Council of the European Union

Brussels, 19 June 2023
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COVER NOTE

From:	Secretary-General of the European Commission, signed by Ms Martine DEPREZ, Director
date of receipt:	16 June 2023
To:	Ms Thérèse BLANCHET, Secretary-General of the Council of the European Union
No. Cion doc.:	SWD(2023) 101 final part 3/7
Subject:	COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT REPORT Accompanying the documents Commission Regulation laying down ecodesign requirements for smartphones, mobile phones other than smartphones, cordless phones and slate tablets pursuant to Directive 2009/125/EC of the European Parliament and of the Council and amending Commission Regulation (EU) 2023/826 and Commission Delegated Regulation supplementing Regulation (EU) 2017/1369 of the European Parliament and of the Council with regard to the energy labelling of smartphones and slate tablets

Delegations will find attached document SWD(2023) 101 final part 3/7.

Encl.: SWD(2023) 101 final part 3/7

EUROPEAN
COMMISSION

Brussels, 16.6.2023
SWD(2023) 101 final

PART 3/7

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the documents

Commission Regulation

laying down ecodesign requirements for smartphones, mobile phones other than smartphones, cordless phones and slate tablets pursuant to Directive 2009/125/EC of the European Parliament and of the Council and amending Commission Regulation (EU) 2023/826

and

Commission Delegated Regulation

supplementing Regulation (EU) 2017/1369 of the European Parliament and of the Council with regard to the energy labelling of smartphones and slate tablets

{C(2023) 1672 final} - {C(2023) 3538 final} - {SEC(2023) 164 final} -
{SWD(2023) 102 final}

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Annex 5: Additional evidence on problem definition and on the legal basis for EU action

Part 1: PROBLEM DEFINITION

Requirements of the French circular economy and anti-waste law

From 1 January 2021 manufacturers, importers, marketers and other retailers that put smartphones, laptops, washing machines, TVs and mowers on the French market have to inform, free of charge, downstream sellers and any person of the reparability index of their products, as well as the parameters explaining how such index was established. Article L541-9-2 (II) of the French Environment Code also foresees to move towards a durability index by 2024, including aspects related to product reliability and upgradability. In March 2021, the Spanish Ministry of Consumer Affairs announced that it wants to pursue a similar approach[1]. Since product manufacturers operate on the European Single Market, these national initiatives are highly relevant for EU legislation and beyond.

Market and stock data

The first smartphones came on the market already in the late 1990s, but it was in 2007 with the introduction of the iPhone that smartphones gained significant market share. Figure 1 shows the number of smartphones sold to end users from 2007 to 2020 worldwide. Initially, a fast growth could be observed in shipments. In 2014, smartphone sales were tenfold as compared to 2007. Since 2015, smartphone growth has been decreasing and sales have remained relatively constant at 1.5 bn per year. In 2019, 31% of the world's population owned a smartphone (Figure 2) and around 600 million users are located in broader Europe (incl. Western and Eastern Europe).

[1] https://www.lamoncloa.gob.es/lang/en/gobierno/news/Paginas/2021/20210315reparability-label.aspx

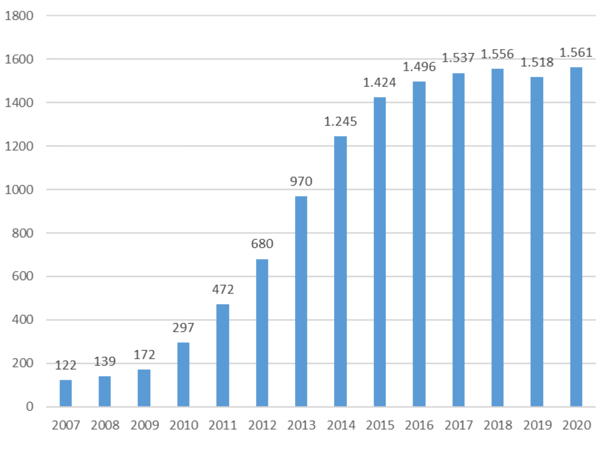


Figure 1 Number of smartphones sold to end users worldwide from 2007 to 2020[2] (in millions)

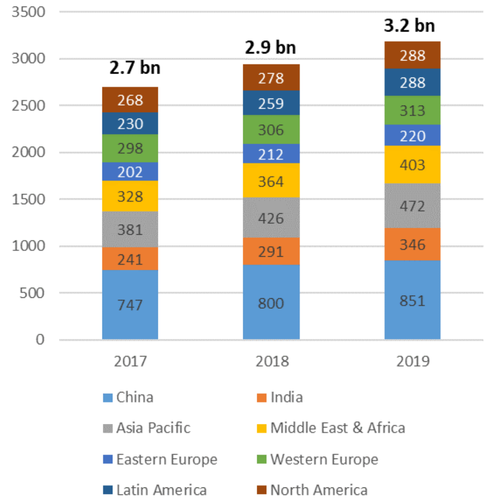


Figure 2: Smart phone user by region[3]

For the EU 27, the stock model developed within the ecodesign preparatory study estimates around 430 million mobile phones and around 150 million tablets in 2020 (5-year lifetime scenario) (European Commission 2021).

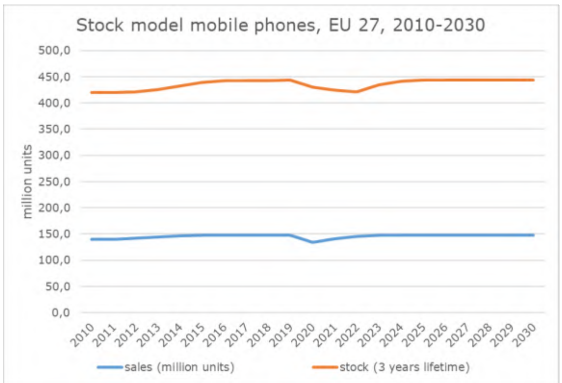


Figure 3: Stock model mobile phones EU (European Commission 2021)

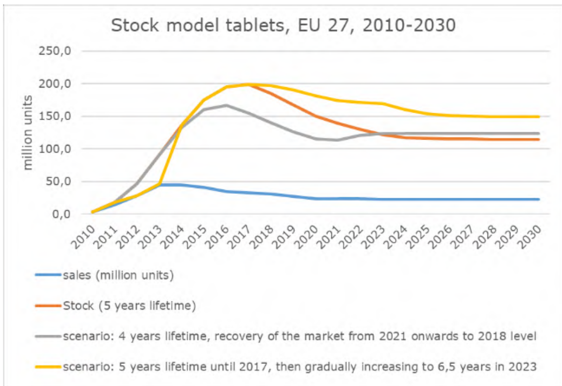


Figure 4: Stock model tablets EU (European Commission 2021)

Suppliers and manufacturers

The landscape of producers of mobile phones and tablets is characterised by few large companies serving the largest share of the global market and shaping the design of mainstream products. In 2020, more than 75% of total mobile phones and more than 85% of

[2] Statista (2020c): Number of smartphones sold to end users worldwide from 2007 to 2020. Available online at https://www.statista.com/topics/840/smartphones/.

[3] Newzoo (2019): Global Mobile Market Report. Insights into the World's 3.2 Billion Smartphone Users, the Devices They Use & the Mobile Games They Play. Available online at https://newzoo.com/insights/articles/newzoos-global-mobile-market-report-insights-into-the-worlds-3-2-billion-smartphone-users-the-devices-they-use-the-mobile-games-they-play/.

tablet shipments in Europe came from the companies Samsung, Apple and Huawei (statcounter 2021). Only few SMEs are active in the EU market (e.g. Gigaset, Wiko, Archos, BQ, Fairphone, Shift) and their market share is very small. Several former European brands, such as Nokia and Alcatel, are now owned by high-tech companies from outside of Europe.

The mobile phone and tablet industry is highly competitive, and the three global brands Apple, Samsung and Huawei are currently dominating the global market with the highest market shares. Some Chinese upstarts like Xiaomi and Oppo are gaining market share, while others are withdrawing from the market. As an example, South Korean LG Electronics announced in April 2021 that it would exit the smartphone business[4].

Many different smartphone and tablet models in low-, mid- and high-ranges exist on the market and consumers have a considerable choice between different devices. Many models within a cost category come with similar features and processing power, which makes differentiation for the suppliers more difficult. While the high number of substitutes contributes positively to the bargaining power of consumers, the big tech companies also invest heavily in marketing activities and customer experience to gain new customers and retain existing ones. Companies such as Apple or Samsung also produce other devices (e.g. watches, speakers, earbuds, etc.) and optimise the interoperability between their devices and systems.

The final production of mobile phones, smartphones and tablets is mostly located in East Asia and particularly in China. The main components such as radio interfaces (baseband chip), processors, flash memory, computer network interfaces, displays, batteries, cameras and audio components come from various regions including Asia, North America and to a small extent Europe. Printed Circuit Boards for these products are typically manufactured in Asia, but Austrian based AT&S is a relevant player in this PCB segment. The value chain is considerably large and underlies constant changes. Some market consolidation trends are noticeable. Most of the manufacturing takes place in Asia, particularly in China. Only few manufacturers are located in the EU 27, and among these the semiconductor fabs represent the majority of the sites, followed by some material suppliers.

Operating systems

Smartphones and tablets are either run on iOS or Android and hardly any other operating system (e.g. Windows). Since 2009, Android increased its EU market share significantly, covering more than 70% of the market, followed by iOS (28%).

