Ecodesign preparatory study on mobile phones, smartphones and tablets

Draft Task 7 Report

Scenarios

Written by Fraunhofer IZM, Fraunhofer ISI, VITO
December – 2020

Authors:

Karsten Schischke (Fraunhofer IZM)
Christian Clemm (Fraunhofer IZM)
Anton Berwald (Fraunhofer IZM)
Marina Proske (Fraunhofer IZM)
Gergana Dimitrova (Fraunhofer IZM)
Julia Reinhold (Fraunhofer IZM)
Carolin Prewitz (Fraunhofer IZM)

Contributors:

Antoine Durand (Quality control, Fraunhofer ISI)
Clemens Rohde (Quality control, Fraunhofer ISI)
Simon Hirzel (Quality control, Fraunhofer ISI)
Mihaela Thuring (Quality control, contract management, VITO)

Study website: https://www.ecosmartphones.info

EUROPEAN COMMISSION

Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
Directorate C — Sustainable Industry and Mobility
DDG1.C.1 — Circular Economy and Construction

Contact: Davide Polverini

E-mail: davide.polverini@ec.europa.eu

European Commission
B-1049 Brussels

Ecodesign preparatory study on mobile phones, smartphones and tablets

Draft Task 7 Report

Scenarios

Europe Direct is a service to help you find answers to your questions about the European Union.

Freephone number (*)**:**

00 800 6 7 8 9 10 11

(*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

LEGAL NOTICE

This document has been prepared for the European Commission however it reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

More information on the European Union is available on the Internet (http://www.europa.eu).

Luxembourg: Publications Office of the European Union, 2020

© European Union, 2020
Reproduction is authorised provided the source is acknowledged.

Printed in Belgium

Images © Fraunhofer IZM, 2020 (unless otherwise specified)

Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs

2020

CONTENT

1. GLOSSARY 10
2. INTRODUCTION 12
3. SUBTASK 7.1 – POLICY ANALYSIS 12
3.1. Option 1: "No action" 12
3.2. Option 2: Self-regulation 13
3.3. Option 3: Introduction of mandatory specific and/or generic ecodesign requirements 14
3.3.1. Reparability and reusability 16
3.3.2. Reliability 20
3.3.3. Confidence in data erasure and ease of data transfer 22
3.3.4. Battery endurance (per cycle) 23
3.3.5. Power consumption 24
3.3.6. Reduction of manufacturing impacts 24
3.4. Option 4: Energy Labelling 25
3.5. Option 5: Ecodesign requirements combined with Energy Labelling 25
3.6. Aspects not covered by any of the policy options 26
4. SUBTASK 7.2 - SCENARIO ANALYSIS (UNIT STOCK/SALE & ENVIRONMENTAL) 27
4.1. Option 1: "No action" 27
4.2. Option 2: EcoRating 30
4.3. Option 3: Introduction of mandatory specific and/or generic ecodesign requirements 34
4.4. Option 4: Energy Labelling 38
4.5. Option 5: Ecodesign requirements combined with Energy Labelling 42
4.6. Comparison of options 46
4.6.1. Smartphones, Feature phones 46
4.6.2. Cordless phones 51
4.6.3. Tablets 55
5. SUBTASK 7.3 – SOCIO-ECONOMIC IMPACT ANALYSIS 60
5.1. Consumer costs 60
5.2. Impact on OEMs 64
5.3. Retailers 65
5.4. Repair business 66
5.5. Reuse market 67
5.6. Recycling 68
6. SUBTASK 7.4 – SENSITIVITY ANALYSIS 68
6.1. Purchase Price – Break-Even 69
6.2. Lifetime – Break-Even 72
7. SUBTASK 7.5 - SUMMARY 75
8. PUBLICATION BIBLIOGRAPHY 77

FIGURES

FIGURE 1 : REPARABILITY LABEL DESIGN, FRANCE 20

FIGURE 2 : OPTION 1 – « NO ACTION » - STOCK DEVELOPMENT, EU27, 2010-2030 28

FIGURE 3 : OPTION 1 – « NO ACTION » - EXTERNAL ANNUAL DAMAGES (UPDATED SOCIETAL COST FACTORS) AND TOTAL ENERGY, EU27, 2010-2030 30

FIGURE 4 : OPTION 1 – « NO ACTION » - GREENHOUSE GAS EMISSIONS AND ACIDIFICATION, EU27, 2010-2030 30

FIGURE 5 : OPTION 2 COMPARED TO OPTION 1 – PER PRODUCT SEGMENT - GREENHOUSE GAS EMISSIONS, EU27, 2010-2030 33

FIGURE 6 : OPTION 3 COMPARED TO OPTION 1 – PER PRODUCT SEGMENT - GREENHOUSE GAS EMISSIONS, EU27, 2010-2030 37

FIGURE 7 : OPTION 3 OPTIMISTIC VS. CONSERVATIVE SCENARIO – PER PRODUCT SEGMENT - GREENHOUSE GAS EMISSIONS, EU27, 2010-2030 38

FIGURE 8 : OPTION 4 COMPARED TO OPTION 1 – PER PRODUCT SEGMENT - GREENHOUSE GAS EMISSIONS, EU27, 2010-2030 42

FIGURE 9 : OPTION 5 – ECODESIGN REQUIREMENTS AND ENERGY LABEL – EXTERNAL ANNUAL DAMAGES (UPDATED SOCIETAL COST FACTORS), EU27, 2010-2030 44

FIGURE 10 : OPTION 5 COMPARED TO OPTION 3 (OPTIMISTIC SCENARIO) – PER PRODUCT SEGMENT - GREENHOUSE GAS EMISSIONS, EU27, 2010-2030 45

FIGURE 11 : SMARTPHONES, FEATURE PHONES – SALES PER POLICY SCENARIO, EU27, 2010-2030 46

FIGURE 12 : SMARTPHONES, FEATURE PHONES – TOTAL ANNUAL CONSUMER EXPENDITURE PER POLICY SCENARIO, EU27, 2010-2030 47

FIGURE 13 : SMARTPHONES, FEATURE PHONES – EXTERNAL ANNUAL DAMAGES (UPDATED DATA) PER POLICY SCENARIO, EU27, 2010-2030 47

FIGURE 14 : SMARTPHONES, FEATURE PHONES – TOTAL ENERGY PER POLICY SCENARIO, EU27, 2010-2030 48

FIGURE 15 : SMARTPHONES, FEATURE PHONES – GREENHOUSE GAS EMISSIONS PER POLICY SCENARIO, EU27, 2010-2030 48

FIGURE 16 : SMARTPHONES, FEATURE PHONES – ACIDIFICATION PER POLICY SCENARIO, EU27, 2010-2030 49

FIGURE 17 : SMARTPHONES, FEATURE PHONES – MATERIAL CONSUMPTION PER POLICY OPTION, EU27, ALL UNITS SOLD IN 2030 51

FIGURE 18 : CORDLESS PHONES – SALES PER POLICY SCENARIO, EU27, 2010-2030 52

FIGURE 19 : CORDLESS PHONES – TOTAL ANNUAL CONSUMER EXPENDITURE PER POLICY SCENARIO, EU27, 2010-2030 52

FIGURE 20 : CORDLESS PHONES – EXTERNAL ANNUAL DAMAGES (UPDATED DATA) PER POLICY SCENARIO, EU27, 2010-2030 53

FIGURE 21 : CORDLESS PHONES – TOTAL ENERGY PER POLICY SCENARIO, EU27, 2010-2030 53

FIGURE 22 : CORDLESS PHONES – GREENHOUSE GAS EMISSIONS PER POLICY SCENARIO, EU27, 2010-2030 54

FIGURE 23 : CORDLESS PHONES – ACIDIFICATION PER POLICY SCENARIO, EU27, 2010-2030 54

FIGURE 24 : TABLETS – SALES PER POLICY SCENARIO, EU27, 2010-2030 56

FIGURE 25 : TABLETS – TOTAL ANNUAL CONSUMER EXPENDITURE PER POLICY SCENARIO, EU27, 2010-2030 56

FIGURE 26 : TABLETS – EXTERNAL ANNUAL DAMAGES (UPDATED DATA) PER POLICY SCENARIO, EU27, 2010-2030 57

FIGURE 27 : TABLETS – TOTAL ENERGY PER POLICY SCENARIO, EU27, 2010-2030 57

FIGURE 28 : TABLETS – GREENHOUSE GAS EMISSIONS PER POLICY SCENARIO, EU27, 2010-2030 58

FIGURE 29 : TABLETS – ACIDIFICATION PER POLICY SCENARIO, EU27, 2010-2030 58

FIGURE 30 : TABLETS – MATERIAL CONSUMPTION PER POLICY OPTION, EU27, ALL UNITS SOLD IN 2030 60

FIGURE 31 : SMARTPHONES, FEATURE PHONES – REPAIR COSTS PER POLICY SCENARIO, EU27, 2010-2030 66

FIGURE 32 : TABLETS – REPAIR COSTS PER POLICY SCENARIO, EU27, 2010-2030 67

TABLES

TABLE 1 : POTENTIAL MATERIAL EFFICIENCY RELATED ECODESIGN REQUIREMENTS DERIVED FROM PRODUCT GROUP ANALYSIS 15

TABLE 2 : SMARTPHONE REPARABILITY SCORING ACCORDING TO UPCOMING FRENCH REGULATION AND CORRELATION WITH FINDINGS OF THIS STUDY 16

TABLE 3 : MOBILE PHONE AND TABLET RELIABILITY SCORING CRITERIA 20

TABLE 4: IP CODES SCORING – RELEVANT PROTECTION LEVELS 22

TABLE 5 : BATTERY ENDURANCE AS BASIS FOR DEFINING ENERGY EFFICIENCY CLASSES FOR SMARTPHONES 25

TABLE 6 : POTENTIAL ECODESIGN REQUIREMENTS AND ENERGY LABEL SCOPE DERIVED FROM PRODUCT GROUP ANALYSIS 26

TABLE 7 : OPTION 1 – « NO ACTION » - SALES, EU27, 2010-2030 28

TABLE 8 : OPTION 1 – « NO ACTION » - TOTAL CONSUMER EXPENDITURE, EU27, 2010-2030 29

TABLE 9 : OPTION 2 – ECORATING – SALES TOTAL AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 31

TABLE 10 : OPTION 2 – ECORATING – TOTAL CONSUMER EXPENDITURE AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 32

TABLE 11 : OPTION 3 – ECORATING – TOTAL ENERGY AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 33

TABLE 12 : OPTION 3 – ECO-DESIGN REQUIREMENTS, OPTIMISTIC SCENARIO – SALES TOTAL AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 35

TABLE 13 : OPTION 3 – ECO-DESIGN REQUIREMENTS, CONSERVATIVE SCENARIO – SALES TOTAL AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 35

TABLE 14 : OPTION 3 – ECODESIGN REQUIREMENTS, OPTIMISTIC SCENARIO – TOTAL CONSUMER EXPENDITURE AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 36

TABLE 15 : OPTION 3 – ECO-DESIGN REQUIREMENTS, OPTIMISTIC SCENARIO – TOTAL ENERGY AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 37

TABLE 16 : OPTION 4 – ENERGY LABEL – SALES TOTAL AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 39

TABLE 17 : OPTION 4 – ENERGY LABEL – TOTAL CONSUMER EXPENDITURE AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 40

TABLE 18 : OPTION 4 – ENERGY LABEL – TOTAL EXTERNAL ANNUAL DAMAGES (UPDATED SOCIETAL COST FACTORS) AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 41

TABLE 19 : OPTION 4 – ENERGY LABEL – TOTAL ENERGY AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 41

TABLE 20 : OPTION 5 – ECODESIGN REQUIREMENTS AND ENERGY LABEL – SALES TOTAL AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 43

TABLE 21 : OPTION 5 – ECODESIGN REQUIREMENTS AND ENERGY LABEL – TOTAL CONSUMER EXPENDITURE AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 44

TABLE 22 : OPTION 5 – ECO-DESIGN REQUIREMENTS AND ENERGY LABEL – TOTAL ENERGY AND IN COMPARISON TO « NO ACTION », EU27, 2010-2030 45

TABLE 23 : SMARTPHONES, FEATURE PHONES – TOTAL ENERGY AND GREENHOUSE GAS EMISSIONS PER POLICY SCENARIO, PER LIFE CYCLE PHASE, EU27, ALL UNITS SOLD IN 2030 50

TABLE 24 : SMARTPHONES, FEATURE PHONES – MATERIAL CONSUMPTION PER POLICY OPTION, EU27, ALL UNITS SOLD IN 2030 50

TABLE 25 : CORDLESS PHONES – TOTAL ENERGY AND GREENHOUSE GAS EMISSIONS PER POLICY SCENARIO, PER LIFE CYCLE PHASE, EU27, ALL UNITS SOLD IN 2030 55

