**Impact Assessment Study to Assess Unbundling of Chargers**

Final report



EUROPEAN COMMISSION

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B-1049 Brussels*

Final Report

Impact Assessment Study to Assess Unbundling of Chargers

*Printed by [XXX] in* *[Country]*

Printed on elemental chlorine-free bleached paper (ecf)

Printed on totally chlorine-free bleached paper (tcf)

Printed on recycled paper

Printed on process chlorine-free recycled paper (pcf)

Manuscript completed in [Month] [Year]

[Revised/Corrected/nth] edition

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| --- | --- | --- | --- | --- |
| Print | ISBN [number] | ISSN [number] | doi:[number] | [Catalogue number] |
| PDF | ISBN [number] | ISSN [number] | doi:[number] | [Catalogue number] |
| EPUB | ISBN [number] | ISSN [number] | doi:[number] | [Catalogue number] |
| HTML | ISBN [number] | ISSN [number] | doi:[number] | [Catalogue number] |

Luxembourg: Publications Office of the European Union, [Year]

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Executive Summary

This study was carried out within the context of the “Common Charger” initiative, on which the European Commission has been working for more than ten years. Since the outset, its rationale has been to reduce the level of fragmentation of charging solutions for mobile phones (and potentially other small electronic portable devices), in order to enhance consumer convenience and reduce unnecessary electronic waste. In 2009, the main mobile phone manufacturers signed a Memorandum of Understanding to harmonise chargers for data-enabled mobile telephones sold in the EU. Ever since this expired in 2014, the Commission has been trying to foster the adoption of a new voluntary agreement. However, to date, no solution that would be acceptable to both the industry and the Commission has been found.

About this study

The purpose of the present study is to further strengthen the evidence base for a possible Commission proposal in the context of the “Common Charger” initiative. It focuses on updating, further refining and filling gaps in the results of the previous impact assessment (IA) study carried out in 2019,[[1]](#footnote-1) by focusing on a set of issues of key interest, namely (1) unbundling – how could the marketing of mobile phones without chargers be facilitated or mandated, and what would be the impacts thereof?; (2) other portable electronic devices – which devices (in addition to mobile phones) could be encompassed within the initiative?; and (3) additional technical analysis of the main features of chargers.

The study was carried out by Ipsos and Trinomics (on behalf of a consortium led by Economisti Associati). It is based on research and analysis undertaken between November 2020 and May 2021. Similarly to the first IA study carried out by the same team, the study employed a mixed-methods approach. The sources of evidence include primary data (collected via a series of in-depth interviews with key stakeholders, a survey of a representative panel of consumers, and a survey of stakeholders) as well as secondary data (including statistics, market data, and literature on a wide range of relevant issues). Where possible, key impacts were estimated quantitatively based on a tailor-made dynamic model of the stock of chargers. Other impacts were assessed qualitatively.

The problem to be addressed

There are two main problems the initiative seeks to address: consumer inconvenience and environmental harm.

**Consumer inconvenience** is caused by the remaining fragmentation of charging solutions available in the market, and by the lack of choice as to whether they want to buy a new charger with their mobile phone. There is still fragmentation in the market in terms of connectors used at the device end (due to the co-existence of USB Type-C, USB micro-B, and Apple’s Lightning connector). As regards battery charging protocols, there appears to be near universal interoperability among the solutions on the market today (including the different versions of USB charging technology, as well as proprietary solutions developed by QualComm, Huawei and Oppo) – meaning all mobile phones sold nowadays can be charged safely with any external power supply (EPS) from a reputable manufacturer. However, the speed of charge can vary significantly depending on the combination of phone and EPS that is used.

The additional stock of chargers available also generates unnecessary **use of raw materials, GHG emissions and e-waste** when chargers are discarded. This problem is alleviated to some extent by the fact that several manufacturers have recently started selling mobile phones unbundled from the EPS (although they continue to bundle the cable). Therefore, the consequences of the problem are expected to decrease in the future, as the stock of chargers gradually reduces. However, the growing market share of fast charging EPS, which also tend to be heavier compared to non-fast charging EPS, risks offsetting this positive trend to some extent.

The policy options

The policy options as defined for this study comprise individual “measures” that would harmonise or address certain technical aspects related to chargers, or the way in which they are marketed. These options are not necessarily mutually exclusive, but could potentially be combined into a “package” of measures (for more on this, see below).

* **Option 1: Harmonise connectors on mobile phones**. This option would entail regulation to ensure all mobile phones have a receptacle for a USB Type-C connector. Proprietary connectors, or solutions that require adapters, would not be allowed.
* **Option 2: Require mobile phones to be compatible with USB charging technology**. This option would regulate to ensure all mobile phones incorporate communication protocols that are compatible with USB specifications, specifically USB Type-C for all mobile phones, as well as USB Power Delivery (PD) for phones that can charge at over 15 W. The inclusion of other (proprietary) charging technology in the phone would be permitted, provided USB PD is used when the phone is connected to a USB PD EPS.
* **Option 3: Require EPS for mobile phones to comply with USB interoperability guidelines**. This option would regulate to require all EPS for mobile phones to be compliant with USB interoperability specifications and communication methods, specifically the international standard IEC 63002:2021 (publication of which was pending at the time of writing). This requirement would apply to all EPS that are sold along with mobile phones, but not to EPS that are marketed separately.[[2]](#footnote-2)
* **Option 4: Mandatory unbundling of chargers from mobile phones**. This option would oblige all manufacturers to offer unbundled solutions, i.e. give all customers the option of purchasing a new mobile phone without an EPS (option 4.a), or even without either an EPS or cable (option 4.b). Ideally, the regulation should be drafted so as to make the phone *without* the charging equipment the “default” option. In principle, vendors would be free to offer charging accessories as an optional item at the point of sale, and to price these as they see fit.
* **Option 5: Voluntary interoperability labelling / information scheme**. This option would entail the creation and promotion of a labelling scheme to signal interoperability of EPS and phones with relevant USB specifications, and thereby to stimulate demand for and supply of unbundled solutions. This is a “soft” (i.e. voluntary) option – compliant / compatible EPS and phones could carry the label, but manufacturers would still be free to use other (proprietary) technologies (and therefore not participate in the scheme).

Assessment and comparison of impacts

The summary table below shows the impacts of the individual policy options, applied to mobile phones only, relative to the baseline. To facilitate comparison, a multi-criteria analysis (MCA) approach has been used, which has converted the impacts for which the study is able to provide quantified estimates (all of the environmental and some of the economic impacts) as well as the ones that were assessed qualitatively (the social and remaining economic impacts) into a common “currency” (from a “major positive” to a “major negative” impact).

Table 1: Summary of the main impacts of the policy options

| **Impacts** | | **Option 1** | **Option 2** | **Option 3** | **Option 4.a** | **Option 4.b** | **Option 5** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Harmonise connectors on mobile phones | Require phones to be compatible with USB technology | Require EPS for phones to comply with USB interop. guidelines | Mandatory unbundling of EPS | Mandatory unbundling of EPS and Cable | Interopera-bility labelling / information scheme |
| **Environ-mental** | GHG emissions | 0/- | 0/+ | 0/- | +/++ | ++ | 0/+ |
| Material use | 0/- | 0/+ | 0/- | +/++ | ++ | 0/+ |
| Electronic waste | 0/- | 0/+ | 0/- | + | +/++ | 0/+ |
| **Economic** | Cost to consumers | +/++ | + | + | - | - | 0/- |
| Gross profit of manufacturers of chargers | -/-- | 0/- | 0/- | - | -- | 0/- |
| Gross profit of distributors and retailers | -/-- | - | - | ++ | ++ | 0/- |
| Innovation | - | 0 | -/-- | 0 | 0 | 0 |
| Other impacts on competitiveness | - | 0 | 0/- | 0 | 0 | 0 |
| Operating costs and conduct of business | - | 0/- | - | 0/- | 0/- | 0/- |
| Costs to public authorities (EU) | 0 | 0 | 0 | 0 | 0 | -/-- |
| Impacts on SMEs (EU) | 0/- | 0/- | 0 | 0 | 0 | 0 |
| **Social** | Consumer convenience | + | + | + | -/-- | -- | + |
| Product safety & illicit markets | 0/+ | 0/+ | 0/+ | -/-- | -- | 0/+ |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. *++ Major positive impact* | 1. *+ Minor positive impact* | 1. *0 No or negligible impact* | 1. *- Minor negative impact* | 1. *-- Major negative impact* |

The main impacts shown in the table can be summed up as follows:

* **Environmental impacts:** As can be seen, options 1, 2, 3 and 5 only have very minor, potentially negligible (no more than 1.5% change compared with the baseline) impacts on the environment, as they are expected to lead to very small changes in the *number* of chargers sold, as well as, in some cases, to changes in the *types* of chargers sold (with very minor impacts on their weight and composition). From an environmental perspective, unbundling is the only intervention that offers major benefits. However, compared with the estimates in the first IA study, these benefits are smaller than anticipated (between 3% and 9% reduction in environmental impacts for option 4.a, and between 10% and 20% for option 4.b, compared to the baseline) due to the fact that a part of the market has begun to sell phones without EPS voluntarily.
* **Economic impacts**: From an economic perspective, the option that generates the most savings for consumers is option 1, due to the savings from switching from (more expensive) Lightning cables to USB Type-C cables, and the reduction in standalone sales of cables (Lightning cables are replaced more frequently than standard cables, according to the results of the consumer survey). This option delivers relatively high economic costs for manufacturers and distributors, and may slightly constrain innovation.[[3]](#footnote-3) It may also entail minor economic costs for SMEs in the EU. Options 2 and 3 are relatively similar in terms of reducing costs for consumers, and generate similar costs for the industry. However, option 2 affects the competitive landscape less and does not constrain innovation. Options 4.a and 4.b deliver similar results, including small cost increases for consumers. Both options, but especially option 4.b, generate a loss of gross profit for manufacturers of chargers, given the reduced number of EPS and cables that would be sold in the EU.
* **Social impacts**: Options 1, 2, 3 and 5 are all expected to result in minor convenience benefits for consumers (each of them addresses the different sources of inconvenience to varying extents), as well as very small improvements in terms of product safety and illicit markets (mainly due to the expected very small reduction in stand-alone charger sales). For the mandatory unbundling options, the conclusion is the opposite: these would reduce consumer convenience overall (especially option 4.b), since the convenience gains for consumers who are keen to have fewer chargers are outweighed by the inconvenience for the majority of consumers for whom the provision of a charger along with new phones is important. They would also lead to higher stand-alone charger sales, some of which are likely to be counterfeit and/or substandard.

Combinations / packages of options

As noted above, the policy options are not necessarily mutually exclusive, but could be combined into a “package” of measures. There are five main combinations: option 1 can be combined with either option 2 or 3, as well as with option 4; option 2 could also be combined with option 4.

By and large, when combined, the impacts of the different options would “stack”, meaning the cumulative impacts of the packages of options can be expected to be equal to the sum of the impacts of the options individually. However, there are some exceptions to this, namely:

* Options 1, 2 and 3 would all lead to the elimination of USB micro-B connectors from all mobile phones (among other effects). When combined, the specific effects of this would obviously only accrue once, meaning the (positive as well as negative) impacts of the package would be slightly smaller than the sum of the impacts of the relevant options individually.
* If any of the “harmonisation” options 1, 2 or 3 is combined with mandatory unbundling (option 4.a or 4.b), there would likely be synergy effects that enhance the overall benefits of the relevant package to slightly beyond those of the options individually, as the enhanced interoperability and/or consumer awareness of this lead to a small reduction in demand for stand-alone chargers, because slightly fewer consumers would be likely to choose to purchase an EPS along with a new unbundled phone (options 2 and 3), and/or a new cable along with an EPS bought separately (option 1).

Option 5 (an interoperability labelling / information scheme) could serve as a flanking measure to *any* of the options or packages. We expect that its marginal effects when combined with any of these would always be in line with those of the scheme individually.

The table below provides a summary of the main impacts of the five packages, applied to mobile phones only, again using an MCA approach to combine impacts that have been estimated quantitatively and others that have been assessed qualitatively:

* **Environmental impacts**: Packages 3, 4 and 5 provide significant environmental benefits. These would be highest for package 5. Although they are in the same broad range as those of the other two (‘+/++’ for GHG emissions and material use, ‘+’ for e-waste), the estimated reductions (see chapter 7) are around 10% higher than for package 4, 30% higher than for package 3, and 50% higher than those that would result from mandatory unbundling (option 4.a) alone.
* **Economic impacts**: All packages except package 4 would lead to savings for consumers; these would be most significant under packages 1 and 2 (which do not entail mandatory unbundling). All packages (especially package 3) would reduce the benefits for charger manufacturers and wholesalers; packages 1 and 2 would also lead to reduced benefits for charger distributors and retailers, while packages 3, 4 and 5 would increase their benefits (due to the higher standalone charger sales). Package 4 is the one that generates the smallest negative impacts on the competitive landscape, innovation, and operating costs for the industry, whereas package 2 is the most disruptive, with significant impacts on innovation and operating costs. All the packages may generate small costs for SMEs in Europe as they all imply the move from USB micro-B connectors to USB Type-C.
* **Social impacts**: While packages 1 and 2 would have a minor positive effect on consumer convenience and lead to very small improvements in terms of product safety and illicit markets (for the same reasons as options 1, 2 and 3 individually), packages 3, 4 and (to a slightly lesser extent) 5 would have minor negative impacts. This is because the improvements from options 1 and/or 2 would be likely to alleviate, but not entirely offset the consumer inconvenience and increased demand for standalone EPS generated by mandatory unbundling.

Table 2: Summary of the main impacts of the packages of options

| **Impacts** | | **Package 1** | **Package 2** | **Package 3** | **Package 4** | **Package 5** |
| --- | --- | --- | --- | --- | --- | --- |
| Package combining PO 1 & 2 | Package combining PO 1 & 3 | Package combining PO 1 & 4a | Package combining PO 2 & 4a | Package combining PO 1, 2 & 4a |
| **Environ-mental** | GHG emissions | 0/+ | 0/- | +/++ | +/++ | +/++ |
| Material use | 0/+ | 0/- | +/++ | +/++ | +/++ |
| Electronic waste | 0 | 0/- | + | + | + |
| **Economic** | Cost to consumers | +/++ | +/++ | +/++ | 0 | + |
| Gross profit of manufacturers of chargers | -/-- | -/-- | -- | -/-- | -/-- |
| Gross profit of distributors and retailers | -/-- | -/-- | + | +/++ | +/++ |
| Innovation | 0/- | -- | 0/- | 0 | 0/- |
| Other impacts on competitiveness | - | -/-- | - | 0 | - |
| Operating costs and conduct of business | - | -/-- | - | - | -/-- |
| Costs to public authorities (EU) | 0 | 0 | 0 | 0 | 0 |
| Impacts on SMEs (EU) | 0/- | 0/- | 0/- | 0/- | 0/- |
| **Social** | Consumer convenience | + | + | - | - | 0/- |
| Product safety & illicit markets | 0/+ | 0/+ | - | - | 0/- |

Other portable electronic devices

As discussed in chapter 6 of this report, all of the options could potentially also affect certain types of other portable electronic devices beyond mobile phones (in particular tablets, headphones and earbuds, hand-held video game consoles, portable speakers, e-readers, smartwatches and fitness trackers):

* **Indirectly**, due to voluntary changes in manufacturer / vendor behaviour, shifts in consumer demand, or other relevant mechanisms that would “spill over” from mobile phones to the chargers of other devices (even though these would not be obliged to comply with the same rules or regulations).
* **Directly**, if the scope of the initiative was broadened to also apply to certain other devices. Not all options (and hence packages) are equally well suited to all categories of devices considered in this study. In particular:
  + Making USB Type-C connectors mandatory (option 1) would not be appropriate for smartwatches and fitness trackers due to their specific form and uses.
  + Harmonising communication protocols (options 2 and 3) would be problematic for devices that routinely charge at low wattages (including earwear and e-readers), or for devices with removable batteries (mainly digital cameras), as there would be insufficient benefits to justify the costs.
  + Making unbundling of EPS mandatory (option 4.a) for devices where this is already the norm (in particular earwear) would be possible, but would not result in any positive or negative impacts.
  + Out of the seven groups of portable electronic devices that were considered as part of this study, the three for which all options appear applicable without giving rise to any significant concerns (other than the negative impacts that also apply to mobile phones) are tablets, hand-held video game consoles, and portable speakers.