[4] https://www.reuters.com/article/us-lg-elec-smartphones/lg-becomes-first-major-smartphone-brand-to-withdraw-from-market-idUSKBN2BS032

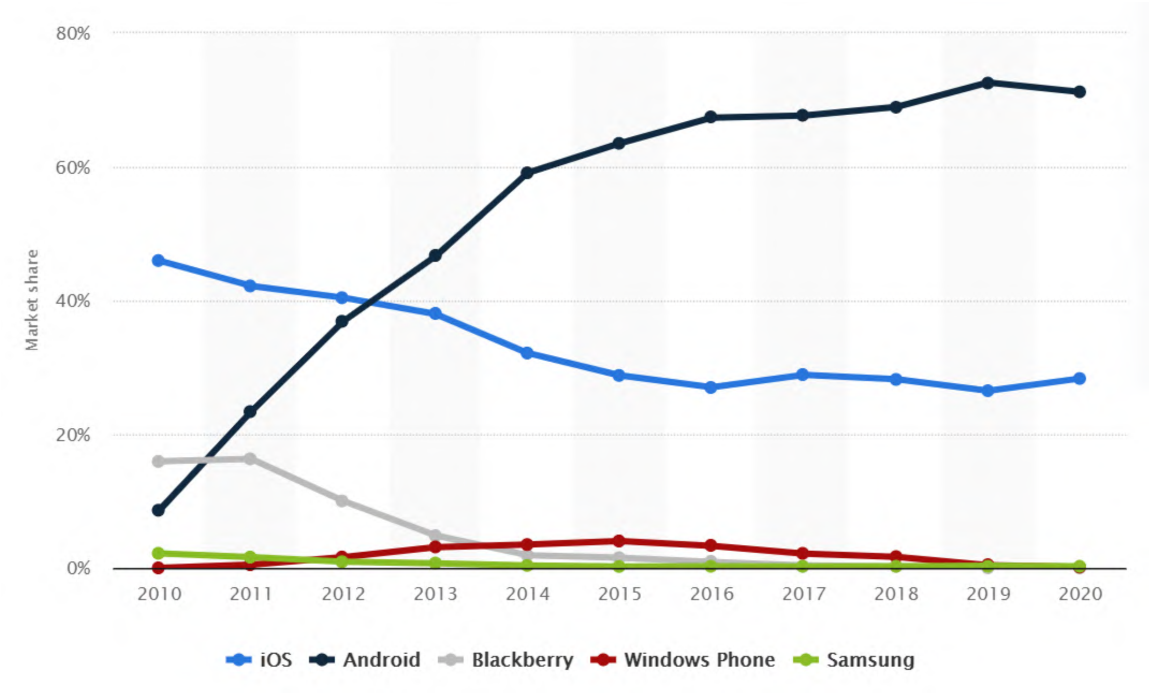


Figure 5: Market share of leading mobile operating systems in Europe from 2010 to 2020[5]

The situation is different for the smaller tablet market where iOS and Android both have around 50% of the market[6]. While Apple has created its own ecosystem, most of the other manufacturers depend on Google for the operating system (Android). This can have consequences when it comes to availability of (security) updates for a certain amount of time.

Supply of repair activities

Repair services can be undertaken either within the legal guarantee period or afterwards. In the EU, a legally binding guarantee is provided for a minimum duration of two years. Out-of-guarantee repairs can be offered once the legal or commercial guarantee period is expired. However, the cost needs to be covered by consumers.

There are many different actors involved in repair activities. Some manufacturers encourage DIY repair through a modular product design (examples: Fairphone, Shift). In these cases the customer has to pay only for the spare parts and shipping costs. While no labour costs apply in these cases, potential costs for tools can occur. As soon as professional repair services are consulted, labour costs and the margin of the repair service has to be accounted for. Many manufacturers offer professional repair services in-house or through authorised independent repairers. The total cost of repair services can vary significantly from one country to another, since repair is a labour-intensive activity subject to regional labour costs. The following Figure provides an overview over the main actors involved in the repair sector.

[5] https://www.statista.com/statistics/639928/market-share-mobile-operating-systems-eu/
[6] https://gs.statcounter.com/os-market-share/tablet/europe

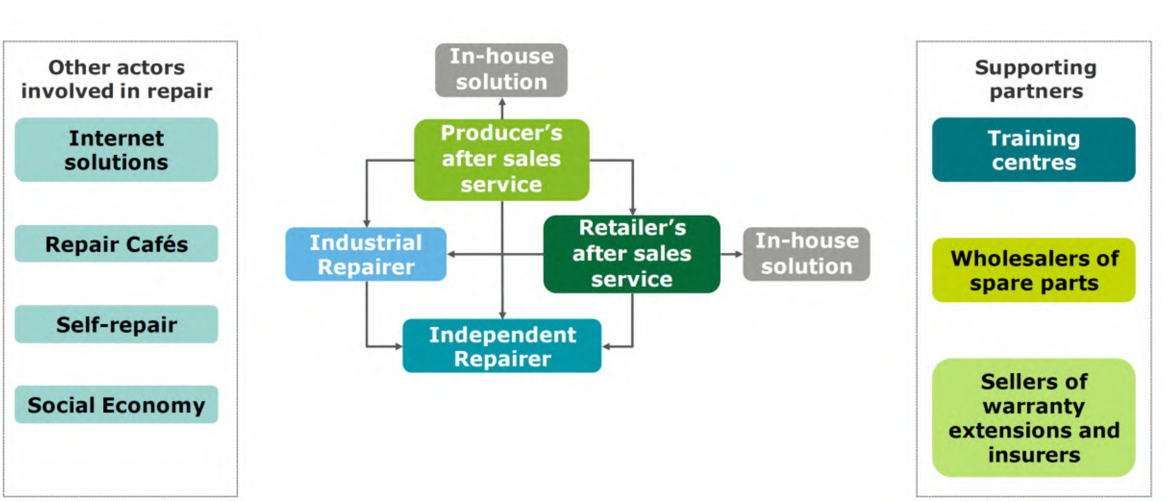
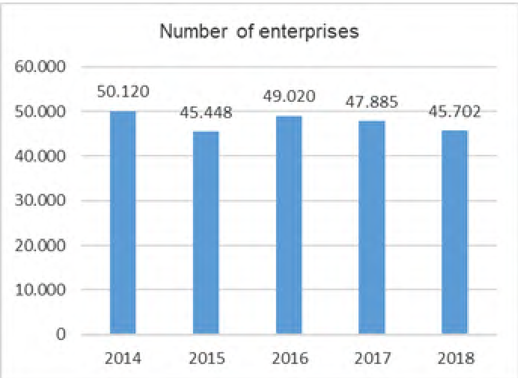
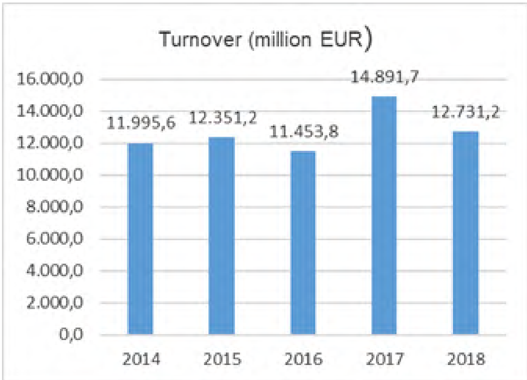


Figure 6: Main and associated actors in the repair sector[7]

Independent repairers usually do not only repair mobile phones and tablets, but also other small ICT equipment.

Independent repairers of computers and communication equipment are classified under the NACE code S951. Recent data from Eurostat suggests that in the EU there are more than 45.000 of such small repair companies with a turnover of 12.7 bn EUR and employing more than 120.000 persons. The following Figures show the development between 2014 and 2018.





[7] Socio-economic analysis of the repair sector in the EU, DG ENV, 2019

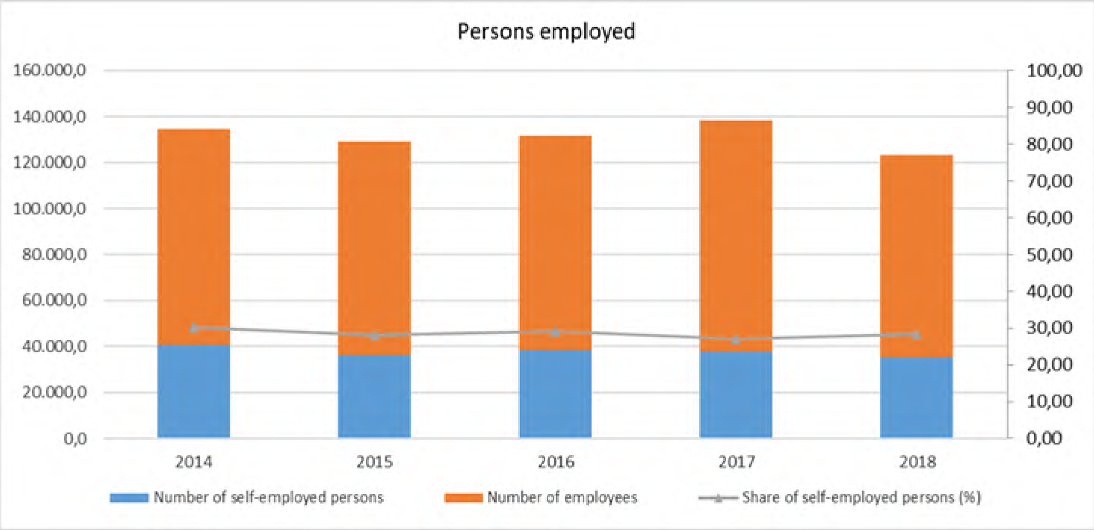


Figure 7: Number of repairers of computers and communication equipment, their turnover and persons employed in EU according to NACE code S951 (Source: Eurostat)

Market of refurbished devices

Refurbished devices have gained in popularity in the last years. The main difference between "refurbished" and "used" devices is that refurbished products have to undergo test and verification processes before being sold to a new owner. Refurbished products can be used, or unused customer returns or trade-ins and phones or tablets usually undergo data cleaning, change of components (if necessary) and external polishing before being resold.

IDC expects global shipments of used smartphones, including both officially refurbished and used smartphones, to reach 225.4 million units in 2020, which represents around 15% of the global market of new smartphones sold to end users in the same year (1.5 bn). IDC also sees a high potential for this market to grow to 351.6 million units in 2024[8]. Main drivers are growth in trade-in programs of the manufactures and on average selling prices of new devices. Contrary to this trend the latest Counterpoint Refurbished Smartphone Market Update showed that the European refurbished smartphone market (not reused) fell 14% YoY in 2020[9], mainly due to COVID-19. Nevertheless, the mid and long-term prospects are positive.

New companies that came on the market recently, like Back Market, refurbed or rebuy could raise significant investments, showing that there is market demand for refurbished devices and a high potential for further growth[10]. Product and software design that facilitates the steps necessary for refurbishment for third parties (e.g. data cleaning, change of components

[8] https://www.idc.com/getdoc.jsp?containerId=prUS47258521
[9] https://www.counterpointresearch.com/global-refurbished-smartphone-market-fell-in-2020/
[10] In May 2021, Back Market raised 276 M EUR; refurbed raised 15.6 M EUR in 2020

(accessibility, price, etc.)) can enhance competition in the sector and lead to innovation and lower prices for end-users.

The consumer perspective

Use-phase

Survey results in different countries show that most smartphones are used between 1-4 years, while tablets are kept in active use for 3-6 years. Below Figure shows exemplary survey results from the UK on the active use time of smartphones and tablets.