TABLE 26 : CORDLESS PHONES – MATERIAL CONSUMPTION PER POLICY OPTION, EU27, ALL UNITS SOLD IN 2030 55

TABLE 27 : TABLETS – TOTAL ENERGY AND GREENHOUSE GAS EMISSIONS PER POLICY SCENARIO, PER LIFE CYCLE PHASE, EU27, ALL UNITS SOLD IN 2030..... 59

TABLE 28 : TABLETS – MATERIAL CONSUMPTION PER POLICY OPTION, EU27, ALL UNITS SOLD IN 2030 59

TABLE 29 : AVERAGE PRODUCT LIFE CYCLE COSTS - LOW-END SMARTPHONE, 5" – STATUS QUO, ECODESIGN REQUIREMENTS, ENERGY LABEL 61

TABLE 30 : AVERAGE PRODUCT LIFE CYCLE COSTS – MID-RANGE SMARTPHONE, 6" – STATUS QUO, ECODESIGN REQUIREMENTS, ENERGY LABEL 62

TABLE 31 : AVERAGE PRODUCT LIFE CYCLE COSTS – HIGH-END SMARTPHONE, 6,5" – STATUS QUO, ECODESIGN REQUIREMENTS, ENERGY LABEL 62

TABLE 32 : AVERAGE PRODUCT LIFE CYCLE COSTS – FEATURE PHONE – STATUS QUO, ECODESIGN REQUIREMENTS, ENERGY LABEL..... 63

TABLE 33 : AVERAGE PRODUCT LIFE CYCLE COSTS – CORDLESS PHONE – STATUS QUO, ECODESIGN REQUIREMENTS, ENERGY LABEL..... 63

TABLE 34 : AVERAGE PRODUCT LIFE CYCLE COSTS – TABLET – STATUS QUO, ECODESIGN REQUIREMENTS, ENERGY LABEL..... 64

TABLE 35 : LOW-END SMARTPHONE - SENSITIVITY ANALYSIS – PURCHASE PRICE BREAK EVEN 69

TABLE 36 : MID-RANGE SMARTPHONE - SENSITIVITY ANALYSIS – PURCHASE PRICE BREAK EVEN 70

TABLE 37 : HIGH-END SMARTPHONE - SENSITIVITY ANALYSIS – PURCHASE PRICE BREAK EVEN 70

TABLE 38 : FEATURE PHONE - SENSITIVITY ANALYSIS – PURCHASE PRICE BREAK EVEN 71

TABLE 39 : CORDLESS PHONE - SENSITIVITY ANALYSIS – PURCHASE PRICE BREAK EVEN .. 71

TABLE 40 : TABLET - SENSITIVITY ANALYSIS – PURCHASE PRICE BREAK EVEN 72

TABLE 41 : LOW-END SMARTPHONE - SENSITIVITY ANALYSIS – LIFETIME BREAK EVEN..... 73

TABLE 42 : MID-RANGE SMARTPHONE - SENSITIVITY ANALYSIS – LIFETIME BREAK EVEN... 73

TABLE 43 : HIGH-END SMARTPHONE - SENSITIVITY ANALYSIS – LIFETIME BREAK EVEN..... 74

TABLE 44 : FEATURE PHONE - SENSITIVITY ANALYSIS – LIFETIME BREAK EVEN..... 74

TABLE 45 : CORDLESS PHONE - SENSITIVITY ANALYSIS – LIFETIME BREAK EVEN 75

TABLE 46 : TABLET - SENSITIVITY ANALYSIS – LIFETIME BREAK EVEN 75

TABLE 47 : COMPARISON ALL POLICY SCENARIOS, EU27, 2030..... 76

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
SDRAM	Synchronous Dynamic Random Access Memory
SDXC	Secure Digital Extended Capacity

Term	Definition
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.

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, overlapping with 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. 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 2021 by major telecommunication operators throughout the European Union and globally. The distribution channel telecommunication operators covers roughly 25-40% of the EU27 market in terms of distributed mobile phones.

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.

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

Aspect	Specific requirement	Generic requirement
Reparability (details: 3.3.1)	user replaceable battery[1] spare parts availability	Multi-criteria reparability scoring
Reliability (details: 3.3.2)	2 years OS support IPx3 Battery minimum lifetime[2]	Multi-criteria reliability scoring
Battery endurance (per cycle) (details: 3.3.4)	-	scoring or lifetime information
Confidence in data erasure and ease of data transfer (details: 3.3.3)	data encryption by default	user information
Unbundling	-	user information (and covered by PEF score below)
environmental footprint of the product (details: 3.3.6)	-	scoring system based on environmental footprint (incl. recycled content)

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*, such as the scoring approaches can be introduced faster as this does not require design changes as such, but testing against scoring 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.

[1] with exemptions, if a similar effect is achieved by other means, such as battery demonstrated to last (indicatively) 1000 cycles @ 80% or unless OEM provides convenient (on-site / same-day / moderate price) battery replacement service

[2] indicatively : 300 cycles @ 80% remaining charge capacity

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.

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, and featuring high ingress protection classes are not yet found combined in a single device.

Mandatory requirements with consumer and environmental benefits, and no apparent compromises on product designs are:

- Spare parts availability for professional repair shops, covering an extended lifetime of 5 years for mobile phones and 6 years for tablets, covering at least the following priority parts (including relevant fasteners, if non-reusable):
  - Display unit,
  - battery,
  - glass back cover (if any)
- Repair instructions for professional repair shops
- Availability of tools to professional repair shops

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).

A generic requirement is a reparability scoring, similar to the reparability scoring introduced in France on January 1, 2021 (Table 2).

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

Table 2 : 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		

#	Sub-Criterion	Scoring system specifics	Relevancy according to this study
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 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
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	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	Confirmed relevant (DO17 in Task 6)
2.2.B	Display device (incl. screen/LCD or display panel and touch device)	Removable only with proprietary tools. Such operation is not feasible with basic or specific tools. These tools are not commercially available	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	Removable only with specific tools. Such operation is not feasible with basic or proprietary tools. These tools include all non-listed tools	Not applicable

#	Sub-Criterion	Scoring system specifics	Relevancy according to this study
		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	
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 completely removed without causing damage or leaving residue, but cannot be reused. 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.	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		
2.3.G	Display device (incl. screen/LCD or display panel and touch device)		
2.3.H	Front-facing camera		
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 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 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	See 3.1
3.3.B	Display device (incl. screen/LCD or display panel and touch device)		

#	Sub-Criterion	Scoring system specifics	Relevancy according to this study
3.3.C	Front-facing camera	- Consumers	
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		
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	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**, 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 2 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 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

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

- User replaceable batteries
- Use of AAA rechargeable batteries

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. 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.

Table 3 : 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.)	High
1.2	Resistance to accidental drops: Availability / provision of screen protectors and protective cases	Yes / no	High
1.3	Scratch resistance (screen, camera, fingerprint sensor, etc.)	Scratch resistance rating	Currently low, but might change with flexible / bendable displays
1.4	Protection from dust	Compliance with IP codes (up to 4 / 5 / 6)	Medium
1.5	Protection from water	Compliance with IP codes (up to 3 / 4 / 5 / 6 / 7 and above)	High

2. Degradation failures (rising probability over time)			
2.1	Battery endurance (charging cycles): Minimum number of cycles with the battery properly functioning	Minimum number of cycles with the battery properly functioning	High
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	Medium
2.5	Reliability of other parts (buttons, speakers, etc.)	tbd	Medium
2.6	Operating System updates	Availability of update support for X years and information on impact/reversibility of updates	High
2.7	Memory extension: slot for memory card	Yes / no, highly relevant for devices up to 32GB only	Medium
2.8	Dual-SIM	Yes / no	Low

3.3.2.1. Operating System support

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.

As 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. A mandatory specific requirement for 2 years OS update support (alternatively: OS upgrade) sets a minimum, which is feasible to meet, but is not yet implemented by all OEMs. Extended OS support periods can be incentivized through a generic requirement, i.e. as part of the reliability scoring (see 3.3.2).

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

3.3.2.2. Battery lifetime (in cycles)

A minimum battery lifetime as a specific requirement eliminates low-quality batteries from the market, thus can potentially reduce battery performance triggered obsolescence. Such a baseline is 300 cycles @ 80% remaining charge capacity.

Better battery lifetimes are incentivized through a staged scoring up to 1000 charging cycles @ 80% remaining charge capacity under test conditions (which deviate from real-use conditions).

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

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.

3.3.2.3. Provision of protective case

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.

3.3.2.4. Water and dust ingress protection

Water and dust ingress protection is considered to be part of the reliability scoring. A distinction of protection levels as listed Table 4 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 IPx3 (subject to further analysis) can be considered a specific requirement. The step from IPx7 to IPx8 matters only in very few cases and no distinction is proposed between these two classes here.

Table 4: IP codes scoring – relevant protection levels

Dust ingress protection	
Level	Object size
IP_x	
up to 4	>1 mm
5	Dust protected
6	Dust tight

Water ingress protection	
Level	Description of the protection
IPx_	
up to 3	
4	Splashing of water
5	Water jets
6	Powerful water jets
7 and above	Immersion, up to 1 m depth

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[3]. 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**.

[3] 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

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. Memory extension is covered by the reliability scoring above.

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.

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.

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.

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 abroad.

ETSI TR 103 679 (see Task 1) addresses product group specific LCA approaches for products covered by this study and as such contains elements of a PEFCR for smartphones. 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%[4]
- 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%[5]
- 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
- 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

[4] Aligned with EPEAT 1680.1 criterion 4.1.10.2

[5] Aligned with EPEAT 1680.1 criterion 4.1.10.1

- 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

3.4. Option 4: Energy Labelling

The battery endurance benchmark (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[6], which is a much lower level than for any other product group regulated under the Energy Efficiency Labelling Directive (EU) 2017/1369.

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"[7] results in a class definition as listed in Table 5.

Table 5 : Battery endurance as basis for defining energy efficiency classes for smartphones

Energy efficiency class	Battery endurance benchmark [in hours]	Market coverage smartphones as of June 2020
A	155h and above	0,1%
B	131h – < 155h	1,1%
C	107h – < 131h	6,5%
D	83h - < 107h	28,8%
E	59h - < 83h	37,4%
F	35h - < 59h	22,5%
G	< 35h	3,5%

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 a score in policy option 3 is instead more prominently translated into an additional Energy

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

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

Label. As such, the battery endurance gets much better visibility for the consumer compared to the other scores on reparability, reliability and PEF.

Table 6 : Potential ecodesign requirements and energy label scope derived from product group analysis

Aspect	Eco-design		Energy Label
	Specific requirement	Generic requirement	
Reparability	user replaceable battery[8]	Multi-criteria reparability scoring	-
	spare parts availability		
Reliability	2 years OS support	Multi-criteria reliability scoring	-
	IPx3		
	Battery minimum lifetime[9]		
Battery endurance (per cycle)	-	scoring or lifetime information	*Energy Label*
Confidence in data erasure and ease of data transfer	data encryption by default	user information	-
Unbundling	-	user information (and covered by PEF score below)	-
environmental footprint of the product	-	scoring system based on PEF (incl. recycled content)	-
Cordless phones only:			
Standby power	0,4 W	-	-
Power management	EcoDECT	-	-

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

3.6. Aspects not covered by any of the policy options

Several aspects are not covered by any of the above mentioned policy options as priority of these is lower based on the analysis in prior tasks and limitations of the MEErP, or as they are already partly addressed by other requirements. These aspects are:

- Information on Material Content: For environmentally relevant and critical raw materials 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

[8] with exemptions, if a similar effect is achieved by other means, such as battery demonstrated to last (indicatively) 1000 cycles @ 80% or unless OEM provides convenient (on-site / same-day / moderate price) battery replacement service

[9] indicatively : 300 cycles @ 80% remaining charge capacity

- Cobalt, Gallium, Rare earth elements: Reduction might have an adverse effect on performance, functionality
- Information on or minimum content of recycled material: No separate calculation of recycled content according to EN 45557:2020 is proposed due to the rather marginal share of recycled material, but use of recycled content is incentivized through the option to calculate with reduced environmental impacts of secondary material for the PEF score.

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.

