, which would benefit most from better reparability and better availability of otherwise hibernating devices. Better reusability however might also lead to increasing exports of reusable devices to non-EU markets.

Also C2C sales of used devices through e.g. eBay (by now 0,5% of the size of the market for new devices, see Task 2 for details) or other platforms is likely to increase.

There are indications, that the reuse market within the EU27 is ready to absorb more devices (given the prices of refurbished units nowadays, see Task 2), but there is definitely a limit to market growth here. The calculated policy scenarios, which do not distinguish in detail if lifetime extension is achieved through repair only or repair in the course of a refurbishment process for following reuse, can lead to an additional reuse market size of roughly 25% compared to the current total market for mobile phones (lower for tablets). This estimate is under the extreme assumption that all lifetime extension is due to reuse and none to repairs initiated by the current user, or by the current user for a following reuse by someone else.

5.6. Recycling

The expected impact on recyclers is a slightly growing amount of devices to be processed, depending on the effectiveness of such design options as creating confidence in data erasure, but also other measures such as enhanced takeback through other policies.

[25] This scenario is mirrored by the DUR path in Task 6 which starts with moderate improvements on reparability

A more reparable design and better access to the battery in particular will simplify processes for recyclers, but given the high material value of devices – at least a high value from the perspective of a recycler – it is not expected, that these design options lead to much more recycling. Some design solutions however might make it more attractive for recyclers to separate further fractions, such as light metal parts, or mono-material plastics.

6. SUBTASK 7.4 – SENSITIVITY ANALYSIS

Elements of a sensitivity analysis have been provided already elsewhere in this preparatory study:

- Implementing an **ambitious repair-friendly design track, compared to a reliability-focussed approach** (see REP and DUR path in Task 6, subtask 6.3 – Analysis of BAT and LLCC, and related Option 3 with a "optimistic" and a "conservative" scenario in this task report): Whereas the ambitious repair-friendly design track results in overall lower LCC and environmental impacts, both reduce costs and impacts significantly; this is also an indication, that the overall analysis is rather robust in terms of the different design options which might be favoured by the market later on
- Calculating with a different, updated **set of societal damage costs** (see Task 5, subtask 5.4 – Base Case Life Cycle Cost for society; calculated costs for MEErP 2011 and updated data depicted in bar charts in Task 6, subtask 6.3 – Analysis of BAT and LLCC): These updated cost factors are significantly higher than the formerly used MEErP 2011 cost factors; trends in terms of social LLCC are the same for both sets of environmental cost factors, but as the updated cost factors are significantly higher, also the resulting societal cost benefits of all the policy scenarios compared to "no action" are significantly higher; be reminded that the original source (Matthey and Bünger 2019) of these societal costs factors even recommended not only to calculate with a costs factor of 187 €/t CO2 eq. as applied in this study but to check sensitivity also with a value of 650 €/t CO2 eq.; the latter would lead to significantly higher absolute societal damages of this whole product group and in turn to a much higher savings potential through the various policy options 2, 3, 4, and 5.

6.1. Purchase Price – Break-Even

A critical assumption made in Task 6 for each of the design options is the product cost impact of each measure. Partly this cost data relies on solid evidence, in other cases rough assumptions had to be made. Hence, a key question for this sensitivity analysis is:

By how much can the product price increase through the implementation of the design options without LCC exceeding costs of the status quo?

Or: What is the break-even-point for the purchase price?

The results of this sensitivity analysis are provided in the following tables, following the segmentation of the base cases.

For low-end smartphones the purchase price can increase from 200,- Euros to 270,- Euros before potential Ecodesign requirements result in increased Life Cycle Costs. These cost figures refer to full implementation of all design options up to the point of societal Least Life Cycle Costs, i.e. implementation of what was defined as "REP path" and "DUR path" in Task 6. With an Energy Label only, prices can increase to 208,- Euros before the point of break-even is reached (Table 47). Even if in the conservative Ecodesign requirements scenario additional costs are a factor 6 higher than assumed in Task 6, the measure still pays off for the consumer – given the calculated lifetime is reached in average. For the more reparability focussed optimistic scenario even 15 times higher costs than what was estimated in Task 6 does not lead to overall higher costs for the consumer, but the question of affordability matters, if product prices really would increase from 270,- to 275,- Euros.

At this point of break-even the external societal damages are still lower than with the status quo as these are not affected by the purchase price.

Table 47 : Low-end smartphone - Sensitivity Analysis – Purchase Price Break Even

low-end smartphone, 5"	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, purchase price		REP scenario	DUR scenario	
product use lifetime (years)	2,50	3,42	3,38	2,59
per product				
purchase price - calculated scenarios	200,00 €	205,47 €	211,32 €	200,40 €
purchase price - break even	200,00 €	**275,09 €**	**270,11 €**	**208,06 €**
electricity costs	3,94 €	4,26 €	4,21 €	3,23 €
repair costs	9,66 €	12,55 €	14,13 €	9,66 €
Totals consumer expenditure	**213,60 €**	**291,90 €**	**288,46 €**	**220,94 €**
external societal damages (MEErP 2011)	3,58 €	3,45 €	3,44 €	3,52 €
external societal damages (updated data)	12,26 €	9,85 €	9,83 €	11,96 €
per year of use				
purchase price	80,00 €	80,52 €	80,01 €	80,46 €
electricity costs	1,57 €	1,25 €	1,25 €	1,25 €
repair costs	3,86 €	3,67 €	4,19 €	3,74 €
Totals consumer expenditure	**85,44 €**	**85,44 €**	**85,44 €**	**85,44 €**
external societal damages (MEErP 2011)	1,43 €	1,01 €	1,02 €	1,36 €
external societal damages (updated data)	4,90 €	2,88 €	2,91 €	4,62 €

For mid-range smartphones the purchase price can increase from 500,- Euros to 669,- Euros before potential Ecodesign requirements result in increased Life Cycle Costs for the consumer. With an Energy Label only, prices can increase to 524,- Euros before the point of break-even is reached (Table 48). For the conservative Ecodesign requirements scenario there is a factor of 20 between estimated product price increase and the calculated point of break-even. For the more reparability focussed optimistic scenario this "safety margin" is even higher than what was estimated in Task 6.

Table 48 : Mid-range smartphone - Sensitivity Analysis – Purchase Price Break Even

mid-range smartphone, 6"	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, purchase price		REP scenario	DUR scenario	
product use lifetime (years)	3,00	4,20	4,10	3,14
per product				
purchase price - calculated scenario	500,00 €	503,53 €	508,35 €	500,00 €
purchase price - break even	500,00 €	**694,28 €**	**669,10 €**	**524,68 €**
electricity costs	6,10 €	6,58 €	6,43 €	4,92 €
repair costs	16,00 €	29,69 €	38,36 €	16,00 €
Totals consumer expenditure	**522,10 €**	**730,55 €**	**713,90 €**	**545,59 €**
external societal damages (MEErP 2011)	5,86 €	5,77 €	5,76 €	5,76 €
external societal damages (updated data)	19,01 €	15,67 €	15,56 €	18,50 €
per year of use				
purchase price	166,67 €	165,39 €	163,11 €	167,36 €
electricity costs	2,03 €	1,57 €	1,57 €	1,57 €
repair costs	5,33 €	7,07 €	9,35 €	5,10 €
Totals consumer expenditure	**174,03 €**	**174,03 €**	**174,03 €**	**174,03 €**
external societal damages (MEErP 2011)	1,95 €	1,37 €	1,40 €	1,84 €
external societal damages (updated data)	6,34 €	3,73 €	3,79 €	5,90 €

The price of already high-priced high-end smartphones can increase by 27,5% before consumer expenditure per year exceeds those of the status-quo (Table 49). Compared to the cost estimates in Task 6 this break even is far beyond any realistic price adder due to potential Ecodesign requirements – if the longer product lifetime is really reached. The additional costs at the point of break-even come already close to the aggregated component costs of today's flagship products, see Task 1.

Table 49 : High-end smartphone - Sensitivity Analysis – Purchase Price Break Even

high-end smartphone, 6,5"	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, purchase price		REP scenario	DUR scenario	
product use lifetime (years)	3,50	4,81	4,55	3,71
per product				
purchase price - calculated scenarios	1.000,00 €	1.004,20 €	1.004,65 €	1.000,00 €
purchase price - break even	1.000,00 €	**1.362,36 €**	**1.275,01 €**	**1.062,55 €**
electricity costs	9,10 €	9,44 €	8,95 €	7,28 €
repair costs	27,84 €	52,02 €	65,11 €	27,84 €
Totals consumer expenditure	**1.036,94 €**	**1.423,82 €**	**1.349,06 €**	**1.097,67 €**
external societal damages (MEErP 2011)	9,44 €	9,33 €	9,25 €	9,28 €
external societal damages (updated data)	29,25 €	25,27 €	24,87 €	28,46 €
per year of use				
purchase price	285,71 €	283,48 €	280,00 €	286,79 €
electricity costs	2,60 €	1,96 €	1,96 €	1,96 €
repair costs	7,95 €	10,82 €	14,30 €	7,51 €
Totals consumer expenditure	**296,27 €**	**296,27 €**	**296,27 €**	**296,27 €**
external societal damages (MEErP 2011)	2,70 €	1,94 €	2,03 €	2,51 €
external societal damages (updated data)	8,36 €	5,26 €	5,46 €	7,68 €

For feature phones the purchase price can increase from 80,- Euros to close to 86,- Euros before potential Ecodesign requirements result in increased Life Cycle Costs for the consumer (Table 50). For the conservative scenario of implementing Ecodesign requirements this product price is already close to the extra costs for design options stated in Task 6. This can be explained by the fact, that for the reliability focussed approach (DUR path in Task 6) major design changes in terms of more durable glass and better water and dust ingress protection is foreseen.

Given these findings there is some uncertainty, if potential Ecodesign requirements really pay off for users of feature phones compared to the current status quo.

Table 50 : Feature phone - Sensitivity Analysis – Purchase Price Break Even

feature phone	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, purchase price		REP scenario	DUR scenario	
product use lifetime (years)	3,00	3,55	3,56	3,00
per product				
purchase price - calculated scenario	80,00 €	82,70 €	85,12 €	80,00 €
purchase price - break even	80,00 €	**85,74 €**	**86,18 €**	**80,00 €**
electricity costs	3,30 €	3,91 €	3,91 €	3,30 €
repair costs	5,25 €	15,09 €	14,85 €	5,25 €
Totals consumer expenditure	**88,55 €**	**104,74 €**	**104,95 €**	**88,55 €**
external societal damages (MEErP 2011)	1,49 €	1,46 €	1,46 €	1,49 €
external societal damages (updated data)	6,27 €	4,87 €	4,87 €	6,27 €
per year of use				
purchase price	26,67 €	24,16 €	24,24 €	26,67 €
electricity costs	1,10 €	1,10 €	1,10 €	1,10 €
repair costs	1,75 €	4,25 €	4,18 €	1,75 €
Totals consumer expenditure	**29,52 €**	**29,52 €**	**29,52 €**	**29,52 €**
external societal damages (MEErP 2011)	0,50 €	0,41 €	0,41 €	0,50 €
external societal damages (updated data)	2,09 €	1,37 €	1,37 €	2,09 €

For cordless phones the purchase price can increase from 50,- Euros to roughly 52,90 Euros before potential Ecodesign requirements result in increased Life Cycle Costs for the consumer (Table 51), which is only 2,5 times higher than the stated price increase in Task 6.

Given these findings there is some minor uncertainty, if potential Ecodesign requirements really pay off for users of cordless phones compared to the current status quo.

Table 51 : Cordless phone - Sensitivity Analysis – Purchase Price Break Even

cordless phone (incl. base station)	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, purchase price		REP scenario	DUR scenario	
product use lifetime (years)	5,00	5,35	5,09	n.a.
per product				
purchase price - calculated scenario	50,00 €	51,76 €	51,20 €	
purchase price - break even	50,00 €	**54,66 €**	**52,89 €**	
electricity costs	5,65 €	4,08 €	3,88 €	
repair costs	3,50 €	4,55 €	3,50 €	
Totals consumer expenditure	**59,15 €**	**63,28 €**	**60,27 €**	
external societal damages (MEErP 2011)	1,91 €	1,63 €	1,60 €	
external societal damages (updated data)	7,78 €	6,06 €	6,03 €	
per year of use				
purchase price	10,00 €	10,22 €	10,38 €	
electricity costs	1,13 €	0,76 €	0,76 €	
repair costs	0,70 €	0,85 €	0,69 €	
Totals consumer expenditure	**11,83 €**	**11,83 €**	**11,83 €**	
external societal damages (MEErP 2011)	0,38 €	0,30 €	0,31 €	
external societal damages (updated data)	1,56 €	1,13 €	1,18 €	

For tablets, just as for smartphones the purchase price can increase well beyond the stated product price with design options as detailed in Task 6 implemented: Only at an average price increase from 330,- Euro to 376,- Euros the consumer would not have any cost benefit from potential Ecodesign requirements (Table 52).

With an Energy Label only, prices can increase by almost 10,- Euros to 340,- Euros before the point of break-even is reached.

Table 52 : Tablet - Sensitivity Analysis – Purchase Price Break Even

tablet	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, purchase price		REP scenario	DUR scenario	
product use lifetime (years)	5,00	5,98	5,93	5,11
per product				
purchase price - calculated scenario	330,00 €	332,97 €	338,80 €	331,00 €
purchase price - break even	330,00 €	**388,36 €**	**376,54 €**	**339,87 €**
electricity costs	9,31 €	8,67 €	8,58 €	7,40 €
repair costs	16,50 €	28,78 €	36,59 €	16,50 €
Totals consumer expenditure	**355,81 €**	**425,80 €**	**421,72 €**	**363,78 €**
external societal damages (MEErP 2011)	7,45 €	7,18 €	7,15 €	7,29 €
external societal damages (updated data)	25,47 €	21,21 €	21,10 €	24,67 €
per year of use				
purchase price	66,00 €	64,90 €	63,54 €	66,49 €
electricity costs	1,86 €	1,45 €	1,45 €	1,45 €
repair costs	3,30 €	4,81 €	6,17 €	3,23 €
Totals consumer expenditure	**71,16 €**	**71,16 €**	**71,16 €**	**71,16 €**
external societal damages (MEErP 2011)	1,49 €	1,20 €	1,21 €	1,43 €
external societal damages (updated data)	5,09 €	3,54 €	3,56 €	4,83 €

Given these break-even calculations for most of the product segments it is safe to say, that additional costs through implementation of design options across the market (to a varying extend depending on the already achieved implementation level) pays off for the consumer. Even with a high uncertainty regarding individual cost estimates in Task 6 the point of break-even is not reached by far. The only critical product segments in this sense are feature phones and cordless phones.

6.2. Lifetime – Break-Even

The other crucial parameter is the (extended) product lifetime. Most of the material efficiency design options, and even the battery endurance (per cycle) design option relies on extended product lifetime to yield material savings, LCC savings and reduction of environmental impacts. Hence, a key question for this sensitivity analysis is:

By how much the product lifetime has to be extended through the implementation of the design options without LCC exceeding costs of the status quo?

Or: What is the break-even-point for lifetime extension?

The results of this sensitivity analysis are provided in the following tables, again following the segmentation of the base cases. In this analysis, for simplification, repair costs scale with product lifetime. The purchase price is now as established in the Task 6 analysis of design options.

The lifetime of low-end smartphones has to be extended through potential Ecodesign requirements at least from 2,5 years to 2,59 years – or roughly one months in average -, then the point of break-even is exceeded and the additional costs pay off for the consumer (Table 53). With the more costly reliability focussed design path, a lifetime extension by 0,19 years is needed. Both values are way below the calculated expected lifetime extension.

The Energy Label reduces costs for the consumer, even if the product lifetime is not extended. This also the case for the other smartphone product segments.