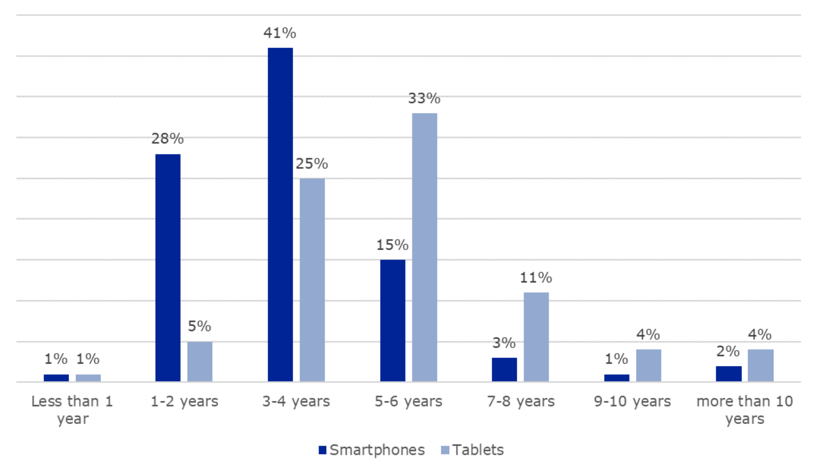


Figure 8: Average use life of portable devices[11]

Slightly longer replacement cycles were identified recently for mobile phones in scientific literature (Ng 2019; Triggs 2018). The main market drivers for this trend are (European Commission 2021):

- advancements in technology;
- increasing prices of phones;
- maturity of the market;
- users with a decade long history of various brands and models having figured out their preferred model by now, rating high the model they own;
- not much further improvements in features and experience expected;
- longer support for older smartphone models, in particular by Apple;
- and consumers increasingly moving away from mobile contracts with telecommunications carriers and related handset upgrade cycles offered by these mobile service providers.

[11] YouGov Research, 2020

According to a recent Eurobarometer survey[12], the main reasons to purchase a new device are:

- Old device broke (37%);
- The performance of the old device had significantly deteriorated (30%);
- Certain applications or software stopped working on the old device (19%).

When a smartphone breaks, around 59% of users purchase directly a new device and only around 11% try to repair their broken device[13]. The main reasons for not repairing are stated to be the cost of repair (53%), but also the perception of users that their device is “old anyway” (53%)[14]. This latter aspect plays an important role in the case of consumer electronics, since psychological obsolescence is an important driver for product replacement[15].

The most common technical lifetime limiting factors for smartphones and tablets are product defects linked to accidental incidents, such as display cracks after a drop on a hard surface, immersion of water, decreasing battery charge capacity over time and less frequently other types of malfunctions due to mechanical stress (e.g. buttons, connectors). Occasionally, also other components fail, such as cameras or radio connectivity components (Cordella et al. 2020; WERTGARANTIE 2018; clickrepair 2019). These kinds of defects frequently trigger the replacement of a device.

The following tables show the main defects in smartphones as well as damages of dropped tablets in Germany.

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[12] European Commission (2020): Attitudes Towards The Impact of Digitalisation on Daily Lives (Special Eurobarometer).

[13] OHA (Obsoleszenz als Herausforderung für Nachhaltigkeit), 2019

[14] YouGov Research, 2020

[15] PROMPT Project, Deliverable 2.6: State-of-the-art knowledge on user, market and legal issues related to premature obsolescence

Table 14: Defects in smartphones (Germany, 2019[16])

Part	Share (%)
Display	67,4%
Casing	50,0%
Battery	33,9%
Connectors	16,1%
Camera	7,9%

Damages of dropped tablets (Germany, 2018[17])

Part	Share (%)
Display	64.1%
Casing	47.1%
Camera	18.1%
Blemish to the appearance	17.5%
Ports	13.6%

Once a product reaches a limiting state where it cannot function as required, repair can be an option to bring the device back to a functional state. A Eurobarometer survey found that 77% of respondents stated that they would make an effort to get broken appliances repaired before buying new ones (European Commission 2014a). However, the share of consumers having their smartphone or tablet repaired once it is broken is relatively low (OHA - Obsoleszenz als Herausforderung für Nachhaltigkeit 2019) and affordable, accessible, and fast repair solutions could contribute to extending the active use lifetime of mobile phones and tablets.

Some case joining techniques (e.g. gluing, sealing) often do not allow for self-repair/replacement of the broken parts and professional repair services can cost from 58.6 EUR for battery replacement (average cost) to 174 EUR for display replacement (average cost)[18]. Compared to the depreciated mental book value consumers attribute to their used device, these sums can be a barrier to demand repair services. Consumers also state that their desired lifetime of a smartphone is around 5.2 years[19], which shows that there is a gap between actual and desired lifetime.

End-of-life stage

Problems arise also at the end-of-life stage of smartphones and tablets. Although collection programmes for mobile devices are in place in many countries, consumers often store their phones after use, leading to a hibernating stock of old devices. A study conducted in France

[16] Clickrepair, 2019
[17] Wertgarantie, 2018
[18] Ecodesign preparatory study on mobile phones, smartphones and tablets, Task 2 Report
[19] Wieser, H., Tröger, N., & Hübner, R. (2015). The consumers' desired and expected product lifetimes. Product Lifetimes And The Environment.

in 2019 concluded that 54-113 million old devices are hibernating in French households, of which more than 2/3 are still functioning[20]. The functioning fraction of the phones is mainly kept as a back-up solution for occasional needs (replacement phone for oneself or relatives/friends). The non-functioning part is mainly retained for data safety reasons, because an easy access to the recycling sector is not available or since people forget about the old device due to the small size. According to the study, 13-25.1 million phones are put in hibernation every year in France, which represents more than 50% of the devices put on the market. According to a survey by Bitkom Research[21] in Germany the number of old mobile phones kept at home but not being used anymore grew rapidly in recent years: Currently, there are 199.3 million mobile phones in hibernation in Germany, compared to 123.9 million in 2018.

Collection programmes need to propose interesting alternatives for users to mitigate expected risks, such as data deletion certificates, financial incentives or nudging techniques. As an example, the Tokyo 2021 Olympic and Paralympic medals are made from recycled electronic waste[22]. Knowing that their old device will serve this purpose, many Japanese people brought their old devices to special collection points.

While smartphones contain critical raw materials and more than 50 metals, their material value is only around 1.11 EUR, making them not the most interesting waste flow for recyclers from an economic perspective[23]. Furthermore, since these devices contain batteries that need to be removed, they are not the easiest products to handle for recyclers and can even lead to fires in the recycling plants or during transportation.

Key technology developments

From a technological point of view, the functionality of smartphones and tablets has been increasing over time, with consequent increase of storage capacity, power demand and materials needed. Through its increased functionality, smartphones and tablets have contributed to dematerialisation, substituting products and materials such as digital cameras, navigation devices, paper, etc. At the same time, devices with an improved functionality (e.g. better cameras, 5G, etc.) can trigger the replacement of the entire device although it is still working.

Storage / memory

Shortage of storage capacity or memory can be one reason for consumers to replace their device prematurely. Figure 9 shows data for the market average (green) and the highest

[20] Sofies & Bio Innovation Service, 2019 - Étude du marché et parc de téléphones portables français en vue d’augmenter durablement leur taux de collecte
[21] Bitkom e.V. 2020
[22] http://svil.recyclingpoint.info/tokyo-2020-olympic-medals-will-be-made-out-of-weee/?lang=en
[23] Bundesanstalt für Geowissenschaften und Rohstoffe: Commodity TopNews 65 – Metalle in Smartphones

(orange) and lowest (blue) value for smartphones among the best-selling devices from 2010-2019. It can be observed that the gap between the best and worst performing devices has been increasing over time. The growth of GB has been nearly exponential for the phones with the highest amount of RAM and internal storage.

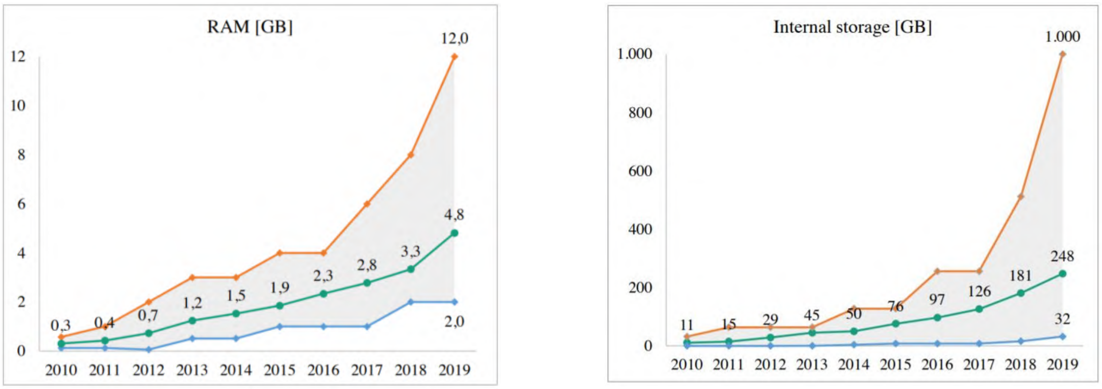


Figure 9: Development of the amount of RAM and internal storage employed in smartphones between 2010 and 2019 (Clemm et al. 2020)

Tablets have usually 2-6 GB RAM and the storage capacity covers the full range from 16 GB to 128 GB and for high-end devices up to 1 TB.

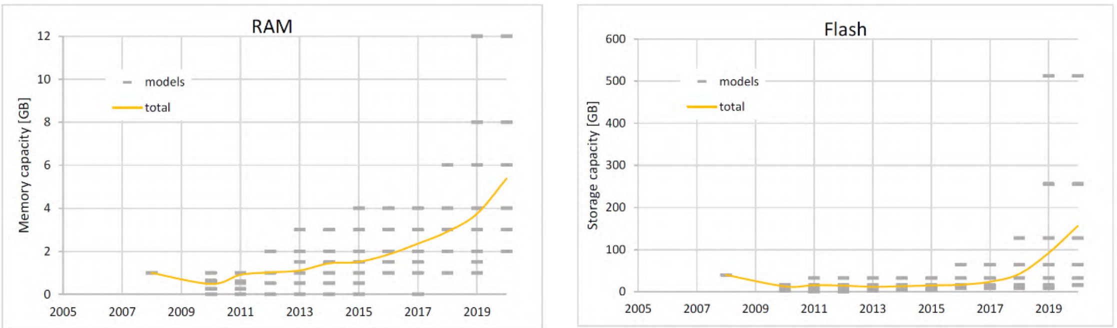


Figure 10: Development of the amount of RAM and internal storage employed in tablets between 2008 and 2019[24]

Battery lifetime and endurance (per cycle)

A weak battery constitutes a significant problem for users and is one if the main replacement reasons for smartphones and tablets. For this reason, long-lasting batteries as well as easy and cost-effective replacement opportunities for degraded batteries can extend the useful lifetime of smartphones and tablets.