Overall, these indirect as well as potential direct effects would amplify the positive as well as negative impacts of the initiative as outlined above. The key drivers of impact are very similar to those that apply to mobile phones and their chargers, albeit with certain nuances for specific options and device categories. As regards the scale of these additional impacts, this would be smaller than for mobile phones, based mainly on the simple fact that far fewer such devices are sold and used in the EU than mobile phones.

Concluding remarks

Based on the analysis presented in this report, the only option for which the balance of benefits vs costs is relatively unambiguously positive is **option 2**. It provides modest benefits for consumers, as well as some very minor environmental benefits, with only very small cost implications for economic operators. Although, as discussed in detail previously, this option would only require phone manufacturers to make relatively small changes to their products (many of which are already fully compliant), and would not significantly enhance interoperability as such, it would nonetheless represent a step forward in terms of cementing the already existing, near universal interoperability of phones and chargers, as well as raising consumer awareness of this fact (if accompanied by effective flanking information requirements).

**Option 3** pursues a similar objective as option 2, but would be less effective overall, given that it would place more restrictions on proprietary fast charging solutions, and that it becomes less effective the more unbundling takes place (since it could only apply to “in the box” EPS). Nonetheless, the imminent publication of IEC 63002:2021 means this option is potentially worth exploring further in a broader context, as the basis for a possible future “universal EPS” initiative.

Regarding **option 1**, it is important to reiterate that, while option 2 would also imply the mandatory adoption of USB Type-C connectors at either the device or the EPS end (or both), option 1 would go beyond this by requiring USB Type-C connectors at the device end, and banning proprietary connectors entirely.[[4]](#footnote-4) As already described in the first IA study, this would generate both positive and negative impacts: it would imply minor benefits for consumers, but at a non-negligible cost for manufacturers, including a possible constraining effect on future innovation. When considering the option in isolation (i.e. not in a package), it also delivers negative environmental impacts. However, when combined with unbundling, we expect there to be small synergy effects that would improve the environmental performance (see below).

As regards the **unbundling options**, these imply very clear and obvious trade-offs – most importantly, significant environmental benefits vs a significant financial cost and loss of convenience for consumers. Whether the benefits outweigh and justify the costs is a political decision. Nonetheless, it is perhaps worth asking whether now is the ideal time to make unbundling mandatory, when significant parts of the market are already moving in this direction voluntarily, to some extent risking negative reactions from their customers. In the view of the study team, it could be argued that it might be more politically and practically expedient for the EU to observe the markets further, and consider regulating in due course, if unbundling does not progress as hoped, rather than step in now, and risk becoming the target of negative sentiment among consumers that would otherwise be directed at manufacturers.

As regards **option 5** (the voluntary interoperability labelling scheme), this would have the potential to bring non-negligible benefits, either on its own or in combination with any of the other options. It therefore seems worth pursuing further, i.e. launching consultations with relevant stakeholders to further explore if and how such a scheme could be designed, launched, managed and monitored, and potentially carrying out market research to test its likely acceptance by consumers, and what design features could help maximise its effectiveness.

When considering the packages of options, **package 5** would provide the best environmental results of all options and packages (except option 4.b), due to the expected synergy effects resulting in lower demand for standalone EPS as well as cables. It would result in minor savings for consumers, as well as additional benefits for distributors and retailers of chargers, at the expense of charger manufacturers and wholesalers, who would see their gross profits significantly reduced. Mobile phone manufacturers would face increased operating costs, in particular those that have invested in proprietary connectors as well as manufacturers of lower tier phones, and would have to re-design their products, packaging and/or business models (though this cost would be reduced if, as envisaged here, the new rules only apply to new models launched on the market after a given date, providing for an adequate transition period). Consumers would still be likely to be inconvenienced by this package, but the harmonisation elements it includes would alleviate the negative impact of unbundling to some extent.

1. Introduction

This document is the final report of Impact Assessment Study to Assess Unbundling of Chargers. The aim of this study is to provide input for the Commission impact assessment accompanying a new initiative to limit fragmentation of charging solutions for mobile phones and similar devices, while also looking at the environmental impacts, and in particular at the potential for unbundling, i.e. the selling of electronic devices without a charger.

The report was written by Ipsos and Trinomics (on behalf of a consortium led by Economisti Associati), based on research and analysis undertaken between November 2020 and May 2021. It was commissioned by the European Commission (Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs).

The report is structured as follows:

* Chapter 1 provides a brief overview of the aim, context, and methodology of the study.
* Chapter 2 contains the definition of the problem the initiative is meant to address, including its drivers and consequences.
* Chapter 3 describes the policy options that were shortlisted for in-depth assessment, as well as other possible options that were considered but subsequently discarded.
* Chapter 4 provides an overview of the approach to assessing the main relevant impacts.
* Chapter 5 contains the analysis of the likely social, environmental and economic impacts of the different options as they apply specifically to mobile phones.
* Chapter 6 broadens the scope to other portable electronic devices, and discusses which types of devices could potentially be encompassed, and the main direct and indirect effects.
* Chapter 7 discusses if and how the main policy options / measures could be combined into “packages”, and how the impacts of these would differ from those of the options individually.
* Chapter 8 summarises the main likely impacts of all shortlisted policy options, and compares these to provide an aid to the political decision making process this study is intended to support.
* The Annexes, provided in a separate document, contain supporting materials, including details on the methodological approach, the results of the surveys carried out as part of the study, technical and market analysis, etc.
  1. The policy context

This study needs to be seen within the context of the “Common Charger” initiative, on which the Commission has been working for more than ten years. Since the outset, its rationale has been to reduce the level of fragmentation of charging solutions for mobile phones (and potentially other small electronic portable devices), in order to enhance consumer convenience and reduce unnecessary electronic waste. Some of the key milestones of this initiative to date have included:

* **2009**: Signature of a Memorandum of Understanding[[5]](#footnote-5) (“MoU”) to harmonise chargers for data-enabled mobile telephones sold in the EU, by which the signatories[[6]](#footnote-6) agreed to develop a common specification based on the USB 2.0 micro-B interface. For those phones that did not have a USB micro-B interface, an adaptor was allowed under the terms of the MoU.
* **2014**: Expiry of the MoU (after two letters of renewal). A study[[7]](#footnote-7) found that the MoU was effective at harmonising charging solutions and improving consumer convenience, but that decoupling had not been achieved to any significant extent, limiting the expected benefits for the environment.
* **2018**: Following discussions with the Commission, the industry proposed a new MoU[[8]](#footnote-8) on the future common charging solution for smartphones, whereby signatures agreed to “gradually transition to the new common charging solution for Smartphones based on USB Type-C”. However, the Commission refused to endorse the new MoU, stating that it did not fully align with the EU’s harmonisation objectives. A number of MEPs also expressed their disappointment with the proposed MoU, and urged the Commission to “take decisive action.”[[9]](#footnote-9)
* **2019**: The Commission launched an impact assessment study (hereinafter referred to as the first IA study).[[10]](#footnote-10) It identified and assessed a range of policy options to address and harmonise both the connectors used for charging mobile phones (and potentially other electronic devices), and the external power supply (EPS). It also explored how to facilitate unbundling (sometimes also referred to decoupling), but in a more limited amount of depth.
* **2020**: The European Parliament adopted a Resolution[[11]](#footnote-11) calling on the Commission to adopt a standard for a common charger “as a matter of urgency in order to avoid further internal market fragmentation”, while also urging the Commission to ensure that “consumers are no longer obliged to buy new chargers with each new device, thereby reducing the volume of chargers produced per year”, based on the consideration that decoupling strategies “would allow for greater environmental benefits”, but “should avoid potentially higher prices for consumers”. The Commission announced a legislative proposal would be tabled in the third quarter of 2020, but this was postponed to 2021 due to the Covid-19 crisis.[[12]](#footnote-12)
  1. About this study

The purpose of the present study is to further strengthen the evidence base for a possible Commission proposal in the context of the “common chargers” initiative. Given that, partly based on the results of the first (2019) IA study, the main focus of the initiative has to some extent shifted away from the issue of consumer convenience and towards the environmental dimension, there is a need for additional evidence and analysis to ensure the most pertinent issues and options are duly considered, and their likely economic, environmental and social impacts can be understood and estimated with a sufficient degree of certainty and rigour to justify (regulatory) EU action.

Specifically, this study focuses on updating, further refining and filling gaps in the results of the previous study, by focusing on a limited set of issues of key interest. These are:

* **Unbundling**: How could this be facilitated (by a voluntary approach) or mandated (via regulation), and what would be the impacts thereof (both in isolation and in combination with the relevant harmonisation / standardisation options assessed as part of the first IA study)?
* **Other portable electronic devices**: In more specific terms than those defined as part of the first IA study, which devices (in addition to mobile phones) could / should be encompassed within the initiative, taking into account their charging profiles? And what would be the main (environmental and other) impacts of their inclusion?
* **Additional technical analysis**: What are the main physical and software/firmware features of chargers (including their durability), so as to facilitate an assessment of the likely impacts of the unbundling options on aspects such as product safety, charging performance, and battery life?

In order to respond to these key questions, the study was charged with **four main tasks**:

1. **Collection of market data related to charging solutions**: The study is to provide an updated analysis of market data (main figure and trends) for mobile phone chargers in Europe, as well as for other small portable electronic devices requiring similar charging capacity.
2. **Mapping of environmental schemes for electronic devices**: The study is to map existing and foreseen environmental schemes for electronic devices, which aim to increase energy efficiency or reduce e-waste, and could potentially be implemented for decoupling of mobile phones and other electronic devices.
3. **Analysis on technical requirements and charger types**: The study is to provide updated technical analysis of the ‘charger’ products, composed of the ‘external power supply’ (EPS) and the cord/cable, including a definition of their main physical and software / firmware features.
4. **Assessment of impacts of policy options**: The study is to analyse the impacts of a range of policy options related to decoupling, their cost-effectiveness, their impact on consumers, e-waste and industry.

The first three tasks are **“preparatory” tasks** for the impact assessment. The updated analysis of the markets for mobile phone chargers, and relevant other small portable devices (Task 1) is a key precondition for the subsequent modelling of the impacts of different policy options. The mapping of existing and foreseen environmental schemes for electronic devices (Task 2) provides contextual information and inspiration for the identification and assessment of policy options that could facilitate unbundling. The updated analysis of technical requirements and charger types (Task 3) ensures both the definition of options and the assessment of impacts is technically sound and realistic in view of the actual key features of relevant types of chargers.

Task 4 relates to the **impact assessment *per se***. Building on the results of the first IA study (including the problem definition and the identification and assessment of technical options for a “common” charger), and on the three “preparatory” tasks, it identifies the most promising policy options, and assesses their likely environmental, economic and social impacts. The assessment is conducted in accordance with the relevant parts of the Commission’s Better Regulation Guidelines and Toolbox.[[13]](#footnote-13)

* 1. Methodology

Similarly to the first IA study carried out by the same team, the study employed a mixed-methods approach, relying on a series of different sources of evidence and analytical tools and techniques to respond to the main study questions and tasks. Following an initial structuring / inception phase, the study proceeded to carrying out the three preparatory tasks listed above, and identifying and screening relevant options; before proceeding to the assessment of their likely impacts.

Sources of evidence

The evidence base for the study consists of both primary and secondary data, gathered and reviewed via the following main methods:

* **Review of documentation and literature**: The study team identified and reviewed a wide range of documents on topics that relate to the issues analysed, including policy documents and legislation; relevant studies, academic and grey literature; technical standards and specifications; as well as technical documentation and information from specialised and corporate websites.
* **Market data review and analysis**: The study team compiled and analysed data on relevant market trends for different devices, using both commercial and public sources, in order to develop an understanding of the annual shipments and total stock of chargers in the EU.
* **Consumer survey**: A survey of a representative sample of 5,000 consumers was carried out in mid-January 2021. It was conducted via Ipsos’s online citizen panels in six EU Member states.
* **Stakeholder survey**: An online survey of stakeholders was conducted in December 2020 / January 2021, and promoted among relevant stakeholders by the study team and the European Commission. 121 responses were received from public authorities, private companies, civil society organisations, and private citizens.
* **In-depth interviews**: A total of 33 in-depth interviews were conducted with stakeholders representing a range of different interests and perspectives, including representatives of the most directly affected industry sectors, environmental and consumer organisations, and public authorities.

Analytical approach

The data and information was analysed with a range of relevant quantitative and qualitative techniques. In particular, it is worth emphasising the stock model of chargers, which was developed as part of the first IA study, and updated and expanded as part of this study. This model compiles sales data on mobile phones, other devices, and stand-alone chargers, and matched this with data and assumptions on charger disposals to simulate changes in the stock of chargers in use in the EU-27. The model enabled calculation of quantitative estimates of the main environmental and certain economic impacts. For further details on the approach to analysing the different types of impacts, please refer to section 4 of this report.

Main limitations and caveats

Limitations to our approach stem from the assumptions made in the stock model, e.g. on production costs, charger weight and composition and future development of the mobile phone market. Whilst we have used the best available evidence, part of the assumptions underlying the stock model and our options assessment relied on inputs from a small number of key stakeholders, or a small number of secondary sources. We are confident that the stakeholders consulted represent a significant proportion of relevant markets (in particular the mobile phone market). All analytical outputs were cross-checked and subjected to internal reviews by senior members of the study team, as well as, where relevant, validated with key stakeholders. However, in the absence of authoritative sources of verifiable data on certain elements, and in view of the impossibility of accurately predicting future technological developments, a certain level of uncertainty remains around the assumptions made in our stock model. For certain key variables (in particular the proportion of consumers that choose to purchase a charger along with an ‘unbundled’ new mobile phone), sensitivity analysis was carried out to clarify how variations would affect the impacts of the different policy options (for details on the stock model and assumptions made, see Annex G).

Furthermore, whilst the study was able to gain access to comprehensive market data available on mobile phone sales and shipments, we found a lack of comprehensive market statistics on standalone chargers and the illicit market. Therefore, data on standalone chargers and illicit markets are mainly drawn from the consumer panel survey and stakeholder consultations, leaving some residual uncertainty. As regards other portable electronic devices, it was not feasible to purchase commercial data for all potentially relevant categories of devices, so the study had to prioritise, meaning the level of detailed data the study had access to varied across device categories.

1. Problem definition

The initial step in defining the objectives of the new, or updated, policy is to consider the problem that is leading to the need to take action.

The approach to this task follows the Better Regulation Guidelines (Tool #14) and answers the following questions:

* What is the nature of the problem(s)?
* What is the scale of the problem(s)?
* Who is affected by the problem(s)?
* What are the drivers and root causes of the problem(s)?
* How has the problem developed over time and how is it likely to develop without action?
* Why does the problem need action at EU level?