Table 53 : Low-end smartphone - Sensitivity Analysis – Lifetime Break Even

low-end smartphone, 5"	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		REP scenario	DUR scenario	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	*DO49 (see Task 6)*
product use lifetime (years)	2,50	3,42	3,38	2,59
product use lifetime (years) - break-even	2,50	**2,59**	**2,68**	**2,50**
per product				
purchase price	200,00 €	205,47 €	211,32 €	200,40 €
electricity costs	3,94 €	4,42 €	4,51 €	3,23 €
repair costs	9,66 €	12,55 €	14,13 €	9,66 €
Totals consumer expenditure	**13,60 €**	**222,43 €**	**229,97 €**	**213,29 €**
per year of use				
purchase price	80,00 €	79,33 €	78,85 €	80,16 €
electricity costs	1,57 €	1,25 €	1,25 €	1,25 €
repair costs	3,86 €	4,84 €	5,27 €	3,86 €
Totals consumer expenditure	**85,44 €**	**85,42 €**	**85,37 €**	**85,27 €**

The lifetime of mid-range smartphones has to be extended through potential Ecodesign requirements at least from 3 years to 3,1 years – slightly more than one months in average -, then the point of break-even is exceeded and the additional costs pay off for the consumer (Table 54). With the more costly reliability focussed design path, a lifetime extension by 0,17 years is needed. Both values are way below the calculated expected lifetime extension of 4,2 and 4,1 years respectively.

Table 54 : Mid-range smartphone - Sensitivity Analysis – Lifetime Break Even

mid-range smartphone, 6"	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		REP scenario	DUR scenario	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	*DO49 (see Task 6)*
product use lifetime (years)	3,00	4,20	4,10	3,14
product use lifetime (years) - break-even	3,00	**3,10**	**3,17**	**3,00**
per product				
purchase price	500,00 €	503,53 €	508,35 €	500,00 €
electricity costs	6,10 €	6,80 €	6,80 €	4,92 €
repair costs	16,00 €	29,69 €	38,36 €	16,00 €
Totals consumer expenditure	**522,10 €**	**540,02 €**	**553,51 €**	**520,92 €**
per year of use				
purchase price	166,67 €	162,43 €	160,36 €	166,67 €
electricity costs	2,03 €	1,57 €	1,57 €	1,57 €
repair costs	5,33 €	9,58 €	12,10 €	5,33 €
Totals consumer expenditure	**174,03 €**	**173,57 €**	**174,03 €**	**173,57 €**

Similar to the other smartphone product segments the lifetime of high-end smartphones has to be extended through potential Ecodesign requirements at least by 0,9 years before the point of break-even is exceeded and the additional costs pay off for the consumer (Table 55). With the more costly reliability focussed design path, a lifetime extension by 0,14 years – or 2 months - is needed. Both values are way below the calculated expected lifetime extension of 4,81 and 4,55 years respectively.

Table 55 : High-end smartphone - Sensitivity Analysis – Lifetime Break Even

high-end smartphone, 6,5"	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		REP scenario	DUR scenario	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	*DO49 (see Task 6)*
product use lifetime (years)	3,50	4,81	4,55	3,71
product use lifetime (years) - break-even	3,50	**3,59**	**3,64**	**3,50**
per product				
purchase price	1.000,00 €	1.004,20 €	1.004,65 €	1.000,00 €
electricity costs	9,10 €	9,68 €	9,30 €	7,28 €
repair costs	27,84 €	52,02 €	65,11 €	27,84 €
Totals consumer expenditure	**1.036,94 €**	**1.065,90 €**	**1.079,06 €**	**1.035,12 €**
per year of use				
purchase price	285,71 €	279,72 €	276,00 €	285,71 €
electricity costs	2,60 €	1,96 €	1,96 €	1,96 €
repair costs	7,95 €	14,49 €	17,89 €	7,95 €
Totals consumer expenditure	**296,27 €**	**296,18 €**	**295,85 €**	**295,63 €**

Mirroring the results of the purchase price sensitivity analysis for feature phones, also the scenario analysis on lifetime unveils some uncertainty: Lifetime of feature phones has to be extended from 3 to 3,45 and 3,52 years respectively, before measures and here in particular additional repair costs pay off (Table 56). These values are already close to the stated lifetime extension in Task 6.

With these findings it can be concluded that for many users the potential Ecodesign requirements will save life cycle costs but there is likely also a larger share of feature phone users for whom costs will increase compared to the status quo.

Table 56 : Feature phone - Sensitivity Analysis – Lifetime Break Even

feature phone	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		REP scenario	DUR scenario	
product use lifetime (years)	3,00	3,55	3,56	3,00
product use lifetime (years) - break-even	3,00	**3,45**	**3,52**	**3,00**
per product				
purchase price	80,00 €	82,70 €	85,12 €	80,00 €
electricity costs	3,30 €	4,49 €	4,59 €	3,30 €
repair costs	5,25 €	15,09 €	14,85 €	5,25 €
Totals consumer expenditure	**88,55 €**	**102,29 €**	**104,56 €**	**88,55 €**
per year of use				
purchase price	26,67 €	23,97 €	24,18 €	26,67 €
electricity costs	1,10 €	1,10 €	1,10 €	1,10 €
repair costs	1,75 €	4,37 €	4,22 €	1,75 €
Totals consumer expenditure	**29,52 €**	**29,45 €**	**29,50 €**	**29,52 €**

The lifetime of cordless phones has to be extended through potential Ecodesign requirements not at all to pay off: In the conservative Ecodesign requirements scenario the savings through reduced standby power consumption lead to the result, that even with the same average product lifetime of 5 years, life cycle costs go down. With the reparability focussed approach, i.e. basically user-replaceable standard size batteries, a lifetime extension across all devices of at least 0,9 years is required before the point of break-even is exceeded and the additional costs pay off for the consumer (Table 57). This is well below the calculated effect of an increase of 0,35 years – or 4 months – in product lifetime.

There is some uncertainty regarding the market share of cordless phones with embedded batteries (see Task 6). This however does not significantly affect the conclusions of this sensitivity analysis: If the market share is significantly different, the calculated lifetime will change accordingly and the average cost of implementing this option as well. These effects in total have no major impact on the break-even point versus the calculated lifetime extension.

Table 57 : Cordless phone - Sensitivity Analysis – Lifetime Break Even

cordless phone (incl. base station)	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		REP scenario	DUR scenario	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	*DO49 (see Task 6)*
product use lifetime (years)	5,00	5,35	5,09	n.a.
product use lifetime (years) - break-even	5,00	**5,09**	**5,00**	
per product				
purchase price	50,00 €	51,76 €	51,20 €	
electricity costs	5,65 €	4,15 €	3,88 €	
repair costs	3,50 €	4,55 €	3,50 €	
Totals consumer expenditure	**59,15 €**	**60,46 €**	**58,58 €**	
per year of use				
purchase price	10,00 €	10,17 €	10,24 €	
electricity costs	1,13 €	0,76 €	0,76 €	
repair costs	0,70 €	0,89 €	0,70 €	
Totals consumer expenditure	**11,83 €**	**11,82 €**	**11,70 €**	

The lifetime of tablets has to be extended through potential Ecodesign requirements at least from 5 years to 5,2 years, then the point of break-even is exceeded and the additional costs pay off for the consumer (Table 58). With the more costly reliability focussed design path, an average lifetime extension by 0,4 years is needed. Both values are way below the calculated expected lifetime extension of 5,98 and 5,93 years respectively.

Table 58 : Tablet - Sensitivity Analysis – Lifetime Break Even

tablet	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		REP scenario	DUR scenario	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	*DO49 (see Task 6)*
product use lifetime (years)	5,00	5,98	5,93	5,11
product use lifetime (years) - break-even	5,00	**5,19**	**5,39**	**5,00**
per product				
purchase price	330,00 €	332,97 €	338,80 €	331,00 €
electricity costs	9,31 €	9,00 €	9,25 €	7,40 €
repair costs	16,50 €	28,78 €	36,59 €	16,50 €
Totals consumer expenditure	**355,81 €**	**370,75 €**	**384,64 €**	**354,90 €**
per year of use				
purchase price	66,00 €	64,16 €	62,86 €	66,20 €
electricity costs	1,86 €	1,45 €	1,45 €	1,45 €
repair costs	3,30 €	5,55 €	6,79 €	3,30 €
Totals consumer expenditure	**71,16 €**	**71,15 €**	**71,09 €**	**70,95 €**

This sensitivity analysis regarding the needed lifetime extending effect of potential Ecodesign requirements and the Energy Label (the latter even pays off for the consumer without the expected product lifetime extension) gives overall good confidence in the analysis: The implementation of multiple design options has to lead to longer lifetimes by one months for smartphones and cordless phones only, for tablets plus 2,5 months, before an overall positive effect is expected. For feature phones the needed lifetime extension comes closer to the calculated effect of implementing design options, indicating some uncertainty for this particular product segment.

6.3. Energy Consumption in use

It has been argued by stakeholders that the power consumption in use might has been overestimated with 1 full charging cycle per day for feature phones and smartphones and 0,5 charging cycles per day for tablets. There are strong indications for smartphones in particular, that one full charging cycle per day is a sound assumption or at least not a major overestimation. Data for feature phones in this regard are less robust and it can be argued, that their dominating use for voice calls and texting only results in a much less frequent charging pattern. Also for tablets there are indications, that these might go through as few as 0,2 charging cycles per day (see Task 3 data for one particular brand). This sensitivity analysis therefore assesses the effect of less energy consumption in use as listed in Table 59. This sensitivity analysis does not cover a change in repair frequency. Although battery lifetime depends on charging frequency, the underlying repair statistics derived from Task 3 which inform the modelling of repairs in Tasks 6 and 7 are not related to the charging frequency.

Table 59: Sensitivity Analysis Assumptions – Charging cycles per day

	Charging cycles per day	
	Standard scenario	Sensitivity analysis
Smartphones	1	0,75
Feature phones	1	0,25
Cordless phones	n.a.	n.a.
Tablets	0,5	0,2

For a comparison how these changed assumptions change the overall outcome of the analysis, compare the results in Table 60 with those in Table 61, where the standard scenarios are summarised: With these parameter settings the savings for Option 2 – EcoRating in terms of Total Energy are 6 PJ compared to 7 PJ in the standard scenario analysis. The reduction potential of Ecodesign requirement is 41 PJ instead of 49 PJ, both for the target year 2030. The effect of the Energy Label reduced down to savings of 10 PJ instead of 15 PJ, in case the parameter settings of this sensitivity analysis would turn out to be the correct ones.

Table 60 : Sensitivity Analysis - Aggregated results per policy option, Environmental Indicators only

2030, all product segments	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
			absolute values				comparison with "no action"		
Environmental indicators (selected)									
Total Energy (PJ)	127,77	121,56	86,12	117,28	85,28	95%	67%	92%	67%
Total Energy (TWh)	35,49	33,77	23,92	32,58	23,69	95%	67%	92%	67%
Greenhouse Gas emissions (mt CO2 eq.)	8,32	7,76	5,12	7,77	5,02	93%	62%	93%	60%
Acidification (kt SO2 eq.)	84,11	80,77	61,41	79,77	61,22	96%	73%	95%	73%

All other values for the economic and material indicators actually remain the same in the sensitivity analysis as for the standard scenarios as they are not affected by the parameter variation.

7. SUBTASK 7.5 - SUMMARY

The impact of the 5 policy options and related scenarios is summarised in Table 61. Values include impacts on EU27 level for 2030, including sales and cost data, environmental impacts and material consumption across all product segments. Be reminded that not all policy options apply to all product segments. Absolute values are complemented by percentages indicating the remaining impact (or cost or number of units) of the product group with the respective policy option in place.

For 2030 both, option 3 (Ecodesign requirements) and option 5 (Ecodesign requirements and Energy Label) have the same positive effect in 2030, but in the years before (not shown in this table, but explained above) the variant including the Energy Label has a higher impact due to the assumed better initial response in the market.

In case EcoRating is implemented as intended, there is a significant positive effect to be expected, but as long as EcoRating applies only to the market share which is channelled through (a major share of) the telecommunication network and service providers, the impact does not come close to EU27 potential Ecodesign requirements.

An Energy Label alone has a positive impact as well, but only in the range of 3 to 6% across the economic and material-related indicators, and 6 to 11% improvement for environmental indicators, including societal damages.

The positive effect of Ecodesign requirement with or without an Energy Label is 23% lower total consumer expenditure – at significantly increased overall repair costs -, 35% less total material consumption, and 19 to 23% less critical raw materials contained in all the products entering the market in 2030 compared to a “no action” scenario. Environmental impacts of the product group are expected to be 28 to 42% lower for the listed indicators. Consumers significantly benefit in terms of Life Cycle Costs from the measures, according to the analysed scenarios.

Table 61 : All product segments - Aggregated results per policy option

2030, all product segments	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
			absolute values				comparison with "no action"		
sales (mln. units)	183,74	180,23	141,75	177,34	141,75	98%	77%	97%	77%
total annual consumer expenditure (mln. €)	89.703	87.011	69.325	85.843	69.314	97%	77%	96%	77%
external annual damages (updated data, mln. €)	3.487	3.317	2.403	3.266	2.379	95%	69%	94%	68%
repair costs only (mln. €)	3.280	3.443	3.757	3.150	3.757	105%	115%	96%	115%
Environmental indicators (selected)									
Total Energy (PJ)	141,61	134,86	92,33	126,36	91,47	95%	65%	89%	65%
Total Energy (TWh)	39,34	37,46	25,65	35,10	25,41	95%	65%	89%	65%
Greenhouse Gas emissions (mt CO2 eq.)	8,91	8,33	5,30	8,15	5,20	93%	59%	91%	58%
Acidification (kt SO2 eq.)	86,72	83,28	62,36	81,46	62,18	96%	72%	94%	72%
Material consumption									
Bulk Plastics (t)	5.359	5.194	3.693	5.237	3.653	97%	69%	98%	68%
TecPlastics (t)	9.813	9.108	5.646	9.481	5.484	93%	58%	97%	56%
Ferro metals (t)	2.996	2.879	2.174	2.892	2.165	96%	73%	97%	72%
Non-ferro metals (t)	20.559	19.863	15.246	19.811	15.192	97%	74%	96%	74%
Electronics (t)	24.569	23.560	17.470	23.720	17.351	96%	71%	97%	71%
Miscellaneous, mainly paper, cardboard (t)	56.091	52.548	33.559	54.167	32.726	94%	60%	97%	58%
Totals materials (t)	119.388	113.152	77.788	115.307	76.571	95%	65%	97%	64%
thereof, Critical Raw Materials (t)									
Tantalum (Ta, t)	4,9	4,7	3,9	4,7	3,9	97%	79%	96%	79%
Indium (In, t)	2,0	1,9	1,5	1,9	1,5	97%	77%	96%	77%
Platinum Group metals (PGM, t)	2,1	2,0	1,6	2,0	1,6	97%	79%	97%	79%
Gallium (Ga, t)	0,17	0,17	0,14	0,16	0,14	98%	81%	96%	81%
Rare earth elements (Sc, Y, Nd; t)	34	33,9	28	33,5	27,8	98%	81%	97%	81%
Cobalt (Co, t)	1.213	1.179	937	1.172	937	97%	77%	97%	77%
Magnesium (Mg, t)	1.217	1.186	945	1.177	945	97%	78%	97%	78%

The effect of the various policy options on smartphones is summarised in Table 62.

Savings across the various environmental indicators is largest for policy options involving Ecodesign Requirements. Whereas the Energy Label as stand-alone measure would have a significant effect on reducing energy consumption and Greenhouse Gas Emissions, the additional effect of an Energy Label on top of Ecodesign requirements is less significant.