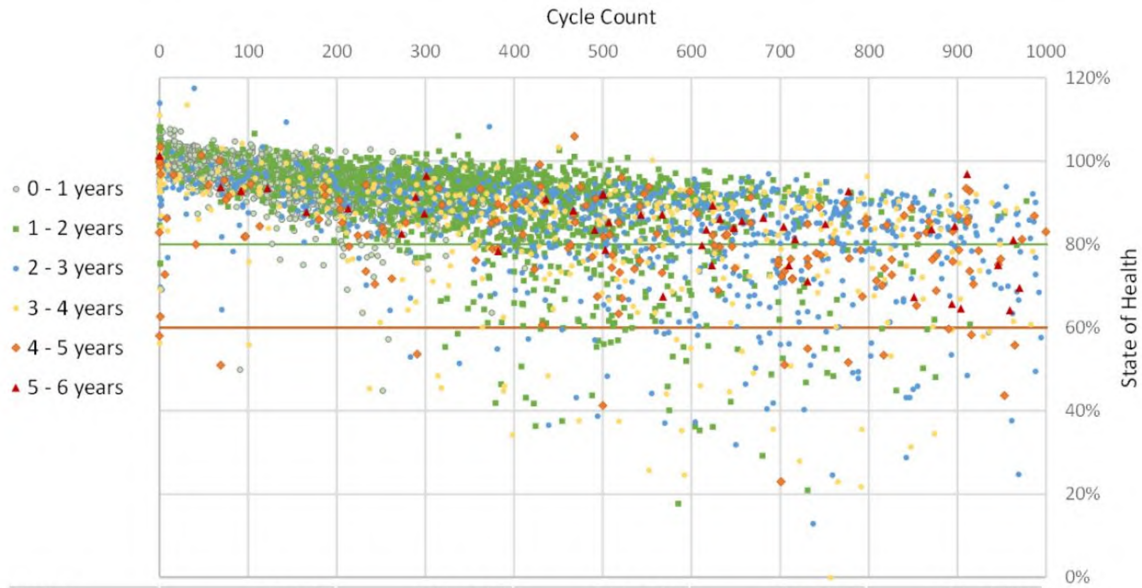
[24] In the framework of the German research project MoDeSt a data set of 9,600 smartphone models and their technical specification was analysed. The data base included also 636 data sets for tablets, which were analysed in the Ecodesign Preparatory Study.

Rechargeable batteries are consumables and degrade with use and over time, resulting in a loss of remaining capacity, energy and/or an increase in impedance, and therefore a reduction in power and efficiency. The lifetime of batteries is measured in two ways:

- Calendar life: time during which the battery can be stored, without or with only minimal use, before its capacity permanently decreases below a certain percentage of its initial capacity;
- And cycle life: number of times (cycles) a battery can be fully charged and discharged before it becomes unsuitable for a given application, e.g. when it can only be charged up to a certain percentage of its initial capacity.

Both aspects can be assessed through laboratory tests (e.g. IEC EN 61960-3).

The analysis of a database with more than 5.600 data sets on battery health from different Apple iPhones (mobile phones) and iPads (tablets) provided insights into the durability of the batteries under real-life use conditions (Clemm et al. 2016).



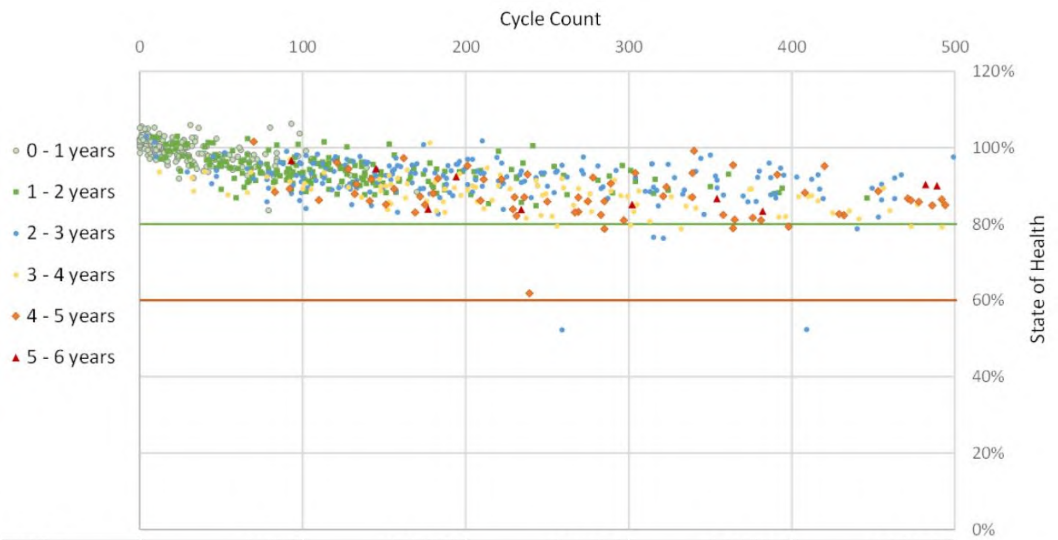
Cycles	0 - 200	201 - 400	401 - 600	601 - 800	801 - 1000
Datasets (n)	1824	1174	887	504	247
SoH > 80 %	99%	92%	75%	64%	55%
SoH > 60 %	100%	99%	95%	90%	88%
SoH < 60 %	0,3%	1,4%	4,8%	10%	12%

Figure 11: State of health (SOH) of smartphone batteries, clustered into intervals of battery age in years, over the course of 1.000 charging cycles (Clemm et al. 2016)

In the Figure 11 above a steady decrease of the share of batteries with a state of health (SOH) above 80 % and 60 % can be observed. While the heterogeneity of the data is significant, a global trend of decreasing capacity with increasing cycle count can be observed. After 800 cycles >55 % of the batteries were, able to retain >80 % of their design capacity, >88 % retained >60 % of their capacity, and >12 % had less than 60 % of their design capacity left.

The study concluded that data appears to indicate that smartphone batteries are technically able to withstand a high number of charge/discharge cycle over the course of several years while retaining a high share of their initial capacity (Clemm et al. 2016).

A similar exercise was conducted for tablets using data on the SOH of iPad batteries, but only up to 500 charge/discharge cycles. 90 % of all batteries that contributed data to the database reported SOH above 80 % even after several hundred charging cycles over several years as can be seen in the following Figure.



Cycles	0-100	101-200	201-300	301-400	401-500
Datasets (n)	308	208	189	76	42
SoH > 80 %	100%	100%	95%	92%	90%
SoH > 60 %	100%	100%	99%	100%	98%
SoH < 60 %	0,0%	0,0%	0,5%	0%	2%

Figure 12: State of health (SOH) of tablet batteries, clustered into intervals of battery age in years, over the course of 500 charging cycles (Clemm et al. 2016)

Battery capacity and integration

Figure 12 shows the market average (green) as well as the highest (orange) and lowest (blue) value among the best-selling smartphones from 2010-2019. The average capacity increased from around 1.300 mAh to 3.300 mAh (+254%) in the course of ten years. However, there is a considerable variance between the highest and lowest capacity among the best-selling phones and the gap has been increasing (Clemm et al. 2020). The average battery capacity of tablets has been increasing from around 4.000 mAh in 2010 to more than 6.000 mAh in 2020 (Proske et al. 2020a).

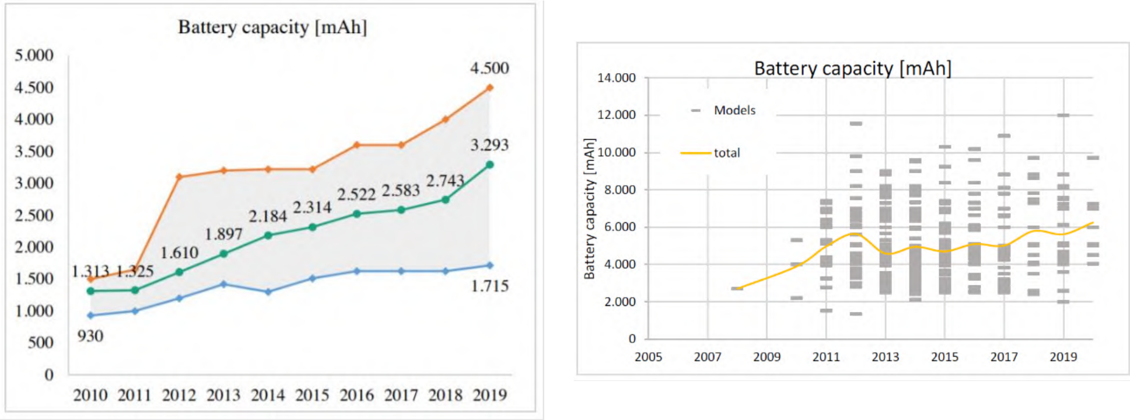


Figure 13: Development of the battery capacity in smartphones (left, (Clemm et al. 2020)) and in tablets (right, (Proske et al. 2020a))

Until 2011, the majority of smartphones had user-replaceable batteries. Since then the number of new models dropped very quickly. There are still models with user-replaceable batteries on the market, but they are rare and not in the high-end segment of smartphones. When it comes to tablets, user-replaceable batteries were never very common as can be seen in below Figure (Proske et al. 2020a).

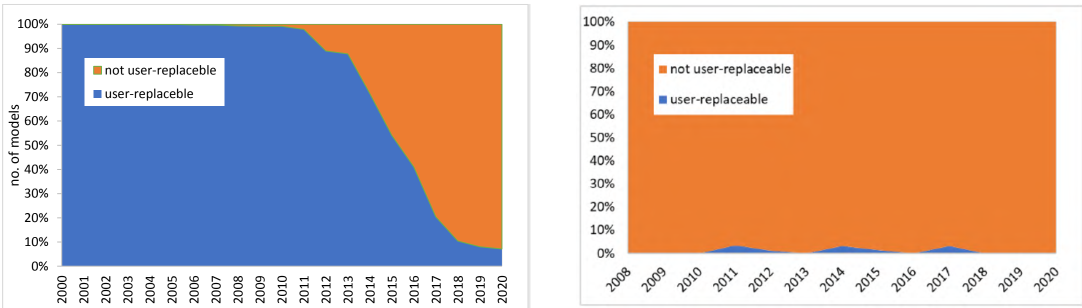


Figure 14: Share of user-replaceable and not user-replaceable batteries in mobile phones (left) and tablets (right), (Proske et al. 2020a)

Battery integration and IP rating

Until 2011, the majority of models on the market had user-replaceable batteries. As of today, some models with user-replaceable batteries can still be found, but they are rare and not available in the high-end segments of smartphones (Clemm et al. 2020). It can be assumed that the practice of embedding batteries and sealing the external housing with adhesives allows more models to successfully reach higher water and dust ingress protection (IP) ratings (commonly IP67 or IP68). Plotting the market share of smartphones with embedded battery and phones with ingress protection (IP) rating (water and dust ingress protection) shows a positive correlation (see Figure below).