The problem identified is two-fold:

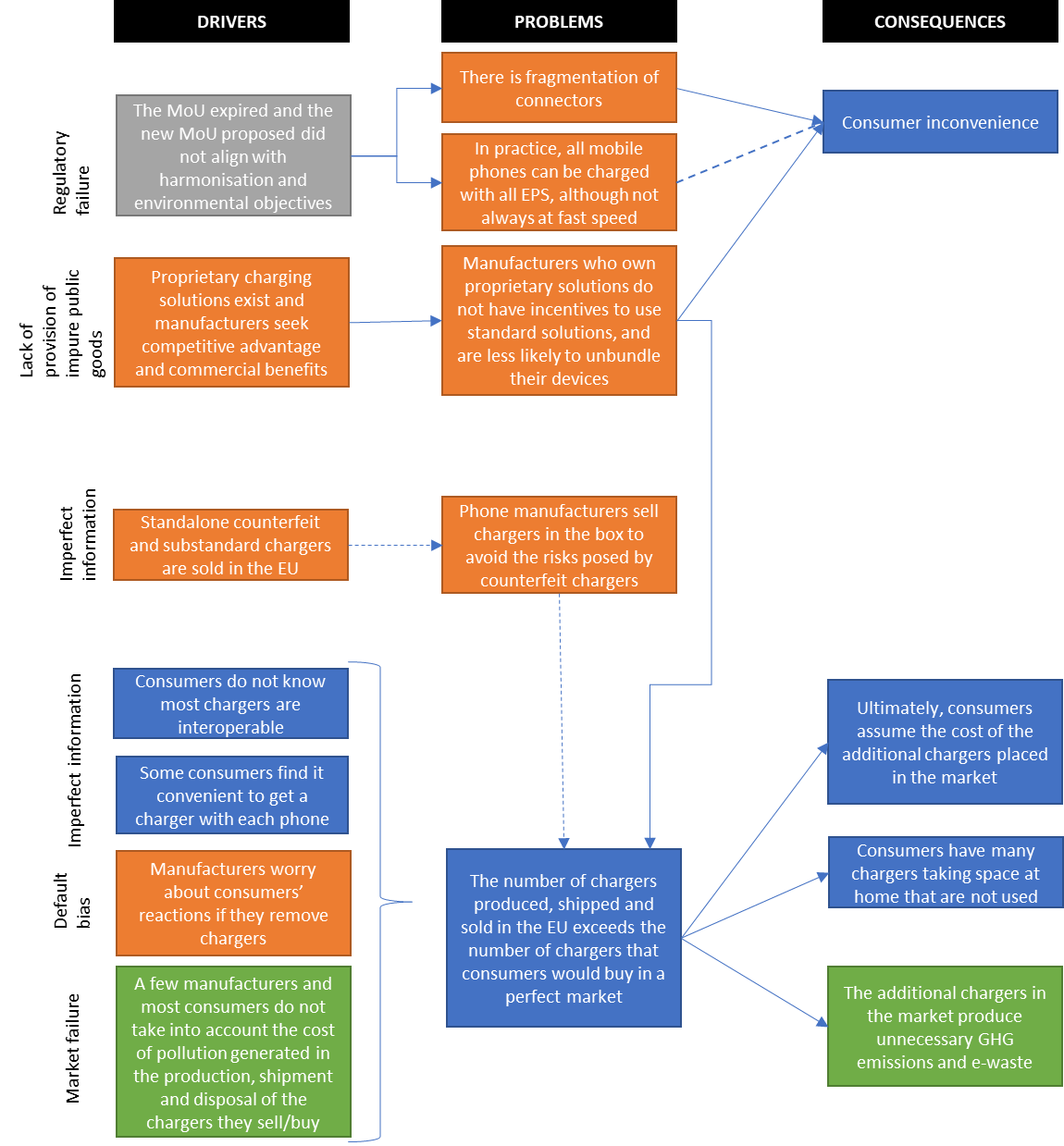
**The volume of chargers produced, shipped and sold in the EU is larger than in a perfect market where consumers can decide whether they want to buy a charger with their new phone. Some of the chargers sold use proprietary connectors and/or battery charging protocols that are not always interoperable with other devices, or that cannot charge other devices at the same speed.**

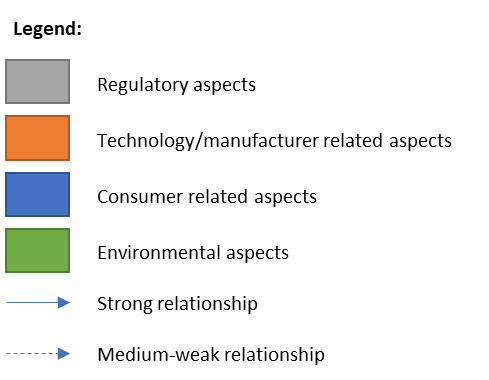
Currently, there is some fragmentation in the market in terms of connectors used, with some phones and other devices using USB Type-C, USB micro-B and Lightning receptacles.[[14]](#footnote-14) There is also fragmentation of fast charging solutions. These solutions are all interoperable, however External Power Supplies (EPS) using proprietary solutions do not always charge other brands’ phones and devices at the same speed.[[15]](#footnote-15) The ensuing section explains why proprietary solutions exist alongside standard solutions, and why manufacturers continue using them.

The second part of the problem is that there are more chargers in the market than what consumers realistically need or want. Most consumers already have one or more (compatible) chargers, so do not always need a new one with each phone.[[16]](#footnote-16) However, with some notable recent exceptions (Apple, Samsung, and HMD), manufacturers continue selling chargers along with phones by default. This generates unnecessary use of raw materials, GHG emissions and e-waste. The ensuing section also explains why unbundling is not more widespread.

A problem tree that visualises the main relationships between drivers, problems and consequences is shown in Figure 1.

Figure 1. Problem tree



1. 
   1. Drivers of the problem

The MoU expired and the new MoU did not align with the Commission’s harmonisation and environmental objectives

The 2009 Memorandum of Understanding (MoU) among industry stakeholders, facilitated by the European Commission, resulted in convergence towards a common external power supply (EPS) and USB micro-B connectors at the device end. The most notable exception was Apple, which continued to use proprietary connectors (from 2012, the Lightning connector) but made an adaptor available for purchase.

Since the expiry of the MoU in 2014, several technological innovations in relation to charging technologies, EPS, and connectors have occurred[[17]](#footnote-17). Also, the Radio Equipment Directive[[18]](#footnote-18) adopted in 2014, under Article 3(3)(a) established that all radio equipment placed on the market should be interoperable “with accessories, in particular with common chargers”, whilst stressing, under Recital 12, that “mobile phones that are made available on the market should be compatible with a common charger”.

The new MoU on wired chargers for smartphones proposed by the industry in March 2018 was found by the European Commission not to align fully with the EU’s harmonisation objectives[[19]](#footnote-19). As a result, there are currently no industry-wide voluntary agreements or regulatory measures in place as regards the harmonisation or unbundling of chargers of mobile phones or other portable devices in the European Union.

Proprietary charging solutions (connectors) exist as manufacturers seek competitive advantage and commercial benefits

Following the 2009 MoU, most of the mobile phone market moved from proprietary connectors towards USB micro-B at the device end, the sole exception being Apple, which introduced the Lightning connector in 2012 and continues to use it in all its phones. Compliance with the MoU was ensured by making adapters available for purchase.[[20]](#footnote-20) Other Apple devices, such as iPads and MacBooks, incorporate USB Type-C receptacles.

Since the introduction of USB Type-C in 2014, there has been a trend towards replacing USB micro-B with Type-C, first in higher-end phones and other portable devices requiring higher levels of power, but now increasingly also in mid-tier ones and smaller portable devices. USB micro-B continues to be used in some lower-end phones and other lower-end, low-power portable devices, but the expectation is that, as the price of USB Type-C drops further, micro-B will disappear entirely from smartphones in the next few years (though it is possible it will continue to be used in very low cost feature phones for longer).

USB Type-C offers many advantages over USB micro-B: it is reversible, easier to use, and more robust; and most importantly, it supports up to 100W (up to 20V @ 5A). Apple has not published the Lightning specifications; however, it should be able to carry, at least, up to 20W, which is the power accepted by the iPhone 12.

Table 3. Maximum power and speed for data transfer supported by USB connectors

| 1. **Type of connector** | 1. **Latest specification connector** | 1. **Latest specification it supports (power)** | 1. **Latest specification it supports (data transfer)** | 1. **Max Power** | 1. **Max data transfer** |
| --- | --- | --- | --- | --- | --- |
| 1. **USB micro-B** | 1. USB 3.1 Micro-B | 1. IEC 62684 | 1. USB 2.0 | 1. 7.5 W | 1. 480 Mbps |
| 1. **USC Type-C** | 1. IEC 62680-1-3 | 1. USB PD (IEC 62680-1-2) | 1. USB 4 | 1. 100W | 1. 40 Gbps |

Apple claims it continues to use Lightning for two main reasons: it provides backwards compatibility with their own devices; it is smaller than USB Type-C, which allows iPhones to be thinner than if they had to incorporate USB Type C. In addition, it seems clear that the sale of accessories that are compatible with Lightning generates profits.[[21]](#footnote-21)

Proprietary charging solutions (battery charging protocols) exist as manufacturers seek competitive advantage and commercial benefits

Proprietary charging solutions also exist in the battery charging protocol, i.e. the communication between the source (the EPS) and the sink (the device being charged). Until relatively recently, EPS mainly adhered to the standard IEC 62684, which was originally published in 2011 (pursuant to the 2009 MoU) and was last updated in 2018. The IEC 62684 standard defines the interoperability of the ‘common’ EPS for use with data-enabled smartphones and allows a maximum power of 7.5W, based on a 5V voltage and a 1.5A current. The other standard followed by manufacturers was the USB Battery Charging (BC) specification (IEC 62680-1-1), released in 2007 and revised in 2015 (Revision 1.2).

As technology evolved and smartphones required higher power than 7.5W (the maximum power allowed by the IEC 62684), new technologies emerged to cover this need. For example, in 2013 Qualcomm released Quick Charge 2.0, which provided a maximum power of 18W by increasing the current and the voltage of the charger. Since then, Qualcomm has released Quick Charge 3, 4, 4+ and 5.

In parallel, the USB Promoter Group, formed by members of UBS-IF[[22]](#footnote-22), was working to develop new battery charging specifications. In 2013 it set a cooperation agreement with IEC to support global recognition and adoption of USB technologies in international and regional standards and regulatory policies. As a result of the work carried out by the USB Promoter Group and USB-IF, IEC started publishing in 2015 the standard series IEC 62680.[[23]](#footnote-23) This standard series set the specifications for, *inter alia*, USB Power Delivery (IEC 62680-1-2) and USB Type C (IEC 62680-1-3).

The USB Power Delivery (PD) specification describes the architecture and protocols to connect the battery charger and the device to be charged (e.g. a smartphone). During this communication, the optimum charging voltage and current are determined to deliver power up to 100W. Some mobile phone manufacturers are already incorporating USB PD in their devices, such as Apple, Google, and Samsung. For more information on the technical specifications of USB PD, see Annex B (pages 8-12).

The USB Type-C specification is intended as a supplement to the existing USB 2.0, USB 3.1 and USB PD specifications. It defines the USB Type-C receptacles, plugs and cable assemblies. This specification also sets charging requirements up to 15 W, and specifies the use of USB PD if the charge exceeds 15 W.

Interoperability of the “USB family” is defined by the standard IEC 63002, which was first released in 2016 and it is currently being updated (publication expected in May 2021).

The latest versions of Quick Charge (4, 4+ and 5) include USB PD. Quick Charge is available in EPS and is an optional feature of the Snapdragon System on a Chip (SoC) for mobile phones and tablets. According to Qualcomm’s website, Quick Charge may charge a device from 0 to 50% in five minutes. There are a number of smartphones using QC from manufacturers such as BQ, HTC, Lenovo, LG, Nokia, Redmi, Xiaomi, and Sony.

Other proprietary charging protocols include Huawei’s SuperCharge and Oppo’s VOOC. These protocols provide fast charge by increasing the current (which with USB PD is limited to max. 5 A). However, it is important to note that Huawei and Oppo phones incorporate both charging protocols: USB PD and the proprietary charging protocol, meaning that their phones can be fast charged with any type EPS (either proprietary or standard USB PD). The Huawei and Oppo EPS, however, only include the proprietary technology, falling back to the more basic USB BC when connected to other devices (i.e. providing up to 7.5W of charge).

According to information provided by industry representatives interviewed, some proprietary solutions are more energy-efficient than USB PD.[[24]](#footnote-24) Interviewees also noted that proprietary solutions are safe (apply several levels of control to ensure the temperature stays low), charge phones quickly, and the production cost is lower than if they used USB PD.

Proprietary fast charging solutions may also be a source of competitive advantage. These manufacturers generally include in the box EPS and cables that provide high wattage to allow the fast charge advertised. For instance, the Huawei Mate 40 Pro includes the Huawei Supercharge EPS (66W). With this charger, it can be fully charged in 49 minutes.[[25]](#footnote-25) For comparison, the EPS included in the box with some Samsung and Apple phones before they started selling phones without chargers was a standard EPS. To enjoy fast charging, consumers had to buy an additional charger. It takes over one hour and a half (100 min) to charge an iPhone SE or an iPhone12 Pro with Apple’s recommended charger,[[26]](#footnote-26) and just over one hour (65 min) to charge the new Samsung S21.[[27]](#footnote-27),[[28]](#footnote-28)

Some consumers do not know most chargers are interoperable

In the consumer survey conducted in this study, less than half of respondents (45%) were fully aware that the vast majority of chargers from all major mobile phone manufacturers are interoperable, i.e. can be used to charge all modern phones irrespective of the brand. The rest of respondents were either partly aware (36%) or did not know it (19%).

Similarly, in the consumer survey conducted for the first IA study, confusion over which charger to use for different mobile phones was a problem that had been experienced by 30% of respondents. For 1% it happened almost every day, for 5% on numerous occasions, for 12% a few times, and for 13% once or twice. When needing to charge their phone, 19% of respondents reported having experienced problems once or twice because all other chargers were incompatible, 15% had this problem on a few occasions, 3% on numerous occasions and less than 1% almost daily. 63% did not face problems relative to interoperability of other chargers.

Some consumers find it convenient to get a charger with each phone

In the consumer survey conducted for this study, 82% of consumers indicated that they consider finding an EPS in the box with a new mobile phone *very important* or *important*, whilst an even larger share of consumers, 89%, considered that it was *very important* or *important* that a cable was supplied along with a new phone. Although these proportions decreased by around 10 percentage points after information on environmental impacts and/or interoperability had been provided, around three quarters of respondents still maintained it was very important or important for them that EPS and cable are provided with the phone. Among the consumers who found it important to have either an EPS and/or cable in the box, almost half (46%) indicated that it is because of habit, i.e. they are used to finding a complete product in the box. Other relevant factors are: safety (50%), performance (48%), and convenience (38%).

However, the survey also shows that a majority of respondents (61%) were supportive of the idea that all mobile phone manufacturers / distributors should give customers the option of purchasing (or not) a new EPS and/or cable with new phones.

A few manufacturers and most consumers do not take into account the environmental cost generated in the production, shipment and disposal of the chargers they sell/buy

Until last year, nearly all mobile phones sold in the EU market were bundled with an EPS and cable.[[29]](#footnote-29) In October 2020, with the release of the iPhone 12, Apple announced that it was removing the EPS (and its EarPods) from iPhone packaging for all of its smartphone range, explaining that the move was due to environmental reasons, “further reducing carbon emissions and avoiding the mining and use of precious materials, which enables smaller and lighter packaging, and allows for 70 percent more boxes to be shipped on a pallet”[[30]](#footnote-30).