Table 62 : Smartphones - Aggregated results per policy option

2030, smartphones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	absolute values					comparison with "no action"			
sales (mln. units)	136,73	131,23	101,05	131,40	101,05	96%	74%	96%	74%
total annual consumer expenditure (mln. €)	79.689	77.004	60.401	76.080	60.394	97%	76%	95%	76%
external annual damages (updated data, mln. €)	2.735	2.570	1.833	2.553	1.814	94%	67%	93%	66%
repair costs only (mln. €)	2.773	2.928	2.997	2.655	2.997	106%	108%	96%	108%
Environmental indicators (selected)									
Total Energy (PJ)	105,31	98,82	66,06	93,66	65,39	94%	63%	89%	62%
Total Energy (TWh)	29,25	27,45	18,35	26,02	18,16	94%	63%	89%	62%
Greenhouse Gas emissions (mt CO2 eq.)	6,78	6,22	3,85	6,18	3,77	92%	57%	91%	56%
Acidification (kt SO2 eq.)	70,62	67,24	49,64	66,24	49,51	95%	70%	94%	70%
Material consumption									
Bulk Plastics (t)	2.189	2.039	1.387	2.104	1.368	93%	63%	96%	63%
TecPlastics (t)	6.843	6.185	3.647	6.580	3.529	90%	53%	96%	52%
Ferro metals (t)	2.336	2.223	1.658	2.246	1.652	95%	71%	96%	71%
Non-ferro metals (t)	14.110	13.433	9.997	13.503	9.957	95%	71%	96%	71%
Electronics (t)	17.314	16.355	11.811	16.627	11.728	94%	68%	96%	68%
Miscellaneous, mainly paper, cardboard (t)	35.127	31.874	19.111	33.714	18.541	91%	54%	96%	53%
Totals materials (t)	77.918	72.109	47.612	74.773	46.776	93%	61%	96%	60%
thereof, Critical Raw Materials (t)									
Tantalum (Ta, t)	2,7	2,6	2,0	2,6	2,0	96%	74%	96%	74%
Indium (In, t)	1,4	1,3	1,0	1,3	1,0	96%	74%	96%	74%
Platinum Group metals (PGM, t)	1,4	1,3	1,0	1,3	1,0	96%	74%	96%	74%
Gallium (Ga, t)	0,05	0,05	0,04	0,05	0,04	96%	74%	96%	74%
Rare earth elements (Sc, Y, Nd; t)	14	13,1	10	13,1	10,1	96%	74%	96%	74%
Cobalt (Co, t)	820	787	606	788	606	96%	74%	96%	74%
Magnesium (Mg, t)	757	727	560	728	560	96%	74%	96%	74%

The effect of the various policy options on mobile phones other than smartphones, which are represented by feature phones in this study, is summarised in Table 63.

The effect of potential Ecodesign requirements is significant in terms of relative improvements in this product segment, but significantly lower than for smartphones as the segment of feature phones is anyhow declining over time.

Table 63 : Feature phones - Aggregated results per policy option

2030, feature phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	absolute values					comparison with "no action"			
sales (mln. units)	13,66	13,35	11,74	13,08	11,74	98%	86%	96%	86%
total annual consumer expenditure (mln. €)	1.230	1.223	1.188	1.178	1.188	99%	97%	96%	97%
external annual damages (updated data, mln. €)	86	82	63	80	62	95%	73%	93%	72%
repair costs only (mln. €)	92	100	175	88	175	109%	190%	96%	190%
Environmental indicators (selected)									
Total Energy (PJ)	5,29	5,03	3,76	4,73	3,69	95%	71%	89%	70%
Total Energy (TWh)	1,47	1,40	1,05	1,31	1,03	95%	71%	89%	70%
Greenhouse Gas emissions (mt CO2 eq.)	0,30	0,28	0,21	0,28	0,20	94%	68%	91%	66%
Acidification (kt SO2 eq.)	1,62	1,55	1,22	1,49	1,20	96%	75%	92%	74%
Material consumption									
Bulk Plastics (t)	287	272	211	275	208	95%	74%	96%	73%
TecPlastics (t)	773	726	540	741	530	94%	70%	96%	68%
Ferro metals (t)	90	86	70	86	69	96%	77%	96%	76%
Non-ferro metals (t)	289	269	191	277	186	93%	66%	96%	64%
Electronics (t)	1.011	961	754	969	745	95%	75%	96%	74%
Miscellaneous, mainly paper, cardboard (t)	3.974	3.683	2.570	3.808	2.500	93%	65%	96%	63%
Totals materials (t)	6.425	5.998	4.336	6.156	4.237	93%	67%	96%	66%
thereof, Critical Raw Materials (t)									
Tantalum (Ta, t)	1,2	1,2	1,1	1,2	1,1	98%	86%	96%	86%
Indium (In, t)	0,1	0,1	0,1	0,1	0,1	98%	86%	96%	86%
Platinum Group metals (PGM, t)	0,3	0,3	0,2	0,3	0,2	98%	86%	96%	86%
Gallium (Ga, t)	0,1	0,1	0,1	0,1	0,1	98%	86%	96%	86%
Rare earth elements (Sc, Y, Nd; t)	1,4	1,3	1,2	1,3	1,2	98%	86%	96%	86%
Cobalt (Co, t)	41	40	35	39	35	98%	86%	96%	86%
Magnesium (Mg, t)	-	-	-	-	-	100%	100%	100%	100%

The effect of the various policy options on cordless phones is summarised in Table 63.

Given that the lifetime extension resulting from potential Ecodesign requirements for cordless phones is lower than for mobile phones and tablets, the reduction in material consumption, including CRM, is also lower: The savings in relevant CRMs is prognosed to be in the range of 7% in 2030 for this product segment.

Policy options EcoRating and Energy Label and consequently also the combined option of Ecodesign requirements and Energy Label do not apply to cordless phones.

Table 64 : Cordless phones - Aggregated results per policy option

2030, cordless phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
			absolute values				comparison with "no action"		
sales (mln. units)	10,40		9,73			100%	93%	100%	100%
total annual consumer expenditure (mln. €)	615		596			100%	97%	100%	100%
external annual damages (updated data, mln. €)	81		66			100%	82%	100%	100%
repair costs only (mln. €)	36		44			100%	122%	100%	100%
Environmental indicators (selected)									
Total Energy (PJ)	4,89		3,83			100%	78%	100%	100%
Total Energy (TWh)	1,36		1,06			100%	78%	100%	100%
Greenhouse Gas emissions (mt CO2 eq.)	0,27		0,21			100%	78%	100%	100%
Acidification (kt SO2 eq.)	1,50		1,24			100%	83%	100%	100%
Material consumption									
Bulk Plastics (t)	1.758		1.361			100%	77%	100%	100%
TecPlastics (t)	507		424			100%	84%	100%	100%
Ferro metals (t)	83		73			100%	87%	100%	100%
Non-ferro metals (t)	245		166			100%	68%	100%	100%
Electronics (t)	765		633			100%	83%	100%	100%
Miscellaneous, mainly paper, cardboard (t)	1.264		1.007			100%	80%	100%	100%
Totals materials (t)	4.622		3.664			100%	79%	100%	100%
thereof, Critical Raw Materials (t)									
Tantalum (Ta, t)	0,0052		0,0049			100%	93%	100%	100%
Indium (In, t)	-		-			100%	100%	100%	100%
Platinum Group metals (PGM, t)	0,21		0,19			100%	93%	100%	100%
Gallium (Ga, t)	-		-			100%	100%	100%	100%
Rare earth elements (Sc, Y, Nd; t)	2,2		2,0			100%	93%	100%	100%
Cobalt (Co, t)	7,3		6,8			100%	93%	100%	100%
Magnesium (Mg, t)	-		-			100%	100%	100%	100%

The effect of the various policy options on tablets is summarised in Table 65.

Policy option EcoRating does not apply to this product segment.

Table 65 : Tablets - Aggregated results per policy option

2030, tablets	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label	Option 2 - EcoRating	Option 3 (REP scenario) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
			absolute values				comparison with "no action"		
sales (mln. units)	22,96		19,24	22,46	19,24	100%	84%	98%	84%
total annual consumer expenditure (mln. €)	8.169		7.140	7.969	7.136	100%	87%	98%	87%
external annual damages (updated data, mln. €)	585		441	552	436	100%	75%	94%	75%
repair costs only (mln. €)	379		541	371	541	100%	143%	98%	143%
Environmental indicators (selected)									
Total Energy (PJ)	26,13		18,67	23,08	18,55	100%	71%	88%	71%
Total Energy (TWh)	7,26		5,19	6,41	5,15	100%	71%	88%	71%
Greenhouse Gas emissions (mt CO2 eq.)	1,56		1,03	1,42	1,02	100%	66%	91%	65%
Acidification (kt SO2 eq.)	12,99		10,26	12,23	10,23	100%	79%	94%	79%
Material consumption									
Bulk Plastics (t)	1.125		733	1.101	715	100%	65%	98%	64%
TecPlastics (t)	1.690		1.034	1.653	1.002	100%	61%	98%	59%
Ferro metals (t)	487		374	476	371	100%	77%	98%	76%
Non-ferro metals (t)	5.916		4.892	5.786	4.883	100%	83%	98%	83%
Electronics (t)	5.479		4.272	5.359	4.245	100%	78%	98%	77%
Miscellaneous, mainly paper, cardboard (t)	15.726		10.871	15.382	10.679	100%	69%	98%	68%
Totals materials (t)	30.423		22.176	29.757	21.894	100%	73%	98%	72%
thereof, Critical Raw Materials (t)									
Tantalum (Ta, t)	0,9		0,8	0,9	0,8	100%	84%	98%	84%
Indium (In, t)	0,5		0,4	0,4	0,4	100%	84%	98%	84%
Platinum Group metals (PGM, t)	0,2		0,2	0,2	0,2	100%	84%	98%	84%
Gallium (Ga, t)	0,0		0,0	0,0	0,0	100%	84%	98%	84%
Rare earth elements (Sc, Y, Nd; t)	17		14	17	14	100%	84%	98%	84%
Cobalt (Co, t)	344		289	337	289	100%	84%	98%	84%
Magnesium (Mg, t)	459		385	449	385	100%	84%	98%	84%

With regards to the effects on the economy the major change is the reduced number of manufactured devices – mainly affecting non-EU businesses -, less turnover for retailers in the EU27, but significantly increased business for the repair and reuse sector within the EU27.

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9. ANNEX: SCENARIO ANALYSIS - ALTERNATIVE OPTION 3: INTRODUCTION OF MANDATORY SPECIFIC AND/OR GENERIC ECO-DESIGN REQUIREMENTS, FOCUS ON SCORING

The alternative, or second-best, option puts more emphasize on a scoring system and is modelled with the following scenarios[26]:

- legislation applies to products put on market from 2023
- 100% of the stock, i.e. devices in use, meets specific requirements by 2027 (approximated by the DO20/15/21a, DO50 options in Task 6); note: although 100% of the sold products need to be compliant as soon as the legislation applies, the effect of legislation materialises only later, mainly through lifetime extension, as only then replacement sales will go down as intended
- 50% of the market (stock) moved towards the point of societal Least Life Cycle Costs by 2027
  - **Conservative scenario**: DUR path as analysed in Task 6
  - **Optimistic scenario**: REP path as analysed in Task 6

  which means for clarity, e.g.,
  - 50% of devices sold without charger / accessories,
  - 50% of devices manufactured with fully optimised processes (PFC abatement), PCB designs, renewable energy for most relevant components and avoidance of air freight
  - 50% of devices with 5 years OS support etc.
- Further slow increase to 60% market (stock) at point of LLCC by 2030 due to assumed increased environmental awareness

The distinction of the *conservative* and the *optimistic scenario* is made to take into account the uncertainty of generic requirements: Information requirements, such as scores on environmental aspects intend to initiate a shift in the market, but how well this is received by the market is much more uncertain than in the case of any specific requirements where 100% compliance with a given criterion can be assumed for scenario calculations.

Both scenarios, the conservative and the optimistic one, are based on the same Ecodesign requirements, but will differ in how design options are implemented by OEMs to reach certain scores. The term "conservative" refers to the fact, that in the LCC analysis this path led to lower cost savings than the other path with more of the reparability options implemented, leading in the calculations to higher cost savings, thus represents a more "optimistic" effect of Ecodesign requirements.

In the optimistic scenario of implementing Eco-design requirements sales of devices decreases by 33,3 million units per year in 2030, under the condition that the stock of devices in use remains the same as without measures, and that the reduction in sales is reached through longer product use lifetime.

[26] These are the scenarios presented in the draft Task 7 report as the option 3 scenario, and have been discussed as such in the stakeholder meeting on December 18, 2020

Table 66 : Alternative Option 3 – Eco-design requirements, optimistic scenario – Sales total and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	**Sales mln. units**	Sales mln. units	**Sales mln. units**
2010	12	0	0	130	32	4	**178**	*178*	**-**
2011	22	0	0	122	32	15	**190**	*190*	**-**
2012	34	0	0	113	32	28	**207**	*207*	**-**
2013	52	7	0	93	28	45	**225**	*225*	**-**
2014	60	22	0	73	26	45	**226**	*226*	**-**
2015	68	35	8	50	24	42	**225**	*225*	**-**
2016	71	39	14	36	20	35	**216**	*216*	**-**
2017	68	41	21	31	18	33	**212**	*212*	**-**
2018	62	43	29	28	17	31	**210**	*210*	**-**
2019	57	44	36	22	15	28	**201**	*201*	**-**
2020	54	45	39	15	14	24	**190**	*190*	**-**
2021	53	45	39	18	14	24	**194**	*194*	**-**
2022	53	45	40	18	14	23	**193**	*193*	**-**
2023	50	43	38	17	13	23	**184**	*190*	**-6,2**
2024	47	41	37	16	13	22	**175**	*188*	**-13,0**
2025	45	39	36	15	12	21	**168**	*188*	**-19,4**
2026	43	37	35	14	12	21	**161**	*187*	**-25,4**
2027	41	36	34	13	11	20	**155**	*186*	**-30,9**
2028	40	35	35	13	11	20	**154**	*185*	**-31,6**
2029	40	36	35	12	10	20	**153**	*184*	**-31,0**
2030	38	35	35	12	10	20	**150**	*184*	**-33,3**

In the more conservative scenario the effect is not too different: Sales of devices in total decreases by almost 31 million units in 2030 compared to "no action".

Table 67 : Alternative Option 3 – Eco-design requirements, conservative scenario – Sales total and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	Sales mln. units	**Sales mln. units**	Sales mln. units	**Sales mln. units**
2010	12	0	0	130	32	4	**178**	*178*	**-**
2011	22	0	0	122	32	15	**190**	*190*	**-**
2012	34	0	0	113	32	28	**207**	*207*	**-**
2013	52	7	0	93	28	45	**225**	*225*	**-**
2014	60	22	0	73	26	45	**226**	*226*	**-**
2015	68	35	8	50	24	42	**225**	*225*	**-**
2016	71	39	14	36	20	35	**216**	*216*	**-**
2017	68	41	21	31	18	33	**212**	*212*	**-**
2018	62	43	29	28	17	31	**210**	*210*	**-**
2019	57	44	36	22	15	28	**201**	*201*	**-**
2020	54	45	39	15	14	24	**190**	*190*	**-**
2021	53	45	39	18	14	24	**194**	*194*	**-**
2022	53	45	40	18	14	23	**193**	*193*	**-**
2023	50	43	39	17	13	23	**185**	*190*	**-5,7**
2024	47	41	38	16	13	22	**176**	*188*	**-11,9**
2025	45	39	37	15	12	21	**170**	*188*	**-18,0**
2026	43	38	36	14	12	21	**163**	*187*	**-23,6**
2027	41	36	35	13	11	20	**157**	*186*	**-28,8**
2028	40	36	36	13	11	20	**156**	*185*	**-29,4**
2029	40	36	36	12	11	20	**156**	*184*	**-28,6**
2030	39	35	36	12	10	20	**153**	*184*	**-30,9**

Total consumer expenditure will decline despite slightly increasing product prices (see assumptions in Task 5). This reduction in Life Cycle Costs is due to longer product lifetimes, i.e. longer replacement cycles and to a minor degree also savings in electricity costs. Whereas total purchasing costs go down, the repair costs share of the Life Cycle Costs is increasing significantly (see 5), which is an expected effect: Through better reparability making use of repair services and purchasing spare parts and tools is a growing market.