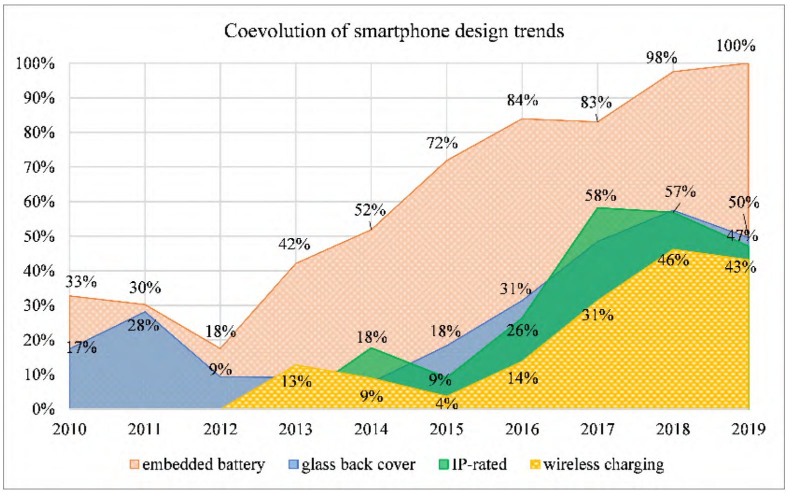


Figure 15: Coevolution of the smartphone design trends embedded battery, glass back cover, IP rating and wireless charging

Higher IP ratings can lead to better reliability of devices, since water damages are one of the main reasons for product failure. However, there might be a conflict with the reparability of the devices, since sealed products are less easy to disassemble. Most of the models on the market are not designed for DIY repair, since they use case joining techniques that require certain skills and tools to open. The following figure shows the evolution of smartphone case joining techniques applied to the best-selling smartphones in Europe.

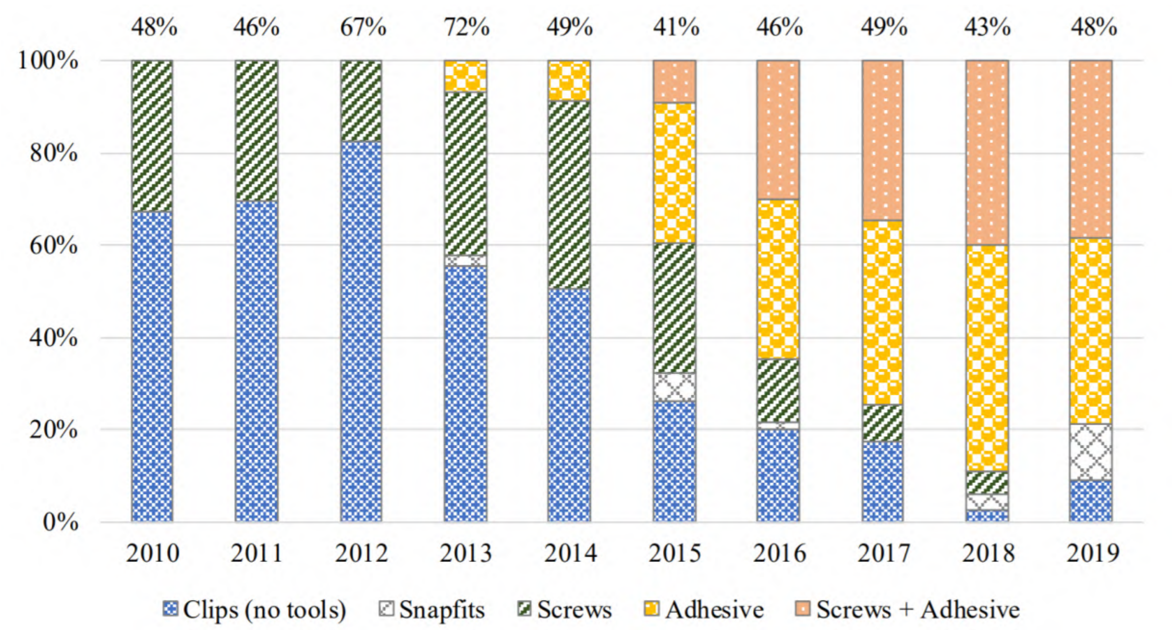


Figure 16: Evolution of smartphone case joining techniques applied to the best-selling smartphones in Europe (based on market data from Counterpoint Research; market coverage denoted on top of data columns) (Berwald et al. 2020)

This design feature can hamper the willingness of a user to repair the device, in particular if the in-house repair solutions are relatively expensive.

Software

Smartphones and tablets run on Operating Systems (OS) and with firmware. An OS allows the device to run applications and programs. Firmware is software that serves specific purposes related to hardware parts. Updates can lead to problems, since they can determine the performance of essential hardware such as the battery and CPU, which can influence the overall performance of the device. Producers provide updates on a regular basis to fix problems and security issues. Updates as well as a lack of updates can bring a device to a limiting state, making it obsolete. Therefore, updates are as important as the physical elements of a smartphone to ensure a longer life of the device and to reduce replacement rates. Although security updates do not significantly affect the performance of a device, a stop of security updates can lead to less secure devices and to potential conditions of software obsolescence (e.g. risk of data leaks). Software updates and in particular security updates of operating systems (OS) are crucial for the functionality and data security of smartphones and tablets. The availability of updates depends strongly on the brand and the operating system. While e.g. Apple, through its integrated ecosystem with iOS, provides >5 years of security updates, other brands that use third-party OS (e.g. Android) provide significantly less time of update support.

Chargers

In earlier days of mobile phones and tablets, most of the devices had their own charger. In 2009, major producers of mobile phones agreed to sign a Memorandum of Understanding (MoU) to harmonise chargers for data-enabled mobile phones sold in the EU. External power supplies (ESP) provided with mobile phones and tablets typically do not have the same power rating, although there can be overlaps. Tablet chargers are usually rated for a higher wattage, sometimes being in the same range as laptops (65W). Today, the EPS is most of the time detachable from the charging cable and most smartphones and tablets on the market use technologies based on USB specifications and standards. USB Type-C connectors have been replacing older USB connectors for most Android OS devices. A still existing alternative proprietary solution is e.g. Lightning by Apple. The impact assessment study on common chargers of portable devices conducted for DG GROW in 2019 (European Commission 2019a) concluded that there is no clear-cut "optimal" solution for common chargers. However, the study stated that consumer's convenience could be improved by pursuing common connectors in combination with interoperable EPS. The common charging approach is however only effective, if an unbundling of handset and charger is implemented at large scale.

More and more smartphones are also equipped with wireless charging and power share features, providing additional charging options and reducing the mechanical strain put on the USB connector throughout the device's lifetime. However, when it comes to charging efficiency, the efficiency can be lower when compared to charging through a wire.

Some mobile phones can be ordered without a power supply unit. Examples are the Fairphone 3 / Fairphone 3+ and SHIFT5me and SHIFT6m. In October 2020 Apple announced to ship iPhones without charger and headset, and just to keep the USB- C to Lightning cable in the shipping box. Later on, Samsung followed with a similar unbundling approach for selected smartphone models.

Different ownership models for mobile phones

The preparatory study, as well as this impact assessment report, are focused on a 'traditional' ownership model (the user buys and owns the device). Ownership models such as free/subsidised phones for subscriptions with mobile phone operators are not infrequent, however:

- it is difficult to analyse and model them, due to the huge variability at national level, and at the level of the contractual relationships[25]
- many types of subscriptions with mobile operators foresee contractual relations which are basically equivalent to buying the product (i.e. the user becomes the owner, and/or he/she must pay the monthly subscriptions for a minimal number of months, a relevant part of which is de facto a deferred payment for the phone plus a fee for the use of the network).

Estimating the market share of mobile phones bought by/via telecom operators is not straightforward, with high variability at national level, and on the typology of contractual solutions. It can be considered that around 25%-35% of products are bought via the telecom operators.

With 'Product-as-a-Service' business models, the client no longer assumes the risk of product failure or the responsibility for maintenance as these are typically included with the service. As the client does not necessarily need to purchase the product, the client does not need to make large capital expenses (and assume the risk of losing the financial investment) but smaller operating expenses. The fact that the client no longer assumes the risk of product failure or the responsibility for maintenance does not necessarily reflects in a lowered lifetime of the product. Within the public consultation (see Annex 2) carried out in relation to the two initiatives[26] under analysis in this impact assessment, some questions were specifically related to the reasons for which the respondent's previous smartphone is no longer in use. The need for fast/better performing /new devices, as well as the lack of

[25] Product-as-a-Service (PaaS) business model allows customers to purchase the services and outcomes a product can provide, rather than the product itself. There may be different PaaS business model scenarios. In one scenario, the manufacturer owns and maintains the product, and the customer leases it for use or subscribes to a menu of services. In other scenarios, the customer owns the product, but is not responsible for maintenance (or such responsibilities are divided according to the license agreement or warranty). In all cases, the manufacturer uses the product as a platform for delivering additional services to the customer.

[26] 'Designing mobile phones and tablets to be sustainable – ecodesign' and 'Energy labelling of mobile phones and tablets – informing consumers about environmental impact'

availability of software and firmware updates, and the high repair prices, were among the most common replies. Only 5% of the respondents motivated their choice of buying a new device, because it was being offered under the contract with the network operator. Similar low results were obtained in other survey, as the one referred to in Figure 66 of the preparatory study.

The environmental perspective

Numerous lifecycle assessments (LCA) of mobile phones and tablets exist and all of them show that the electronic components in phones cause the main environmental impact (production phase). The following table shows a comparison of different LCA results with respect to GWP (in %).

Table 15: Comparison of different LCA results with respect to GWP (in %) (Berwald et al. 2020)

Product Group	Product Reference	Prod.	Use	Distr.	EOL	Source
Smartphones	Fairphone 2	82%	14%	7%	-3%	Proske M. et al. 2016
	Apple iPhone 8	80%	16%	3%	1%	Apple 2017
	Apple iPhone XR	76%	19%	4%	1%	Apple 2018
	Google Pixel 3XL	71%	22%	6%	1%	Google 2018
	Sony Z5	78%	13%	10%	-1%	Ercan et al. 2016
Tablets	iPad—6th generation (32 GB)	82%	13%	4%	1%	Apple 2018
	iPad - 7th gen	79%	14%	6%	1%	Apple 2019

Smartphones and tablets contain precious, critical and conflict minerals. Gold can be found in electronic components, printed circuit board finish as well as connectors or contact pads. Tantalum is the main component of some capacitors. The number of tantalum capacitors usually ranges between 2 – 7, but some phones (e.g. Fairphone 3) also don’t use tantalum capacitors at all (European Commission 2021). Electrical components are soldered on the PCB, mainly through solder alloys with tin as main constituent as well as silver and copper. Furthermore, many other elements such as platinum and palladium are used in the devices. Next to gold, tantalum and tin, smartphones also contain tungsten, which can be a potential conflict material (3TG). Tungsten is used in very small amounts in semiconductors and in more significant amounts in the vibration alert modules. It has to be noted that the overall use of tungsten in mobile devices is only a marginal share of the overall global demand for tungsten.