Similarly, starting in January 2021 with its Galaxy S21, Samsung has begun to sell its smartphones without EPS and earpods in the package, citing its intention to “minimise the impact that [their] products have on the environment” in order to support Galaxy users in making “sustainable choices in their daily lives to promote better recycling habits”[[31]](#footnote-31).

Most recently, in April 2021 HMD has removed their EPS from the Nokia X20 and Nokia X10 smartphones, also citing environmental reasons: “We want to do our bit to reduce [e-waste], so we’ve removed the wall charger from the package contents of Nokia X20 and Nokia X10”.[[32]](#footnote-32) HMD / Nokia also announced it will donate the money it raises from selling EPS (approx. €10 per EPS) to an environmental charity.[[33]](#footnote-33)

In interviews, other manufacturers informed that they are considering their options at the moment, and it seems highly likely that at least some of them will also begin to offer unbundled solutions in the near future. However, as per the interviews conducted, those manufacturers that have invested heavily in proprietary charging technology appear less keen on the idea, since they consider the high charging performance that can be obtained from their “bundled” phones and EPS is an important part of their value proposition, as explained above.

In relation to other devices, the mapping exercise conducted showed that unbundling of the EPS from the device is already common in certain categories of products, such as hearables, e-readers, and portable speakers, whilst it is rare for portable videogame consoles and tablets. As regards the cable, this is almost always provided in the box with all types of devices.[[34]](#footnote-34)

Consumers appear to be less aware of the environmental impacts of chargers. In the consumer survey conducted in this study, less than a third of respondents (29%) knew that chargers’ production requires raw materials and generates CO2 emissions, and when chargers are no longer used, they generate electronic waste. 38% of respondents partly knew this, and 33% did not know it. Knowing this information changed slightly the extent to which they think having a charger in the box is important. Those who thought it is important to have an EPS decreased from 82% to 71%, and those who thought it is important to have a cable decreased from 89% to 78% of respondents.

A minority of consumers (6%), however, indicated that it is not important for them to have an EPS in the box, and that this is because of sustainability reasons.

Manufacturers worry about consumers’ reactions if they remove chargers from the box

In interviews, manufacturers’ have expressed their concern about consumers’ reactions if they stop selling chargers with their devices. This concern was motivated by two main drivers:

* Results from previous unbundling pilots: Two manufacturers informed that they had previously tried unbundling schemes. One camera manufacturer noted that they started selling their cameras without the EPS and received very negative feedback from consumers. A phone manufacturer also noted that they piloted an unbundling scheme in Russia (in this case, the phones were sold without EPS or cable), but most consumers chose to buy the charger when acquiring a new phone. The lack of effectiveness in the scheme also meant that the environmental benefits they were expecting to achieve were not realised.
* Consumers’ reactions to Apple’s move to start unbundling their phones: Following the announcement by Apple in October 2020 that the company would be selling phones without EPS in the box, some consumers reacted negatively, arguing the firm follows commercial rather than environmental reasons. There was some mistrust that unbundling would generate the environmental benefits that Apple claimed. For instance, a consumer protection agency in Brazil fined the company 10.5 million Brazilian Reals (1.5 million EUR).[[35]](#footnote-35) The fine covers several activities, one of the them being the sale of mobile phones without the charger and without a reduction in the retail price.

Standalone counterfeit and substandard chargers are sold in the EU

Product safety is an important issue for chargers that are sold via channels that are difficult for legitimate manufacturers and distributors to control (especially online). Serious safety issues for chargers most often relate to electric shock, electrocution and fire risks from poorly designed and manufactured chargers. Other problems are of a chemical nature due to the materials used in the products. These problems primarily affect the EPS.

In the context of this study (and initiative), it is important to emphasise that product safety issues are only indirectly related to the fragmentation of charging solutions. They stem not from any risks inherent in particular charging technologies, or from an absence of relevant safety legislation, but from the existence of a market for substandard and/or counterfeit standalone chargers, and the difficulty for the competent authorities of controlling this market and enforcing the applicable safety as well as IPR rules. And although the possible initiative is not intended to directly address this problem, it is nonetheless relevant to acknowledge it, and to consider if and how a possible “common charger” initiative might affect its future evolution.

The 2014 RPA assessment[[36]](#footnote-36) flagged safety as a particular issue for standalone chargers, noting ‘that as much as 30-60% of the standalone charger market may not comply with applicable technical standards, some of which relate to safety’[[37]](#footnote-37). This is in large part attributable to chargers produced by non-OEM firms, which were often, but not always, counterfeits. A contributory factor may also be the growth in online purchases sent directly to consumers where counterfeit products are more common and expose consumers to the risk of buying dangerous goods[[38]](#footnote-38).

The results of an analysis of the number of risk alerts for chargers of portable devices based on USB standards between 2014 and part of 2021 from the European Commission’s RAPEX[[39]](#footnote-39) show that the number of safety alerts issued peaked in 2019 with 50 alerts submitted (see Figure 12 below). Alerts for unsafe chargers in 2020 where less than half compared to the previous year, presumably due to the impact of the COVID-19 pandemic on international trade. It should be noted, however, that these alerts only refer to safety issues related to chargers that are detected by the national authorities and economic operators, and that 2021 figures only include alerts submitted until 31 March.

On average across the period 2014-2021, 20% of the products with risk alerts analysed were original brands, 75% did not have a brand, and 4% were counterfeit. A recent European Commission Staff Working Document highlighted how the sales of counterfeit goods, in particular through e-commerce, poses an increasingly greater risk because consumers may buy sub-standard products[[40]](#footnote-40). Similarly, the European Union Intellectual Property Office and Europol found that the number of counterfeit electronic products on the market is growing, and the problem of counterfeit affects especially chargers[[41]](#footnote-41). Other reports also highlight the safety risks of counterfeit products. For instance, a report by Electrical Safety First (funded by Apple) found that only 1 of 64 counterfeit Apple chargers from the UK and in the EU passed all technical and safety tests[[42]](#footnote-42).

Figure 2: Number of risk alerts in the Single Market for chargers from 2014 to 2019 by brand

1. *Source: Own elaboration based on the rapid alert system for dangerous non-food products (RAPEX).*
2. *Note: Data until 31 December 2020 includes alerts issued by the United Kingdom. Data for 2021 is up to 31 March.*

From the RAPEX data analysis, almost all the technical defects that triggered the risk alerts failed to comply with safety requirements of the Low Voltage Directive[[43]](#footnote-43), due to one or more of the following technical defects:

* Insufficient clearance or creepage distance between the primary and secondary parts of the transformer and the circuits, which could lead to the user receiving an electric shock;
* Lack of additional fixing of the soldered connections of the primary circuits. If a wire disconnects, the creepage distances and clearances of the reinforced insulation may be reduced;
* Inadequate electrical insulation and/or housing that is not sufficiently resistant to heat or breaking, as a result live parts could become accessible to the user and cause an electric shock, burns and a fire;
* Poor product design, that does not withstand foreseeable electric current overloads, leading to the overheating of components with the risk fire.
  1. Scale and evolution of the problem

The table below summarises the current scale of the problem, and how we expect the drivers to evolve in the future under the baseline (no policy change) scenario:

| Driver | Resulting problems and their scale | Expected evolution under baseline / assumptions |
| --- | --- | --- |
| The MoU expired and the new MoU proposed did not align with harmonisation and environmental objectives | The signatories of the 2018 MoU represented just over half of the EU market (54% in units of sales). The scope of the MoU was only smartphones, it did not cover battery charging protocols and it still allowed the use of proprietary connectors. | It seems unlikely that a voluntary agreement that satisfies both the Commission and the industry’s objectives in terms of harmonisation of connectors may be reached. A voluntary approach, however, is the option preferred by the industry. In the stakeholder survey, 64% of respondents from private companies agreed that the EU should work with the industry (mobile phone manufacturers and distributors) to explore how they could decouple voluntarily.  IEC is about to publish a revision of their standard IEC 63002, which provides common charging interoperability guidelines for EPS used with computing and consumer electronic devices that implement IEC 62680-1-3 (USB Type-C®1 Cable and Connector Specification) and IEC 62680-1-2 (USB Power Delivery). The standard is “expected to make a significant contribution to the global goals of consumer convenience and re-usability of power supplies by expanding common charging interoperability across different product categories while preserving backwards compatibility with the installed base of billions of IEC 62680 compliant devices worldwide”.[[44]](#footnote-44) If it achieves broad adoption by industry, it may provide the legal certainty the Commission is looking for in terms of harmonisation of battery charging protocols and (partly) connectors.[[45]](#footnote-45) |
| Proprietary charging solutions (connectors) exist and manufacturers seek competitive advantage and commercial benefits | Currently, phones use three types of connectors: USB Type C, USB micro-B, and Lightning. In 2019, the share of mobile phones sold in the EU using each type of connector was:[[46]](#footnote-46)   * USB Type C: 44% * USB micro-B: 38% * Lightning: 18% | USB micro-B is expected to be completely superseded by USB Type C by 2026. The use of Lightning connectors will remain constant at 18%, as the driver for Apple to continue using Lightning won’t change. |
| Proprietary charging solutions (battery charging protocols) exist and manufacturers seek competitive advantage and commercial benefits | It is estimated that market shares of mobile phones and EPS sold along with phones in 2019 were as follows:   * USB Battery Charging (up to 7.5W) or QC 1/2/3: 45% of EPS and 38% of mobile phones[[47]](#footnote-47) * USB Type C (up to 15W), USB PD (up to 100W) or QC 4/5: 22% of EPS and 39% of mobile phones * Huawei SuperCharge: 22% of phones and EPS   Oppo VOOC: 1% | The share of the proprietary charging technologies Huawei SuperCharge and Oppo VOOC will also remain constant at 22% and 1%, respectively (this assumes manufacturers’ market shares remain constant), as the driver for these manufacturers to continue using proprietary fast charging solutions won’t change.  USB BC and old versions of QC will gradually be replaced by fast charging standards (USB Type C and USB PD) or QC 4/5, which are fully compliant with USB PD. It is expected that only 11% of the EPS placed in the EU market along with a mobile phone by 2030 will continue using USB BC or old versions of QC. |
| Consumers do not know most chargers are interoperable | Almost a fifth of consumers (19%) who participated in the survey did not know that most chargers are interoperable, and 36% partly knew it. The survey conducted in the first IA revealed that almost a third (30%) of consumers have been confused over which charger to use for different mobile phones. For 1% it happened almost every day, for 5% on numerous occasions, for 12% a few times, and for 13% once or twice. In addition, only 15% of respondents indicated that they used their mobile phone chargers to charge other mobile phones, and 14% used it to charge other devices. This indicates that consumers are not taking full advantage of the interoperability of their chargers.  Currently, all the EPS sold with mobile phones can charge other devices.[[48]](#footnote-48) If the EPS supports USB PD, then the fast charge is assured for all phones with fast charging capabilities (provided the right cable is used[[49]](#footnote-49)). If the EPS uses only proprietary fast charging solutions, then it will charge other brands’ phones at maximum 7.5W. | The evolution of this problem will partly depend on the adoption of standard battery charging protocols by manufacturers, which would provide more reliability on interoperability. It is not expected that any of the main manufacturers will change their main battery charging protocols. Only small manufacturers who have not yet adopted fast charging solutions may start using them in the future, and these will likely be standard solutions.  Unbundling may also force consumers to educate themselves on which charger works with their phone. |
| Some consumers find it convenient to get a charger with each phone | 8 in 10 consumers find it important to have an EPS in the box, and 9 in 10 find it important to find a cable in the box. These figures did not change significantly after consumers were provided with information on interoperability, environmental impacts, safety, and performance. | The evolution of this driver is uncertain. Around half of respondents (54%) indicated they thought it is important to get an EPS with a new phone because of habit (i.e. they are used to find it in the box). If manufacturers continue unbundling, consumers may become used not to get it with their phone and perceive lower inconvenience. However, other factors were almost as important for consumers: safety (45%) and performance (44%). |
| A few manufacturers and most consumers do not take into account the cost of pollution generated in the production, shipment and disposal of the chargers they sell/buy. | All manufacturers who have started unbundling have argued they do so for environmental reasons. These manufacturers represent 52% of the market in the EU27 (IDC data for 2018), although they do not yet unbundle all their mobile phones.  Other manufacturers argued that the shipment of EPS/cables out of the box might be detrimental for the environment if a majority of consumers continue buying a charger with their new phone, as it would add additional packaging and GHG emissions in transport.  Only a minority of consumers (29%) know of the environmental impacts of chargers. The consumer survey suggested 57% of consumers would purchase an EPS when they buy an unbundled phone. | As more data becomes available on environmental impacts of unbundling (from manufacturers who are already piloting it), it is expected that environmental impacts will be taken more into account in the decision of unbundling or not. It is expected that in the baseline, unbundling of the EPS will reach 54% of the market by 2030. [[50]](#footnote-50) For the time being, all manufacturers continue shipping cables with their mobile phones, and the assumption is that they will continue to do so in the baseline scenario.  It is not yet clear how consumers in the EU will react to unbundling (i.e. how many will continue buying a charger when they buy a new phone that is unbundled) and how their views/knowledge of environmental impacts will evolve. In the baseline scenario, the estimation that 57% of consumers would buy an EPS with unbundled phones remains constant over time.[[51]](#footnote-51) |
| Manufacturers worry about consumers’ reactions if they remove chargers | All the manufacturers we have interviewed expressed some level of concern about consumers’ reactions to unbundling. Apple has been the first manufacturer unbundling their phones, and has done it in all their iPhones and all markets. Samsung has started with just one model in all the world, HMD with two models only in the EU, and Xiaomi only one model in China (but not the EU). Manufacturers who have started unbundling noted that the spread of unbundling to other products in their portfolio/markets will largely depend on consumers’ reactions.  The volume of phones sold unbundled in 2020 in the EU was 11% of the market.[[52]](#footnote-52) Before 2020, it was nearly 0% (only one small manufacturer, Fairphone, offered this option). | The relevance of this driver is expected to decrease as more manufacturers pilot unbundling. In the baseline, unbundling is expected to increase gradually, reaching 54% of the market in 2030. |
| Standalone counterfeit and substandard chargers are sold in the EU | The size of the counterfeit and substandard market is unknown, but it could be as much as 30-60% of the standalone charger market. | The unbundling of devices may have a rebound effect on the sale of standalone chargers. Standalone chargers are more likely to be counterfeit and/or substandard, as they don’t pass through mobile manufacturers’ quality checks.  In the stakeholder survey, 47% of respondents agreed that widespread unbundling is likely to produce an increase in product safety risks for mobile phones and/or chargers, 37% expected no change, and 9% thought it would lead to a decrease of product safety risks. |

* 1. Consequences of the problem

The problem generates two main consequences: consumer inconvenience and environmental harm.

**Consumer inconvenience** is caused by the remaining fragmentation of charging solutions available in the market, and by the lack of choice as to whether they want to buy a new charger with their mobile phone.

There is still fragmentation in the market in terms of connectors used at the device end (Lightning is 18% of the market and USB micro-B is 38%), but there appears to be near universal interoperability among battery charging protocols. Based on the information at our disposal, all mobile phones sold nowadays can be charged safely with an USB PD EPS and/or a QC EPS. The speed of charge may not be as fast in all cases as if the original EPS was used, but – provided the phone includes some type of fast charging technology – it would nonetheless be charged at a relatively fast speed (10-15W, i.e. between two and three times more powerful than standard charge).