The development of total consumer expenditure is shown in Table 27: In 2027 total expenditure is 13,3 billion Euros lower, in 2030 15,1 billion Euros lower than in a "no action" scenario. For the conservative scenario of option 3 total savings in 2027 are 11 billion Euros and 12,5 billion Euros in 2030 respectively.

Table 68 : Alternative Option 3 – Ecodesign requirements, optimistic scenario – Total consumer expenditure and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5" mln. €	Base Case 2 - mid-range smartphone, 6" mln. €	Base Case 3 - high-end smartphone, 6,5" mln. €	Base Case 4 - Feature phone mln. €	Base Case 5 - cordless phone mln. €	Base Case 6 - Tablet mln. €	**Totals mln. €**	Totals - Option 1 mln. €	**Improvement mln. €**
2010	2.512	-	-	11.530	1.893	1.223	**17.158**	*17.158*	-
2011	4.665	-	-	10.786	1.893	4.983	**22.326**	*22.326*	-
2012	7.211	-	-	9.965	1.885	9.634	**28.695**	*28.695*	-
2013	11.022	3.742	-	8.250	1.656	15.237	**39.907**	*39.907*	-
2014	12.858	11.225	-	6.494	1.538	15.626	**47.741**	*47.741*	-
2015	14.610	18.012	7.999	4.383	1.395	14.630	**61.030**	*61.030*	-
2016	15.161	20.588	14.828	3.223	1.207	12.550	**67.557**	*67.557*	-
2017	14.542	21.615	21.805	2.716	1.047	11.839	**73.564**	*73.564*	-
2018	13.309	22.254	30.308	2.471	996	11.183	**80.521**	*80.521*	-
2019	12.117	23.064	37.196	1.922	892	10.051	**85.242**	*85.242*	-
2020	11.534	23.494	39.996	1.360	823	8.664	**85.871**	*85.871*	-
2021	11.419	23.494	40.596	1.611	848	8.506	**86.474**	*86.474*	-
2022	11.304	23.494	41.205	1.562	818	8.392	**86.775**	*86.775*	-
2023	10.758	22.543	40.114	1.517	784	8.373	**84.089**	*86.813*	- **2.723**
2024	10.259	21.681	39.139	1.473	750	7.957	**81.260**	*86.862*	- **5.602**
2025	9.800	20.897	38.265	1.431	718	7.847	**78.958**	*87.303*	- **8.345**
2026	9.376	20.180	37.480	1.389	688	7.743	**76.856**	*87.757*	- **10.901**
2027	8.984	19.522	36.774	1.349	658	7.645	**74.932**	*88.224*	- **13.293**
2028	8.835	19.379	37.089	1.305	635	7.609	**74.852**	*88.704*	- **13.852**
2029	8.677	19.211	37.365	1.263	613	7.569	**74.697**	*89.198*	- **14.501**
2030	8.524	19.052	37.654	1.222	591	7.531	**74.573**	*89.703*	- **15.130**

Total Energy savings to be achieved by specific and generic eco-design requirements combined are 36 PJ in 2027 and 41 PJ in 2030 (optimistic scenario). This is a savings potential of 29%, which materializes only partially within the EU27, and to a significant extend in the global supply chains. An estimate, which share of the savings will be achieved within EU27 and which share is an effect on the global level, is provided in 4.6, Table 33, Table 38 and Table 40.

Even in the conservative scenario savings are in the range of 33 PJ (2027) and 37 PJ (2030), i.e. a reduction of 26% in 2030.

Similar trends can be observed for other environmental indicators: Reduction in carbon emissions is 3,1 million tons CO2 eq. in 2030, which corresponds to a reduction by 35% compared to the "no action" option.

Table 69 : Alternative Option 3 – Eco-design requirements, optimistic scenario – Total Energy and in comparison to « no action », EU27, 2010-2030

	Base Case 1 - low-end smartphone, 5"	Base Case 2 - mid-range smartphone, 6"	Base Case 3 - high-end smartphone, 6,5"	Base Case 4 - Feature phone	Base Case 5 - cordless phone	Base Case 6 - Tablet	**Totals**	Totals - Option 1	**Improvement**
	Total Energy	Total Energy	Total Energy	Total Energy	Total Energy	Total Energy	**Total Energy**	Total Energy	**Total Energy**
	PJ	PJ	PJ	PJ	PJ	PJ	**PJ**	PJ	**PJ**
2010	6	-	-	50	15	4	**76**	*76*	-
2011	11	-	-	47	15	17	**90**	*90*	-
2012	17	-	-	44	15	32	**108**	*108*	-
2013	27	5	-	36	13	51	**132**	*132*	-
2014	31	16	-	28	12	51	**139**	*139*	-
2015	35	26	8	19	11	47	**147**	*147*	-
2016	37	29	15	14	10	40	**145**	*145*	-
2017	35	31	22	12	8	37	**146**	*146*	-
2018	32	32	31	11	8	35	**149**	*149*	-
2019	29	33	38	8	7	32	**148**	*148*	-
2020	28	33	41	6	6	27	**142**	*142*	-
2021	28	33	42	7	7	27	**144**	*144*	-
2022	27	33	42	7	6	27	**143**	*143*	-
2023	26	31	41	6	6	26	**136**	*142*	**- 6**
2024	23	29	38	6	5	24	**126**	*141*	**- 16**
2025	21	27	37	5	5	23	**118**	*141*	**- 23**
2026	20	25	35	5	5	22	**111**	*141*	**- 30**
2027	18	24	33	5	4	21	**105**	*141*	**- 36**
2028	18	23	33	4	4	21	**104**	*141*	**- 38**
2029	17	23	33	4	4	21	**102**	*142*	**- 39**
2030	17	22	33	4	4	20	**101**	*142*	**- 41**

Comparing the Greenhouse Gas emissions per product segment unveils some major differences (Figure 6): For feature phones and cordless phones, given the lower overall market share and further declining sales figures the savings potential compared to "no action" is comparing low at 80.000 and 60.000 tons CO2 eq. savings in 2030. For the other market segments savings are 1,1 million tons CO2 eq. for high-end smartphones, 830.000 tons CO2 eq. for mid-range smartphones, 600.000 tons CO2 eq. for low-end smartphones and 440.000 t CO2 eq. for tablets.

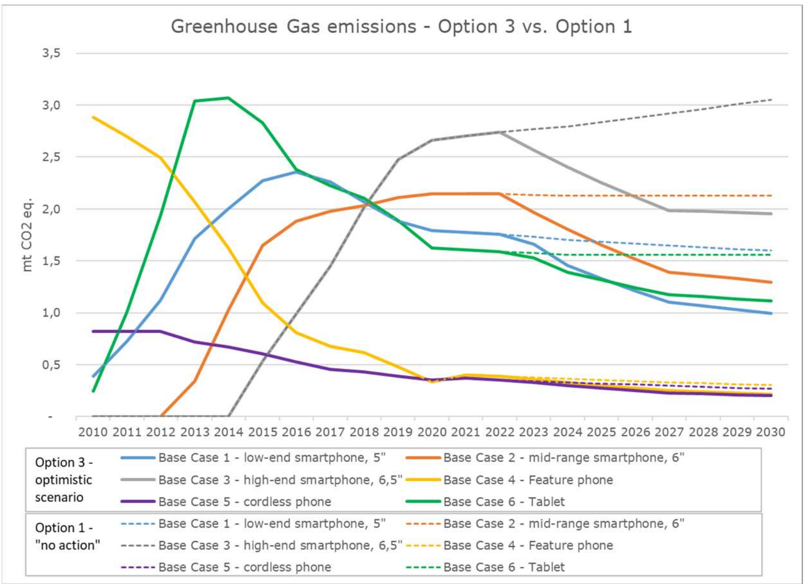

Figure 40 : Alternative Option 3 compared to Option 1 – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

The difference between the optimistic and the conservative scenario in terms of Greenhouse Gas emissions seem to be marginal according to the analysis. Figure 7 compares both scenarios and the differences hardly can be distinguished for most of the product segments.

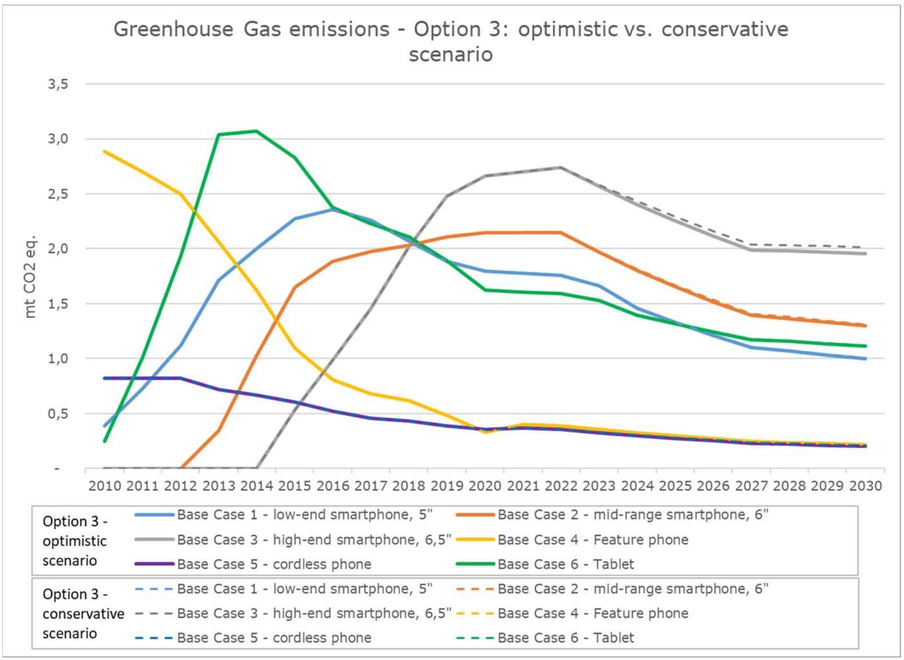

Figure 41 : Alternative Option 3 optimistic vs. conservative scenario – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

10. ANNEX: ADDITIONAL DATA FOR SCENARIO ANALYSIS PER PRODUCT SEGMENT

Complementing the analysis provided in subtask 7.2 the effect of the analysed policy scenarios in terms of Total Energy (primary energy), expressed in TWh is provided below for each of the product segments

- Smartphones
- Mobile phones other than smartphones (represented by feature phones)
- Cordless phones
- Tablets

Table 70 : Smartphones – Total Energy (TWh) per policy scenario, EU27, 2010-2030

Smartphones	Option 1 - "No action" Total Energy TWh	Option 2 - EcoRating Total Energy TWh	Option 3 (REP scenario) - Ecodesign Total Energy TWh	Option 4 - Energy Label Total Energy TWh	Option 5 - Ecodesign and Energy label Total Energy TWh
2010	2	2	2	2	2
2011	3	3	3	3	3
2012	5	5	5	5	5
2013	9	9	9	9	9
2014	13	13	13	13	13
2015	19	19	19	19	19
2016	23	23	23	23	23
2017	25	25	25	25	25
2018	26	26	26	26	26
2019	28	28	28	28	28
2020	29	29	29	29	29
2021	29	28	29	29	29
2022	29	28	29	29	29
2023	29	27	26	29	25
2024	29	27	24	28	22
2025	29	27	22	28	20
2026	29	27	20	28	19
2027	29	27	19	27	19
2028	29	27	19	27	19
2029	29	27	19	26	18
2030	29	27	18	26	18

Table 71 : Feature phones – Total Energy (TWh) per policy scenario, EU27, 2010-2030

Feature phones	Option 1 - "No action" Total Energy TWh	Option 2 - EcoRating Total Energy TWh	Option 3 (REP scenario) - Ecodesign Total Energy TWh	Option 4 - Energy Label Total Energy TWh	Option 5 - Ecodesign and Energy label Total Energy TWh
2010	14,0	14,0	14,0	14,0	14,0
2011	13,1	13,1	13,1	13,1	13,1
2012	12,1	12,1	12,1	12,1	12,1
2013	10,0	10,0	10,0	10,0	10,0
2014	7,9	7,9	7,9	7,9	7,9
2015	5,3	5,3	5,3	5,3	5,3
2016	3,9	3,9	3,9	3,9	3,9
2017	3,3	3,3	3,3	3,3	3,3
2018	3,0	3,0	3,0	3,0	3,0
2019	2,3	2,3	2,3	2,3	2,3
2020	1,6	1,6	1,6	1,6	1,6
2021	2,0	1,9	2,0	2,0	2,0
2022	1,9	1,8	1,9	1,9	1,9
2023	1,8	1,8	1,7	1,8	1,7
2024	1,8	1,7	1,6	1,8	1,5
2025	1,7	1,6	1,4	1,7	1,3
2026	1,7	1,6	1,3	1,6	1,2
2027	1,6	1,5	1,2	1,5	1,2
2028	1,6	1,5	1,1	1,4	1,1
2029	1,5	1,4	1,1	1,4	1,1
2030	1,5	1,4	1,0	1,3	1,0

Table 72 : Cordless phones – Total Energy (TWh) per policy scenario, EU27, 2010-2030

Cordless phones	Option 1 - "No action" Total Energy TWh	Option 2 - EcoRating Total Energy TWh	Option 3 (REP scenario) - Ecodesign Total Energy TWh	Option 4 - Energy Label Total Energy TWh	Option 5 - Ecodesign and Energy label Total Energy TWh
2010	4,2		4,2		
2011	4,2		4,2		
2012	4,2		4,2		
2013	3,7		3,7		
2014	3,4		3,4		
2015	3,1		3,1		
2016	2,7		2,7		
2017	2,3		2,3		
2018	2,2		2,2		
2019	2,0		2,0		
2020	1,8		1,8		
2021	1,9		1,9		
2022	1,8		1,8		
2023	1,7		1,7		
2024	1,7		1,5		
2025	1,6		1,4		
2026	1,6		1,3		
2027	1,5		1,2		
2028	1,5		1,2		
2029	1,4		1,1		
2030	1,4		1,1		

Table 73 : Tablets – Total Energy (TWh) per policy scenario, EU27, 2010-2030

Tablets	Option 1 - "No action" Total Energy TWh	Option 2 - EcoRating Total Energy TWh	Option 3 (REP scenario) - Ecodesign Total Energy TWh	Option 4 - Energy Label Total Energy TWh	Option 5 - Ecodesign and Energy label Total Energy TWh
2010	1,2		1,2	1,2	1,2
2011	4,7		4,7	4,7	4,7
2012	9,0		9,0	9,0	9,0
2013	14,1		14,1	14,1	14,1
2014	14,3		14,3	14,3	14,3
2015	13,2		13,2	13,2	13,2
2016	11,1		11,1	11,1	11,1
2017	10,4		10,4	10,4	10,4
2018	9,8		9,8	9,8	9,8
2019	8,8		8,8	8,8	8,8
2020	7,6		7,6	7,6	7,6
2021	7,5		7,5	7,5	7,5
2022	7,4		7,4	7,4	7,4
2023	7,3		7,1	7,3	7,0
2024	7,3		6,4	7,2	6,0
2025	7,3		6,0	7,1	5,6
2026	7,3		5,6	7,0	5,3
2027	7,3		5,3	6,8	5,2
2028	7,3		5,2	6,7	5,2
2029	7,3		5,2	6,5	5,2
2030	7,3		5,2	6,4	5,2

11. ANNEX: INPUT TO LEGISLATION

NB: in this annex, potential formulations of Ecodesign requirements (and an Energy Labelling scheme) affecting smartphones, mobile phones (other than smartphones), tablets and cordless phones are proposed. Given the declining market figures – and related environmental impacts - for mobile phones (other than smartphones) and cordless phones, it will be decided at a later stage (i.e. after the completion of the current preparatory study) whether or not to include these products in the scope of potential Regulations.