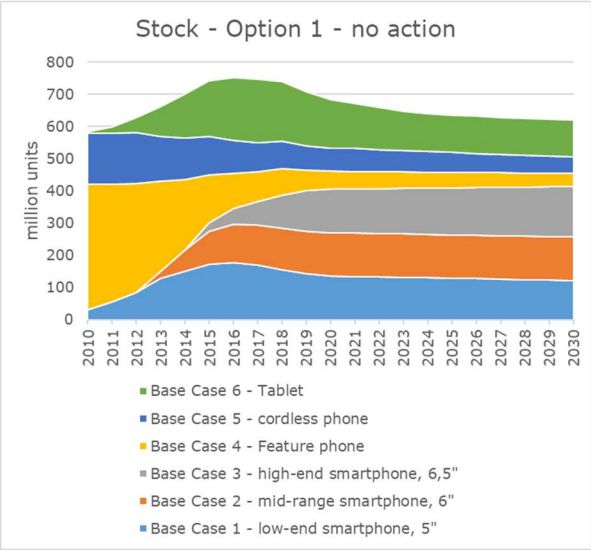

Figure 2 : Option 1 – « no action » - Stock development, EU27, 2010-2030

Sales figures in million units per product type from 2010 to 2030 are documented in Table 7.

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

Table 7 : Option 1 – « no action » - Sales, 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**
	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**
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 8).

Table 8 : 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.

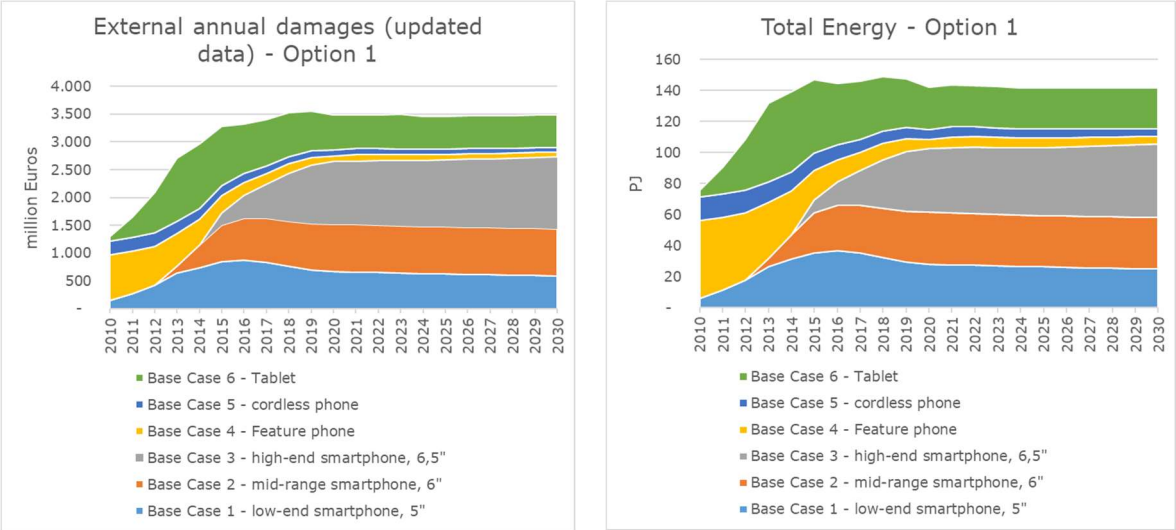

Figure 3 : Option 1 – « no action » - External annual damages (updated societal cost factors) and Total Energy, EU27, 2010-2030

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.

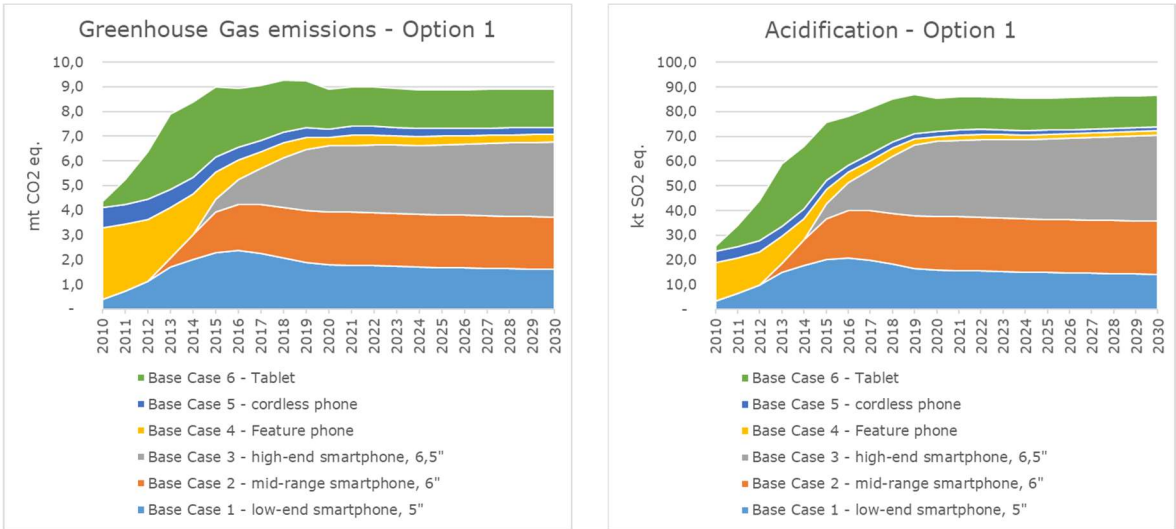

Figure 4 : Option 1 – « no action » - Greenhouse Gas emissions and Acidification, EU27, 2010-2030

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.

Table 9 : 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**
	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	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*	- **6**
2025	25	31	41	6	6	26	**135**	*141*	- **6**
2026	25	31	42	6	6	26	**135**	*141*	- **6**
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**

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 10: In 2027 total expenditure is 2,5 billion Euros lower than in a "no action" scenario and this level of savings remains stable for the years thereafter.

Table 10 : 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	11.326	23.280	40.281	1.610	848	8.506	**85.851**	*86.474*	**- 623**
2022	11.121	23.070	40.572	1.561	818	8.392	**85.534**	*86.775*	**- 1.242**
2023	10.892	22.820	40.757	1.516	790	8.286	**85.061**	*86.813*	**- 1.751**
2024	10.641	22.521	40.835	1.474	762	8.181	**84.412**	*86.862*	**- 2.449**
2025	10.530	22.521	41.447	1.429	736	8.175	**84.838**	*87.303*	**- 2.464**
2026	10.419	22.521	42.069	1.386	710	8.172	**85.277**	*87.757*	**- 2.480**
2027	10.308	22.521	42.700	1.345	685	8.170	**85.729**	*88.224*	**- 2.496**
2028	10.197	22.521	43.341	1.305	661	8.169	**86.193**	*88.704*	**- 2.512**
2029	10.086	22.521	43.991	1.265	638	8.169	**86.670**	*89.198*	**- 2.528**
2030	9.976	22.521	44.651	1.227	615	8.169	**87.158**	*89.703*	**- 2.545**

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 CO2 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 11 : Option 3 – 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	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	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*	**- 6**
2025	25	31	41	6	6	26	**135**	*141*	**- 6**
2026	25	31	42	6	6	26	**135**	*141*	**- 6**
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.

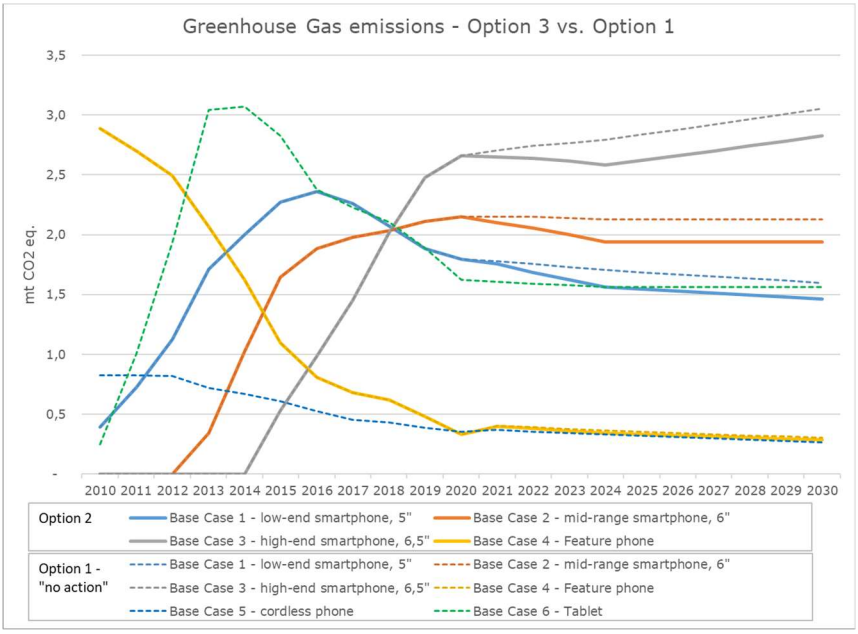

Figure 5 : Option 2 compared to Option 1 – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

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., the scoring and 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 the generic scoring and information measures. The reliability focussed path is more a conservative scenario for the combination of specific and generic requirements, whereas the ambitious reparability path is rather a best-case scenario for implementing the same requirements.

Given that consumers are willing to purchase more sustainable devices (see Task 3), and under the condition that the scoring systems 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 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.

Table 12 : 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" 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**	Totals - Option 1 Sales mln. units	**Improvement 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 13 : 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" 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**	Totals - Option 1 Sales mln. units	**Improvement 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 17: 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 14 : 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"	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	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 23, Table 26 and Table 28.

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 15 : 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.

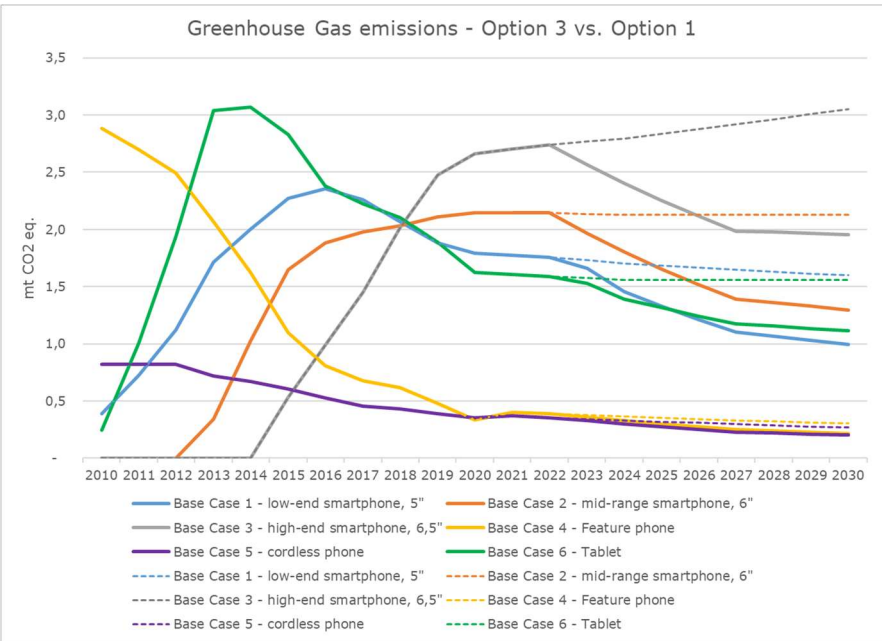

Figure 6 : Option 3 compared to Option 1 – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

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.

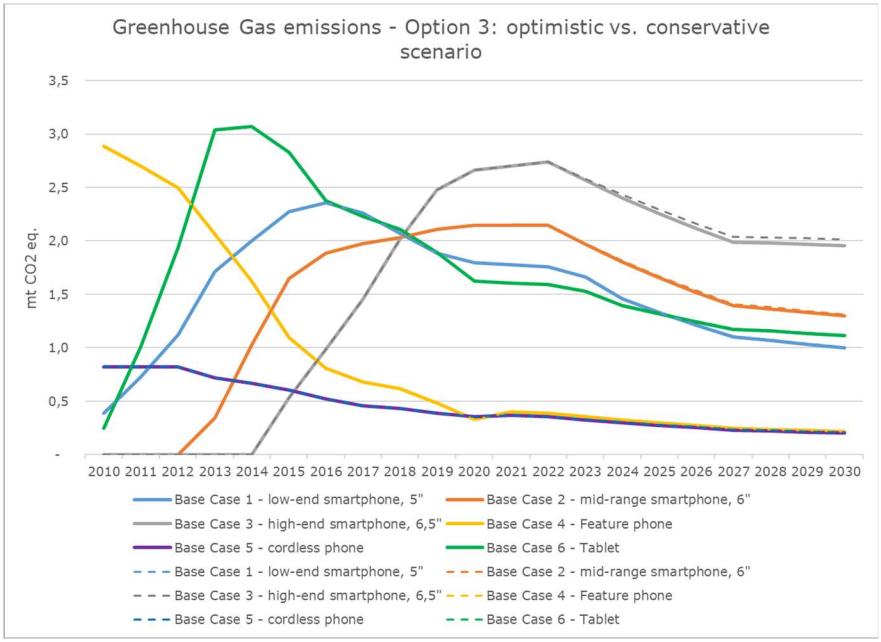

Figure 7 : Option 3 optimistic vs. conservative scenario – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

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 5,8 million units lower than in a business-as-usual scenario is expected, due to lower sales figures across the smartphones and tablet market segment. Total sales of products covered by this product study is expected to be 178 million units in 2030 in EU27.