Nowadays, most of the smartphones and tablets contain lithium ion or lithium polymer batteries. For these batteries lithium cobalt oxide is often used as the positive electrode in the battery (although other transition metals are sometimes used instead of cobalt). A large share of the mined cobalt production stems from the Democratic Republic of Congo (around 50%), where a significant amount of the material is mined through unregulated artisanal and small-scale mining practices (Cordella et al. 2020). The negative electrode is mostly formed from carbon in the form of graphite (European Commission 2021).

Another element used in smartphones and tablets is indium that can be found as transparent indium-tin-oxide layer (ITO) in displays. Furthermore, Gallium is used in Power Amplifiers (PAs), usually as GaAs III-V semiconductor material, to amplify voice and data signals to the required power level allowing the transmission to the network base-station and in LED-backlights (Manhart et al. 2016). Magnets can be found in microphones and speakers. These are often neodymium-iron-boron alloys, although dysprosium and praseodymium are also often present in the alloy and can also be found in the motor of the vibration unit of the phone, where tungsten is used as rotating component (European Commission 2021). A large variety of plastics is also used in smartphones and tablets (ABS, PC, TPU, TPE, PMMA, PA, PP, silicone rubber, etc.), but they have a relatively low environmental impact when compared to the other materials (European Commission 2021).

Modularity of certain components can facilitate repair, but a modular design usually comes with a slightly higher environmental impact during manufacturing when compared to a non-modular device. This is due to additional board-to-board connectors, sub-housing of the modules and more PCB area for the connectors (Proske et al. 2016). However, this additional environmental impact during the manufacturing phase can be compensated through an extended lifetime which modularity can enable. The following analysis from the Fairphone 3 LCA shows the potential of a modular and therefore repairable/upgradable design as compared to a baseline scenario. In repair scenario A, faulty modules are assumed to be replaced by new ones, taking advantage of modular design. In repair scenario B, it is assumed that some of the faulty modules are repaired at board-level, allowing for replacement of specific components. A per-year comparison of the results are shown in the following Figure. The benefits from both repair scenarios are highly dependent on the related use phase extension.

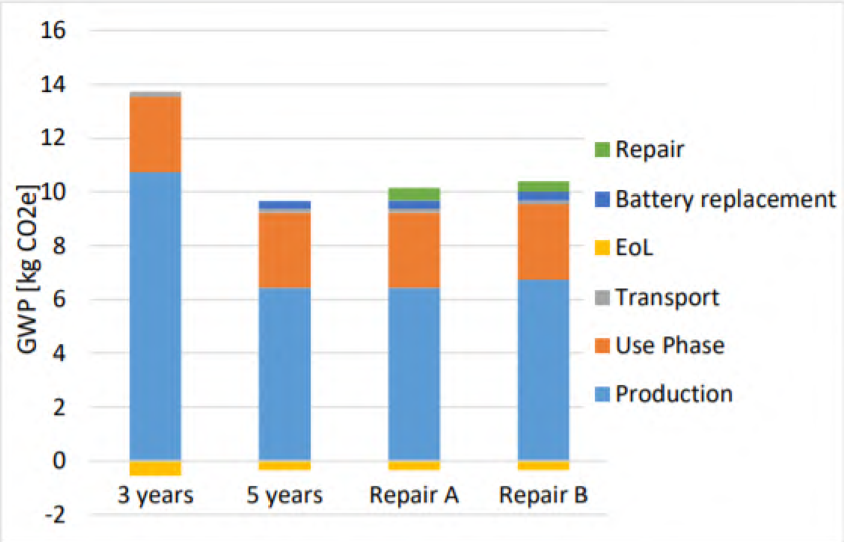


Figure 17: Relative impact per year use for the impact category GWP (Proske et al. 2020b)

These results were also confirmed during the Base Case modelling exercise of the ecodesign preparatory study. The following figures show the environmental indicators for a mid-range smartphone (Base Case 2) and a tablet (Base Case 6).

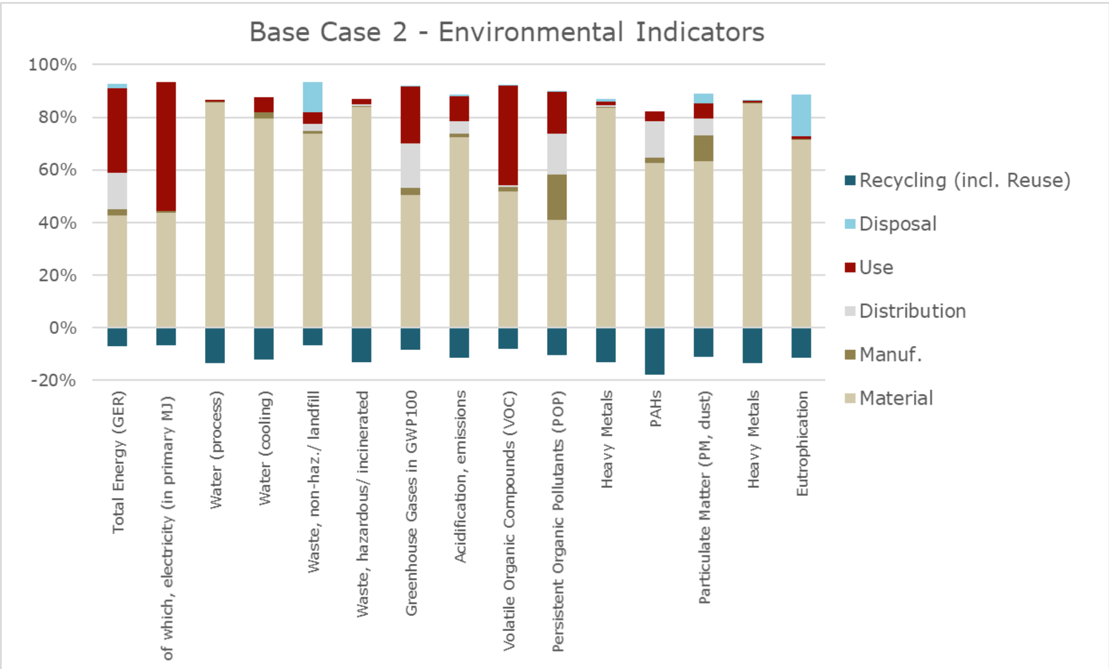


Figure 18: Mid-range smartphone (Base Case 2) - Relative contribution of the life cycle stages based on the EcoReport LCA results

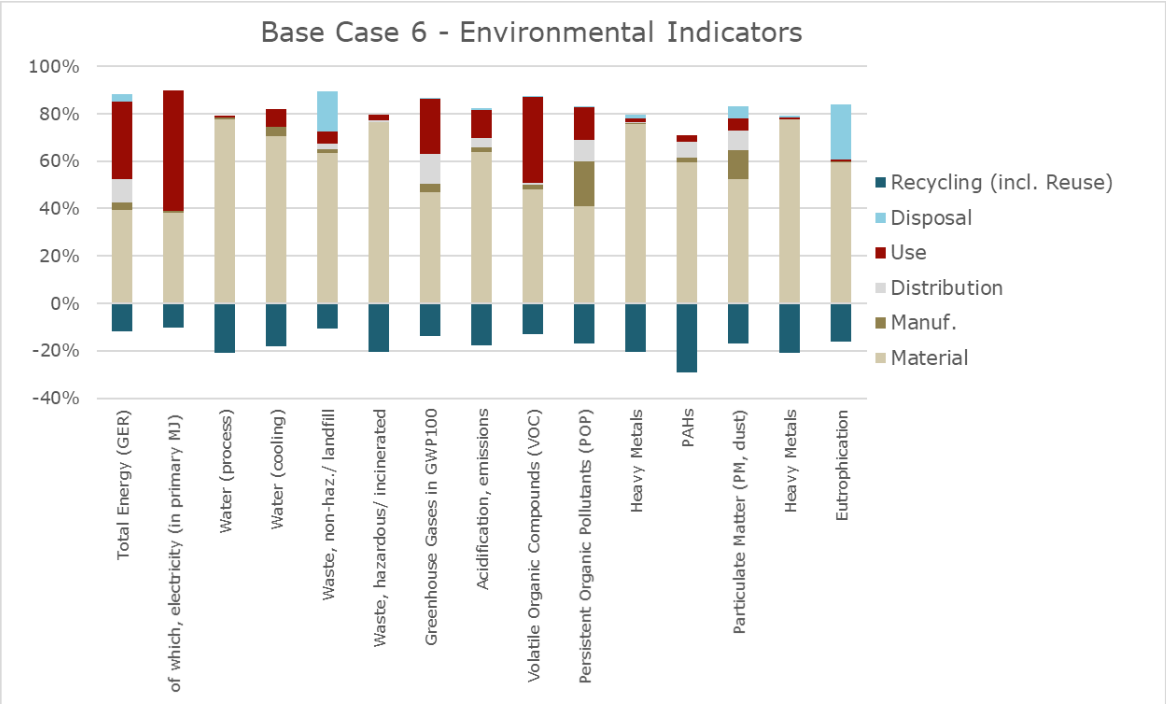


Figure 19: Tablet (Base Case 6) - Relative contribution of the life cycle stages based on the EcoReport LCA results

Despite the small product size distribution impacts significantly contribute to the overall environmental impacts. Due to the short innovation cycles, a major share of devices is shipped by air cargo from the region, where product assembly takes place (typically East Asia), to the EU.

Since the main impact is related to the product manufacturing, prolonging the use time (number of years) has a high potential to reduce the overall environmental impact. This can be reached through more robust design, better reparability, longer battery lives and modularity of certain components.

Recycling sector and recyclability rate

Most of the European WEEE recyclers are small and medium-sized companies (SMEs) and many of them are members of the European Electronics Recyclers Association (EERA). EERA members process around 2.2 million tonnes of WEEE per year, ca. 2/3 of overall WEEE accounted for as treated in compliance with legislation in the EU. Together with the supply chain of collectors, transporters, sorters, the WEEE reuse, recycling and reprocessing industry provides jobs for more than 10.000 people in the EU[27].

The recyclability rate at end of life of smartphones, mobile phones other than smartphones and tablets is rather low in terms of a mass-based recycling rate as only some materials are

[27] Source: https://www.eera-recyclers.com/recyclers

recovered through typical recycling processes. These recycled materials are however those, which constitute the majority of the material value (not component value). The usual end of life process is an extraction of the battery, and all remaining parts are recycled in a copper or precious metal smelter (integrated smelter). As the smelters require the pre-processors to extract the battery first, this is done regardless how difficult this is. Integrated batteries are extracted by brute force, breaking the device open and ripping off the battery. The smelters accept all the remainder of the phone or tablet as a high-value fraction. This is due to the fact, that precious metals are scattered all over the device and found also in the display, flex printed circuit boards, connectors etc. Not to lose this share of precious metals all this is meant to go as one fraction to the smelter.