The EPS included in the box with mobile phones, however, are not quite as versatile. In some cases, they only include the proprietary solution, meaning they can charge other devices, but not at fast speed (i.e. the maximum wattage they would provide is in the range of 5W-7.5W). Most cables are fully compatible with USB standards and can charge any phone provided they have the same connectors. However, there appear to be a few instances where USB Type-C cables are not recognised by other brands’ devices, preventing the charge. The scale of the problem is small, as it seems to only affect Google Pixel phones when charged with Huawei cables.[[53]](#footnote-53)

In the consumer survey conducted in the first IA, consumer inconvenience due to lack of interoperability appears to be relatively widespread, but not particularly severe:

* The inconvenience of not being able to use a previous charger to charge a new phone was experienced by 38% of respondents.[[54]](#footnote-54) However, the issue was significant only for 21% of respondents.
* 38% of respondents reported having experienced problems when needing to charge their phone because all other chargers were incompatible[[55]](#footnote-55), but the issue was significant only for 19% of respondents.
* Difficulties in charging other devices with the primary phone charger occurred to 49% of respondents[[56]](#footnote-56), but only 21% thought this caused significant issues.

Another source of inconvenience is not having the choice of not acquiring a new charger when purchasing a phone. In the survey conducted in the first IA, preference for using an older charger despite being provided a new one with every new phone was indicated as a problem by 39% of respondents.[[57]](#footnote-57)

Not having the choice not to buy the charger implies that consumers have more chargers than they need. In the consumer survey conducted for the first IA, chargers taking up space at home or at work was indicated as an issue by 44% of respondents.[[58]](#footnote-58) Accumulating chargers at home was the single most common way of dealing with old chargers (49% of cases).

The additional stock of chargers available also generates unnecessary **use of raw materials, GHG emissions and e-waste** when chargers are discarded. The previous Impact Assessment found that chargers (both cables and EPS) were responsible for an average e-waste generation of around 11,000 tonnes a year in the EU28, [[59]](#footnote-59) and 600 kt CO2e in associated life-cycle emissions in 2018, which were expected to reach 900 kt CO2e by 2023 due to the growing market share of fast charging EPS, which are also heavier compared to non-fast charging EPS.[[60]](#footnote-60)

Manufacturers have already started selling mobile phones unbundled from the EPS (although they continue to bundle the cable). As explained in the section above, 11% of mobile phones sold in the EU market in 2020 were unbundled, and this percentage is expected to increase to 54% by 2030 in the baseline. Therefore, the consequences of the problem are expected to decrease in the future, as the stock of chargers gradually reduces.

* 1. Need for action at EU level

In the EU, the regulatory framework for placing radio equipment on the market is established by the radio equipment directive 2014/53/EU (RED). One of the aspects it regulates is interoperability. In paragraph 12, the Directive establishes that “mobile phones that are made available on the market should be compatible with a common charger”.

Interoperability is generally based upon international standards. In Europe, standards are developed and agreed by the three officially recognized European Standardization Organizations: the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI). CEN and CENELEC have dedicated agreements with the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) for the development and adoption of standards.

Although the trend seems to be towards standardisation and use of standard solutions (e.g. Quick Charge, which started as a proprietary solution, now incorporates USB PD), it cannot be completely discarded that new proprietary connectors or charging protocols might appear in the future, hence increasing the fragmentation of charging solutions.

Individual actions by MS to harmonise the market of chargers of portable devices might be detrimental for harmonisation and environmental objectives, as different MS could apply different requirements. Uncoordinated action might also lead to trade barriers among MS and/or with third countries. The need for coordinated action justifies the relevance of action at the EU level.

Currently, there are not unbundling measures in any MS.[[61]](#footnote-61) In a consultation with members of the RED expert group, MS representatives were divided among those who thought the EU should act, and those who thought it should not. Those who thought unbundling of EPS should not be regulated argued it could have negative impacts on free trade principles and product safety.

* 1. Policy objectives

This section summarises the general policy objectives as well as the specific objectives.

**General objective 1: Reduce consumer inconvenience produced by the fragmentation of charging solutions.**

Specific objective 1.1: Ensure the interoperability and performance of the chargers placed on the EU market.

Specific objective 1.2: Ensure citizens have enough information as to make informed choices when they decide to buy a new charger. Consumers should be able to identify which chargers work with their devices.

**General objective 2: Reduce environmental damage produced by the excess of chargers that are produced, shipped and discarded in the EU**

Specific objective 2.1: Provide consumers with a choice as to whether they want to acquire a new charger when they purchase electronic devices.

Specific objective 2.2: Raise awareness on the environmental impact of chargers.

1. Policy options

This chapter presents the policy options for the potential new initiative on common chargers aimed at addressing the problems identified previously. It defines the baseline scenario, provides the short-list of policy options that are assessed in-depth in the ensuing chapters, and briefly outlines other options that were considered, but subsequently discarded for a variety of reasons. Both the retained and the discarded options build on and incorporate parts of the analysis carried out as part of the first IA study, while expanding on and updating certain key elements based on recent market and technological developments, and on the key issues this study was tasked with focusing on.

* 1. Baseline

The “dynamic” baseline scenario for this IA study refers to how the situation is expected to evolve without EU intervention. As described in more detail in the previous section (problem definition), the current situation is characterised by the co-existence of standard (USB) and proprietary charging solutions, as regards both the connectors and the communication protocols. In spite of this, there is near universal interoperability of mobile phones and EPS. Different generations of USB specifications are backward and forward compatible; and even the proprietary charging solutions are designed to ensure they are compatible with USB devices and EPS, i.e. they guarantee devices are charged safely with at least a basic power output of around 7.5 W (provided a cable with the “right” connectors is used). Compatibility tests suggest there may be a few isolated exceptions to this, but the vast majority of mobile phones and EPS from major OEM manufacturers are in fact interoperable. However, the charging performance (i.e. speed) can vary significantly depending on different combinations of phones and EPS.

By and large, in the absence of intervention by the EU (or other public authorities), we expect this situation to continue for the foreseeable future. While it is of course possible that future Apple iPhones abandon the Lightning connector in favour of USB Type-C (as has already been the case for iPads), that one or more manufacturers develop new proprietary connectors, or that some manufacturers switch from proprietary fast charging solutions to USB PD, or vice versa, there are currently no strong indications of this, meaning it appears appropriate to assume a continuation of the status quo as regards the prevalence of standard vs proprietary solutions. Similarly, while wireless (inductive) charging is clearly gaining ground, the consensus among stakeholders consulted for this study was that wired charging will continue to be important, and present in all mobile phones, for the foreseeable future.

However, in a number of other respects, the existing market trends point to further changes over the course of the next decade or so. The main trends we assume to affect the baseline scenario can be summed up as follows (for further details see Annex F):

* The number of mobile phones sold in the EU has been decreasing steadily in recent years (by 21% between 2013 and 2019). We assume this trend of decreasing sales to continue, albeit at a slower pace, until 2030 (which is the period we are modelling for this study).
* In view of the recently launched voluntary unbundling initiatives, it would no longer be appropriate to assume each mobile phone sold equals one EPS added to the stock. In 2021, we estimate 25% of phones will be sold without an EPS in the box, and that this proportion will increase to 48% by 2023, and more slowly thereafter, to 54% by 2030.
* Based on the results of our consumer survey, we estimate that 57% of consumers who purchase an unbundled new phone (that does not include an EPS by default) will choose to purchase one along with the phone. However, we also expect that there will be a “rebound” effect: since these consumers will be able to choose which kind of EPS they acquire, demand for stand-alone EPS bought at other times (i.e. not along with a new phone) will decrease, by an estimated 31%.[[62]](#footnote-62)
* The net effect of these two trends is that, for every phone sold without an EPS, we assume an additional 0.39 stand-alone EPS will be bought. In other words, every phone sold without an EPS reduces the total number of EPS bought by 0.61.
* In 2021, for cable additions, on the EPS side, approximately 69% have a USB Type-A connector, and 31% USB Type-C connectors. This situation is expected to reverse by 2030, with far more EPS having USB Type-C connectors.
* In 2021, around 25% of all cables (including “in the box” as well as stand-alone sales) have a USB Micro-B connector on the device side, but these will decline rapidly, to 1% by 2028. Lightning connectors will remain 22% of the total over time. USB Type-C to USB Type-C cables constitute around 19% of cable additions in 2021 but this share will increase to 42% by 2030.
* EPS are becoming more powerful over time. In 2021 it is estimated that 23% of EPS provide less than 7.5W power, while 66% provide between 7.5W and 27W, and the remaining 12% more than 27W. The trend towards more powerful (and therefore faster) EPS is expected to increase in future, with EPS providing less than 7.5W reducing to 7% by 2030.
* Of EPS added to the stock in 2021 (excluding unbundled), around 79% are estimated to have USB Type-A receptacles and 17% USB Type-C (the remainder are multi-port EPS). By 2030, the share of EPS with USB Type-C receptacles is modelled to increase to 61%.

The overall effects of these key trends on the sales and the resulting stock of mobile phone chargers are shown in the graphs overleaf, which contain the estimates derived from the stock model. The total annual sales of EPS are expected to decline by around 20% compared with 2017 levels, leading to a similar reduction in the stock, due to the voluntary unbundling described above. By contrast, both sales and the stock of cables are expected to decline only marginally, as no voluntary unbundling of cables is expected to occur in the baseline scenario.

Figure 3: Baseline scenario evolution 2017-2030

|  |  |  |
| --- | --- | --- |
|  | **Annual sales (with Smartphones + standalone) [units]** | **Stock [units]** |
| **EPS** |  |  |
| **Cables** |  |  |

**Source:** Own TRI-STOCK-CHARGER model calculations. **Note:** The “No EPS” area in the stock graph does not decline as there are no disposals assumed (unlike other EPS); for this reason, the total accumulates.

* 1. Options to be retained for in-depth analysis

The policy options as defined for this study comprise individual “measures” that would harmonise or address certain technical aspects related to chargers, or the way in which they are marketed. These options are not necessarily mutually exclusive, but could potentially be combined into a “package” of measures (for more on this, see below). The elements that are addressed are the following:

* **Connectors on the device (option 1):** As noted previously, presently three types of receptacles are used in phones marketed in the EU (and corresponding connectors in charging cables): USB Type-C, USB micro-B, and Lightning. This option would make it mandatory for all phones to have the same receptacle (USB Type-C).
* **(Fast) charging technology (options 2 and 3):** The interoperability of chargers and mobile phones, and their charging performance, depend not only on common connectors and receptacles, but also on the charging technology (and communication protocols) used by both the EPS and the device. Interoperability could be ensured by making it mandatory for phones (option 2) and/or EPS (option 3) to comply with certain USB specifications.
* **Unbundling (options 4.a and 4.b):** Since late 2020, certain manufacturers have begun to market unbundled solutions (i.e. mobile phones without EPS). This could be made mandatory, by obliging all manufacturers to offer unbundled solutions, i.e. to give all customers the option of purchasing a new phone without an EPS (option 4.a), or even without an EPS or cable (option 4.b).
* **Information on interoperability (option 5):** The final option would seek to enhance transparency and consumer understanding of the interoperability of EPS and phones, and thereby to stimulate both demand for and supply of unbundled solutions, via a voluntary labelling scheme based on USB charging modes.

Other elements, including connectors on the EPS, wireless charging, and a “universal” EPS, were also considered, but not taken forward as part of the policy options assessed in depth at this stage (for the main reasons, see section 3.3 below).

In the first instance, the shortlisted options, as listed above and described in more detail below, are assessed individually for mobile phones only (see chapter 5). In a second and third step, we also consider and analyse the following:

* **Product scope**: Could each of these options be applied to portable electronic devices other than mobile phones? If so, which devices, and what would be the main impacts, as well as implementation challenges / risks? (see chapter 6)
* **Combinations of options**: The initiative that is likely to be most effective (i.e. maximises benefits while minimising costs) may well be a combination of these “measures”. Therefore, following the initial analysis of the individual options, we undertake a qualitative assessment of different combinations (or packages), followed by a quantitative estimate of the main impacts of those combinations that appear most promising (see chapter 7).

We assume that all options would apply to all new products (i.e. models) launched on the market after a given date, providing for an adequate transition period. For the sake of the analysis, we assume any new rules (whether legislative or voluntary) will apply from 1 January 2024.

* + 1. Option 1: Harmonise connectors on mobile phones

This option would entail regulation to ensure all mobile phones have a receptacle for a USB Type-C connector. Proprietary connectors, or solutions that require adapters, would not be allowed.

This would be implemented via the amendment of certain provisions of the RED (2014/53/EU) for regulating the aspects of interoperability (via the co-decision procedure). Reference would have to be made to standard IEC 62680-1-3 to define the “common” connector. The Commission would be empowered to update the requirement, taking into account future technical innovation.

The impacts of this option were already assessed as part of the first IA study (as option 1). It found that this option would result in minor benefits for consumers, and be broadly neutral from an environmental perspective.

The only (minor) difference with how this option is framed now is that legislative action is focused on the receptacle on the device, rather than the connector on the cable. Therefore, the present study revisits and, where appropriate, updates the results of the first IA study in light of recent developments.

* + 1. Option 2: Require mobile phones to be compatible with USB charging technology

This option would regulate to ensure all mobile phones incorporate communication protocols that are compatible with USB specifications, specifically:

* USB Type-C for all mobile phones; this will be used by default when receiving a charge of up to 15 W (5 V and either 1.5 A or 3 A); as well as
* USB Power Delivery (PD)[[63]](#footnote-63) for phones that can charge at over 15 W

This option would ensure that all phones can be charged safely with at least 7.5 W with a USB Type-C EPS; and that phones with fast charging capabilities, when connected to a USB PD EPS, can take full advantage of the EPS’s power output and management features.

It is worth reiterating that USB Type-C charging requires at least one USB Type-C receptacle (either on the EPS or on the device). This means that this option would oblige manufacturers to phase out USB micro-B connectors, but Lightning could continue to be used (as long as there is a USB Type-C connector at the other (EPS) end of the cable).

The inclusion of other (proprietary) charging technology in the phone would be permitted, provided USB PD is used when the phone is connected to a USB PD EPS. Thus, for example, Huawei could continue to incorporate its Super Charge technology in its phones (and use this when the phone is connected to a Super Charge EPS), as long as it continues to also incorporate USB PD communication protocols (which would be used when the phone is connected to a USB PD EPS).

Like option 1, this would be implemented via an amendment to the RED, making compatibility with USB PD an “essential requirement” for all mobile phones. Reference would have to be made to (key parts of[[64]](#footnote-64)) standards IEC 62680-1-3 (for USB Type-C) and IEC 62680-1-2 (for USB PD) to define the required features. The Commission would be empowered to update the requirement, taking into account future technical innovation. Information requirements could be considered as a “flanking measure” (to highlight the USB Type-C / USB PD compatibility of both phones and EPS).

In terms of how this option would be operationalised, monitored and enforced, compliance with this new essential requirement would be communicated via the CE marking. In line with the principle of presumption of conformity, manufacturers could self-certify their products, with market surveillance authorities only expected to verify compliance in cases where specific doubts or concerns arise.

This option was not assessed as such in the first IA study (which only considered interoperability requirements for the EPS, not for the device receiving the charge). It has been added in light of recent developments and considerations, including the ongoing work on a “universal” EPS (see section 3.2.3 below).

* + 1. Option 3: Require EPS for mobile phones to comply with USB interoperability guidelines

Under this option, the EU would regulate to require all EPS for mobile phones to be compliant with USB interoperability specifications and communication methods. The legal basis for this option would need to be defined, as (based on the results of the first IA study) it seems unlikely EPS could be regulated under the RED.