Table 16 : 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*	**- 0,3**
2025	50	44	41	16	12	23	**187**	*188*	**- 1,0**
2026	50	44	41	15	12	23	**185**	*187*	**- 2,0**
2027	49	43	41	15	12	23	**183**	*186*	**- 3,2**
2028	48	43	41	15	11	23	**181**	*185*	**- 4,5**
2029	47	43	41	14	11	23	**179**	*184*	**- 5,8**
2030	47	43	42	14	10	22	**178**	*184*	**- 5,8**

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 17: In 2027 total expenditure is 2,1 billion Euros lower, in 2030 3,8 billion Euros lower than in a "no action" scenario.

Table 17 : 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	1.477	762	8.170	**86.652**	*86.862*	- **209**
2025	10.817	23.191	42.353	1.432	736	8.145	**86.673**	*87.303*	- **629**
2026	10.647	23.031	42.610	1.389	710	8.111	**86.498**	*87.757*	- **1.259**
2027	10.460	22.820	42.748	1.348	685	8.069	**86.130**	*88.224*	- **2.095**
2028	10.276	22.613	42.892	1.307	661	8.028	**85.777**	*88.704*	- **2.927**
2029	10.094	22.410	43.042	1.268	638	7.989	**85.440**	*89.198*	- **3.758**
2030	9.983	22.410	43.687	1.230	615	7.969	**85.895**	*89.703*	- **3.809**

Besides the cost benefits for the consumers in EU27 an Energy Label reduces the external societal costs of this product group by just above 200 million Euros in 2030 (Table 18). This corresponds to 6% of the aggregated external societal costs in 2030.

Total Energy savings to be achieved by an Energy Label are 6 PJ in 2027 and 11 PJ in 2030. This is a savings potential of 7,6%, 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 23 and Table 28.

Table 18 : 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	**3.452**	*3.464*	**- 11**
2025	618	839	1189	100	97	587	**3.429**	*3.463*	**- 34**
2026	606	830	1191	97	93	579	**3.396**	*3.465*	**- 69**
2027	593	818	1189	94	90	570	**3.355**	*3.468*	**- 114**
2028	579	807	1187	91	87	563	**3.315**	*3.473*	**- 159**
2029	567	795	1185	89	84	557	**3.277**	*3.480*	**- 203**
2030	560	795	1203	86	81	554	**3.280**	*3.487*	**- 207**

Table 19 : 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	27	33	43	6	6	26	**141**	*141*	**- 1**
2025	27	33	43	6	6	26	**140**	*141*	**- 2**
2026	27	32	43	6	6	25	**138**	*141*	**- 3**
2027	27	31	42	6	5	25	**136**	*141*	**- 6**
2028	27	30	41	6	5	24	**133**	*141*	**- 8**
2029	27	30	41	5	5	23	**131**	*142*	**- 10**
2030	26	30	41	5	5	23	**131**	*142*	**- 11**

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

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

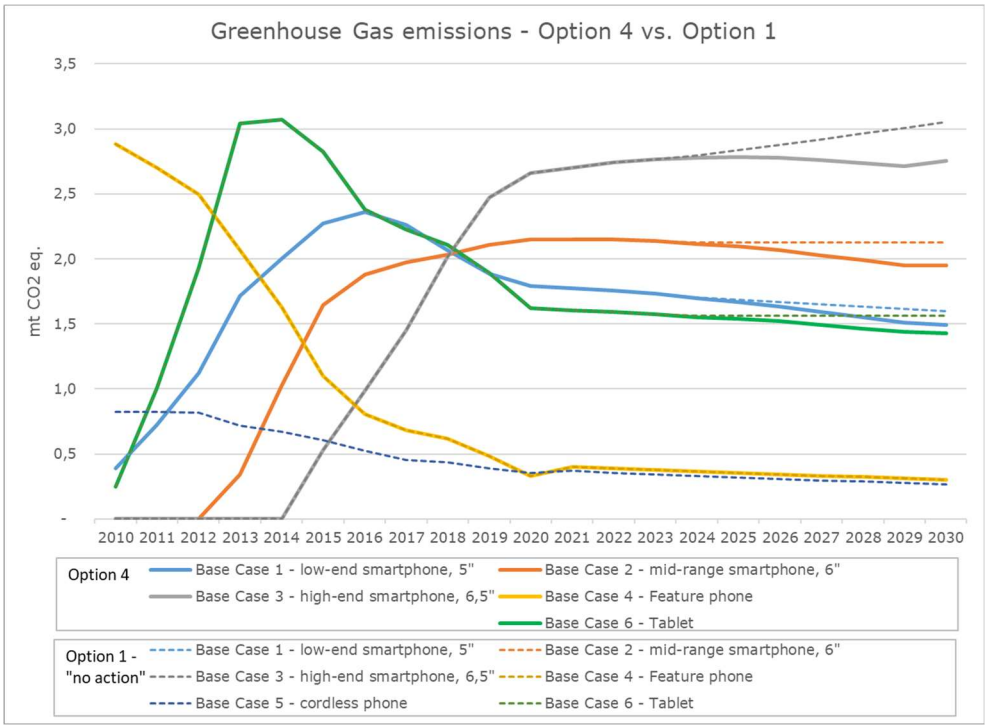

Figure 8 : Option 4 compared to Option 1 – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

4.5. Option 5: Ecodesign requirements combined with Energy Labelling

The effect of introducing an Energy Label combined with 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 the market reaches the point of Least Life Cycle costs already one year earlier, i.e. in 2026.

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 33,3 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 150 million units in 2030 in EU27.

Table 20 : 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	48	41	37	16	13	23	**178**	*190*	- **12,6**
2024	45	39	36	15	13	21	**169**	*188*	- **19,4**
2025	43	37	35	14	12	21	**162**	*188*	- **25,4**
2026	41	36	34	14	12	20	**156**	*187*	- **30,8**
2027	40	35	34	13	11	20	**154**	*186*	- **31,6**
2028	40	36	35	13	11	20	**154**	*185*	- **31,1**
2029	39	35	35	12	10	20	**151**	*184*	- **33,3**
2030	38	35	35	12	10	20	**150**	*184*	- **33,3**

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 17: In 2027 total expenditure is 13,8 billion Euros lower, in 2030 15,1 billion Euros lower than in a "no action" scenario.

Table 21 : 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"	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	10.366	21.681	38.561	1.519	784	8.457	**81.367**	*86.813*	- **5.445**
2024	9.903	20.897	37.700	1.475	750	7.854	**78.578**	*86.862*	- **8.283**
2025	9.476	20.180	36.927	1.432	718	7.748	**76.480**	*87.303*	- **10.822**
2026	9.081	19.522	36.230	1.390	688	7.648	**74.559**	*87.757*	- **13.198**
2027	8.931	19.379	36.541	1.346	658	7.611	**74.466**	*88.224*	- **13.759**
2028	8.772	19.211	36.812	1.302	635	7.569	**74.302**	*88.704*	- **14.403**
2029	8.619	19.052	37.098	1.260	613	7.531	**74.171**	*89.198*	- **15.027**
2030	8.524	19.052	37.654	1.222	591	7.531	**74.573**	*89.703*	- **15.130**

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

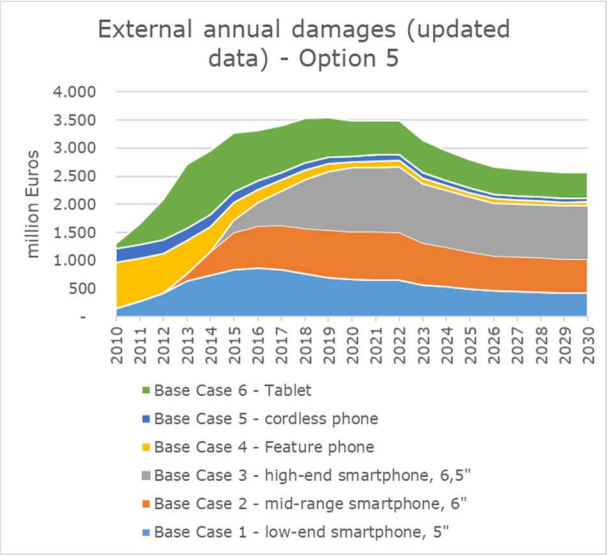

Figure 9 : Option 5 – Ecodesign requirements and Energy Label – External annual damages (updated societal cost factors), EU27, 2010-2030

Total Energy savings to be achieved by specific and generic eco-design requirements in combination with an Energy Label are 38 PJ in 2027 and 41 PJ in 2030 (Table 22). This is a savings potential of 29%, 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 3,1 million tons CO2 eq. in 2030, which corresponds to a reduction by 35% compared to the "no action" option.

Table 22 : 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	25	29	38	6	6	25	**129**	*142*	**- 13**
2024	22	27	36	6	5	23	**119**	*141*	**- 23**
2025	20	25	34	5	5	22	**112**	*141*	**- 30**
2026	19	24	33	5	5	21	**105**	*141*	**- 36**
2027	18	23	33	5	4	21	**104**	*141*	**- 38**
2028	18	23	33	4	4	21	**102**	*141*	**- 39**
2029	17	22	33	4	4	20	**101**	*142*	**- 41**
2030	17	22	33	4	4	20	**101**	*142*	**- 41**

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.

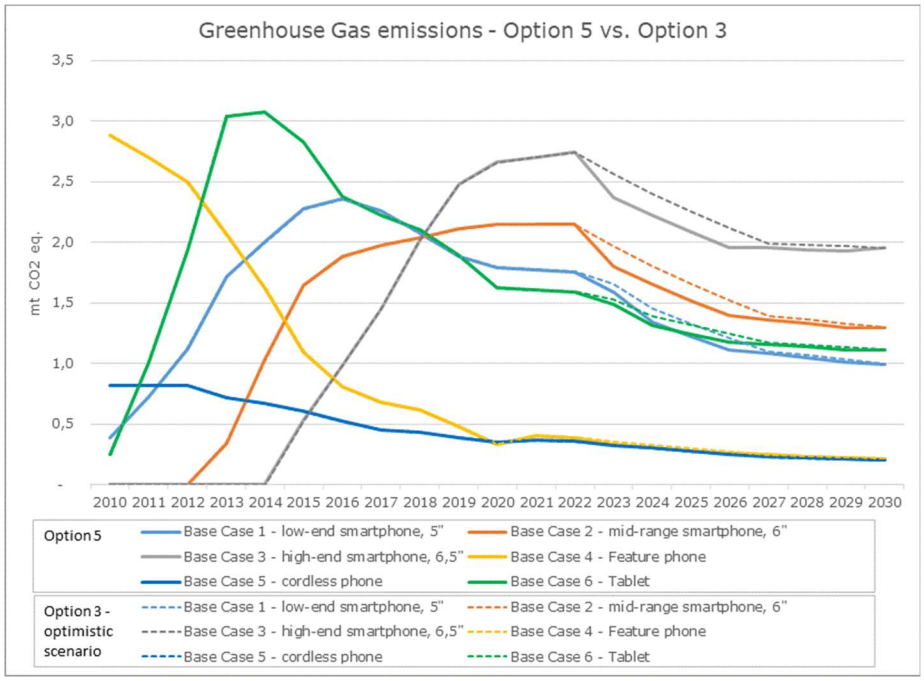

Figure 10 : Option 5 compared to Option 3 (optimistic scenario) – per product segment - Greenhouse Gas emissions, EU27, 2010-2030

4.6. Comparison of options

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

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

4.6.1. Smartphones, 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. Consequently, also the combination of Ecodesign requirements and Energy Label reduces the number of sold units by 30 million phones per year on the EU27 market in 2030, which is 20% less devices put on the market (Figure 11).