11.1. Definitions

(1) 'mobile phone' means a cordless handheld electronic device designed for long-range voice communication over either a cellular telecommunications network or a satellite based telecommunications network, requiring a SIM card, eSIM or similar means to identify the connected parties. It is designed for battery mode usage, and connection to mains via an external power supply is mainly for battery charging purposes;

(2) 'smartphone' means a mobile phone characterized by WiFi connectivity, mobile use of internet services, and the ability to accept original and third-party software applications. A smartphone has an integrated touch screen display with a diagonal size between 4 and 7 inches. Devices with more than one and/or foldable displays are characterized as smartphones if at least one of the displays falls into the size range in either opened or closed mode;

(3) 'cordless phone' means a cordless handheld electronic device designed for long-range voice communication over a landline telecommunications network, which is connected to a base station through a radio interface. It is designed for battery mode usage, and connection to mains via an external power supply is mainly for battery charging purposes;

(4) 'tablet' means a type of notebook computer designed for portability that includes an integrated touch-sensitive display with a diagonal size greater than 7 inches but does not have an integrated, physical attached keyboard in its as-shipped configuration. A tablet relies on a wireless network connection, which might or might not be a telecommunications network, and is primarily powered by an internal battery (with connection to the mains for battery charging, not primary powering of the device). A tablet is furthermore characterized by an operating system, mobile use of internet services, and the ability to accept original and third-party software applications;

(5) 'battery endurance per cycle' means the time a mobile phone or tablet can operate with an initially fully charged battery, running a defined test scenario, before the device shuts off automatically due to a drained battery, expressed in hours (h);

(6) 'battery endurance in cycles' means the number of charge/discharge cycles a battery can withstand until its usable electrical capacity has reached 80% of its rated capacity, expressed in cycles (n);

(7) 'equivalent mobile phone, cordless phone or tablet' means a model of a mobile phone, cordless phone or tablet placed on the market with the same technical and performance characteristics as regards generic and specific eco-design requirements as another model of a mobile phone,

cordless phone or tablet placed on the market under a different commercial code number by the same manufacturer;

(8) ‘base station’ means a device, which acts as the bridge between the network connection (telephone or Internet connection) and one or several cordless phone handset(s), but does not provide router functionality for any other devices; a base station typically provides also the build-in charging cradle to recharge the handset;

(9) 'networked standby' is defined as in Regulation (EC) No 1275/2008;

(10) ‘P_n (W)’ is the power consumption in networked standby mode, expressed in Watt and rounded to two decimal places;

(11) ‘spare part’ means a separate part that can replace a part with the same or similar function in a mobile phone, cordless phone or tablet. The part is considered necessary for use if the mobile phone, cordless phone or tablet cannot function as intended without that part. The functionality of the mobile phone, cordless phone or tablet is restored or is upgraded when the part is replaced by a spare part;

(12) ‘display unit’ means the image displaying unit, which might include electronics components and a unit housing and/or carrier elements, but excludes touch-sensitive parts;

(13) ‘display assembly’ means the assembly of display unit and front panel digitizer unit;

(14) ‘front panel digitizer unit’ means the touch-sensitive part including the front panel, which might include a bezel, including related electronics components;

(15) ‘IP’ means dust and water ingress protection according to IEC 60529;

(16) ‘faulty operation’ means a state, where a connection between a base station and a handset cannot be established, e.g. if one or more handsets are outside the radio range of the base station, if registered handsets are switched off by the user or they are no longer ready for use due to a low battery;

(17) ‘dismantling’ means possibly irreversible taking apart of an assembled product into its constituent materials and/or components;

(18) ‘disassembling’ means reversible taking apart of an assembled product into its constituent materials and/or components without functional damage that would preclude reassembling, reuse or refurbishment of the product;

(19) ‘security updates’ means operating system updates with the main purpose to provide enhanced security for the device;

(20) ‘operating system version upgrade’ means a change-over to an operating system version with new functionalities, corresponding to the latest version of this operating system available in the market;

(21) ‘C (h^{-1})’ is a measure of the rate at which a battery is charged relative to its capacity, defined as the charge current divided by the capacity, expressed in 1/h;

(22) ‘fast charging’ means charging a battery at a charging rate of above 0,7C for at least part of the charging cycle;

(23) 'smart charging' means an adaptive battery charging profile based on algorithms learning from user behaviour to optimise the charging profile in terms of reducing battery lifetime limiting effects;

(24) 'END_{talk} (h)' is the measured battery endurance per cycle for the function "phone call", expressed in hours;

(25) 'END_{web} (h)' is the measured battery endurance per cycle for the function "browsing the web", expressed in hours;

(26) 'END_{video} (h)' is the measured battery endurance per cycle for the function "playing a video", expressed in hours;

(27) '$END_{standby}$ (h)' is the measured battery endurance per cycle for the function "standby", expressed in hours;

(28) 'END_{Device} (h)' is the calculated battery endurance as calculated weighted value based on the measured endurance for defined functions, expressed in hours;

(29) '$END_{Device,active}$ (h)' is the calculated battery endurance as calculated weighted value based on the measured endurance for defined functions, excluding standby, expressed in hours;

11.2. Ecodesign Requirements

11.2.1. Requirements per product segment

Mobile phones other than smartphones

From 1 xxx 2023, mobile phones other than smartphones shall meet the following requirements:

1. RESOURCE EFFICIENCY REQUIREMENTS

1.1. Design for repair and reuse

(1) availability of spare parts:

(a) manufacturers, importers or authorised representatives shall make available to professional repairers at least the following spare parts, including required fasteners, if not reusable, for a minimum period from 6 months after placing the first unit of a model on the market until five years after placing the last unit of the model on the market, when present:

- battery;
- back cover or back cover assembly;
- front-facing camera assembly;
- rear-facing camera assembly;
- external connectors;
- buttons;
- microphone;
- speaker(s);

- hinge assembly;
- mechanical display folding mechanism;
- mechanical display rolling mechanism.

(b) manufacturers, importers or authorised representatives shall either make available to end-users at least the following spare parts, for a minimum period from 6 months after placing the first unit of a model on the market until five years after placing the last unit of the model on the market:

- battery;

or shall ensure that the battery endurance in cycles achieves a minimum of 1000 full charge cycles, and after 1000 full charge cycles the battery must, in addition, have in a fully charged state, a remaining capacity of at least 80 percent of the rated capacity and the device is at least IP67 rated according to IEC 60529.

(c) manufacturers, importers or authorised representatives shall make available to professional repairers and end-users at least the following spare parts, for a minimum period from 6 months after placing the first unit of a model on the market until five years after placing the last unit of the model on the market:

- display unit;
- charger

(d) the list of spare parts concerned by point (a), (b) and (c) and the procedure for ordering them shall be publicly available on the free access website of the manufacturer, importer or authorised representative, from 6 months after placing the first unit of a model on the market and until the end of the period of availability of these spare parts;

(e) the repair instructions for parts concerned by points (b) and (c) shall be publicly available on the free access website of the manufacturer, importer or authorised representative, from 6 months after placing the first unit of a model on the market and until seven years after placing the last unit of the model on the market;

(2) access to repair and maintenance information

From 6 months after placing on the market the first unit of a model and until seven years after placing the last unit of the model on the market, the manufacturer, importer or authorised representative shall provide access to the repair and maintenance information to professional repairers for parts concerned by point 1(a) in the following conditions:

(a) the manufacturer's, importer's or authorised representative's website shall indicate the process for professional repairers to register for access to information; to accept such a request, the manufacturers, importers or authorised representatives may require the professional repairer to demonstrate that:

(i) the professional repairer has the technical competence to repair mobile phones, cordless phones and tablets and complies with the applicable regulations for repairers of electrical equipment in the Member States where it operates. Reference to an official registration system as professional repairer, where such system exists in the Member States concerned, shall be accepted as proof of compliance with this point;

(ii) the professional repairer is covered by insurance covering liabilities resulting from its activity regardless of whether this is required by the Member State;

(b) manufacturers, importers or authorised representatives shall accept or refuse the registration within 5 working days from the date of request;

(c) manufacturers, importers or authorised representatives may charge reasonable and proportionate fees for access to the repair and maintenance information or for receiving regular updates. A fee is reasonable if it does not discourage access by failing to take into account the extent to which the professional repairer uses the information;

(d) once registered, a professional repairer shall have access, within one working day after requesting it, to the requested repair and maintenance information. The information may be provided for an equivalent model or model of the same family, if relevant;

(e) the repair and maintenance information referred to in (a) shall include:

i. the unequivocal appliance identification;

ii. a disassembly map or exploded view;

iii. wiring and connection diagrams, as required for failure analysis;

iv. electronic board diagrams, as required for failure analysis;

v. list of necessary repair and test equipment;

vi. technical manual of instructions for repair;

vii. diagnostic fault and error codes (including manufacturer-specific codes, where applicable);

viii. component and diagnosis information (such as minimum and maximum theoretical values for measurements);

ix. instructions for software and firmware (including reset software);

x. information on how to access data records of reported failure incidents stored on the device (where applicable);

xi. software tools, firmware and similar auxiliary means required for full functionality of the spare part and device after repair, such as remote authorisation of serial numbers.

(f) third parties shall be allowed to use and publish repair and maintenance information covered by point (e) once the manufacturer, importer or authorised representative terminates access to this information after end of the period of access to repair and maintenance information.

(g) for access to information and tools referred to in (e, xi) the manufacturer, importer or authorised representative might require the owner of the device to notify the manufacturer, importer or authorised representative of the intended repair case

(3) maximum delivery time of spare parts

(a) During the period mentioned under points 1(a), 1(b) and 1(c) the manufacturers, importers or authorised representatives shall ensure the delivery of the spare parts within 5 working days after having received the order.

(b) in the case of spare parts concerned by point 1(a) the availability of spare parts may be limited to professional repairers registered in accordance with point 2 (a) and (b);

(4) maximum price of spare parts

(a) during the period mentioned under points 1(a), 1(b) and 1(c) the manufacturers, importers or authorised representatives shall indicate a maximum pre-tax price for spare parts listed in points 1(a), 1(b) and 1(c) disclosed on the free access website of the manufacturer, importer or authorised representative mentioned under points 1(d) and 1(e). The stated maximum pre-tax price may not be increased after it has been published on the website.

(5) disassembly requirements

Manufacturers, importers or authorised representatives shall meet the following disassembly requirements according to EN 45554:2020:

(a) manufacturers, importers or authorised representatives shall ensure that the process for battery replacement meets either the following criteria:

- Fasteners and connectors: Reusable (Class A)
- Tools: Feasible with the use of no tool, or a tool or set of tools that is supplied with the product or spare part, or basic tools as listed in Table A.4 of EN 45554 (Class A)
- Working environment: Use environment (Class A)
- Skill level: Layman (Class A)

or shall ensure that the battery endurance in cycles achieves a minimum of 1000 full charge cycles, and after 1000 full charge cycles the battery must, in addition, have in a fully charged state, a remaining capacity of at least 80 percent of the rated capacity and the device is at least IP67 rated according to IEC 60529.

(b) manufacturers, importers or authorised representatives shall ensure that the process for display unit replacement meets the following criteria:

- Fasteners and connectors: Removable (Class B)
- Tools: Feasible with commercially available tools (Class C)
- Working environment: Workshop environment (Class B)
- Skill level: Generalist (Class B)

(c) manufacturers, importers or authorised representatives shall ensure, that joining, fastening or sealing techniques do not prevent the disassembly of parts concerned by points 1(a) using commercially available tools.

(6) requirements for preparation for reuse

(a) manufacturers, importers or authorised representatives shall ensure, that devices include a software function, that resets the device to its factory settings and erases by default address book, text messages and call history;

1.2. Design for reliability

(1) resistance to accidental drops

manufacturers, importers or authorised representatives shall ensure that the devices pass 200 falls (may be tested with protective cover, if shipped with product), and in any case 100 falls without cover, without loss of functionality, following the test procedure set out in 11.2.2; for devices with movable parts this requirement applies to both, the state in which the device is shipped and the fully extended state;

(2) scratch resistance

manufacturers, importers or authorised representatives shall ensure that the screen of the device passes the hardness level 4 on the Mohs hardness scale.

(3) protection from dust and water

manufacturers, importers or authorised representatives shall ensure that the devices are dust and water ingress protected complying to an IP rating of at least IP44 according to IEC 60529.

(4) battery endurance in cycles

manufacturers, importers or authorised representatives shall ensure that the devices achieve at least 500 cycles at 80 percent remaining charge capacity according to IEC EN 61960.

(5) battery management and fast charging

(a) manufacturers, importers or authorised representatives shall ensure that by default the charging rate does not exceed 0,7C at any point during the charging process; fast charging may be available as an option, but needs to be activated by the user.

(b) fast charging might be enabled by the user.

(6) software upgrades and updates

(a) manufacturers, importers or authorised representatives shall ensure the availability of security updates for at least 5 years and the availability of operating system version upgrades for at least 3 years, at no costs

(b) the user shall have the option to de-install an operating system version upgrade and to re-install the operating system version running on the device prior to the upgrade.

(c) updates mentioned under (a) need to be available to the user latest 2 months after the public release of the source code of an update of the underlying operating system or, if the source code is not publicly released, after an update of the same operating system is released by the operating system provider or on any other product of the same brand

(d) upgrades mentioned under (a) need to be available to the user latest 3 months after the public release of the source code of an upgrade of the underlying operating system or, if the source code is not publicly released, after an upgrade of the same operating system is released by the operating system provider or on any other product of the same brand

1.3. Marking of plastic components

Plastic components heavier than 50 g shall be marked by specifying the type of polymer with the appropriate standard symbols or abbreviated terms set between the punctuation marks ‘>’ and ‘<’ as specified in available standards. The marking shall be legible.

Plastic components are exempt from marking requirements in the following circumstances:

- the marking is not possible because of the shape or size;
- the marking would impact on the performance or functionality of the plastic component; and
- marking is technically not possible because of the molding method.

For the following plastic components no marking is required:

- packaging, tape, labels and stretch wraps;
- wiring, cables and connectors, rubber parts and anywhere not enough appropriate surface area is available for the marking to be of a legible size;
- PCB assemblies, PMMA boards, optical components, electrostatic discharge components, electromagnetic interference components, speakers;
- transparent parts where the marking would obstruct the function of the part in question.