Specifically, interoperability of EPS could be ensured via a reference to the international standard IEC 63002:2021. As noted previously, this standard has been updated and strengthened recently by the USB-IF, in order to enable interoperability of EPS with devices that implement USB Type-C and USB PD, by specifying the minimum technical requirements for an EPS to ensure interoperability (in particular, the data communicated from a power source to a device, and certain safety elements of the EPS, cable, and device), and making recommendations for EPS functionality.

The publication of IEC 63002:2021 was pending at the time of writing, but based on the preview version to which the study team has been provided with access, the requirements for EPS that are most relevant in the context of this initiative are:

* The EPS has to provide power on at least one USB Type-C receptacle (either on the EPS or on the device).
* By default, the EPS has to supply 5 V with a minimum current capacity of 1.5 A.
* The EPS may also provide a current of 3 A (using USB Type-C).
* For power transfer at voltages other than 5 V, or over 3 A, USB Power Delivery has to be used.[[65]](#footnote-65)

Put simply, all EPS would have to be compliant with the USB Type-C specifications (IEC 62680-1-3) and provide either 7.5 W or 15 W. Any EPS providing a higher power output would also have to be compliant with USB PD (IEC 62680-1-2). “Legacy” EPS providing, for instance, 7.5 W using USB BC 1.2, via a USB Type-A to USB micro-B cable, would not be compliant (meaning that, just like options 1 and 2, this option would also effectively oblige manufacturers to stop using USB micro-B receptacles in their phones). This option would also ban EPS that use proprietary fast charging technology (such as Huawei’s Super Charge or OPPO’s VOOC), since compliance with the USB PD specifications rules out proprietary “add-ons”.

This requirement would apply to all EPS that are sold along with mobile phones, but not to EPS that are marketed separately. In theory, it could be envisaged that this option applies to all EPS, including those sold separately. However, this (requiring all or a specific subset of stand-alone EPS to comply with IEC 63002:2021) would have potentially very wide-ranging impacts, as it could affect chargers for a very wide range of devices (not just the “small portable electronic devices” that are within the scope of this study). Exploratory work on such a genuinely “universal” EPS is currently ongoing within the context of the Ecodesign and Energy Labelling Working Plan 2020-2024[[66]](#footnote-66); it would not be appropriate to duplicate or anticipate this here.

A version of this option was already assessed, as option 4, as part of the first IA study. It has now been refined and updated in view of recent development, in particular the greater clarity regarding the content of standard IEC 63002:2021.

* + 1. Option 4.a: Mandatory unbundling of EPS from mobile phones

This option would oblige all manufacturers to offer unbundled solutions, i.e. give all customers the option of purchasing a new mobile phone without an EPS. Ideally, the regulation should be drafted so as to make the phone *without* the EPS the “default” option. In principle, vendors would be free to offer charging accessories as an optional item at the point of sale, and to price these as they see fit.

Like options 1 and 2, this would be implemented via an amendment to the RED, making the marketing of phones without EPS an “essential requirement” for all mobile phones. This obligation would have to apply to manufacturers themselves, as well as to distributors (incl. retailers and mobile network operators).

Based on the market trends that can be observed to date (at the time of writing, three major manufacturers – Apple, Samsung and Nokia – were marketing some or all of their phones without EPS in Europe), and on interviews with a range of industry stakeholders, we expect manufacturers would react to such an initiative as follows:

* Produce and market a single version of their phones, without an EPS. In theory, vendors could produce two different versions of their phones (one with, one without an EPS ‘in the box’), and ship both in the EU – but in practice, market trends to date as well as stakeholder feedback suggest that, commercially, it makes far more sense (i.e. reduces design, production and shipping costs) to produce a single version without the EPS, and package the latter separately.
* Offer EPS as an optional accessory at the point of sale. The price will obviously depend on the specific EPS, but is likely to be in the range of between €10 and €25 for all but the most high-power models.[[67]](#footnote-67) Some manufacturers have reduced the retail price of their EPS when they launched their unbundled phones, but to date, we are not aware of any instances where “bundles” of phones and chargers have been offered at a discounted price.

Obviously, the above are reasonable assumptions based on the information at our disposal, but we cannot completely rule out divergent behaviour by individual vendors. For example, it seems unlikely but not unthinkable that, at some point in time, a given manufacturer might try to obtain a competitive advantage by offering its customers EPS along with new phones at a heavily discounted price, or perhaps even for free.

If the EU wishes to categorically rule out such behaviours, additional safeguards would have to be built into the text of the regulatory proposal. In principle, this could include a prohibition to offer EPS at a discount to buyers of new phones (or, put another way, an obligation to charge all customers the same for an EPS, whether or not they buy it along with a new phone or not). Whether such interference in the market is necessary and justified, and whether the benefits outweigh the risks (which would include negative public sentiment if the EU is seen to prevent consumers from acquiring cheaper EPS), could be open to debate. In any case, in view of the assumptions outlined above, whether or not such clauses are included makes no difference to the assessment of the main environmental, economic and social impacts of a mandatory unbundling measure.

To improve the effectiveness of this option, an obligation for manufacturers to provide information about the charging capacity / requirements of their phones (e.g. USB PD, up to 45W) could be added. A campaign to highlight the environmental benefits could also be considered.

* + 1. Option 4.b: Mandatory unbundling of the entire charger (EPS and cables)

This option is identical to option 4.a above, with the sole exception that the cable is also included. It would oblige all manufacturers to give customers the option of purchasing a new phone without an EPS or cable.

It should be noted that none of the voluntary unbundling initiatives launched by major manufacturers to date have included the cable. In other words, all Apple, Samsung and Nokia phones sold in the EU at the time of writing include a cable in the box, and during interviews, no manufacturers expressed any intention to change this, and to ship phones without cables, in the foreseeable future.[[68]](#footnote-68) The main reasons cited for this are (1) the fact that cables are used not only for charging, but also for data transfer; (2) the typically shorter lifespan / lower durability of cables compared with EPS; and (3) the much smaller size, lower weight, and hence environmental impact, of cables.

Therefore, adopting this option would run counter to existing market trends. On the other hand, the fact that close to 50% of phones are expected to already be shipped without an EPS in the near future under the baseline scenario, whereas 100% still come with cables, means the marginal impact of mandatory unbundling of cables is worth investigating. Also, it is worth considering whether the unbundling of cables could potentially also make the unbundling of EPS more effective (e.g. by preventing cases where phones are shipped with a USB Type-C to Type-C cable, forcing consumers to buy a new EPS that fits with this).

* + 1. Option 5: Voluntary interoperability labelling / information scheme

This option would entail the creation and promotion of a labelling scheme to signal interoperability of EPS and phones with relevant USB specifications, and thereby to stimulate demand for and supply of unbundled solutions. This is a “soft” (i.e. voluntary) option – compliant / compatible EPS and phones could carry the label, but manufacturers would still be free to use other (proprietary) technologies (and therefore not participate in the scheme). The premise of this option is that, if consumers had a better understanding and an easy way of identifying which chargers work with which devices, they would be more open to re-using existing compatible chargers, and make more informed purchasing decisions (i.e. only buy chargers they really need), thereby reducing the overall demand for chargers. Similarly, such a scheme could offer a certain guarantee that consumers will only use compatible chargers, thereby incentivising manufacturers to ensure the compatibility of their devices and EPS, and to voluntarily offer unbundled solutions where this is in line with their business objectives and strategies.

When considering such a labelling scheme, it is important to consider that one would not have to (and should not) start from scratch. The current high degree of interoperability is due to the family of USB standards and specifications. The USB Implementers Forum[[69]](#footnote-69) (USB-IF) also offers a certification scheme, whereby compliant USB chargers (and since, 2018, USB fast chargers) are listed on the USB IF website and acquire the right to use the “Certified USB Charger” logo.[[70]](#footnote-70) Ideally, a new (EU) scheme would build on (rather than duplicate) this, and seek to increase its attractiveness to and buy-in from manufacturers, as well as awareness among consumers.

A key issue that has limited the uptake of the USB-IF certification scheme is that it is based on full compliance (rather than compatibility), and requires strict adherence to the relevant USB specifications in their entirety. Deviations or “add-ons” are explicitly forbidden, so as to ensure the relevance and transparency of the certification, and the safety of the products (according to USB-IF members interviewed for this study). This means that any charger that incorporates a proprietary technology (such as Quick Charge or Super Charge) is not eligible for certification – even if it is compatible with USB PD, it is not considered compliant. Therefore, as things stand, many chargers (up to 30% of the 2019 market of ‘in the box’ mobile phone chargers[[71]](#footnote-71)) that could be used to charge a phone that incorporates USB PD would not be allowed to carry the USB Certified (Fast) Charger label.

The interoperability scheme envisaged here would have to be more flexible, and entail various categories to help consumers understand which products are *compatible* (as opposed to fully compliant), as well as which provide optimum charging performance. Indicatively, this could entail different (variations of) labels for four categories: one “basic” USB Charging label that only signifies that it is safe to use this EPS with a device (or vice versa) that supports any USB standard power mode (all of which are backward and forward compatible), and that it delivers a certain minimum level of output (e.g. 7.5 W); and three different USB Fast Charging “ratings” (corresponding with USB PD and different output levels, e.g. up to 27 W, up to 45 W, and more than 45 W). The different ratings could be communicated by adding the wattage to the logo, or by creating categories (e.g. I, II, III…) or a colour scheme.

The labels should ideally be on both EPS and on mobile phones (on the packaging as well as, if desired, on the product itself), so as to enable users to “match” the two. To provide a few examples of how this might work in practice:

* A Samsung 45W USB PD EPS, and a Samsung mobile phone that incorporates USB PD and is built so as to take full advantage of this EPS, would both carry a “USB Fast Charging level 2” (or similar) label.
* A Huawei 65W SuperCharge EPS that does not support USB PD, but reverts to USB Battery Charging at 10W when connected to a non-SuperCharge phone, could carry the basic “USB Charging” label.
* A Huawei mobile phone that incorporates both SuperCharge and USB PD technology could presumably obtain the label for “USB Fast Charging” at the appropriate level.

It is important to note that the exact design features of such a scheme would need to be explored further, ideally in collaboration between the European Commission, the industry and other stakeholders. There are many technical, commercial and other considerations; defining these in detail would have exceeded the scope of the present study. It is worth highlighting that some interviewed stakeholders were sceptical of the effectiveness of such schemes, citing previous experiences and market research that suggests consumers tend to pay very little attention to logos. How such concerns could be mitigated is an important question in the design of the scheme.

In any case, since the scheme would be voluntary, and its exact parameters and technical requirements are subject to further analysis and consultations with relevant stakeholders, its impacts would be subject to a very high degree of uncertainty. The level of industry participation and buy-in to the scheme is unknown at this stage, as are the unbundling rates that would follow, and the effect the scheme would have on consumer choices. Therefore, it is very difficult to provide any robust, quantitative estimates of its likely impacts.

* 1. Discarded options

A number of other aspects and options were considered and screened as part of this study and/or other studies. These options have not been shortlisted for this study, but discarded from the in-depth analysis for a variety of reasons. These can be summarised as follows:

* **Harmonise connectors on the EPS end**: This option was discussed and discarded in the first IA study because “in view of the available evidence, it appears far preferable to allow the transition from one common solution (USB Type-A) to the next common solution (USB Type-C) to proceed naturally, keeping pace with market developments and the evolution of consumer preferences.”[[72]](#footnote-72)
* **Mandatory adaptors**: The first IA study assessed options (options 2 and 3) that would harmonise the receptacles on the device or connectors on the device end, while allowing the continued use of proprietary connectors / receptacles, but obliging manufacturers to supply adaptors to USB Type-C in the box. The study concluded that these options, which were devised as possible compromise solutions, would not generate any significant net benefits, and are therefore not worth pursuing further.
* **Interoperability plus minimum power requirements for EPS:** Option 5 in the first IA study included a requirement for EPS to guarantee the provision of at least 15W of power. However, this requirement was found to not generate significant additional benefits, but risk making lower-end phones (many of which currently do not incorporate fast charging technology) more expensive.
* **Harmonise wireless charging technology**: This has been assessed as part of a separate study[[73]](#footnote-73), the results of which do not support action at this point (but may justify an empowerment for the EU to act on wireless charging at a later date).
* **“Universal” EPS (for all kinds of devices)**: One could also envisage a genuinely “universal” EPS, for use with a wide range of devices. This would entail the definition of interoperability requirements that would apply to all EPS, independently of whether they are sold alongside certain devices, or on their own. As noted under option 3 above, the consequences of such an initiative would potentially be very far-ranging, exceeding the scope defined for this study (which is on mobile phones and other small portable electronic devices). Exploratory work on such a “universal” EPS is currently ongoing within the context of the Ecodesign and Energy Labelling Working Plan 2020-2024[[74]](#footnote-74); it would not be appropriate to duplicate or anticipate this here.
* **Environmental information**: Finally, during the early stages of this study, we considered a range of environmental schemes for electronic devices that aim to increase energy efficiency or reduce e-waste, and could potentially be used to facilitate the unbundling of chargers from mobile phones and other electronic devices (see Annex E). In particular, we identified the EU Ecolabel and EU Energy labelling requirements as potentially relevant, and explored how these might be used to create an incentive for manufacturers to offer, and for consumers to demand, unbundled (and hence more environmentally friendly) devices. However, we concluded that neither was viable at this stage, because:
* Although the **EU Ecolabel** covers electronic equipment, the only product groups currently covered are televisions and electronic displays. As such, new criteria would have to be developed for mobile phones (and potentially other portable electronic devices). Furthermore, the EU Ecolabel is awarded based on a variety of criteria and considerations – and given the low proportion of the overall environmental footprint of mobile phones that corresponds with the charger[[75]](#footnote-75), it seems unlikely that the question of whether or not a charger is included in the box would be a decisive factor in determining if a given phone is awarded the label. Even if it were decided that only chargerless phones would be eligible for the label, it would still remain to be seen how many (if any) of the most popular phones would be able to meet the other (inevitably stringent) criteria. It therefore seems that an Ecolabel for phones might be an idea worth pursuing with a view to improving the overall environmental performance of mobile phones – but it would be very unlikely to create significant incentives for unbundling (except as one element of a wider drive for more sustainable phones).
* Mobile phones are also not currently subject to **EU energy efficiency ratings and labels**. Their energy consumption is much lower than any other product group currently regulated under the Energy Efficiency Labelling Regulation.[[76]](#footnote-76) Nonetheless, the subject of extending energy labelling requirements to mobile phones has been considered as part of the recent Ecodesign preparatory study, which proposes to base the ratings on battery endurance benchmarks (in hours per cycle) rather than energy usage per se.[[77]](#footnote-77) The merits of this will be analysed further in the upcoming Commission impact assessment.[[78]](#footnote-78) However, even if energy labelling for mobile phones were to go ahead, it is difficult to see how the absence of a charger in the box could have a positive effect on the energy efficiency rating, so as to create an incentive for unbundling.[[79]](#footnote-79) In view of this, it would not be appropriate to analyse this option as part of this study – although it may be worth considering it again in the future, once it is clearer whether energy labelling requirements will be extended to mobile phones, and if so, in what form.

1. Approach to assessing impacts

This section includes a description of the environmental, economic, and social impacts screened for assessment, and our assessment approach to qualify and/or quantify impacts for mobile phones.

* 1. Environmental impacts

Environmental impacts are assessed in Chapter 5 using a stock model developed for the purpose of this work. The model is described in detail in Annexes F and G, but the essential element is that charger (EPS and cable) additions and disposals are modelled each year, and that these flows, when combined with impact assumptions are used to calculate the impacts presented in Chapter 5. In this section we present the approach to assessing the environmental impacts, including elaborating the assumptions used in the stock model.