Smartphones, Feature phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - 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	142	142	142	142	142
2011	144	144	144	144	144
2012	146	146	146	146	146
2013	152	152	152	152	152
2014	155	155	155	155	155
2015	160	160	160	160	160
2016	161	161	161	161	161
2017	161	161	161	161	161
2018	162	162	162	162	162
2019	158	158	158	158	158
2020	153	153	153	153	153
2021	156	154	156	156	156
2022	155	152	155	155	155
2023	154	150	148	154	141
2024	153	147	141	152	135
2025	152	146	135	151	129
2026	152	146	129	150	124
2027	151	146	124	148	123
2028	151	145	123	147	123
2029	151	145	123	145	121
2030	150	145	120	145	120

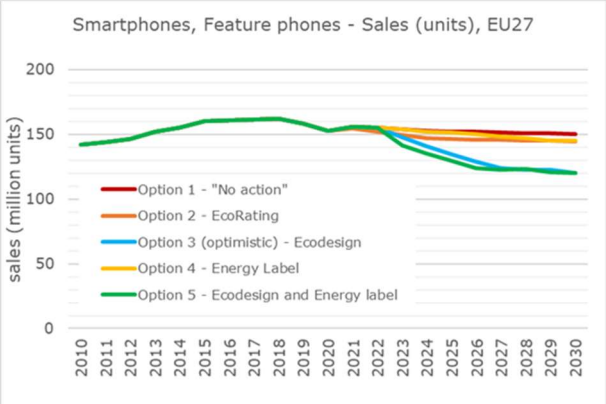

Figure 11 : Smartphones, Feature phones – Sales per policy scenario, EU27, 2010-2030

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, Feature phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	total annual consumer expenditure mln. €	total annual consumer expenditure mln. €	total annual consumer expenditure mln. €	total annual consumer expenditure mln. €	total annual consumer expenditure mln. €
2010	14.042	14.042	14.042	14.042	14.042
2011	15.451	15.451	15.451	15.451	15.451
2012	17.176	17.176	17.176	17.176	17.176
2013	23.013	23.013	23.013	23.013	23.013
2014	30.577	30.577	30.577	30.577	30.577
2015	45.005	45.005	45.005	45.005	45.005
2016	53.801	53.801	53.801	53.801	53.801
2017	60.677	60.677	60.677	60.677	60.677
2018	68.342	68.342	68.342	68.342	68.342
2019	74.299	74.299	74.299	74.299	74.299
2020	76.385	76.385	76.385	76.385	76.385
2021	77.120	76.497	77.120	77.120	77.120
2022	77.565	76.323	77.565	77.565	77.565
2023	77.737	75.986	74.932	77.737	72.127
2024	77.919	75.470	72.553	77.720	69.975
2025	78.392	75.927	70.393	77.793	68.015
2026	78.875	76.395	68.426	77.677	66.224
2027	79.369	76.874	66.629	77.376	66.196
2028	79.875	77.363	66.608	77.088	66.098
2029	80.391	77.863	66.516	76.813	66.028
2030	80.919	78.374	66.452	77.310	66.452

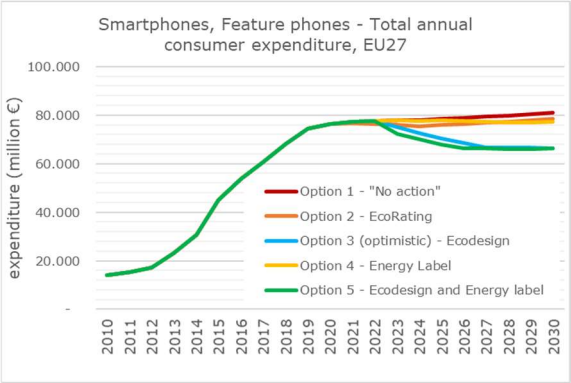

Figure 12 : Smartphones, Feature phones – Total annual consumer expenditure per policy scenario, EU27, 2010-2030

For the specific aspect of repair costs, which show a fundamentally different trend, see chapter 5, Figure 31, p. 66.

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 800 million Euros in 2030 (Figure 13).

Smartphones, Feature phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	external annual damages (updated data) mln. €	external annual damages (updated data) mln. €	external annual damages (updated data) mln. €	external annual damages (updated data) mln. €	external annual damages (updated data) mln. €
2010	961	961	961	961	961
2011	1.032	1.032	1.032	1.032	1.032
2012	1.120	1.120	1.120	1.120	1.120
2013	1.353	1.353	1.353	1.353	1.353
2014	1.607	1.607	1.607	1.607	1.607
2015	2.030	2.030	2.030	2.030	2.030
2016	2.266	2.266	2.266	2.266	2.266
2017	2.429	2.429	2.429	2.429	2.429
2018	2.604	2.604	2.604	2.604	2.604
2019	2.721	2.721	2.721	2.721	2.721
2020	2.746	2.746	2.746	2.746	2.746
2021	2.770	2.729	2.770	2.770	2.770
2022	2.777	2.695	2.777	2.777	2.777
2023	2.772	2.655	2.617	2.772	2.465
2024	2.767	2.604	2.472	2.757	2.332
2025	2.775	2.612	2.339	2.745	2.211
2026	2.783	2.620	2.218	2.724	2.099
2027	2.792	2.629	2.106	2.694	2.080
2028	2.801	2.638	2.087	2.665	2.057
2029	2.811	2.647	2.064	2.636	2.036
2030	2.821	2.656	2.043	2.645	2.043

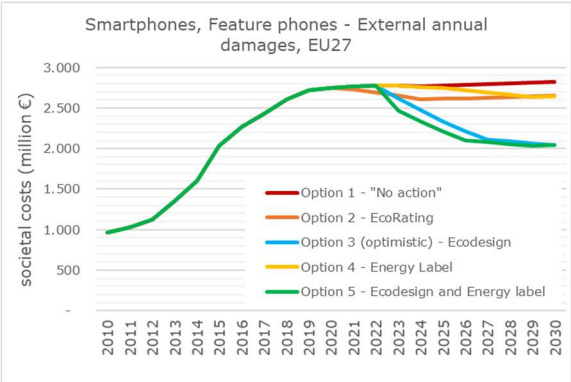

Figure 13 : Smartphones, Feature phones – External annual damages (updated data) per policy scenario, EU27, 2010-2030

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 and feature phones is reduced significantly on the EU27 market only with options involving Ecodesign requirements (Figure 31).

Smartphones, Feature phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	Total Energy PJ	Total Energy PJ	Total Energy PJ	Total Energy PJ	Total Energy PJ
2010	56	56	56	56	56
2011	58	58	58	58	58
2012	61	61	61	61	61
2013	68	68	68	68	68
2014	75	75	75	75	75
2015	88	88	88	88	88
2016	95	95	95	95	95
2017	100	100	100	100	100
2018	106	106	106	106	106
2019	109	109	109	109	109
2020	108	108	108	108	108
2021	110	108	110	110	110
2022	110	107	110	110	110
2023	110	105	104	110	98
2024	109	103	96	109	90
2025	109	103	90	108	85
2026	110	103	85	107	80
2027	110	103	80	106	79
2028	110	104	79	104	78
2029	110	104	78	103	77
2030	111	104	77	103	77

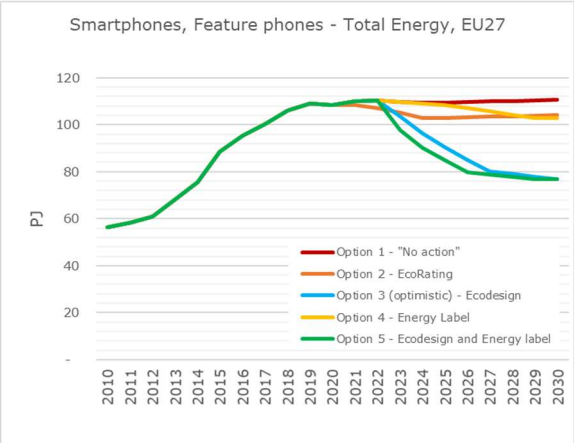

Figure 14 : Smartphones, Feature phones – Total Energy per policy scenario, EU27, 2010-2030

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

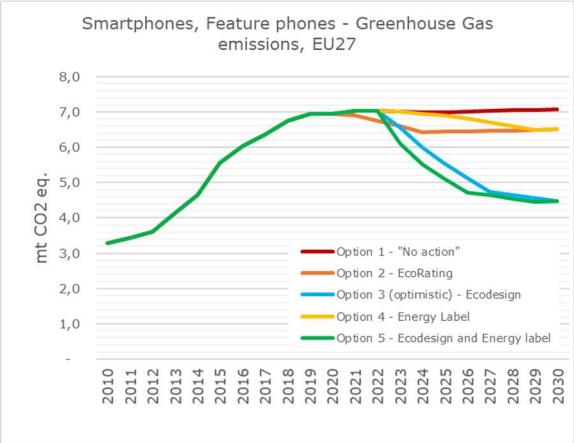

Figure 15 : Smartphones, Feature phones – Greenhouse Gas emissions per policy scenario, EU27, 2010-2030

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 2,6 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 17 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, Feature phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	Acidification kt SO2 eq.	Acidification kt SO2 eq.	Acidification kt SO2 eq.	Acidification kt SO2 eq.	Acidification kt SO2 eq.
2010	18,8	18,8	18,8	18,8	18,8
2011	20,8	20,8	20,8	20,8	20,8
2012	23,2	23,2	23,2	23,2	23,2
2013	29,6	29,6	29,6	29,6	29,6
2014	36,7	36,7	36,7	36,7	36,7
2015	48,7	48,7	48,7	48,7	48,7
2016	55,5	55,5	55,5	55,5	55,5
2017	60,3	60,3	60,3	60,3	60,3
2018	65,3	65,3	65,3	65,3	65,3
2019	69,0	69,0	69,0	69,0	69,0
2020	69,9	69,9	69,9	69,9	69,9
2021	70,6	69,8	70,6	70,6	70,6
2022	70,8	69,1	70,8	70,8	70,8
2023	70,7	68,3	67,4	70,7	64,1
2024	70,5	67,2	64,0	70,3	60,8
2025	70,8	67,5	61,1	70,1	58,2
2026	71,0	67,8	58,4	69,6	55,7
2027	71,3	68,0	55,9	68,9	55,4
2028	71,6	68,3	55,7	68,3	55,1
2029	71,9	68,6	55,4	67,7	54,8
2030	72,2	68,9	55,1	67,9	55,1

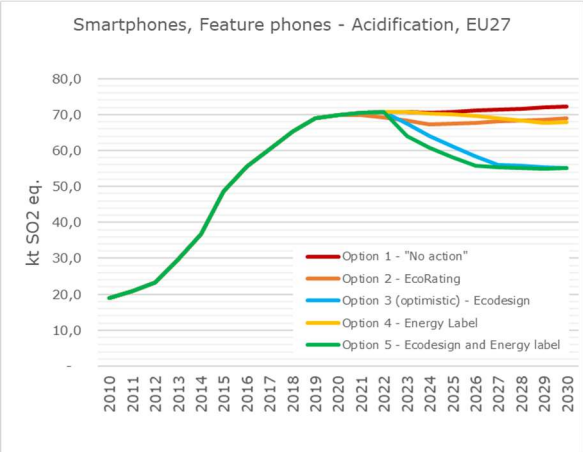

Figure 16 : Smartphones, Feature phones – Acidification per policy scenario, EU27, 2010-2030

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 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 23 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 2,75 PJ in the production phase. Option 3 (Ecodesign requirements) results in 6,3 PJ use phase related Total Energy savings, but more than 13 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 23 : Smartphones, Feature phones – Total Energy and Greenhouse Gas emissions per policy scenario, per life cycle phase, EU27, all units sold in 2030

2030: smartphones, feature phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Total Energy (PJ)					
Production	61,16	58,41	48,10	59,53	48,10
Distribution	21,67	18,79	9,29	21,02	9,29
Use	46,77	45,25	40,45	38,80	40,45
Totals	**129,61**	**122,45**	**97,84**	**119,35**	**97,84**
Greenhouse Gas emissions (mt CO2 eq.)					
Production	4,54	4,22	3,09	4,42	3,09
Distribution	1,68	1,45	0,72	1,63	0,72
Use	2,02	1,95	1,74	1,67	1,74
Totals	**8,23**	**7,62**	**5,54**	**7,72**	**5,54**

In the "no action" scenario the overall amount of material, of which smartphones, feature phones, accessories and packaging are made in 2030 is calculated to be roughly 105.000 t[10], thereof 21.900 t electronics and 19.000 t metals other than those in the electronics parts (Table 24). Total material consumption is reduced with option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) down to just below 70.000 t, which is a 35% reduction. These figures include already spare parts, which will be used for repairs of these units over their lifetime.

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

2030: smartphones, feature phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Material categories					
Bulk Plastics (t)	3.318,10	3.089,70	2.273,49	3.219,53	2.273,49
TecPlastics (t)	9.907,76	9.000,97	5.896,90	9.613,43	5.896,90
Ferro metals (t)	2.777,90	2.640,26	2.117,57	2.695,37	2.117,57
Non-ferro metals (t)	16.214,94	15.391,34	12.317,97	15.733,24	12.317,97
Electronics (t)	21.863,64	20.607,16	15.974,98	21.214,14	15.974,98
Miscellaneous, mainly paper, cardboard (t)	51.232,47	46.518,19	30.354,15	49.710,51	30.354,15
Totals materials (t)	**105.314,79**	**97.247,63**	**68.935,06**	**102.186,22**	**68.935,06**
thereof, Critical Raw Materials (t)					
Tantalum (Ta)	7,21	6,92	5,76	6,99	5,76
Indium (In)	1,92	1,85	1,54	1,87	1,54
Platinum Group metals (PGM)	2,40	2,31	1,92	2,33	1,92
Gallium (Ga)	0,30	0,29	0,24	0,29	0,24
Rare earth elements (Sc, Y, Nd)	19,22	18,45	15,37	18,65	15,37
Cobalt (Co)	1.009,27	968,65	806,88	979,29	806,88
Magnesium (Mg)	798,77	766,62	638,59	775,04	638,59

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

The consumption of Critical Raw Materials, provided that the composition of smartphones and feature phones does not change fundamentally, is reduced along with the declining sales of phones (Table 24): The amount of Tantalum is reduced from 7,2 t in the "no action" scenario to 5,8 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 200 t with Ecodesign requirements.