2. INFORMATION REQUIREMENTS

2.1 Manufacturers, importers or authorised representatives shall provide in the technical documentation and make publicly available on free-access websites the following information:

(a) compatibility with removable memory cards, if any;

(b) results of a Life Cycle Assessment following the method set out in 11.2.3, including the assessed environmental impact indicators and the results of the calculation, over the product life cycle from cradle to the location, where the product is put on the market in the European Union;

(c) whether the semiconductor chips are produced in a fab with a high reduction rate for fluorinated greenhouse gas emissions, separately for

- SoC/CPU,
- RAM,
- Storage (flash memory only or including memory controller);

(d) whether the display is produced in a fab with a high reduction rate for fluorinated greenhouse gas emissions;

(e) whether air cargo is involved in shipping the device from final assembly to the location, where the product is put on the market in the European Union;

(f) list of up to ten components, where electricity consumption is based on 100% renewable energy in the manufacturing stage with the highest electricity consumption of this particular supply chain;

(g) indicative weight range of the following critical raw materials and environmentally relevant materials:

- Cobalt in the battery (weight range: less than 2 g, between 2 g and 10 g, above 10 g)
- Tantalum in capacitors (weight range: less than 0,05 g, between 0,05 g and 0,2 g, above 0,2 g)
- Neodymium in loud speakers, vibration motors, and other magnets (weight range: less than 0,05 g, between 0,05 g and 0,2 g, above 0,2 g)
- Gold in all components (weight range: less than 0,02 g, between 0,02 g and 0,05 g, above 0,05 g)

2.2 Manufacturers, importers or authorised representatives shall provide in the technical documentation and make publicly available on free-access websites the following information:

(a) energy efficiency index (EEI) according to 11.2.2;

(b) ingress protection rating;

(c) minimum battery endurance in cycles in number of cycles;

(d) minimum battery endurance in cycles under conditions of fast charging (if applicable) in numbers of cycles;

2.3 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and shall include:

(a) instructions for battery maintenance,

- including impacts on battery lifetime related to exposing the device to elevated temperatures, state of charge, fast charging and other known adverse effects on battery lifetime;
- including effects of switching off radio connections, such as WiFi, Bluetooth, on power consumption;

- if the device supports other features, which extend battery lifetime, such as smart charging and how these features are activated or under which conditions these features work best;

2.4 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and shall include:

(a) instructions for de-installation of operating system upgrades, and re-installation of the operating system version running on the device prior to an upgrade

2.5 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and on the sales packaging of the device and shall include:

(a) if the package does not include a charger the following information: "For environmental reasons this package does not include a charger. This device is compatible with <connector type> chargers."

Smartphones

From 1 xxx 2023, smartphones shall meet the following requirements:

1. RESOURCE EFFICIENCY REQUIREMENTS

1.1. Design for repair and reuse

(1) availability of spare parts:

(a) manufacturers, importers or authorised representatives shall make available to professional repairers at least the following spare parts, including required fasteners, if not reusable, for a minimum period from 6 months after placing the first unit of a model on the market until five years after placing the last unit of the model on the market, when present:

- battery;
- back cover or back cover assembly;
- front-facing camera assembly;
- rear-facing camera assembly;
- external connectors;
- buttons;
- microphone;
- speaker(s);
- hinge assembly;
- mechanical display folding mechanism;
- mechanical display rolling mechanism.

(b) manufacturers, importers or authorised representatives of smartphones shall either make available to end-users at least the following spare parts, for a minimum period from 6 months after placing the first unit of a model on the market until five years after placing the last unit of the model on the market:

- battery;

or shall shall ensure that the battery endurance in cycles achieves a minimum of 1000 full charge cycles, and after 1000 full charge cycles the battery must, in addition, have in a fully charged state, a remaining capacity of at least 80 percent of the rated capacity and the device is at least IP67 rated according to IEC 60529.

(c) manufacturers, importers or authorised representatives of smartphones shall make available to professional repairers and end-users at least the following spare parts, for a minimum period from 6 months after placing the first unit of a model on the market until five years after placing the last unit of the model on the market:

- display assembly;
- charger

(d) the list of spare parts concerned by points (a), (b) and (c) and the procedure for ordering them shall be publicly available on the free access website of the manufacturer, importer or authorised representative, from 6 months after placing the first unit of a model on the market and until the end of the period of availability of these spare parts;

(e) the repair instructions for parts concerned by points (b) and (c) shall be publicly available on the free access website of the manufacturer, importer or authorised representative, from 6 months after placing the first unit of a model on the market and until seven years after placing the last unit of the model on the market;

(2) access to repair and maintenance information

From 6 months after placing on the market the first unit of a model and until seven years after placing the last unit of the model on the market, the manufacturer, importer or authorised representative shall provide access to repair and maintenance information to professional repairers for parts concerned by point 1(a) in the following conditions:

(a) the manufacturer's, importer's or authorised representative's website shall indicate the process for professional repairers to register for access to information; to accept such a request, the manufacturers, importers or authorised representatives may require the professional repairer to demonstrate that:

(i) the professional repairer has the technical competence to repair mobile phones, cordless phones and tablets and complies with the applicable regulations for repairers of electrical equipment in the Member States where it operates. Reference to an official registration system as professional repairer, where such system exists in the Member States concerned, shall be accepted as proof of compliance with this point;

(ii) the professional repairer is covered by insurance covering liabilities resulting from its activity regardless of whether this is required by the Member State;

(b) manufacturers, importers or authorised representatives shall accept or refuse the registration within 5 working days from the date of request;

(c) manufacturers, importers or authorised representatives may charge reasonable and proportionate fees for access to the repair and maintenance information or for receiving regular updates. A fee is reasonable if it does not discourage access by failing to take into account the extent to which the professional repairer uses the information;

(d) once registered, a professional repairer shall have access, within one working day after requesting it, to the requested repair and maintenance information. The information may be provided for an equivalent model or model of the same family, if relevant;

(e) the repair and maintenance information referred to in (a) shall include:

i. the unequivocal appliance identification;

ii. a disassembly map or exploded view;

iii. wiring and connection diagrams, as required for failure analysis;

iv. electronic board diagrams, as required for failure analysis;

v. list of necessary repair and test equipment;

vi. technical manual of instructions for repair;

vii. diagnostic fault and error codes (including manufacturer-specific codes, where applicable);

viii. component and diagnosis information (such as minimum and maximum theoretical values for measurements);

ix. instructions for software and firmware (including reset software);

x. information on how to access data records of reported failure incidents stored on the device (where applicable);

xi. software tools, firmware and similar auxiliary means required for full functionality of the spare part and device after repair, such as remote authorisation of serial numbers.

(f) third parties shall be allowed to use and publish repair and maintenance information covered by point (e) once the manufacturer, importer or authorised representative terminates access to this information after end of the period of access to repair and maintenance information.

(g) for access to information and tools referred to in (e, xi) the manufacturer, importer or authorised representative might require the owner of the device to notify the manufacturer, importer or authorised representative of the intended repair case

(3) maximum delivery time of spare parts

(a) During the period mentioned under points 1(a), 1(b) and 1(c) the manufacturers, importers or authorised representatives shall ensure the delivery of the spare parts within 5 working days after having received the order.

(b) in the case of spare parts concerned by point 1(a) the availability of spare parts may be limited to professional repairers registered in accordance with point 2 (a) and (b);

(4) maximum price of spare parts

(a) during the period mentioned under points 1(a), 1(b) and 1(c) the manufacturers, importers or authorised representatives shall indicate a maximum pre-tax price for spare parts listed in points 1(a), 1(b) and 1(c) disclosed on the free access website of the manufacturer, importer or authorised representative mentioned under points 1(d) and 1(e). The stated maximum pre-tax price may not be increased after it has been published on the website.

(5) disassembly requirements

Manufacturers, importers or authorised representatives shall meet the following disassembly requirements according to EN 45554:2020:

(a) manufacturers, importers or authorised representatives shall ensure that the process for battery replacement meets either the following criteria:

- Fasteners and connectors: Reusable (Class A)
- Tools: Feasible with the use of no tool, or a tool or set of tools that is supplied with the product or spare part, or basic tools as listed in Table A.4 of EN 45554 (Class A)
- Working environment: Use environment (Class A)
- Skill level: Layman (Class A)

or shall ensure that the battery endurance in cycles achieves a minimum of 1000 full charge cycles, and after 1000 full charge cycles the battery must, in addition, have in a fully charged state, a remaining capacity of at least 80 percent of the rated capacity and the device is at least IP67 rated according to IEC 60529.

(b) manufacturers, importers or authorised representatives shall ensure that the process for display assembly replacement meets the following criteria:

- Fasteners and connectors: Removable (Class B)
- Tools: Feasible with commercially available tools (Class C)
- Working environment: Workshop environment (Class B)
- Skill level: Generalist (Class B)

(c) manufacturers, importers or authorised representatives shall ensure, that joining, fastening or sealing techniques do not prevent the disassembly of parts concerned by points 1(a) using commercially available tools.

(6) requirements for preparation for reuse

manufacturers, importers or authorised representatives shall ensure, that devices

(a) encrypt user data by default;

(b) include a software function, that resets the device to its factory settings and erases by default the encryption key;

(c) record the following data from the battery management system in the system settings or another location accessible for end-users:

- Date of manufacturing of the battery;
- Date of first use of the battery;
- Number of full charge/discharge cycles (reference: rated capacity);
- Estimated state of health (full charge capacity relative to the rated capacity in %).

1.2. Design for reliability

(1) resistance to accidental drops

manufacturers, importers or authorised representatives shall ensure that the devices pass 200 falls (may be tested with protective cover, if shipped with product), and in any case 100 falls without cover, without loss of functionality, following the test procedure set out in 11.2.2; for devices with movable parts this requirement applies to both, the state in which the device is shipped and the fully extended state;

(2) scratch resistance

manufacturers, importers or authorised representatives shall ensure that the screen of the device passes the hardness level 4 on the Mohs hardness scale.

(3) protection from dust and water

manufacturers, importers or authorised representatives shall ensure that the devices are dust and water ingress protected complying to an IP rating of at least IP44 according to IEC 60529.

(4) battery endurance in cycles

manufacturers, importers or authorised representatives shall ensure that the devices achieve at least 500 cycles at 80 percent remaining charge capacity according to IEC EN 61960.

(5) battery management and fast charging

(a) manufacturers, importers or authorised representatives shall ensure that by default the charging rate does not exceed 0,7C at any point during the charging process; fast charging may be available as an option, but needs to be activated by the user.

(b) fast charging might be enabled by the user.

(6) software upgrades and updates

(a) manufacturers, importers or authorised representatives shall ensure the availability of security updates for at least 5 years and the availability of operating system version upgrades for at least 3 years, at no costs

(b) the user shall have the option to de-install an operating system version upgrade and to re-install the operating system version running on the device prior to the upgrade.

(c) updates mentioned under (a) need to be available to the user latest 2 months after the public release of the source code of an update of the underlying operating system or, if the source code is not publicly released, after an update of the same operating system is released by the operating system provider or on any other product of the same brand

(d) upgrades mentioned under (a) need to be available to the user latest 3 months after the public release of the source code of an upgrade of the underlying operating system or, if the source code is not publicly released, after an upgrade of the same operating system is released by the operating system provider or on any other product of the same brand

1.3. Marking of plastic components

Plastic components heavier than 50 g shall be marked by specifying the type of polymer with the appropriate standard symbols or abbreviated terms set between the punctuation marks ‘>’ and ‘<’ as specified in available standards. The marking shall be legible.

Plastic components are exempt from marking requirements in the following circumstances:

- the marking is not possible because of the shape or size;
- the marking would impact on the performance or functionality of the plastic component; and
- marking is technically not possible because of the molding method.

For the following plastic components no marking is required:

- packaging, tape, labels and stretch wraps;
- wiring, cables and connectors, rubber parts and anywhere not enough appropriate surface area is available for the marking to be of a legible size;
- PCB assemblies, PMMA boards, optical components, electrostatic discharge components, electromagnetic interference components, speakers;
- transparent parts where the marking would obstruct the function of the part in question.

2. INFORMATION REQUIREMENTS

2.1 Manufacturers, importers or authorised representatives shall provide in the technical documentation and make publicly available on free-access websites the following information:

(a) compatibility with removable memory cards, if any;

(b) results of a Life Cycle Assessment following the method set out in 11.2.3, including the assessed environmental impact indicators and the results of the calculation, over the product life cycle from cradle to the location, where the product is put on the market in the European Union;

(c) whether the semiconductor chips are produced in a fab with a high reduction rate for fluorinated greenhouse gas emissions, separately for

- SoC/CPU,
- RAM,
- Storage (flash memory only or including memory controller);

(d) whether the display is produced in a fab with a high reduction rate for fluorinated greenhouse gas emissions;

(e) whether air cargo is involved in shipping the device from final assembly to the location, where the product is put on the market in the European Union;

(f) list of up to ten components, where electricity consumption is based on 100% renewable energy in the manufacturing stage with the highest electricity consumption of this particular supply chain;

(g) indicative weight range of the following critical raw materials and environmentally relevant materials:

- Cobalt in the battery (weight range: less than 2 g, between 2 g and 10 g, above 10 g)
- Tantalum in capacitors (weight range: less than 0,05 g, between 0,05 g and 0,2 g, above 0,2 g)
- Neodymium in loud speakers, vibration motors, and other magnets (weight range: less than 0,05 g, between 0,05 g and 0,2 g, above 0,2 g)
- Gold in all components (weight range: less than 0,02 g, between 0,02 g and 0,05 g, above 0,05 g)

2.2 Manufacturers, importers or authorised representatives shall provide in the technical documentation and make publicly available on free-access websites the following information:

(a) energy efficiency index (EEI) according to 11.2.2;

(b) ingress protection rating;

(c) minimum battery endurance in cycles in number of cycles;

(d) minimum battery endurance in cycles under conditions of fast charging (if applicable) in numbers of cycles;

2.3 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and shall include:

(a) how to access on the device information from the battery management system on:

- Date of manufacturing of the battery;
- Date of first use of the battery;
- Number of full charge/discharge cycles (reference: rated capacity);
- Estimated state of health (full charge capacity relative to the rated capacity in %).

2.4 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and shall include:

(a) instructions for battery maintenance,

- including impacts on battery lifetime related to exposing the device to elevated temperatures, state of charge, fast charging and other known adverse effects on battery lifetime;
- including effects of switching off radio connections, such as WiFi, Bluetooth, on power consumption;
- if the device supports other features, which extend battery lifetime, such as smart charging and how these features are activated or under which conditions these features work best;

2.5 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and shall include:

(a) instructions for de-installation of operating system upgrades, and re-installation of the operating system version running on the device prior to an upgrade

2.6 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and instructions shall be displayed on the device under certain conditions and shall include:

(a) information that data encryption is enabled by default shall be displayed in the course of configuring a new device, including an explanation that this eases data erasure through factory reset;

(b) if fast charging is permanently selectable, a message shall notify the user that fast charging may have a negative impact on battery endurance.

2.7 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and on the sales packaging of the device and shall include:

(a) if the package does not include a charger the following information: "For environmental reasons this package does not include a charger. This device is compatible with <connector type> chargers."

Cordless phones

From 1 xxx 2023, cordless phones shall meet the following requirements:

1. LOW POWER MODES

Manufacturers, importers or authorised representatives shall ensure, that devices meet the following requirements:

(1) the networked standby power consumption of cordless phones

- shipped with a base station shall not exceed 0,4 W;
- shipped with a charging cradle without base station functionality shall not exceed 0,2 W.

(2) devices shall be configured in their factory settings to cut off the radio signals of the base station and handset (or handsets) in network standby mode. The base station must switch off its radio signal in this operating mode regardless of the number of registered handsets. This must also be ensured in the event of 'faulty operation'. Resetting the device to the factory settings must restore the configuration described above.