Following a screening of the main environmental impacts, the study focuses on the 3 key environmental impacts of EPS and cables, namely: (1) use of raw materials, as the production of chargers consumes metals, plastics, and other materials; (2) e-waste, generated as chargers are discarded; and (3) greenhouse gas (GHG) emissions over the life-cycle of the chargers (e.g. manufacturing, transport, and disposal and materials recovery). The following indicators are assessed:

* Material use [tonnes] – calculated in the stock model by multiplying additions to the charger stock by a profile of the materials used. The profiles vary per EPS and cable type (weight and material content), and over time (modelling the introduction of more efficient, lighter materials). Material use is split into the most relevant materials.
* E-waste [tonnes] – calculated in the stock model as the weight of chargers disposed of each year. This is calculated by multiplying the number of units disposed by the material and weight composition of the charger component type. Sub-indicators on volumes of e-waste left untreated or recycled are also calculated.
* GHG emissions [tonnes] – are calculated in the stock model as life-cycle emissions (cradle-to-grave) per charger component type, accounted in the year of sale. Emissions are calculated on the basis of component specific emission profiles multiplied by additions to the charger stock.

The key assumptions made in the 2019 IA study were reviewed and updated to take into account, amongst other issues, the various technological developments that may have an impact on one or more of the environmental areas.

The following sections give an overview of the approach and main assumptions, further detailed description of how these assumptions were derived is provided in Annex G.

* + 1. Material use

Understanding the material composition of both the EPS and cables is crucial to identifying the main environmental impacts associated with the use of raw materials. This includes not only which materials are used, but also in which proportions.

To measure material use a bill of materials (BoM) was developed in consultation with a technical expert and following a bottom-up approach, as there was little or no useful new data (compared to the 2019 study) in the available literature concerning the material contents of EPS or cables. The BoM (See Annex G for further detail) considers all of the components contained in a mobile phone charger[[80]](#footnote-80) which allowed us to identify the heaviest and largest components (e.g., transformer, electrolytic capacitors, and transistors), based on the datasheets published by the manufacturers. Once the key components of the EPS were identified, we conducted desk research to determine the materials used in each of the components. Table 2 presents the standard material composition of a mobile charger and cable obtained as a result of this analysis. We note that in preparing this composition the information about the materials used for most components is limited, as manufacturers generally do not include these details in the datasheets of the components. Therefore, the proportion of the materials as presented in Table 2 should be interpreted as indicative compositions of the components. Additional to the material categories ‘plastics’, ‘copper’ and ‘others’ included in the IA 2019 study, the refined stock model also includes for the EPS the categories ‘stainless steel’, ‘aluminium’ and ‘other (EPS)’, the latter of which includes all the materials contained in the smallest components (e.g., resistors, diodes) as well as the ferrite, silicon, solder, and other insulation materials contained in the EPS. Regarding the cables, the updated stock model also adds the subcategory ‘stainless steel’ (present in the USB connector), in addition to copper, plastics and ‘others’.

Table 4. Standard material composition of a mobile charger and cable[[81]](#footnote-81)

|  |  |
| --- | --- |
| **Component** | **% of total weight** |
| **EPS** | |
| Plastic | 36% |
| Copper and copper alloys | 13% |
| Stainless steel (USB connectors) | 6% |
| Aluminium | 7% |
| Others | 37% |
| **Cable** | |
| Copper | 30% |
| Plastic | 30% |
| Stainless steel (USB connectors) | 24% |
| Others | 16% |

Furthermore, In the previous 2019 IA study, we indicated that there is a trend towards heavier chargers as fast charging EPS technologies were assessed to have more complex and heavier components and would gradually become the new standard. However, our literature research and the interviews also highlighted that new technological developments may mitigate this trend. As indicated during an interview with a supplier of high-performance electronic components, it was estimated that the new technologies (e.g., Gallium Nitride [GaN] diodes, super-junction) would enable 40% less volume and 30% less weight for EPS, through providing improved energy efficiency and reduction in heat, and therefore a reduction in insulation and other materials. Therefore, the refined stock model assumes that the high-power and high-quality EPS will become lighter than current models (per wattage) in the future. Table 3 below presents the total weight per component type at 5 years intervals used in the analysis.

Table 5. Modelled total weight per component type (2015-2030)

| **Component type** | | **2015** | **2020** | **2025** | **2030** |
| --- | --- | --- | --- | --- | --- |
| **Weight (g)** | | | |
| EPS < 7.5 W | USB Type-A receptacle | 28 | 28 | 28 | 28 |
| EPS < 7.5 W | USB Type-C receptacle | 28 | 28 | 28 | 28 |
| EPS < 7.5 W | USB Type-A and Type-C receptacles (multi-port) | 28 | 28 | 28 | 28 |
| 7.5W <= EPS <=27W | USB Type-A receptacle | 50 | 50 | 45 | 40 |
| 7.5W <= EPS <=27W | USB Type-C receptacle | 60 | 60 | 54 | 48 |
| 7.5W <= EPS <=27W | USB Type-A and Type-C receptacles (multi-port) | 102 | 102 | 92 | 82 |
| EPS > 27W | USB Type-A receptacle | 94 | 94 | 80 | 66 |
| EPS > 27W | USB Type-C receptacle | 117 | 117 | 99 | 82 |
| EPS > 27W | USB Type-A and Type-C receptacles (multi-port) | 131 | 131 | 111 | 92 |
| EPS > 27W | Captive cable | 113 | 113 | 96 | 79 |
| Cable | USB Type-A - USB Micro B plugs | 19 | 19 | 19 | 19 |
| Cable | USB Type-A – USB Type-C plugs | 34 | 34 | 34 | 34 |
| Cable | USB Type-A – proprietary (Lightning) plugs | 23 | 23 | 23 | 23 |
| Cable | USB Type -A – proprietary (Other device) plugs | 23 | 23 | 23 | 23 |
| Cable | USB Type-C – USB Type-C plugs | 45 | 45 | 45 | 45 |
| Cable | USB Type-C – proprietary (Lightning) plugs | 37 | 37 | 37 | 37 |
| Cable | USB Type-C - proprietary (Other device) plugs | 37 | 37 | 37 | 37 |
| Cable | USB Type-C plugs – wireless pad – Qi or other | 37 | 37 | 37 | 37 |

**Source:** Own TRI-STOCK-CHARGER model, weight data from various manufacturers and retailers.

Taking all the above into consideration, key assumptions related to the materials contained in the EPS and cables were made. In brief, the main stock model inputs related to material use include:

* A refined bill of materials that includes all the components contained in a standard EPS and cable.
* Adjusted material content profiles for EPS of different nominal power. The stock model includes an adjustment of the standard composition of materials for EPS>27W.
* Adjusted material content profiles for USB-C cables (i.e. with at least one connector to be of type C). Compared to the ‘standard composition’, the amount of copper contained in USB-C cables is assumed to be higher than for USB Type-A and/or Micro B cables.
* Projected weight decrease of EPS driven by technological developments in the next decade (30% less weight of EPS>27W, and 20% weight decrease of 7.5W<=EPS<=27W).

Based on the above, the material used (tonnes) is calculated in the stock model by multiplying additions to the charger stock by the corresponding EPS and cables materials profiles. The profiles varying over time per EPS and cable type (weight and material content). An extended explanation of the modelling inputs input values used is provided in Annex G.

* + 1. E-waste, treatment and recycling

We estimate e-waste volumes and sub-indicators on waste treatment and recycling in the stock model based on the average material composition of the chargers, the recyclability of the materials, the volume of chargers disposed of, the method of disposal, and how disposed chargers are treated.

To estimate the volume of EPS and cables disposed of every year, average values based on the responses to the consumer survey were considered. These suggested that approximately 10% of the EPS and cables in stock are being disposed of each year. This assumption was applied in the model such that after 10 years all chargers purchased 10 years previously would be removed from the stock. Although during these 10 years a share of the EPS and cables in the stock would effectively be ‘in reserve’, i.e. functional, but stored and not in use. The consumer survey found that on average 1.32 EPS and 1.75 cables are reported to be held ‘in reserve’, whilst 1.75 EPS and 2.05 cables are ‘in-use’.

The volume of untreated and recycled EPS and cables was estimated considering WEEE disposal and treatment[[82]](#footnote-82) studies which, despite many data gaps, predict increasing recycling rates over time. Based on analysis of the data for WEEE of small equipment and treatment in 2010 and 2018, we derive an assumption for waste disposal and treatment. This estimates for 2010 a rate of 41% of e-waste being sent for treatment, increasing to 65% by 2018. An annual increment of a 1.5% point improvement in the treatment rate is applied per year based on this historic trend and an assumption that improvements will tail off somewhat over time as the ‘low hanging fruit’ in increasing rates is used. By 2030, this increase increment sees 84% of charger disposals sent for treatment. As a result of these assumptions, the share of untreated waste decreases from 35% in 2018 to 16% in 2030. Table 4 below presents the modelled recycling rates at 5 years intervals used in the analysis (% recycled and % untreated waste). Additional key assumptions made related to the e-waste generated, treated and recycled are summarised in Annex G.

Table 6 Modelled recycling rates for EPS and cables (2015-2030)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Disposal method** | **2015** | **2020** | **2025** | **2030** |
| Disposed to recycling | 56% | 69% | 76% | 84% |
| Incorrectly disposed (untreated waste) | 44% | 31% | 24% | 16% |

**Source:** Own TRI-STOCK-CHARGER model.

Concerning the treatment of different materials, the splits of materials used and specific recycling rates assumed in the stock model are mainly based on the input provided during the interviews with recycling experts.

In brief, the main stock model inputs related to e-waste include:

* Number of EPS and cables disposed of every year, average values based on the responses to the consumer survey were considered.
* Material and weight composition of the EPS and cables disposed of every year, based on average material content profiles (as explained in 4.1.1)
* Collection and treatment of EPS and cables and variation over time (as presented in Table 4)
* Recycling rates (and variation over time) per material type: Based on stakeholder input, 40% of plastics contained in the EPS and cable are assumed to recycled in 2020, a rate that increases 1 percentage point annually until 2030. In the case of metals, 90% are recycled in 2020, which increases 0.25 percentage points each year until 2030. For other materials, the stock model assumes that 40% are recycled, increasing 1 percentage point annually.

Based on these inputs, the e-waste volume (tonnes) is calculated in the stock model as the weight of chargers disposed of each year. This is calculated by multiplying the number of units disposed of by the material and weight composition of the charger component type. The volumes of untreated waste and recycled waste are calculated in a similar fashion. An extended explanation of the modelling inputs input values used is provided in Annex G.

* + 1. Greenhouse Gas Emissions (GHG)

GHG emissions are released over the full lifecycle of a charger, starting from material extraction, and through all the life-cycle steps of manufacturing, transport, use, and disposal. To consider the impact of these emissions, the first IA was mainly based on the results of the EU funded project SustainabilitySmart[[83]](#footnote-83), and other studies[[84]](#footnote-84) which focused on specific smartphone models and their accessories. The studies provided the Global Warming Potential (GWP) of each charger component (EPS and cable) and life-cycle phase (e.g. raw material acquisition, manufacturing, transport), which were then used to calculate an average CO2 emissions impact per unit (g) of weight for the component types.

We note that further review of available information finds only very limited additional published information on the environmental impact of chargers.I It remains an issue not widely addressed by LCA practitioners nor where companies publish their own results. Therefore, to refine the GWP values considered in the 2019 IA study, we considered the data presented in the framework of the *Eco-design preparatory study on mobile phones, smartphones and tablets[[85]](#footnote-85)*. Table 5 and Table 6 below present the input values used by the updated stock model.

Table 7. Average GWP per g of the weight of component[[86]](#footnote-86)

|  |  |  |
| --- | --- | --- |
| **Life-Cycle Phase** | **Average GWP  (kg CO2e per g of weight of component)** | |
| **EPS** | **Cable** |
| Raw material and manufacturing | 0.035 | 0.012 |
| Transport | 0.031 | 0.023 |
| End of life | 0.0003 | 0.0002 |
| **Total** | **0.066** | **0.035** |

Table 8. Average GHG emissions per unit of component

| **Component type** | | **Average GHG emissions (kg CO2e)** |
| --- | --- | --- |
| EPS < 7.5 W | USB Type-A receptacle | 1.8 |
| EPS < 7.5 W | USB Type-C receptacle | 1.8 |
| EPS < 7.5 W | USB Type-A and Type-C receptacles (multi-port) | 1.8 |
| 7.5W <= EPS <=27W | USB Type-A receptacle | 3.3 |
| 7.5W <= EPS <=27W | USB Type-C receptacle | 4.0 |
| 7.5W <= EPS <=27W | USB Type-A and Type-C receptacles (multi-port) | 6.7 |
| EPS > 27W [[87]](#footnote-87) | USB Type-A receptacle | 6.2 |
| EPS > 27W | USB Type-C receptacle | 7.7 |
| EPS > 27W | USB Type-A and Type-C receptacles (multi-port) | 8.6 |
| EPS > 27W | Captive cable | 7.4 |
| Cable | USB Type-A - USB Micro B plugs | 0.7 |
| Cable | USB Type-A – USB Type-C plugs | 1.2 |
| Cable | USB Type-A – proprietary (Lightning) plugs | 0.8 |
| Cable | USB Type -A – proprietary (Other device) plugs | 0.8 |
| Cable | USB Type-C – USB Type-C plugs | 1.6 |
| Cable | USB Type-C – proprietary (Lightning) plugs | 1.3 |
| Cable | USB Type-C - proprietary (Other device) plugs | 1.3 |
| Cable | USB Type-C plugs – wireless pad – Qi or other | 1.3 |

**Source:** Own TRI-STOCK-CHARGER model, results based on Table 5 and Table 7.

During the scoping phase, we identified potential additional impacts from unbundling related to GHG emissions. For instance, not including an EPS and/or cable in the box could reduce the size of the packaging, impacting the environment in three main ways: firstly, it may reduce the materials used in packaging (fibre and plastic); Secondly, it may allow for more devices to be shipped within the same space, hence reducing the environmental footprint of distribution, whilst the reduction in weight being shipped may also reduce the environmental impact; but, thirdly, shipping phones and EPS and/or cables separately may require additional packaging, distribution and delivery journeys, which would increase the footprint. An analysis of the combined impact of these factors indicated the likelihood that their impact is relatively low compared to the impacts attributed to the other life-cycle phases considered, and additionally that there remain substantial uncertainties in estimating these impacts. For these reasons the impacts are not included in the main modelling and impact analysis.

In brief, the main stock model inputs related to the estimation of GHG emissions include:

* Weight composition of the EPS and cables added to the stock every year, based on average material content profiles (as explained in 4.1.1)
* Average CO2 eq emissions per weight of component (as presented in Table 5)

Based on these inputs, the GHG emissions (tonnes)are calculated in the stock model on the basis of component specific weight and emission profiles, multiplied by the annual additions to the EPS and cables stock. An extended explanation of the modelling inputs input values used is provided in Annex G.

* 1. Economic impacts

The screening of economic impacts conducted in the first IA study, which followed the Tool #19 of the Better Regulation Toolbox, still applies (see page 100 of the first IA study). It identified as relevant the following types of impacts: Operating costs and conduct of business; administrative burdens on businesses; competitiveness of businesses, innovation and research; and impacts on consumers and households.

Impacts on trade and investment flows were not considered relevant. The initiative may give rise to non-tariff barriers (e.g. if manufacturers cannot sell mobile phones using proprietary charging solutions) and it may also affect regulatory convergence with third countries (e.g. if a third country regulates for the use of different charging technologies). However, all policy options are based on international standards, meaning these impacts (if any) are expected to remain limited.