EN 45555:2019 "General methods for assessing the recyclability and recoverability of energy-related products" defines the framework to develop product group specific recyclability rates, which could be specified as a specific or generic ecodesign requirement. Pre-condition is the definition of a reference end-of-life treatment scenario, which is supposed to reflect typical end-of-life processes. Given the explanation above such a flow chart looks as follows.

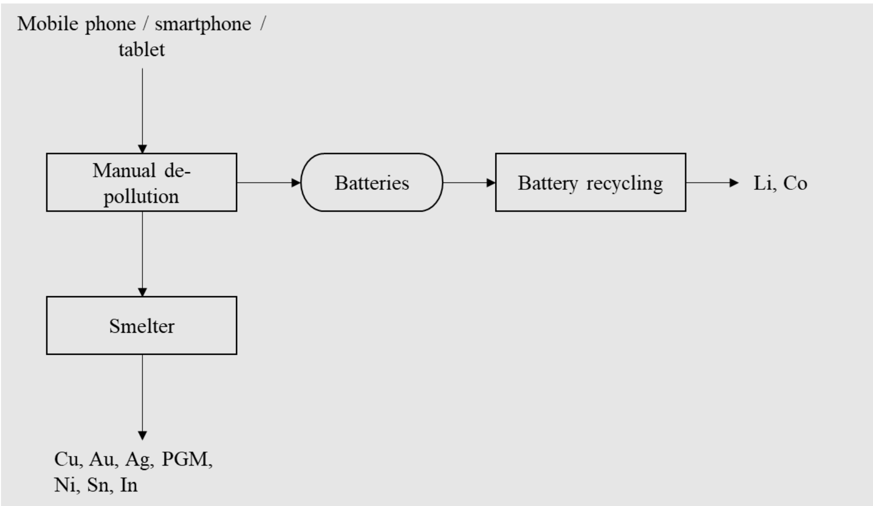


Figure 20: Flow chart for an end-of-life process for mobile phones and tablets

Recovery rates for most recovered metals is above 90%, and up to 99% for some precious metals. Only the recovery rate for indium is significantly lower as it is partly lost in the slag (Chancerel et al. 2016).

Under these conditions there is not much room to manoeuvre to improve the recyclability rate by design, except for increasing the weight share of the recyclable materials, copper being the only one – besides the battery materials -, which could make a significant difference. Or, vice versa, reducing the share of all non-recoverable materials, which are basically all usual housing and frame materials (plastics, aluminium, steel, ceramics, glass).

Fairphone published a comprehensive analysis demonstrating the benefits of a modular design, in case the product is dismantled accordingly at end of life (Fairphone 2017). Then the display unit can be separated for light-metal recycling (as the display backside is an aluminium plate), the plastic back cover turned into a plastics recyclate, and battery to battery recycling, and all other parts to copper recycling or an integrated smelter. In such a scenario a significantly higher recyclability rate can be achieved, but this scenario does not materialise in current pre-treatment processes: The display unit as a composite part will hardly be separated for aluminium recycling, although Fairphone's analysis shows some merit in doing so. The plastics back cover might be separated as it happens to be a separate part anyhow when removing the battery – just as with feature phones.

With sophisticated dismantling processes as demonstrated by Apple separation of further material fractions from smartphones is feasible (Apple Inc. 2019), but as this is not established recycling practice and as the capacity of Apple to process phones is only a fraction of Apple's market share, this cannot qualify as a reference end-of-life treatment scenario in the sense of EN 45555:2019.

The following table lists an approximate material composition derived from the preparatory study, representing base case 2, a mid-range smartphone.

Table 16: Approximate material composition of a mid-range smartphone

Smartphone composition roughly corresponding with mid-range devices (i.e., base case 2 in preparatory study)				**Recycling in typical EoL processes** (Umicore electronics and battery recycling processes)		**Design for (optimised) Recycling**: optimised manual dismantling and recycling processes ("Fairphone 2 scenario")		**Robots disassembly**: optimised robotics dismantling and recycling processes ("Apple scenario")	environmentally highly relevant materials
Plastics	15,9%	Plastics	15,87%	Copper / precious metal smelter*	energetic recovery	Plastics recycling (backcover only)	8%		
						Copper / precious metal smelter (PCB material)			
Glas	15,9%	Glas	15,87%	Copper / precious metal smelter		light-metal recycling (display assembly only)			
						Copper / precious metal smelter (PCB material)			
Ceramics	0,3%	Ceramics	0,34%	Copper / precious metal smelter		Copper / precious metal smelter			
Ferrite	0,8%	Ferrite	0,82%	Copper / precious metal smelter*		Copper / precious metal smelter*			
other	3,4%	other	3,43%	Copper / precious metal smelter*		Copper / precious metal smelter*			
Metals	51,2%	Aluminum	16,42%	Copper / precious metal smelter*		light-metal recycling (display assembly only)	8%	16,42%	
						Copper / precious metal smelter			
		Magnesium	10,30%	Copper / precious metal smelter		light-metal recycling (display assembly only)	5%		
						Copper / precious metal smelter			
		Steel	8,11%	Copper / precious metal smelter*	reducing agent	Copper / precious metal smelter*	reducing agent	8,11%	
		Copper	5,97%	Copper / precious metal smelter*	5,97%	Copper / precious metal smelter*	5,97%	5,97%	
		Neodymium	0,89%	Copper / precious metal smelter		Copper / precious metal smelter		0,89%	+
		Tin	0,62%	Copper / precious metal smelter	0,62%	Copper / precious metal smelter	0,62%	0,62%	
		Tungsten	0,34%	Copper / precious metal smelter		Copper / precious metal smelter		0,34%	
		Nickel	0,03%	Copper / precious metal smelter	0,03%	Copper / precious metal smelter	0,03%	0,03%	
		Silicon	0,07%	Copper / precious metal smelter		Copper / precious metal smelter			
		Gold	0,002%	Copper / precious metal smelter	0,002%	Copper / precious metal smelter**	0,00%	0,00%	++
		Tantalum	0,01%	Copper / precious metal smelter		Copper / precious metal smelter			
		Indium	0,01%	Copper / precious metal smelter	0,01%	Copper / precious metal smelter	0,01%	0,01%	
		Palladium	0,01%	Copper / precious metal smelter	0,01%	Copper / precious metal smelter	0,01%	0,01%	++
		Gallium	0,0003%	Copper / precious metal smelter		Copper / precious metal smelter			
		Silver	0,02%	Copper / precious metal smelter	0,02%	Copper / precious metal smelter	0,02%	0,02%	+
		Cobalt	5,50%	Battery extraction and recycling	5,50%	Battery extraction and recycling	5,50%	5,50%	
		Lithium	2,86%	Battery extraction and recycling	2,86%	Battery extraction and recycling	2,86%	2,86%	
Graphite	12,5%	Graphite	12,50%	Battery extraction and recycling		Battery extraction and recycling			
				* = minor amounts also to battery recycling	**15%**	** = minor losses to light-metal recycling	**approx. 36%**	**41%**	
								this sum is a theoretical value as Apple's robot is optimised for iPhones and Mg, plastics and other materials are contained in much lower amounts in iPhones than in this mid-range average device modelled here	

Neglecting the actual recovery rates in metallurgical processes, the current recycling rate for smartphones is roughly 15%, mainly driven by copper recycling, followed by cobalt and lithium recycling from batteries. With the modular design approach of Fairphone, combined with a partly theoretical end of life scenario the recyclability rate is at approximately 36%, with a more plausible value of approximately 23% ignoring the potential to feed the display unit into light-metal recycling. With the Apple approach of robotics for smartphone dismantling a recycling rate of approximately 41% might be feasible, not implementing any distinct design measure to enhance recyclability.

This leads to the insight, that a recyclability rate of 20% might be set as a feasible specific requirement under the conditions, that the reference end-of-life scenario anticipates a recycling of all recyclable mono-material parts (i.e., aluminium, steel, magnesium, plastics, all with a very low amount of any other materials) separated (i.e., fasteners being clips, sliders or similar which result in a full separation) when removing the battery with destructive means. Actually, 20% is likely to be achieved in fact *only*, if such a larger mono-material part is removed, otherwise it will be extremely challenging to meet this criterion. Theoretical design measures to meet a recyclability rate of 20% could be:

- larger batteries (negative effect on manufacturing impact, but positive impact on device lifetime);
- more light-weight housings to reduce overall product weight (which could have an adverse effect on robustness);
- more copper or brass use instead of other metals.

Given the rather low difference in recycling rates (15% as status-quo and 20% as an already ambitious specific requirement) such a criterion rather qualifies as a generic information requirement, with requiring to state the recyclability rate as such or ranges of <10%, 10 - <20%, 20 - <30%, >30%. The latter without any known existing design. Furthermore data points on exact material composition of products are very limited and frequently refer to end-of-life analysis.

The reference end-of-life scenario is defined as

- Battery: Co, Li ($R_{cyc,Li}$ 50%) masses count towards recyclability rate;
- Mono-material parts removed when extracting the battery: Steel, Al, Mg, plastics or copper masses count towards recyclability rate;
- All other parts: Cu, Co, Sn ($R_{cyc,Sn}$ 50%), Ni ($R_{cyc,Ni}$ 85%), In ($R_{cyc,In}$ 50%), Au, Ag, PGM ($R_{cyc,PGM}$ 95%) masses count towards recyclability rate.

Material specific recyclability rates derived from (Deubzer 2007; Velázquez-Martínez et al. 2019), rounded values.

The recyclability rate is calculated according to EN 45555:

$$R_{cyc} = \frac{\sum_{k=1}^{n} (m_k \cdot R_{cyc,k})}{m_{tot}} \cdot 100\ \%$$

This is a mass-based calculation. EN 45555 also allows for an environmental weighting of recyclable materials, following the White Paper “Quantitative environmental benefits of recycling and energy recovery" (Wolf 2018). Actually, the recycling of precious metals is most important from an environmental perspective, but as this is done anyhow due to the outstanding economic value, no further incentive in this direction is needed.

Part 2: LEGAL BASIS FOR EU ACTION

The Ecodesign Directive and Energy Labelling Regulation are framework acts and both include a built-in proportionality and significance test.

Ecodesign

With regard to the Ecodesign Directive, Article 15(1)-(2) provides that a product shall be covered by an ecodesign or a self-regulation measure if the following conditions are met:

i. the product represents significant volume of sales in the EU;
ii. the product has significant environmental impact within the EU;
iii. the product presents a significant potential for improvement without entailing excessive costs, while taking into account:
    - an absence of other relevant Union legislation or failure of market forces to address the issue properly;
    - a wide disparity in environmental performance of products with equivalent functionality.