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

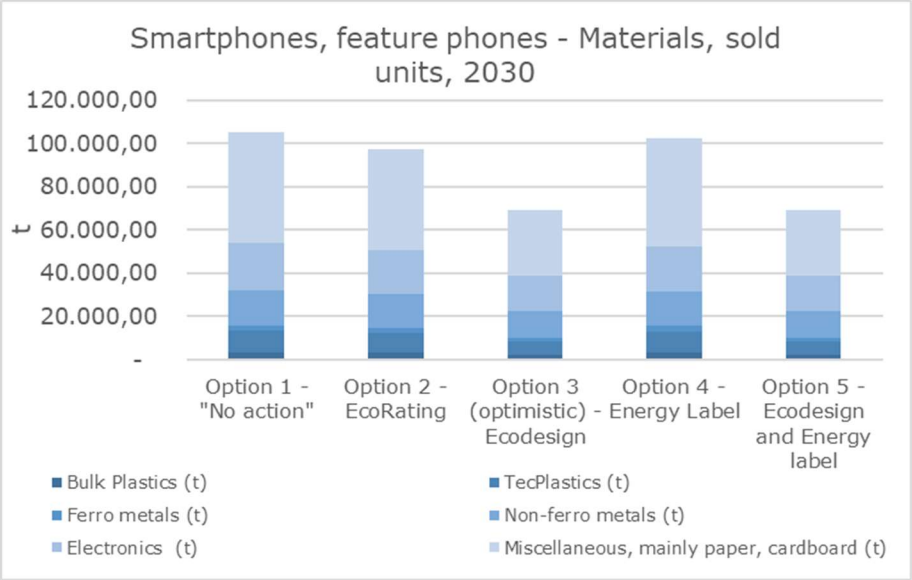

Figure 17 : Smartphones, Feature phones – Material consumption per policy option, EU27, all units sold in 2030

4.6.2. 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 11): 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"	Option 2 - EcoRating	Option 3 (optimistic) - 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	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		13,3		
2024	12,9		12,7		
2025	12,4		12,2		
2026	12,0		11,7		
2027	11,6		11,2		
2028	11,2		10,8		
2029	10,8		10,5		
2030	10,4		10,0		

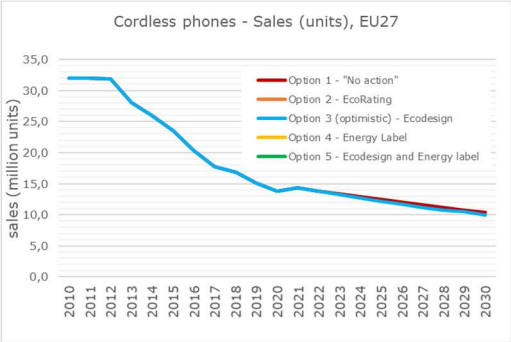

Figure 18 : Cordless phones – Sales per policy scenario, EU27, 2010-2030

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"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	total annual consumer expenditure mln. €	total annual consumer expenditure mln. €	total annual consumer expenditure mln. €	total annual consumer expenditure mln. €	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		784		
2024	762		750		
2025	736		718		
2026	710		688		
2027	685		658		
2028	661		635		
2029	638		613		
2030	615		591		

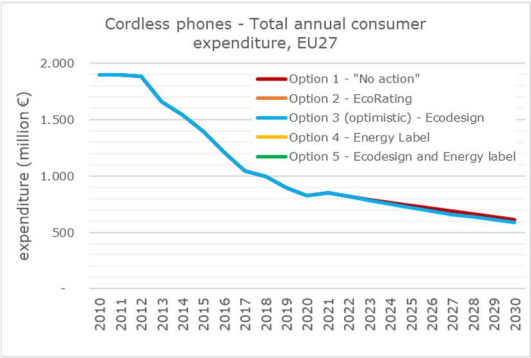

Figure 19 : Cordless phones – Total annual consumer expenditure per policy scenario, EU27, 2010-2030

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 17 million Euros, compared to 84 million Euros in a "no action" scenario (Figure 20).

Cordless phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	external annual damages (updated data) mln. €	external annual damages (updated data) mln. €	external annual damages (updated data) mln. €	external annual damages (updated data) mln. €	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		92		
2025	97		85		
2026	93		79		
2027	90		73		
2028	87		70		
2029	84		67		
2030	81		64		

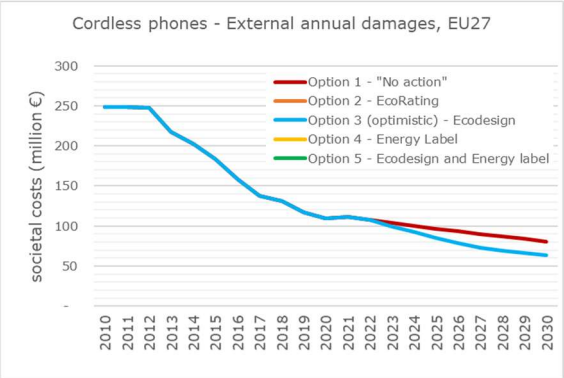

Figure 20 : Cordless phones – External annual damages (updated data) per policy scenario, EU27, 2010-2030

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 21).

Cordless phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	Total Energy PJ	Total Energy PJ	Total Energy PJ	Total Energy PJ	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		5,4		
2025	5,8		5,0		
2026	5,6		4,5		
2027	5,4		4,1		
2028	5,2		3,9		
2029	5,1		3,8		
2030	4,9		3,6		

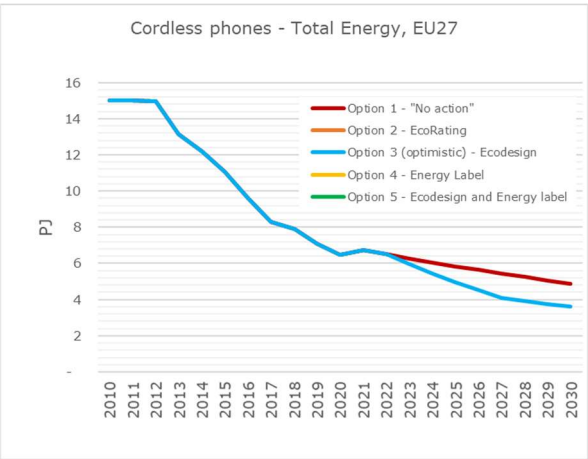

Figure 21 : Cordless phones – Total Energy per policy scenario, EU27, 2010-2030

Greenhouse Gas emission reductions mirror the scenario analysis for Total Energy (Figure 22): Savings potential for the cordless phones market in EU27 is 70.000 tons CO2 eq. from 2027 onwards, compared to the "no action" scenario.

Cordless phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	Greenhouse Gas emissions mt CO2 eq.	Greenhouse Gas emissions mt CO2 eq.	Greenhouse Gas emissions mt CO2 eq.	Greenhouse Gas emissions mt CO2 eq.	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		0,25		
2027	0,30		0,23		
2028	0,29		0,22		
2029	0,28		0,21		
2030	0,27		0,20		

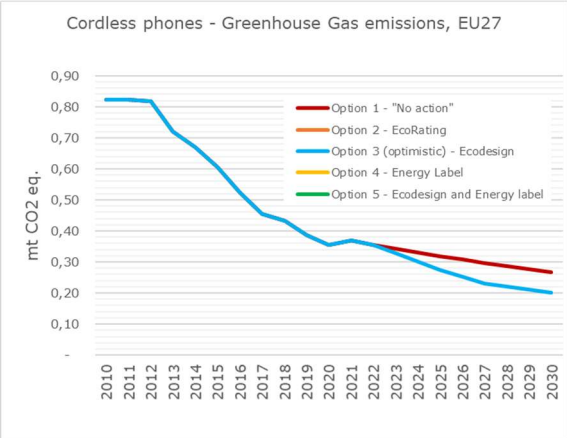

Figure 22 : Cordless phones – Greenhouse Gas emissions per policy scenario, EU27, 2010-2030

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 23).

Smartphones, Feature phones	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	Acidification kt SO2 eq.	Acidification kt SO2 eq.	Acidification kt SO2 eq.	Acidification kt SO2 eq.	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		1,3		
2029	1,6		1,3		
2030	1,5		1,2		

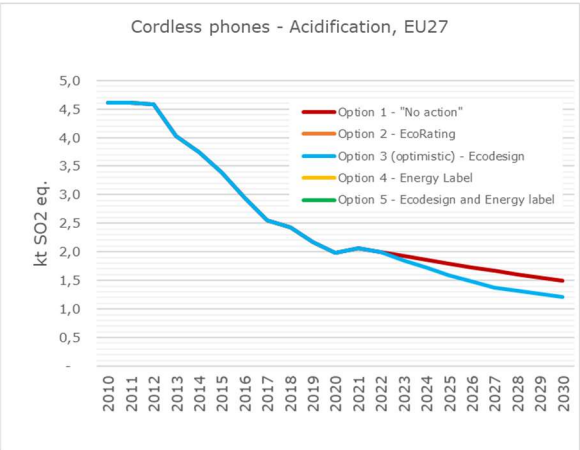

Figure 23 : Cordless phones – Acidification per policy scenario, EU27, 2010-2030

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 0,6 PJ use phase related Total Energy savings, and 1,3 PJ production related Total Energy savings (Table 25).

Table 25 : 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 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Total Energy (PJ)					
Production	4,76		3,45		
Distribution	5,39		2,78		
Use	6,85		6,26		
Totals	**17,00**		**12,49**		
Greenhouse Gas emissions (mt CO2 eq.)					
Production	0,29		0,20		
Distribution	0,42		0,21		
Use	0,29		0,27		
Totals	**1,00**		**0,68**		

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 21.350 t, thereof 3.500 t electronics and 1.500 t metals other than those in the electronics parts (Table 26). Total material consumption is reduced with option 3 (Ecodesign requirements) down to just below 14.500 t.

Table 26 : 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 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Material categories					
Bulk Plastics (t)	8.120,73		5.378,79		
TecPlastics (t)	2.340,55		1.675,70		
Ferro metals (t)	383,76		286,52		
Non-ferro metals (t)	1.131,20		657,23		
Electronics (t)	3.534,13		2.501,33		
Miscellaneous, mainly paper, cardboard (t)	5.839,35		3.976,78		
Totals materials (t)	**21.349,71**		**14.476,35**		
thereof, Critical Raw Materials (t)					
Tantalum (Ta)	0,02		0,02		
Indium (In)	-		-		
Platinum Group metals (PGM)	0,96		0,77		
Gallium (Ga)	-		-		
Rare earth elements (Sc, Y, Nd)	10,09		8,07		
Cobalt (Co)	33,64		26,90		
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.

4.6.3. 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 2,8 – 3 million units on the EU27 market in the years 2027 to 2030, which is 13% less devices put on the market (Figure 24).