2. RESOURCE EFFICIENCY REQUIREMENTS

2.1. Design for repair and reuse

(1) availability of spare parts:

(a) manufacturers, importers or authorised representatives shall make available to professional repairers at least the following spare parts, including required fasteners, if not reusable, for a minimum period from 6 months after placing the first unit of a model on the market until seven years after placing the last unit of the model on the market, when present:

- display unit;
- external connectors;
- buttons;
- microphone;
- speaker;

(b) manufacturers, importers or authorised representatives shall make available to professional repairers and end-users at least the following spare parts, for a minimum period from 6 months after placing the first unit of a model on the market until seven years after placing the last unit of the model on the market:

- battery;
- battery compartment cover;
- charger

(c) the list of spare parts concerned by point (a) and the procedure for ordering them shall be publicly available on the free access website of the manufacturer, importer or authorised representative, from 6 months after placing the first unit of a model on the market and until the end of the period of availability of these spare parts;

(d) the list of spare parts concerned by point (b) and the procedure for ordering them and the repair instructions shall be publicly available on the free access website of the manufacturer, importer or authorised representative, from 6 months after placing the first unit of a model on the market and until the end of the period of availability of these spare parts;

(2) cordless phones shall be designed for the use of rechargeable batteries with standardised physical dimensions corresponding to those defined in IEC 60086-2:2015

(3) access to repair and maintenance information

From 6 months after placing on the market the first unit of a model and until seven years after placing the last unit of the model on the market, the manufacturer, importer or authorised representative shall provide access to the repair and maintenance information to professional repairers in the following conditions:

(a) the manufacturer's, importer's or authorised representative's website shall indicate the process for professional repairers to register for access to information; to accept such a request, the manufacturers, importers or authorised representatives may require the professional repairer to demonstrate that:

(i) the professional repairer has the technical competence to repair mobile phones, cordless phones and tablets and complies with the applicable regulations for repairers of electrical equipment in the Member States where it operates. Reference to an official registration system as professional repairer, where such system exists in the Member States concerned, shall be accepted as proof of compliance with this point;

(ii) the professional repairer is covered by insurance covering liabilities resulting from its activity regardless of whether this is required by the Member State;

(b) manufacturers, importers or authorised representatives shall accept or refuse the registration within 5 working days from the date of request;

(c) manufacturers, importers or authorised representatives may charge reasonable and proportionate fees for access to the repair and maintenance information or for receiving regular updates. A fee is reasonable if it does not discourage access by failing to take into account the extent to which the professional repairer uses the information;

(d) once registered, a professional repairer shall have access, within one working day after requesting it, to the requested repair and maintenance information. The information may be provided for an equivalent model or model of the same family, if relevant;

(e) the repair and maintenance information referred to in (a) shall include:

i. the unequivocal appliance identification;

ii. a disassembly map or exploded view;

iii. wiring and connection diagrams, as required for failure analysis;

iv. electronic board diagrams, as required for failure analysis;

v. list of necessary repair and test equipment;

vi. technical manual of instructions for repair;

vii. diagnostic fault and error codes (including manufacturer-specific codes, where applicable);

viii. component and diagnosis information (such as minimum and maximum theoretical values for measurements);

ix. instructions for software and firmware (including reset software);

x. information on how to access data records of reported failure incidents stored on the device (where applicable);

xi. software tools, firmware and similar auxiliary means required for full functionality of the spare part and device after repair, such as remote authorisation of serial numbers.

(f) third parties shall be allowed to use and publish repair and maintenance information covered by point (e) once the manufacturer, importer or authorised representative terminates access to this information after end of the period of access to repair and maintenance information.

(g) for access to information and tools referred to in (e, xi) the manufacturer, importer or authorised representative might require the owner of the device to notify the manufacturer, importer or authorised representative of the intended repair case

(4) maximum delivery time of spare parts

(a) During the period mentioned under points 1(a) and 1(b) the manufacturers, importers or authorised representatives of mobile phones, cordless phones and tablets shall ensure the delivery of the spare parts within 5 working days after having received the order.

(b) in the case of spare parts concerned by point 1(a) the availability of spare parts may be limited to professional repairers registered in accordance with point 3 (a) and (b);

(5) maximum price of spare parts

(a) during the period mentioned under points 1(a) and 1(b) the manufacturers, importers or authorised representatives shall indicate a maximum pre-tax price for spare parts listed in points 1(a) and 1(b) disclosed on the free access website of the manufacturer, importer or authorised representative mentioned under points 1(c) and 1(d). The stated maximum pre-tax price may not be increased after it has been published on the website.

(6) disassembly requirements

Manufacturers, importers or authorised representatives shall meet the following disassembly requirements according to EN 45554:2020:

(a) manufacturers, importers or authorised representatives shall ensure that the process for battery replacement meets the following criteria:

- Fasteners and connectors: Reusable (Class A)
- Tools: Feasible with the use of no tool, or a tool or set of tools that is supplied with the product or spare part, or basic tools as listed in Table A.4 of EN 45554 (Class A)
- Working environment: Use environment (Class A)
- Skill level: Layman (Class A)

(b) manufacturers, importers or authorised representatives shall ensure that the process for display unit replacement meets the following criteria:

- Fasteners and connectors: Removable (Class B)
- Tools: Feasible with commercially available tools (Class C)
- Working environment: Workshop environment (Class B)
- Skill level: Generalist (Class B)

(c) manufacturers, importers or authorised representatives shall ensure, that joining, fastening or sealing techniques do not prevent the disassembly of parts concerned by point 1(a) using commercially available tools.

(7) requirements for preparation for reuse

(a) manufacturers, importers or authorised representatives shall ensure, that devices includes a software function, that resets the device to its factory settings and erases by default address book, text messages and call history;

2.2. Marking of plastic components

Plastic components heavier than 50 g shall be marked by specifying the type of polymer with the appropriate standard symbols or abbreviated terms set between the punctuation marks ‘>’ and ‘<’ as specified in available standards. The marking shall be legible.

Plastic components are exempt from marking requirements in the following circumstances:

- the marking is not possible because of the shape or size;
- the marking would impact on the performance or functionality of the plastic component; and
- marking is technically not possible because of the molding method.

For the following plastic components no marking is required:

- packaging, tape, labels and stretch wraps;
- wiring, cables and connectors, rubber parts and anywhere not enough appropriate surface area is available for the marking to be of a legible size;
- PCB assemblies, PMMA boards, optical components, electrostatic discharge components, electromagnetic interference components, speakers;

- transparent parts where the marking would obstruct the function of the part in question.

3. INFORMATION REQUIREMENTS

3.1 Manufacturers, importers or authorised representatives shall provide in the technical documentation and make publicly available on free-access websites the following information:

(a) compatibility with removable memory cards, if any;

(b) results of a Life Cycle Assessment following the method set out in 11.2.3, including the assessed environmental impact indicators and the results of the calculation, over the product life cycle from cradle to the location, where the product is put on the market in the European Union;

(c) whether the semiconductor chips are produced in a fab with a high reduction rate for fluorinated greenhouse gas emissions, separately for

- SoC/CPU,
- RAM,
- Storage (flash memory only or including memory controller);

(d) whether the display is produced in a fab with a high reduction rate for fluorinated greenhouse gas emissions;

(e) whether air cargo is involved in shipping the device from final assembly to the location, where the product is put on the market in the European Union;

(f) list of up to ten components, where electricity consumption is based on 100% renewable energy in the manufacturing stage with the highest electricity consumption of this particular supply chain;

(g) indicative weight range of the following critical raw materials and environmentally relevant materials:

- Cobalt in the battery (weight range: less than 2 g, between 2 g and 10 g, above 10 g)
- Tantalum in capacitors (weight range: less than 0,05 g, between 0,05 g and 0,2 g, above 0,2 g)
- Neodymium in loud speakers, vibration motors, and other magnets (weight range: less than 0,05 g, between 0,05 g and 0,2 g, above 0,2 g)
- Gold in all components (weight range: less than 0,02 g, between 0,02 g and 0,05 g, above 0,05 g)

3.2 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and on the sales packaging of the device and shall include:

(a) if the package does not include a charger the following information: “For environmental reasons this package does not include a charger. This device is compatible with <connector type> chargers.”

Tablets

From 1 xxx 2023, tablets shall meet the following requirements:

1. RESOURCE EFFICIENCY REQUIREMENTS

1.1. Design for repair and reuse

(1) availability of spare parts:

(a) manufacturers, importers or authorised representatives shall make available to professional repairers at least the following spare parts, including required fasteners, if not reusable, for a minimum period from 6 months after placing the first unit of a model on the market until six years after placing the last unit of the model on the market, when present:

- display unit;
- front panel digitizer unit;
- battery;
- back cover or back cover assembly;
- front-facing camera assembly;
- rear-facing camera assembly;
- external connectors;
- buttons;
- microphone;
- speaker(s);
- hinge assembly;
- mechanical display folding mechanism;
- mechanical display rolling mechanism.

(b) manufacturers, importers or authorised representatives shall either make available to end-users at least the following spare parts, for a minimum period from 6 months after placing the first unit of a model on the market until six years after placing the last unit of the model on the market:

- battery;

or shall ensure that the battery endurance in cycles achieves a minimum of 1000 full charge cycles, and after 1000 full charge cycles the battery must, in addition, have in a fully charged state, a remaining capacity of at least 80 percent of the rated capacity.

(c) manufacturers, importers or authorised representatives shall make available to professional repairers and end-users at least the following spare parts, for a minimum period from 6 months after placing the first unit of a model on the market until six years after placing the last unit of the model on the market:

- charger

(d) the list of spare parts concerned by point (a), (b) and (c) and the procedure for ordering them shall be publicly available on the free access website of the manufacturer, importer or authorised representative, from 6 months after placing the first unit of a model on the market and until the end of the period of availability of these spare parts;

(e) the repair instructions for parts concerned by points (b) and (c) shall be publicly available on the free access website of the manufacturer, importer or authorised representative, from 6 months after placing the first unit of a model on the market and until seven years after placing the last unit of the model on the market;

(2) access to repair and maintenance information

From 6 months after placing on the market the first unit of a model and until seven years after placing the last unit of the model on the market, the manufacturer, importer or authorised representative shall provide access to repair and maintenance information to professional repairers for parts concerned by point 1(a) in the following conditions:

(a) the manufacturer's, importer's or authorised representative's website shall indicate the process for professional repairers to register for access to information; to accept such a request, the manufacturers, importers or authorised representatives may require the professional repairer to demonstrate that:

(i) the professional repairer has the technical competence to repair mobile phones, cordless phones and tablets and complies with the applicable regulations for repairers of electrical equipment in the Member States where it operates. Reference to an official registration system as professional repairer, where such system exists in the Member States concerned, shall be accepted as proof of compliance with this point;

(ii) the professional repairer is covered by insurance covering liabilities resulting from its activity regardless of whether this is required by the Member State;

(b) manufacturers, importers or authorised representatives shall accept or refuse the registration within 5 working days from the date of request;

(c) manufacturers, importers or authorised representatives may charge reasonable and proportionate fees for access to the repair and maintenance information or for receiving regular updates. A fee is reasonable if it does not discourage access by failing to take into account the extent to which the professional repairer uses the information;

(d) once registered, a professional repairer shall have access, within one working day after requesting it, to the requested repair and maintenance information. The information may be provided for an equivalent model or model of the same family, if relevant;

(e) the repair and maintenance information referred to in (a) shall include:

i. the unequivocal appliance identification;

ii. a disassembly map or exploded view;

iii. wiring and connection diagrams, as required for failure analysis;

iv. electronic board diagrams, as required for failure analysis;

v. list of necessary repair and test equipment;

vi. technical manual of instructions for repair;

vii. diagnostic fault and error codes (including manufacturer-specific codes, where applicable);

viii. component and diagnosis information (such as minimum and maximum theoretical values for measurements);

ix. instructions for software and firmware (including reset software);

x. information on how to access data records of reported failure incidents stored on the device (where applicable);

xi. software tools, firmware and similar auxiliary means required for full functionality of the spare part and device after repair, such as remote authorisation of serial numbers.

(f) third parties shall be allowed to use and publish repair and maintenance information covered by point (e) once the manufacturer, importer or authorised representative terminates access to this information after end of the period of access to repair and maintenance information.

(g) for access to information and tools referred to in (e, xi) the manufacturer, importer or authorised representative might require the owner of the device to notify the manufacturer, importer or authorised representative of the intended repair case

(3) maximum delivery time of spare parts

(a) During the period mentioned under points 1(a), 1(b) and 1(c) the manufacturers, importers or authorised representatives shall ensure the delivery of the spare parts within 5 working days after having received the order.

(b) in the case of spare parts concerned by point 1(a) the availability of spare parts may be limited to professional repairers registered in accordance with point 2 (a) and 2 (b);

(4) maximum price of spare parts

(a) during the period mentioned under points 1(a), 1(b) and 1(c) the manufacturers, importers or authorised representatives shall indicate a maximum pre-tax price for spare parts listed in points 1(a), 1(b) and 1(c) disclosed on the free access website of the manufacturer, importer or authorised representative mentioned under points 1(d) and 1(e). The stated maximum pre-tax price may not be increased after it has been published on the website.

(5) disassembly requirements

Manufacturers, importers or authorised representatives shall meet the following disassembly requirements according to EN 45554:2020:

(a) manufacturers, importers or authorised representatives shall ensure that the process for battery replacement meets either the following criteria:

- Fasteners and connectors: Reusable (Class A)
- Tools: Feasible with the use of no tool, or a tool or set of tools that is supplied with the product or spare part, or basic tools as listed in Table A.4 of EN 45554 (Class A)
- Working environment: Use environment (Class A)
- Skill level: Layman (Class A)

or shall shall ensure that the battery endurance in cycles achieves a minimum of 1000 full charge cycles, and after 1000 full charge cycles the battery must, in addition, have in a fully charged state, a remaining capacity of at least 80 percent of the rated capacity.

(b) manufacturers, importers or authorised representatives shall ensure that the process for display unit and front panel digitizer unit replacement each meet the following criteria:

- Fasteners and connectors: Removable (Class B)
- Tools: Feasible with commercially available tools (Class C)
- Working environment: Workshop environment (Class B)
- Skill level: Generalist (Class B)

(c) manufacturers, importers or authorised representatives shall ensure, that joining, fastening or sealing techniques do not prevent the disassembly of parts concerned by point 1(a) using commercially available tools.

(7) requirements for preparation for reuse

manufacturers, importers or authorised representatives shall ensure, that devices

(a) encrypt user data by default;

(b) include a software function, that resets the device to its factory settings and erases by default the encryption key;

(c) record the following data from the battery management system in the system settings or another location accessible for end-users:

- Date of manufacturing of the battery;
- Date of first use of the battery;

- Number of full charge/discharge cycles (reference: rated capacity);
- Estimated state of health (full charge capacity relative to the rated capacity in %).

1.2. Design for reliability

(1) scratch resistance

manufacturers, importers or authorised representatives shall ensure that the screen of the device passes the hardness level 4 on the Mohs hardness scale.

(3) protection from dust and water

manufacturers, importers or authorised representatives shall ensure that the devices are dust and water ingress protected complying to an IP rating of at least IP44 according to IEC 60529.

(4) battery endurance in cycles

manufacturers, importers or authorised representatives shall ensure that the devices achieve at least 500 cycles at 80 percent remaining charge capacity according to IEC EN 61960.

(5) battery management and fast charging

(a) manufacturers, importers or authorised representatives shall ensure that by default the charging rate does not exceed 0,7C at any point during the charging process; fast charging may be available as an option, but needs to be activated by the user.

(b) fast charging might be enabled by the user.

(6) software upgrades and updates

(a) manufacturers, importers or authorised representatives shall ensure the availability of security updates for at least 5 years and the availability of operating system version upgrades for at least 3 years, at no costs

(b) the user shall have the option to de-install an operating system version upgrade and to re-install the operating system version running on the device prior to the upgrade.

(c) updates mentioned under (a) need to be available to the user latest 2 months after the public release of the source code of an update of the underlying operating system or, if the source code is not publicly released, after an update of the same operating system is released by the operating system provider or on any other product of the same brand

(d) upgrades mentioned under (a) need to be available to the user latest 3 months after the public release of the source code of an upgrade of the underlying operating system or, if the source code is not publicly released, after an upgrade of the same operating system is released by the operating system provider or on any other product of the same brand

1.3. Marking of plastic components

Plastic components heavier than 50 g shall be marked by specifying the type of polymer with the appropriate standard symbols or abbreviated terms set between the punctuation marks ‘>’ and ‘<’ as specified in available standards. The marking shall be legible.