The first criterion (representing a significant volume of sales, indicatively more than 200.000 units a year) is clearly satisfied in the case of mobile phones and tablets. According to the preparatory study, EU sales of mobile phones were forecasted as 141 million units in 2021. In addition, 13 million cordless phones and 23 million tablets were expected to be sold in 2021.

Concerning the second criterion, it should first be noted that what needs to be established is that the environmental impacts in the EU are significant as compared to the overall environmental impacts taking place in the EU. It is not necessary that those impacts are significant from the perspective of overall impacts stemming from the life cycle of the relevant product (i.e. relative to those taking place in third countries). With this in mind, it should be noted that:

- the life cycle environmental impacts related to smartphones and tablets are considerable. Of particular importance are the climate change impacts stemming from Greenhouse Gas Emissions (GHG) and acidification impacts. As calculated within this impact assessment report, the life cycle greenhouse gas emissions of this product group are equal to 0.18% of the total EU emissions. It is true that a relevant share of these emissions originates outside the EU. However, the resulting environmental impacts frequently have a global dimension and have clear and noticeable effects inside the EU. Especially when it comes to climate change, there is strong scientific evidence[28] supporting not only the relevance of the impacts and their dramatic

[28] Only quoting a few examples:

consequences, but also that those consequences take place across the world, including the EU, irrespective from where the emissions take place.

- in addition to the impacts originating from the manufacturing phase, there is also a considerable share of environmental impacts stemming from the use phase, in particular the impacts linked to energy consumption. The yearly energy consumption in the use phase amounts to ~10TWh (~35 PJ) for all the four product segments analysed in this IA. This is equal to 0.38% of the total EU electricity consumption. It also means that (as shown in the preparatory study estimations), the GHG emissions linked to the use phase are in the range of 25-27% for smartphones and 31% for tablets (compared to total GHG emissions throughout the lifecycle). This means that, in absolute terms, the GHG emissions and energy consumption related to the use phase are higher than for other products covered by existing ecodesign measures[29], for which it was concluded that there are significant environmental impacts within the EU[30].
- At the end of life, all the relevant products placed on the market translate into several thousands of tonnes of device materials to be disposed. These materials eventually end up in recycling, landfilling, incineration, etc. These processes happen in the EU, and it is well known that waste processing can contribute to climate change, soil and air pollution, and directly affects many ecosystems and species[31]. The IA estimates that in 2030, for the 4 product segments analysed in this IA, the material consumption is expected to be in the order of 120.000t, with the preferred policy option estimated to foster a decrease of 35-40%. This will also lead to a significant decrease in the amount of waste to be managed.

Given the above points, it can be concluded that there are significant environmental impacts within the EU.

Concerning the third criterion, and in particular with reference to the 'wide disparity in environmental performance of products with equivalent functionality', it can be noted that the present impact assessment report, as well as the preparatory study, clearly show that such a disparity exists. In particular, it is shown that the devices are, in many cases, put out of use (to go to hibernation or disposal) prematurely (in the case of smartphones, the

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- Regulation 2021/1119 on achieving climate neutrality states: "Climate change is by definition a trans-boundary challenge'.
- 'Climate change is already affecting every inhabited region across the globe' (Summary for Policymakers IPCC, 2021: Summary for Policymakers)
- 'Transboundary air pollution (generated in one country and impacting in others) makes a major contribution to acidification and summer smog', EEA (https://www.eea.europa.eu/publications/92-9157-202-0/page304.html)

[29] See for instance the Commission Regulation (EU) 2019/1784 laying down ecodesign requirements for welding equipment.

[30] The impacts related to the energy consumption of the use phase are primarily covered by the option of an energy label. Under the draft Ecodesign requirements, specific requirements concerning the battery management systems are also aimed to improve the energy performance of the product.

[31] See e.g, for a description of the various effects: Huisman, J., Stevels, A., Baldé, K., Magalini,F., Kuehr, R.3 "The e-waste development cycle, part II - Impact assessment of collection and treatment (Chapter 3).

average lifetime of devices is 3 years). Prolonging their lifetime in active use allows a tangible decrease of the environmental impacts associated with the device. In quantitative terms, as estimated in this impact assessment, an increase in lifetime of smartphones of for instance 15 months (compared to the 3 years of the baseline) can bring about reductions in the various environmental impacts categories (GHG emissions, total energy, material consumption) of at least 30%. This can be achieved without otherwise affecting functionality[32]. Furthermore, with reference to the 'absence of other relevant Union legislation or failure of market forces to address the issue properly', it can be noted that:

- no other Union legislation regulates directly the aspects of environmental sustainability of mobile phones and tablets covered by the initiatives discussed in this impact assessment, as shown in detail under Annex 6;

as shown in the 'problem definition' section of the main report, there are currently no indications that manufacturers would drastically change their product design towards more reliable and repairable devices (apart from the limited effect of self-repair schemes and eco-ratings, as discussed in sections in sections 5.1 and 5.2 of the main report).

[32] An increase in durability from 36 to 51 months (with unaltered product functionality) implies that per year less than one quarter of the stock is replaced as opposed to one third, which corresponds to a reduction of annual sales by 30%.

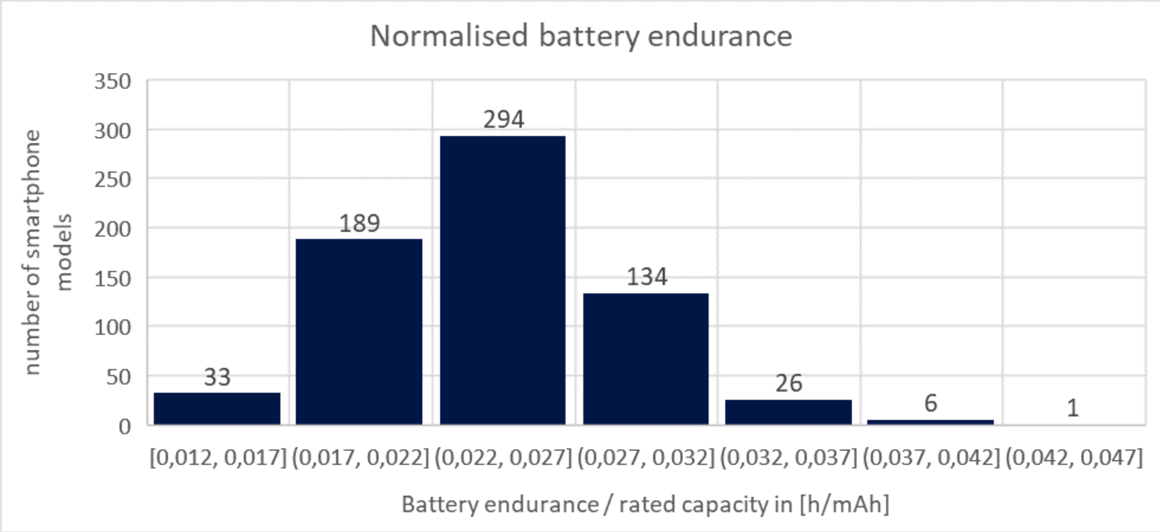
Energy Labelling

The Energy Labelling Regulation includes, in its Article 16, similar criteria for products to be covered by an energy label:

- the product group has significant potential for saving energy and where relevant, other resources;
- models with equivalent functionality differ significantly in the relevant performance levels within the product group;

Concerning the first Energy Labelling criterion (*a significant potential for saving energy or other resources),* it should be noted that:

- as calculated in this impact assessment, the increase in lifetime of smartphones attainable by means of an energy label can bring reductions in certain environmental impacts categories (GHG emissions, total energy) of an estimated 10%. In relative terms, this is certainly less than the impact from the Ecodesign option. However, in absolute terms it still qualifies as significant, as the estimated energy savings (related to the use phase) that could be associated only to an Energy Label for smartphones and tablets are in the order of 3 TWh/y in 2030 (see the section on the 'preferred option'). This is a similar value to other already existing Energy Labelling Regulations, such as Regulation 2015/1094 on professional refrigerators.
- as shown more in detail in Annex 9, the energy label for smartphones and tablets would give relevant quantitative information also on the material efficiency aspects (on top of the information on energy use). Therefore, on top of promoting energy efficient devices, the label would also facilitate the purchase of devices that are durable (thanks to the information on the battery long term performance, on the water and dust protection rating, and on the impact resistance) and/or reparable (thanks to the reparability scoring). This is explicitly foreseen in the framework. Article 16(3)(c) and related recital 36 of the Energy Labelling Regulation explicitly foresee the inclusion in the label of supplementary information on the performance of a product other than energy consumption, such as on its durability and environmental performance, with a view to promoting the circular economy.



Concerning the second Energy Labelling criterion (*that models with equivalent functionality differ significantly in [energy] performance levels*), the evidence in support of the conformity with this criterion stems from the following observation: in the course of the preparatory study, an Energy Efficiency Index (EEI) for smartphones and tablets was developed[33]. An analysis of the values of the EEI indexes for various devices on the market, (see figure above) clearly shows the spread of the various energy performance levels, thus confirming the significant differences (in relative terms) between the best and the worst performers.

In a conceptually similar manner, it can be argued that *models with equivalent functionality differ significantly in performance levels* also with regard to the durability aspect, which is the one targeted by the icons (battery long term performance, water and dust protection rating and impact resistance) below the EEI index in the energy label (described more in detail under Annex 9). As shown in the preparatory study, the lifetime in use for the smartphones and tablets varies between 1 and 9 years, with most of the users keeping these products in active use for a period between 3 and 6 years[34]. Assuming that the user keeps the product in active use as a proxy of the fact that the product is regarded as (still) functional, it soon emerges how wide the range of the durability is for these products (this is accompanied by relevant differences in terms of the environmental impacts, as discussed above, for the third Ecodesign criterion).

Based on the above analysis, it can be concluded that the proportionality requirements laid down in the Ecodesign and Energy labelling frameworks are met in the case of potential measures on mobile phones and tablets[35].

[33] The EEI index developed during the preparatory study is not exactly the same of the EEI index currently defined (i.e. the one shown in the annex of the label design), as some updates/improvements have been introduced, but conceptually the methodology for calculating the EEI index is unchanged.

[34] Similar results were obtained within the public consultation (see Annex 2) carried out in relation to the two initiatives under analysis in this impact assessment: a question was posed, to understand for how long did respondents use their last device. Nearly 45% of respondents used it for less than 3 years, whereas nearly 39% used it between 3 and 5 years.

[35] Please note that the energy label for smartphones and tablets is proposed – as argued in the text - in line with the rules laid down in Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017

setting a framework for energy labelling. This is without prejudice to the ongoing preparatory work related to the Ecodesign for Sustainable Products Regulation, which includes the revision of Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products, which is – inter alia - assessing the potential to set labelling requirements in relation to material efficiency aspects of products.