Tablets	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - 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	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		21,8	22,9	21,2
2025	23,0		21,2	22,9	20,7
2026	23,0		20,7	22,8	20,2
2027	23,0		20,2	22,7	20,2
2028	23,0		20,2	22,6	20,3
2029	23,0		20,3	22,5	20,0
2030	23,0		20,0	22,5	20,0

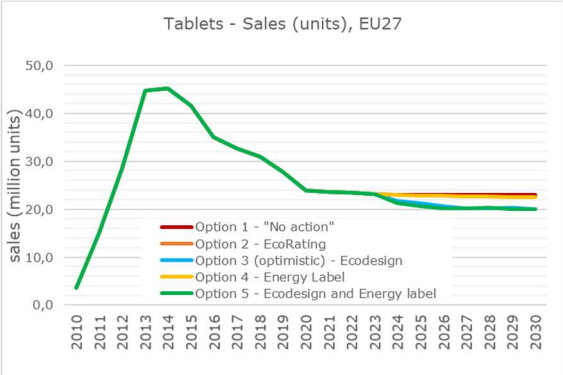

Figure 24 : Tablets – Sales per policy scenario, EU27, 2010-2030

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 600 million 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"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	total annual consumer expenditure mln. €	total annual consumer expenditure mln. €	total annual consumer expenditure mln. €	total annual consumer expenditure mln. €	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		8.373	8.286	8.457
2024	8.181		7.957	8.170	7.854
2025	8.175		7.847	8.145	7.748
2026	8.172		7.743	8.111	7.648
2027	8.170		7.645	8.069	7.611
2028	8.169		7.609	8.028	7.569
2029	8.169		7.569	7.989	7.531
2030	8.169		7.531	7.969	7.531

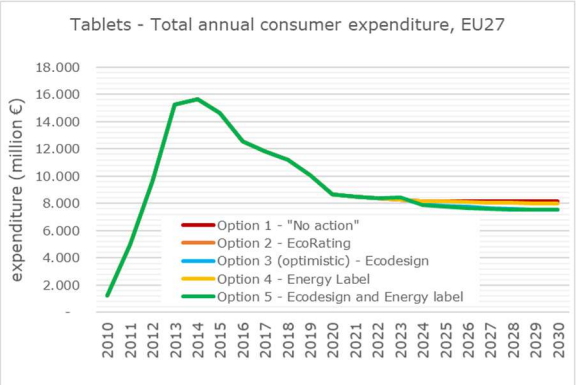

Figure 25 : Tablets – Total annual consumer expenditure per policy scenario, EU27, 2010-2030

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 32, p. 67.

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 120 million Euros in 2030 (Figure 26).

Tablets	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	external annual damages (updated data) mln. €	external annual damages (updated data) mln. €	external annual damages (updated data) mln. €	external annual damages (updated data) mln. €	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		597	621	573
2024	597		551	595	529
2025	591		525	587	505
2026	588		502	579	483
2027	586		481	570	477
2028	585		476	563	470
2029	585		470	557	465
2030	585		465	554	465

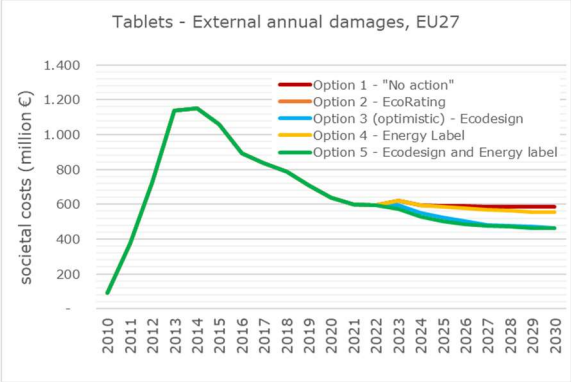

Figure 26 : Tablets – External annual damages (updated data) per policy scenario, EU27, 2010-2030

Energy consumption for the product segment of tablets is reduced significantly on the EU27 market with options involving Ecodesign requirements (Figure 27). The savings potential of these options 3 and 5 is 6 PJ by 2030. For option 4 (Energy Label) still half of this potential materialises.

Tablets	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	Total Energy PJ	Total Energy PJ	Total Energy PJ	Total Energy PJ	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		24	26	23
2025	26		23	26	22
2026	26		22	25	21
2027	26		21	25	21
2028	26		21	24	21
2029	26		21	23	20
2030	26		20	23	20

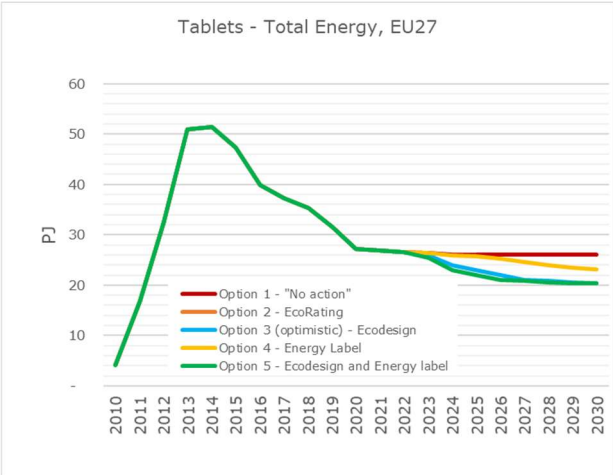

Figure 27 : Tablets – Total Energy per policy scenario, EU27, 2010-2030

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 0,5 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 (optimistic) - 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		1,4	1,6	1,3
2025	1,6		1,3	1,5	1,2
2026	1,6		1,2	1,5	1,2
2027	1,6		1,2	1,5	1,2
2028	1,6		1,2	1,5	1,1
2029	1,6		1,1	1,4	1,1
2030	1,6		1,1	1,4	1,1

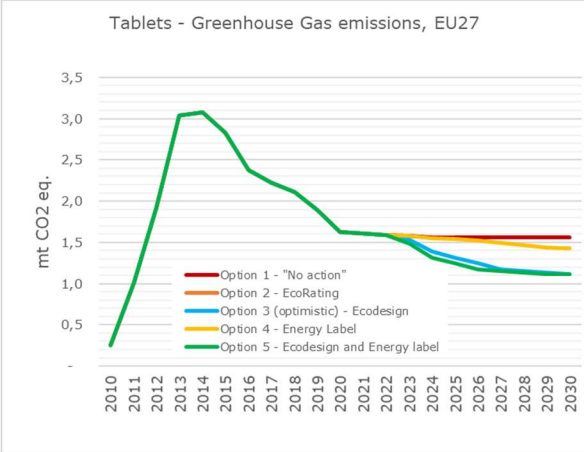

Figure 28 : Tablets – Greenhouse Gas emissions per policy scenario, EU27, 2010-2030

The same trends for the various policy scenarios are confirmed for other environmental indicators as well. As an example, Figure 29 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 2 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 (optimistic) - 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	13,0
2024	13,0		12,2	12,9	11,8
2025	13,0		11,8	12,9	11,4
2026	13,0		11,4	12,8	11,1
2027	13,0		11,1	12,6	11,0
2028	13,0		11,0	12,5	10,9
2029	13,0		10,9	12,3	10,9
2030	13,0		10,9	12,3	10,9

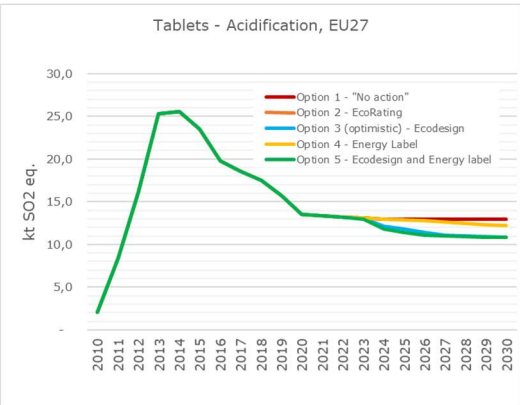

Figure 29 : Tablets – Acidification per policy scenario, EU27, 2010-2030

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 27 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 4 PJ use phase related Total Energy savings, and more than 5 PJ production related Total Energy savings.

Table 27 : 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 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Total Energy (PJ)					
Production	24,91		19,87	24,29	19,87
Distribution	5,65		2,46	5,48	2,46
Use	19,17		15,14	14,84	15,14
Totals	**49,72**		**37,47**	**44,61**	**37,47**
Greenhouse Gas emissions (mt CO2 eq.)					
Production	1,79		1,23	1,75	1,23
Distribution	0,44		0,19	0,42	0,19
Use	0,82		0,65	0,64	0,65
Totals	**3,05**		**2,07**	**2,81**	**2,07**

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 63.700 t[11], thereof 11.500 t electronics and 13.400 t metals other than those in the electronics parts (Table 33). Total material consumption is reduced with option 3 (Ecodesign requirements) and 5 (Ecodesign requirements and Energy Label) down to 44.300 t. These figures include already spare parts, which will be used for repairs of these units over their lifetime.

Table 28 : Tablets – Material consumption per policy option, EU27, all units sold in 2030

2030: Tablet	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
Material categories					
Bulk Plastics (t)	2.355,44		1.463,53	2.285,47	1.463,53
TecPlastics (t)	3.538,69		2.065,49	3.433,57	2.065,49
Ferro metals (t)	1.018,88		746,33	988,61	746,33
Non-ferro metals (t)	12.384,70		9.772,40	12.016,79	9.772,40
Electronics (t)	11.469,63		8.530,49	11.128,91	8.530,49
Miscellaneous, mainly paper, cardboard (t)	32.921,43		21.708,98	31.943,44	21.708,98
Totals materials (t)	**63.688,78**		**44.287,22**	**61.796,79**	**44.287,22**
thereof, Critical Raw Materials (t)					
Tantalum (Ta)	1,92		1,54	1,87	1,54
Indium (In)	0,96		0,77	0,93	0,77
Platinum Group metals (PGM)	0,48		0,38	0,47	0,38
Gallium (Ga)	0,10		0,08	0,09	0,08
Rare earth elements (Sc, Y, Nd)	36,05		28,82	34,97	28,82
Cobalt (Co)	720,91		576,34	699,49	576,34
Magnesium (Mg)	961,21		768,46	932,66	768,46

The same data for major material categories is depicted in Figure 30.

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

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 28): The amount of Tantalum is reduced from 1,9 t in the "no action" scenario to 1,5 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 almost 150 t with Ecodesign requirements.

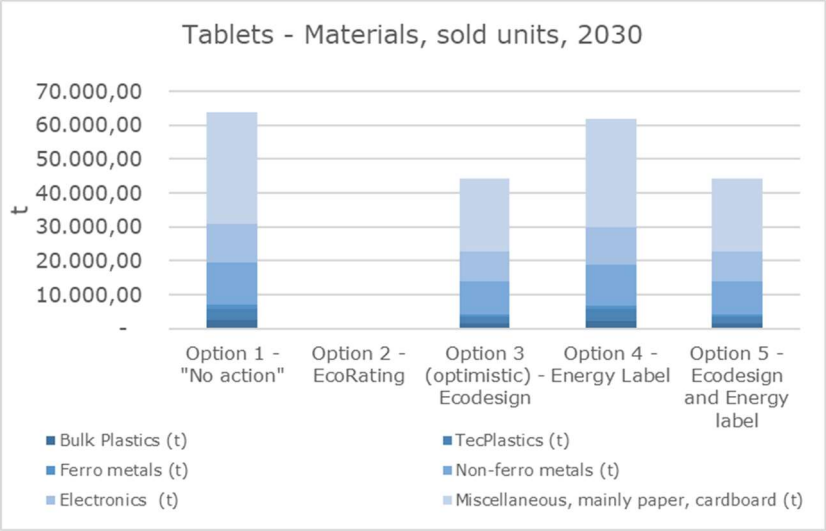

Figure 30 : Tablets – Material consumption per policy option, EU27, all units sold in 2030

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 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 Ecodesign requirements (Table 29). 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 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 65,06 Euros to 68,02 Euros with Ecodesign requirements in place.

Table 29 : 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
		optimistic	conservative	
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
per product				
purchase price	200,00 €	205,47 €	211,32 €	200,40 €
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 €**	**222,28 €**	**229,66 €**	**213,29 €**
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 €	60,14 €	62,59 €	77,49 €
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 €**	**65,06 €**	**68,02 €**	**82,48 €**
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 €

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 30). 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 128,59 Euros to 134,84 Euros with Ecodesign requirements in place which lead to the implementation of design features mirroring the point of Least Life Cycle Costs.

Table 30 : 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
		optimistic	conservative	
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
per product				
purchase price	500,00 €	503,53 €	508,35 €	500,00 €
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 €**	**539,80 €**	**553,14 €**	**520,92 €**
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 €	119,95 €	123,92 €	159,49 €
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 €**	**128,59 €**	**134,84 €**	**166,16 €**
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 €

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 Ecodesign requirements total consumer expenditures increase by 30 to 42 Euros, mainly due to increased spending on repairs (Table 31).
As the average device lifetime (use lifetime) increases from 3,5 years to 4,55 to 4,8 years if 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 221,74 Euros to 236,89 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 31 : 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
		optimistic	conservative	
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
per product				
purchase price	1.000,00 €	1.004,20 €	1.004,65 €	1.000,00 €
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 €**	**1.065,66 €**	**1.078,71 €**	**1.035,12 €**
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 €	208,95 €	220,63 €	269,91 €
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 €**	**221,74 €**	**236,89 €**	**279,38 €**
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 €

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 3,55 years the annual total consumer expenditures decrease from 29,52 Euros towards 29,22 Euros and 28,66 Euros respectively, depending on the chosen design path (Table 32). In total, Ecodesign requirements will not change consumer expenditures much, but societal damages will be reduced by roughly one third on an annual basis.