Plastic components are exempt from marking requirements in the following circumstances:

- the marking is not possible because of the shape or size;
- the marking would impact on the performance or functionality of the plastic component; and
- marking is technically not possible because of the molding method.

For the following plastic components no marking is required:

- packaging, tape, labels and stretch wraps;
- wiring, cables and connectors, rubber parts and anywhere not enough appropriate surface area is available for the marking to be of a legible size;
- PCB assemblies, PMMA boards, optical components, electrostatic discharge components, electromagnetic interference components, speakers;
- transparent parts where the marking would obstruct the function of the part in question.

2. INFORMATION REQUIREMENTS

2.1 Manufacturers, importers or authorised representatives shall provide in the technical documentation and make publicly available on free-access websites the following information:

(a) compatibility with removable memory cards, if any;

(b) results of a Life Cycle Assessment following the method set out in 11.2.3, including the assessed environmental impact indicators and the results of the calculation, over the product life cycle from cradle to the location, where the product is put on the market in the European Union;

(c) whether the semiconductor chips are produced in a fab with a high reduction rate for fluorinated greenhouse gas emissions, separately for

- SoC/CPU,
- RAM,
- Storage (flash memory only or including memory controller);

(d) whether the display is produced in a fab with a high reduction rate for fluorinated greenhouse gas emissions;

(e) whether air cargo is involved in shipping the device from final assembly to the location, where the product is put on the market in the European Union;

(f) list of up to ten components, where electricity consumption is based on 100% renewable energy in the manufacturing stage with the highest electricity consumption of this particular supply chain;

(g) indicative weight range of the following critical raw materials and environmentally relevant materials:

- Cobalt in the battery (weight range: less than 2 g, between 2 g and 10 g, above 10 g)
- Tantalum in capacitors (weight range: less than 0,05 g, between 0,05 g and 0,2 g, above 0,2 g)
- Neodymium in loud speakers, vibration motors, and other magnets (weight range: less than 0,05 g, between 0,05 g and 0,2 g, above 0,2 g)
- Gold in all components (weight range: less than 0,02 g, between 0,02 g and 0,05 g, above 0,05 g)

2.2 Manufacturers, importers or authorised representatives shall provide in the technical documentation and make publicly available on free-access websites the following information:

(a) energy efficiency index (EEI) according to Annex III;

(b) ingress protection rating;

(c) minimum battery endurance in cycles in number of cycles;

(d) minimum battery endurance in cycles under conditions of fast charging (if applicable) in numbers of cycles;

2.3 Manufacturers, importers or authorised representatives shall provide in the technical documentation and make publicly available on free-access websites the following information:

(a) passed falls according to IEC 60068-2-31 and the methodology set out in 11.2.2

- with protective cover (if shipped with product)
- without protective cover
- fully extended state (applicable to devices with movable parts)

2.4 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and shall include:

(a) how to access on the device information from the battery management system on:

- Date of manufacturing of the battery;
- Date of first use of the battery;
- Number of full charge/discharge cycles (reference: rated capacity);
- Estimated state of health (full charge capacity relative to the rated capacity in %).

2.5 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and shall include:

(a) instructions for battery maintenance,

- including impacts on battery lifetime related to exposing the device to elevated temperatures, state of charge, fast charging and other known adverse effects on battery lifetime;
- including effects of switching off radio connections, such as WiFi, Bluetooth, on power consumption;
- if the device supports other features, which extend battery lifetime, such as smart charging and how these features are activated or under which conditions these features work best;

2.6 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and shall include:

(a) instructions for de-installation of operating system upgrades, and re-installation of the operating system version running on the device prior to an upgrade

2.7 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and instructions shall be displayed on the device under certain conditions and shall include:

(a) information that data encryption is enabled by default shall be displayed in the course of configuring a new device, including an explanation that this eases data erasure through factory reset;

(b) if fast charging is permanently selectable, a message shall notify the user that fast charging may have a negative impact on battery endurance.

2.8 Manufacturers, importers or authorised representatives shall provide user instructions in the form of a user manual on a free access website of the manufacturer, importer or authorised representative, and on the sales packaging of the device and shall include:

(a) if the package does not include a charger the following information: "For environmental reasons this package does not include a charger. This device is compatible with <connector type> chargers."

11.2.2. Measurements and calculations

1. For the purposes of compliance and verification of compliance with the applicable requirements of this Regulation, measurements and calculations shall be made using harmonised standards, the reference numbers of which have been published in the Official Journal of the European Union, or using other reliable, accurate and reproducible methods which take into account the generally recognised state of the art, and produce results deemed to be of low uncertainty.

2. Cordless phones shipped with a base station shall be tested for networked standby power consumption, with the following test settings,

(1) Tests shall be performed on the base station both, without the handset on the base station as well as with the charged handset on the base station.

(2) The devices shall be measured in the condition as delivered to the end customer (factory setting).

(3) The power consumptions shall be measured as average power consumptions over a time period of 10 minutes.

(4) The measurements are to be carried out with a mains supply voltage of 230V ± 1%.

3. Cordless phones shipped with a charging cradle shall be tested for networked standby power consumption, with the following test settings,

(1) Tests shall be performed with the charged handset placed on the charging cradle.

(2) The devices shall be measured in the condition as delivered to the end customer (factory setting).

(3) The power consumptions shall be measured as average power consumptions over a time period of 10 minutes.

(4) The measurements are to be carried out with a mains supply voltage of 230V ± 1%.

4. Mobile phones and tablets shall be tested for battery endurance per cycle, consecutively with the following test settings, each with a fully charged battery

(1) Phone call (mobile phones only)

- all applications closed (except required system applications), all radios switched off except cellular network,
- for Dual-SIM devices only 1 SIM card inserted; for Dual-SIM devices with eSIM, eSIM to be switched off; for devices with eSIM only, eSIM to be used,
- initiate 3G call, or 4G in case of no 3G capability; test setting with a base station simulator, sending constant "power up command" to the terminal, i.e. the phone is commanded to transmit at full power,
- audio at 80% volume,
- measure talk time (END_{talk}) until phone shuts off (screens may shut off during a call, if this is the default setting)

(2) Browsing the web (smartphones and tablets only)

- display brightness set to 200 candela per square meter (cd/m2); automatic screen brightness adjustment disabled
- 802.11n access point in short distance for full connectivity
- running an automated script which reloads a webpage every ten seconds; no flash elements on the web pages
- measure web browsing time (END_{web}) until phone shuts off

(3) Playing a video (smartphones and tablets only)

- display brightness set to 200 candela per square meter (cd/m2); automatic screen brightness adjustment disabled
- radios on the device switched off (airplane mode)
- looping a standard-definition video
- end-point: battery state of charge at 10% (END_{video})

(4) Standby (mobile phones and tablets)

- all applications closed (except required system applications), all radios switched off except cellular network,
- measure standby time ($END_{standby}$) until phone shuts off

The endurance score is an aggregated and normalised value in hours, as a calculated value derived from the four types of battery endurance per cycle tests.

Overall battery endurance (END_{device}) in hours is calculated as follows:

(a) smartphones:

$$END_{device} = \frac{24}{(\frac{1}{END_{talk}}+\frac{1}{END_{web}}+\frac{1}{END_{video}}+\frac{21}{END_{standby}})}$$

(b) mobile phones other than smartphones:

$$END_{device} = \frac{24}{(\frac{1}{END_{talk}}+\frac{23}{END_{standby}})}$$

(c) tablets:

$$END_{device} = \frac{24}{(\frac{1}{END_{web}}+\frac{1}{END_{video}}+\frac{22}{END_{standby}})}$$

The energy efficiency index (EEI) of a mobile phone or tablet shall be calculated using the following equation:

$$EEI = \frac{END_{Device}}{C_{rated}}$$

Where:

C_{rated} is the rated battery capacity in mAh

5. Mobile phones and tablets shall be tested for battery endurance in cycles, according to EN 61960-3:2017, until the battery's usable electrical capacity has reached 80% of its rated capacity; the battery shall be tested

   (a) according to the default charging algorithms implemented by the manufacturer, and

   (b) with fast charging enabled (if applicable)

   The resulting number of cycles shall be rounded down to full hundreds and stated as "≥ x00".

6. Mobile phones shall be tested for resistance to accidental drops following IEC 60068-2-31, Free fall repeated – Procedure 2, fall height 1 meter; the test has to be performed with 5 units consecutively and is passed, if at least 3 units pass the test.

7. Tablets shall be tested for resistance to accidental drops following IEC 60068-2-31, Free fall repeated – Procedure 2, fall height 1 meter; the test has to be performed with 5 units consecutively. The free fall test shall be interrupted after 50, 100, 150 falls and terminated after 200 falls to verify, if full functionality of the device is still given. The number of falls passed by at least 3 out of 5 units is the value to be stated in user instructions as set out in 11.2.1.

8. When a manufacturer, importer or authorised representative voluntarily states in any product related information a percentage of recycled content for the product or a part thereof, it shall be calculated in conformance with EN 45557:2020.

11.2.3. Transitional Methods

Table 1

References and qualifying notes for mobile phones, cordless phones and tablets

Parameter	Source	Reference Test Method / Title	Notes
Life Cycle Impact Assessment indicator(s)	***(with the impact assessment it will be defined, which single approach of the following methods will apply:)***		a. system boundaries include cradle to the location, where the product is put on the market in the European Union; calculating with average values for transportation and distances to the various locations is allowed.
		ISO 14040:2006 and 14044:2006	b. calculated life cycle impacts may be calculated as a single indicator or as indicator set. c. calculated life cycle impacts shall include packaging and all accessories shipped with the device. d. if the display is calculated with secondary datasets, either static component data or parameterised data models, up to 5% of the cradle to gate GHG emissions in CO2e can be deducted, if an abatement rate for fluorinated gas emissions is calculated in accordance with IEEE 1680.1 (paragraph 4.1.10.1); calculated abatement rate for the display fab qualifies to reduce the calculated GHG emissions for the display by 0.05 x abatement rate.
		ISO 14067:2018	e. if semiconductor components are calculated with secondary datasets, either static component data or parameterised data models, up to 5% of the cradle to gate GHG emissions in CO2e can be deducted, if an abatement rate for fluorinated gas emissions is calculated in accordance with IEEE 1680.1 (paragraph 4.1.10.2); calculated abatement rate per fab for a given chip qualifies to reduce the calculated GHG emissions for this chip by 0.05 x abatement rate.
	ETSI	ETSI ES 203 199	f. manufacturing processes shall be modelled with national or regional electricity grid mixes or an average of national electricity grid mixes representing the typical origin of a part, material or component. Manufacturing processes may be modelled with a higher rate of renewable energy, if evidence based on Guarantees of Origin under the European Energy Certificate System or a similar scheme in non-EU, non-EFTA countries is provided.
	Consortium of telecom operators	EcoRating	g. materials with a recycled content can be modelled with generic data for recycled materials, if the recycled content is calculated according to EN 45557:2020
	EC	Revised MEErP EcoReport	h. transportation from final assembly to the target market shall be calculated with data models matching the actual means of transportation i. credits for recycling at end of life shall be taken into account only, if there is evidence that an actual recycling of at least 10% of the devices at end of life is likely j. the Life Cycle Assessment shall be reviewed by an external reviewer against either • ISO14040:2006 and 14044:2006 or • ISO 14067:2018 or • the EcoRating methodology and may additionally confirm conformance with ETSI ES 203 199, and shall comprise explicitly a review of conformance with a – i above, where applicable.

high reduction rate for fluorinated greenhouse gas emissions	IEEE	IEEE 1680.1	a. for displays, deviating from IEEE 1680.1, demonstrating that F-GHG emissions have been reduced by at least 90% by all fabs b. deviating from IEEE 1680.1, for CPU/SoC, RAM, flash memory each ≥ 70% F-GHG emission reduction if F-HTF emissions are included in the reduction assessment and ≥ 75% if F-HTF emissions are excluded from the assessment, for all fabs manufacturing one of the covered semiconductor components
electricity consumption based renewable energy	EECS		evidence based on Guarantees of Origin under the European Energy Certificate System or a similar scheme in non-EU, non-EFTA countries to be provided
Base station simulator for battery endurance test	ETSI	ETSI TR 125 914 - V16.0.0, chapter 9	
Battery endurance test ambient conditions	ECMA	ECMA 383	Ambient temperature (23±5) °C, relative humidity 10% to 80%, ambient light (250±50) Lux
Critical raw material (CRM) content		EN 45558:2019	To be applied to gold following the same approach as for CRMs

11.3. Energy Label Requirements

11.3.1. Energy efficiency classes

The energy efficiency class of a mobile phone and a tablet shall be determined on the basis of its Energy Efficiency Index (EEI) as set out in point 1 of 11.3.2.

Table 74: Energy efficiency classes of mobile phones and tablets

Energy Efficiency Class	Energy Efficiency Index (EEI)
A (most efficient)	EEI > 0,042
B	0,037 < EEI ≤ 0,042
C	0,032 < EEI ≤ 0,037
D	0,027 < EEI ≤ 0,032
E	0,022 < EEI ≤ 0,027
F	0,017 < EEI ≤ 0,022
G (least efficient)	EEI ≤ 0,017

11.3.2. Measurement and calculation methods

1. CALCULATION OF THE ENERGY EFFICIENCY INDEX

– Same as 11.2.2 –

2. MEASUREMENT AND CALCULATION OF THE BATTERY ENDURANCE PER CYCLE, ACTIVE USE ONLY

– Test setting as 11.2.2 –

Overall battery endurance in active use ($END_{device,active}$) in hours is calculated as follows:

(a) smartphones:

$$END_{device,active} = \frac{3}{(\frac{1}{END_{talk}}+\frac{1}{END_{web}}+\frac{1}{END_{video}})}$$

(b) mobile phones other than smartphones:

$$END_{device,active} = END_{talk}$$

(c) tablets:

$$END_{device,active} = \frac{2}{(\frac{1}{END_{web}}+\frac{1}{END_{video}})}$$

3. MEASUREMENT OF THE BATTERY ENDURANCE IN CYCLES

Mobile phones and tablets shall be tested for battery endurance in cycles, according to EN 61960-3:2017, until the battery's usable electrical capacity has reached 80% of its rated capacity; the battery shall be tested according to the default charging algorithms implemented by the manufacturer.

The resulting number of cycles shall be rounded down to full hundreds and stated as "≥ x00".

4. MEASUREMENT OF THE INGRESS PROTECTION

– IEC 60529 –

5. CALCULATION OF THE ENVIRONMENTAL IMPACT SCORE

– to be defined, e.g. a revised version of the MEErP Ecoreport –

11.3.3. Label for mobile phones and tablets

1. LABEL FOR MOBILE PHONES AND TABLETS

Label:

– design to be defined –

The following information shall be included in the label for mobile phones and tablets:

I. supplier's name or trade mark;
II. supplier's model identifier, meaning the code, usually alphanumeric, which distinguishes a specific mobile phone or

tablet model from other models with the same trade mark or supplier's name;

III. the (energy) efficiency class determined in accordance with 11.3.1; the head of the arrow containing the energy efficiency class shall be placed at the same height as the head of the arrow of the relevant energy efficiency class;

IV. battery endurance per cycle, active use only ($END_{device,active}$) in h per full battery charge, rounded to full hours in accordance with point 2 of 11.3.2;

V. battery endurance in cycles, in cycles, in ranges ≥500, ≥600, ≥700, ≥800, ≥900, ≥1000, ≥1100, ≥1200, ≥1300, ≥1400 in accordance with point 3 of 11.3.2;

VI. ingress protection rating in accordance with point 4 of 11.3.2;

VII. environmental impact score in accordance with point 5 of 11.3.2;

VIII. the QR code with access to the product information sheet

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