Table 32 : Average Product Life Cycle costs – Feature phone – Status quo, Ecodesign Requirements, Energy Label

feature phone	Status quo	Ecodesign requirements		Energy Label
		optimistic	conservative	
proxy	*Base Case*	*REP path (see Task 6)*	*DUR path (see Task 6)*	*DO49 (see Task 6)*
product use lifetime (years)	3,00	3,55	3,56	3,00
per product				
purchase price	80,00 €	82,70 €	85,12 €	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 €	101,70 €	103,88 €	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 €	23,31 €	23,94 €	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 €	28,66 €	29,22 €	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 €

The Energy Label scenario does not apply for cordless phones. 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 AAA 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 AAA 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 33).
External societal damages drop more significantly by roughly 25% taking year of use as the calculation basis.

Table 33 : Average Product Life Cycle costs – Cordless phone – Status quo, Ecodesign Requirements, Energy Label

cordless phone (incl. base station)	Status quo	Ecodesign requirements		Energy Label
		optimistic	conservative	
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 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 34). 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 61,90 Euros to 64,79 Euros with Ecodesign requirements in place.

Table 34 : Average Product Life Cycle costs – Tablet – Status quo, Ecodesign Requirements, Energy Label

tablet	Status quo	Ecodesign requirements		Energy Label
		optimistic	conservative	
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
per product				
purchase price	330,00 €	332,97 €	338,80 €	331,00 €
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 €**	**370,42 €**	**383,98 €**	**354,90 €**
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 €	55,65 €	57,17 €	64,75 €
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 €**	**61,90 €**	**64,79 €**	**69,43 €**
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 €

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 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 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 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[12]. This indicates that the effect of extended lifetime and decreasing sales will be on non-EU industry mainly.

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

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[13].

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 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.

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

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

design changes related to the packaging through unbundling reduce logistics costs for retailers.

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 31). 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 (optimistic) - 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	2.484	2.422	2.422	2.422
2022	2.430	2.554	2.430	2.430	2.430
2023	2.612	2.737	2.868	2.612	3.258
2024	2.794	2.993	3.270	2.788	3.629
2025	2.805	3.005	3.643	2.785	3.974
2026	2.816	3.017	3.990	2.777	4.297
2027	2.828	3.030	4.315	2.762	4.243
2028	2.840	3.043	4.262	2.748	4.178
2029	2.852	3.057	4.197	2.735	4.117
2030	2.865	3.071	4.135	2.747	4.135

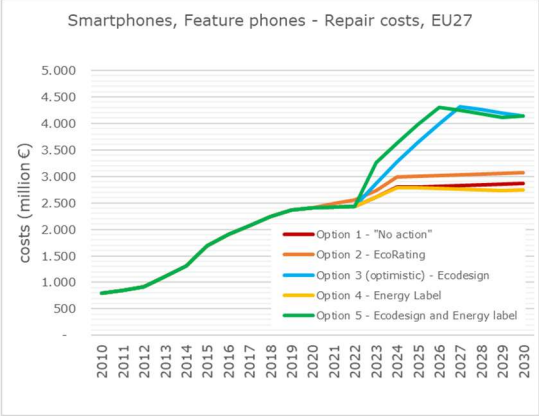

Figure 31 : Smartphones, Feature phones – Repair costs per policy scenario, EU27, 2010-2030

A similar effect is observed for the policy scenarios involving Ecodesign requirements for tablets (Figure 32): 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 (optimistic) - 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		489	403	572
2024	386		549	386	624
2025	383		619	382	690
2026	381		686	379	753
2027	380		750	375	738
2028	379		736	373	722
2029	379		722	371	708
2030	379		708	371	708

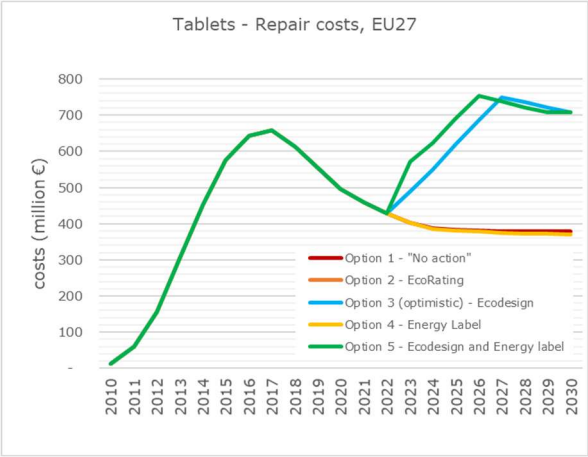

Figure 32 : Tablets – Repair costs per policy scenario, EU27, 2010-2030

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[14]. 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 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

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

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.

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 Ecodesign requirements result in increased Life Cycle Costs. With an Energy Label only, prices can increase to 208,- Euros before the point of break-even is reached (Table 35). 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 35 : Low-end smartphone - Sensitivity Analysis – Purchase Price Break Even

low-end smartphone, 5"	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, purchase price		optimistic	conservative	
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 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 36). 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 36 : Mid-range smartphone - Sensitivity Analysis – Purchase Price Break Even

mid-range smartphone, 6" sensitivity analysis, purchase price	Status quo	Ecodesign requirements optimistic	Ecodesign requirements conservative	Energy Label
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 37). Compared to the cost estimates in Task 6 this break even is far beyond any realistic price adder due to 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 37 : High-end smartphone - Sensitivity Analysis – Purchase Price Break Even

high-end smartphone, 6,5" sensitivity analysis, purchase price	Status quo	Ecodesign requirements optimistic	Ecodesign requirements conservative	Energy Label
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 Ecodesign requirements result in increased Life Cycle Costs for the consumer (Table 38). 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 Ecodesign requirements really pay off for users of feature phones compared to the current status quo.

Table 38 : Feature phone - Sensitivity Analysis – Purchase Price Break Even

feature phone sensitivity analysis, purchase price	Status quo	Ecodesign requirements optimistic	 conservative	Energy Label
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 Ecodesign requirements result in increased Life Cycle Costs for the consumer (Table 39), which is only 2,5 times higher than the stated price increase in Task 6.

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

Table 39 : Cordless phone - Sensitivity Analysis – Purchase Price Break Even

cordless phone (incl. base station) sensitivity analysis, purchase price	Status quo	Ecodesign requirements optimistic	 conservative	Energy Label
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 Ecodesign requirements (Table 40).

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

Table 40 : Tablet - Sensitivity Analysis – Purchase Price Break Even

tablet	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, purchase price		optimistic	conservative	
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 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 41). 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 41 : Low-end smartphone - Sensitivity Analysis – Lifetime Break Even

low-end smartphone, 5"	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		optimistic	conservative	
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	**213,60 €**	**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 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 42). 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 42 : Mid-range smartphone - Sensitivity Analysis – Lifetime Break Even

mid-range smartphone, 6"	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		optimistic	conservative	
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 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 43). 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 43 : High-end smartphone - Sensitivity Analysis – Lifetime Break Even

high-end smartphone, 6,5"	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		optimistic	conservative	
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 44). 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 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 44 : Feature phone - Sensitivity Analysis – Lifetime Break Even

feature phone	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		optimistic	conservative	
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 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 AAA standard 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 45). 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 45 : Cordless phone - Sensitivity Analysis – Lifetime Break Even

cordless phone (incl. base station)	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		optimistic	conservative	
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 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 46). 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 46 : Tablet - Sensitivity Analysis – Lifetime Break Even

tablet	Status quo	Ecodesign requirements		Energy Label
sensitivity analysis, lifetime		optimistic	conservative	
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 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.

7. SUBTASK 7.5 - SUMMARY

The impact of the 5 policy options and related scenarios is summarised in Table 47. 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 Ecodesign requirements.

An Energy Label alone has a positive impact as well, but only in the range of 3% across the economic and material-related indicators, and 6-8% improvement for environmental indicators, including societal damages.

The positive effect of Ecodesign requirement with or without an Energy Label is 17% lower total consumer expenditure – at significantly increased overall repair costs -, 33% less total material consumption, and 20% 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 23 to 35% lower for the listed indicators Consumers significantly benefit in terms of Life Cycle Costs from the measures, according to the analysed scenarios.

Table 47 : Aggregated results per policy option

2030, all product segments	Option 1 - "No action"	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label	Option 2 - EcoRating	Option 3 (optimistic) - Ecodesign	Option 4 - Energy Label	Option 5 - Ecodesign and Energy label
	absolute values					comparison with "no action"			
sales (mln. units)	183,74	180,42	150,40	177,92	150,40	98%	82%	97%	82%
total annual consumer expenditure (mln. €)	89.703	87.158	74.573	85.895	74.573	97%	83%	96%	83%
external annual damages (updated data, mln. €)	3.487	3.322	2.572	3.280	2.572	95%	74%	94%	74%
repair costs only (mln. €)	3.280	3.487	4.884	3.154	4.884	106%	149%	96%	149%
Environmental indicators (selected)									
Total Energy (PJ)	141,61	135,05	100,87	130,87	100,87	95%	71%	92%	71%
Greenhouse Gas emissions (mt CO2 eq.)	8,91	8,34	5,78	8,19	5,78	94%	65%	92%	65%
Acidification (kt SO2 eq.)	86,72	83,39	67,14	81,71	67,14	96%	77%	94%	77%
Material consumption									
Bulk Plastics (t)	13.794	13.566	9.116	13.626	9.116	98%	66%	99%	66%
TecPlastics (t)	15.787	14.880	9.638	15.388	9.638	94%	61%	97%	61%
Ferro metals (t)	4.181	4.043	3.150	4.068	3.150	97%	75%	97%	75%
Non-ferro metals (t)	29.731	28.907	22.748	28.881	22.748	97%	77%	97%	77%
Electronics (t)	36.867	35.611	27.007	35.877	27.007	97%	73%	97%	73%
Miscellaneous, mainly paper, cardboard (t)	89.993	85.279	56.040	87.493	56.040	95%	62%	97%	62%
Totals materials (t)	190.353	182.286	127.699	185.333	127.699	96%	67%	97%	67%
thereof, Critical Raw Materials (t)									
Tantalum (Ta, t)	9,2	8,9	7,3	8,9	7,3	97%	80%	97%	80%
Indium (In, t)	2,9	2,8	2,3	2,8	2,3	97%	80%	97%	80%
Platinum Group metals (PGM, t)	3,8	3,7	3,1	3,8	3,1	97%	80%	98%	80%
Gallium (Ga, t)	0,39	0,38	0,32	0,38	0,32	97%	80%	97%	80%
Rare earth elements (Sc, Y, Nd; t)	65	64,6	52	63,7	52,3	99%	80%	97%	80%
Cobalt (Co, t)	1.764	1.723	1.410	1.712	1.410	98%	80%	97%	80%
Magnesium (Mg, t)	1.760	1.728	1.407	1.708	1.407	98%	80%	97%	80%

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.

8. PUBLICATION BIBLIOGRAPHY

Apple; Google; Lenovo; LG Electronics; Motorola Mobility; Samsung; Sony Mobile (2018): Memorandum of Understanding on the future of Common Charging Solutions for Smartphones. Available online at https://www.digitaleurope.org/wp/wp-content/uploads/2019/01/2018.03.20-MoU%20on%20the%20future%20of%20Common%20Charging%20Solutions%20(1)%20(1)%202.pdf, checked on 11/27/2020.

Kemna, René (2011): Methodology for Ecodesign of Energy-related Products - MEErP 2011. Methodology Report. Part 1: Methods. With assistance of Nelly Azaïs, Martijn van Elburg, Maaike van der Voort, William Li. Brussels / Delft.

Matthey, Astrid; Bünger, Björn (2019): Methodenkonvention 3.0 zur Ermittlung von Umweltkosten – Kostensätze. Available online at https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2019-02-11_methodenkonvention-3-0_kostensaetze_korr.pdf, checked on 9/11/2020.

Mudgal, Shailendra; Tinetti, Benoît; Prado Trigo, Alvaro de; Faninger, Thibault; Schischke, Karsten; Proske, Marina et al. (2013): Material-efficiency ecodesign report and module to the methodology for the ecodesign of energy-related products (MEErP). Part 1, material efficiency for ecodesign - Study. Brussels.

HOW TO OBTAIN EU PUBLICATIONS

Free publications:

- one copy:
  via EU Bookshop (http://bookshop.europa.eu);

- more than one copy or posters/maps:
  from the European Union's representations (http://ec.europa.eu/represent_en.htm);
  from the delegations in non-EU countries
  (http://eeas.europa.eu/delegations/index_en.htm);
  by contacting the Europe Direct service (http://europa.eu/europedirect/index_en.htm)
  or calling 00 800 6 7 8 9 10 11 (freephone number from anywhere in the EU) (*).

  (*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

Priced publications:

- via EU Bookshop (http://bookshop.europa.eu).

Priced subscriptions:

- via one of the sales agents of the Publications Office of the European Union
  (http://publications.europa.eu/others/agents/index_en.htm).

Publications Office