The position of SMEs was also considered of low relevance, since most economic operators in the sector are big companies located in third countries. The first IA, however, recognised that a minority of European SMEs (some manufacturers of mobile phones and other portable electronic devices and some companies that supply charging solutions to phone manufacturers) could be affected.[[88]](#footnote-88) This impact, although continues to be minor, is investigated in this study.

All the impacts identified for further assessment in the first IA study continue to be relevant,[[89]](#footnote-89) and we have added two new impacts: costs to public authorities, and macroeconomic impacts.

As a result, we focus the assessment on the following types of impacts:

* Competitiveness of businesses
* Innovation and research
* Costs for consumers
* Operating costs and conduct of business
* Costs to public authorities
* Impacts on SMEs

Competitiveness of businesses

The policy options considered may affect competitiveness in several ways. For instance, some connectors are more expensive than others, and mandating USB Type-C may increase the cost of lower-end devices that still use USB micro-B connectors. The options that consider unbundling, on the other hand, would affect the overall cost of the product, and it is still unclear whether savings from not including chargers in the box will be passed on to consumers, or absorbed by the industry. Finally, some manufacturers receive income from the sale of proprietary charging solutions/accessories. Their income may be affected if standard solutions are mandated.

Therefore, this type of cost encompasses four different effects:

* Revenues and/or costs generated from the production and sale of chargers that have different characteristics than in the baseline scenario;
* Reduction in the number of chargers sold in the EU market as a result of unbundling;
* Changes to the distribution of revenue among competitors, due to harmonisation and/or unbundling of chargers;
* Variations in income from receiving/paying royalties.

These effects are summarised below, per type of stakeholder affected.

Table 9. Impact on competitiveness of businesses, per type of stakeholder

| **Stakeholder** | **Differences in costs** | **Fewer chargers sold** | **Changes in distribution of revenue among competitors** | **Variations in income from royalties** |
| --- | --- | --- | --- | --- |
| **Manufacturers of System on a Chip (SoC)** | Currently, manufacturers of SoC are already including USB PD in their chips. It may affect, however, the cost of SoC for lower-end devices. | Not applicable | The battery charging protocol is only a small component of the chip. It is not expected that any of the options would produce changes in the distribution of revenue. | The options considered allow the use of proprietary charging protocols, as long as USB PD is also included. Therefore, no losses of income from royalties are expected for SoC manufacturers. |
| **Manufacturers of mobile phones and other portable devices** | Differences in cost among different technologies are assumed to be passed on to consumers. | The unbundling options would generate savings for manufacturers, as they would not need to include EPS and/or cables in the box anymore.  Some of these savings may be passed on to consumers through reductions in the price of the device, but some may be absorbed by manufacturers as additional income. | Some manufacturers argue that their proprietary fast charging technologies offer them a competitive advantage, and mandatory standardisation or unbundling would affect their competitive position. | Manufacturers of devices using proprietary connectors may lose incomes from royalties (e.g. sale of compatible accessories) if connectors are standardised. |
| **Manufacturers of chargers** | Differences in cost among different technologies are assumed to be passed on to consumers. | The unbundling options will likely reduce the total number of chargers sold in the EU, and therefore all manufacturers of chargers selling in the EU will be affected. | With unbundling options, firms who produce chargers to be sold in the box may lose market share if they are not able to adapt their distribution networks rapidly. This share would be won by manufacturers who distribute to retailers/consumers.  Harmonisation options may also trigger a reduction of sales of proprietary chargers and cables that would benefit manufacturers of standard charging solutions. | Harmonisation options would lead to further adoption of USB PD / USB Type C than in the baseline, which may incentivise some firms to stop manufacturing proprietary solutions. This would lead to a reduction in royalty fees that charger manufacturers pay. As this is a very concentrated market, it is expected that marginal reductions in costs would be passed on to consumers, rather than producing gains for manufacturers. |
| **Distributors, retailers, and wholesalers** | No major impacts expected | Distributors may benefit from the increased sales of stand-alone chargers (if their revenue is higher than when sold in the box) | No major impacts expected | No major impacts expected |

A key question when assessing economic impacts is whether the savings from not including chargers in the box (for options that consider unbundling) will be reflected in the retail price of the devices or whether they will be absorbed as additional income by manufacturers.

In the online survey of stakeholders, two thirds of industry stakeholders (64%) answered that it is very unlikely or quite unlikely that the average retail price of mobile phones will decrease in the short term if the EPS is not included in the box, and the majority (57%) were of the same view when considering the effects in the long term.

Another key aspect is whether manufacturers will offer EPS out of the box at a reduced price if unbundling becomes mandatory. In the survey, just over half of respondents (54%) thought this is quite or very unlikely. However, in interviews, manufacturers who have started to unbundle commented that they have reduced the price of their stand-alone EPS.[[90]](#footnote-90)

Figure 4: Anticipated impacts of mandatory unbundling as perceived by industry stakeholders

Question: If mobile phone manufacturers and distributors were obliged (be it via a voluntary industry commitment or via regulation) to decouple the EPS from the phone (i.e. to no longer include an EPS in the box, but rather offer this as an optional accessory), how do you think the market would react? How likely would the following be to occur?

Source: Ipsos (2021), stakeholder survey. N=28, all private sector respondents

In our stock model, we have assumed that the savings of selling mobile phones unbundled from the EPS/cable are passed on to consumers. In the premium segment of the market this might not be so obvious, as prices are not (only) determined by marginal costs but instead by market positioning strategies. However, evidence suggests that manufacturers are likely to offer other “accessories” instead (e.g. HMD is extending the guarantee of the device by one year). The price in medium and low tier phones is largely determined by the marginal price, and therefore it is to be expected that when savings are achieved from not including chargers in the box, these are passed on to consumers.

This impact has been quantified through the stock model. It is assumed that, when EPS and cables are sold bundled with mobile phones, they are sold at the wholesale price (industry representatives interviewed in this and the first IA assured that they do not obtain any profits for the sale of bundled EPS). When EPS/cables are not bundled to mobile phones, consumers save the wholesale price of the charger; however, if they buy an EPS/cable separately, they pay the retail price. That is why, even when there are fewer chargers in the market, consumers might not obtain any savings. Their capacity to obtain savings will depend on the effectiveness of unbundling (i.e. how many consumers would continue buying EPS).

The supply chain of chargers of mobile phones is formed by, inter alia, manufacturers of chargers (EPS and cables), wholesalers, manufacturers of mobile phones and other portable devices (when chargers are sold unbundled), distributors, and retailers. In many cases, however, large firms have integrated vertically. For instance, Huawei manufacture their own chargers, and Apple control their distribution until the point of sale.

Our stock model calculates the gross profit for the industry in a relatively simple way: production costs (e.g. costs of materials and other fixed costs) are deducted from consumer costs (i.e. retail price of chargers). See the costs and prices used in Table 8. Other costs that are borne by the industry since chargers are acquired from producers/wholesalers until they are placed in the market (e.g. transport, labour costs, etc.) are not included in the model. This simplicity (only accounting for changes in price and quantities resulting from the policy options) allows us to understand the net impact of the policy options.

The stock model separates the benefits for producers of chargers and wholesalers, on the one hand, and the rest of the supply chain, on the other. The benefits for producers and wholesalers are calculated as the difference between the wholesale price of chargers and the production cost. The benefits for the rest of the supply chain, from wholesalers/producers until chargers are sold to consumers, are calculated as the difference between the retail and the wholesale price of chargers.

The quantitative impact for manufacturers of mobile phones is not directly included in the model. From interviews with these stakeholders, it has become clear that they typically do not obtain a profit margin from the sale of chargers when they are bundled with mobile phones (without considering brand reputation, competitive advantages, etc.). Therefore, the policy options do not generate a direct quantitative economic impacts on manufacturers of mobile phones for the sale of chargers, with a few exceptions:

* As explained above, some manufacturers of mobile phones have integrated their business vertically. Huawei, for instance, manufacture their own chargers. Therefore, quantitative impacts for Huawei are included under “benefit for manufacturers of chargers and wholesalers”.
* Apple do not manufacture chargers, but they have integrated their business vertically in the opposite direction, i.e. towards the point of sale. In this case, impacts on benefits for Apple (exclusively from the sale of chargers) are included under “benefits for distributors and retailers”. Other manufacturers of mobile phones also sell their devices directly to consumers (e.g. via online sales). Their benefits from selling chargers directly to consumers are also included under “benefits for distributors and retailers”.

Manufacturers of phones, however, bear the cost of including USB PD in their devices, as well as the cost of the connector at the device end (costs are ultimately passed on to consumers). From information facilitated by interviewees and secondary research conducted, our estimation is that the cost of including USB PD charging protocol is 0.42 Euros per device, which translates into 2.10 Euros in the retail price. USB Type-C receptacles are also more expensive than USB micro-B receptacles. The difference in cost for manufacturers is estimated to be 0.17 Euros per device, which translates into 0.85 Euros in the retail price of the device. It has not been possible in this study to obtain information on the difference in cost between Lightning and USB Type-C. As information was incomplete, this cost has not been input in the stock model and is reported separately. This impact is calculated for Options 1 and 2, which affect the connectors and/or battery charging protocols at the device end. It should be noted that this impact is very minor in both costs for producers and consumers.

It is also important to highlight that the benefits for distributors and retailers are likely to be overestimated, as they only consider the costs of acquiring chargers from wholesalers. In practice, distributors also bear other costs such as transport, labour costs, storage, etc. that are not accounted for in the model. Benefits in this case should be understood as the difference between the cost of inputs and turnover.

We have estimated the **gross profit generated via the sale of chargers** (both in the box and stand-alone) for each policy option, and we have compared it to the gross profit in the baseline, using the following formula:

GPPOj = - -

Where:

* GPPOj = Gross profit for manufacturers in Policy Option j
* Pi = Price of type of charger I (EPS/cable) when sold in the box
* Qi = Quantity of type of charger i (EPS/cable) sold in the box
* SPi = Price of type of charger i (EPS/cable) when sold as a standalone charger
* SQi = Quantity of standalone chargers sold of type i (EPS/cable)
* Ci = Production cost of manufacturing a charger of type i (EPS/cable)

Prices per type of product have been determined as follows: first, the study team conducted a mapping of all types of cables and EPS in retail websites. An average retail price was then calculated per product. A similar exercise was conducted for the wholesale prices. Our estimate is that, on average, the wholesale price is 45% of the retail price. In other words, the retail price is 2.2 times the wholesale price. Estimating production costs required a different approach, as this is not public information. In interviews, we asked manufacturers about the production costs or their products, and about differences in production cost between, e.g. USB Type-C receptacles and USB micro-B receptacles. Our estimate is that the production cost is, approximately, 20% of the retail price. In other words, the retail price is 5 times the production cost. The table below details the prices used in the impact assessment. The quantities are derived from the stock model.

Table 10. Assumed costs and prices of chargers

| **Product** | **Type of product** | **Production cost (€)** | **Price when sold in the box (€)** | **Stand-alone price (€)** |
| --- | --- | --- | --- | --- |
| EPS <7.5W | USB Standard-A receptacle | 3.3 | 5.8 | 16.7 |
| USB Type-C receptacle | 3.0 | 5.3 | 15.0 |
| Multiport | 3.0 | 5.3 | 15.0 |
| EPS 7.5-27W | USB Standard-A receptacle | 3.0 | 5.2 | 15.0 |
| USB Type-C receptacle | 4.8 | 8.4 | 24.0 |
| Multiport | 5.5 | 9.6 | 27.4 |
| EPS >27W | USB Standard-A receptacle | 6.0 | 10.5 | 30.0 |
| USB Type-C receptacle | 6.4 | 11.2 | 32.0 |
| Multiport | 7.6 | 13.3 | 38.1 |
| Captive cable | 5.5 | 9.6 | 27.5 |
| Cables (1m) | USB Standard-A - USB Micro-B | 1.4 | 2.5 | 7.0 |
| USB Standard-A - USB Type-C | 1.9 | 3.3 | 9.5 |
| USB Standard-A – proprietary (Lightning) | 5.0 | 8.8 | 25.0 |
| USB Type-C - USB Type-C | 2.8 | 4.9 | 14.0 |
| USB Type-C – proprietary (Lightning) | 5.0 | 8.8 | 25.0 |

Source: Own estimates based on retail and wholesale prices from online vendors. Wholesale prices were consulted at the Irish website of Farnell, Mouser and Aulola. Retail prices were obtained from a large number of online retail vendors in the EU such as Curries, Mediamarkt, Samsung, Amazon, Aukey, etc. The table includes average prices from across different vendors.

It should be noted that the prices have been kept constant over time in our model. However, interviews with experts and industry representatives suggest that the cost and price of USB Type-C connectors will decrease over time, as more devices incorporate this connector and more economies of scale are achieved. However, the trend is highly uncertain, and we have not observed any changes in prices between now and 2019, when the first IA was conducted. As a result, we have decided to keep the prices constant.

Other impacts on competitiveness, i.e. changes in distribution of revenue among competitors and loss of income from royalties, are explored qualitatively.

Innovation and research

The initiative may affect innovation in charging technologies that are not compliant with the policy options (e.g. innovation in new connectors or fast charging technologies). Innovations may be pursued in a collaborative environment to develop new standards (e.g. the USB-IF), or by private companies individually to obtain new sources of comparative advantage. The new regulation or voluntary agreement on harmonisation could be updated to incorporate new standards (e.g. USB Type-D[[91]](#footnote-91)), but not proprietary charging technologies.

Given the size of the EU market, a regulation that prohibits proprietary charging technologies to be placed in the EU market may preclude private companies from investing in this type of innovation (i.e. not cooperative). Under the voluntary agreement, companies would voluntarily commit, but not be obliged, to remove proprietary charging technologies from their phones, which means they would not be disincentivised (or not to the same extent) from investing in new technologies.

The development of the USB Type-C connector may serve as an illustrative example. During the interviews conducted in the first IA, it was widely recognised by the industry that the development of USB Type-C connectors was influenced (and to some extent facilitated) by the existence of Lightning. In particular, industry commented that some features of Lightning, including the fact that it is reversible, found their way into the USB Type-C connector. By extension, it appears plausible that the development of future USB technology could be negatively affected by the absence of any competing connector technologies whose features could eventually be incorporated.

Businesses’ capacity to innovate, in this case, is also linked to their competitiveness. In fact, as explained in section 2 (problem definition), fast charging solutions are a source of competitive advantage for some companies.

The significance of this impact will depend on the chosen policy instrument, with higher negative impacts if the instrument is a regulation (as opposed to a voluntary agreement). It should be noted that companies innovating in charging solutions are not based in the EU (companies with proprietary charging solutions are based in California and Asia). This impact is analysed qualitatively.[[92]](#footnote-92)

Impacts on consumers

Impacts on consumers are primarily assessed in the sections dedicated to “social impacts” (sections 4.3 and 5.3). However, the policy options may also have economic impacts for consumers, which are assessed in section 5.2.

As explained above when describing the impacts on competitiveness, the policy options may require the use of certain inputs (e.g. USB Type-C connectors) or unbundling the chargers, which would have an impact on the price consumers pay when acquiring a new mobile phone. This impact is quantified following the same approach as for impacts on competitiveness.

The price that consumers will pay for their chargers, whether included in the box or bought separately, will be affected by the policy options, in the same way that the options affect the gross profit that manufacturers receive. The formula to calculate the cost for consumers is as follows:

CPOj =

Where:

* CPOj = Cost for consumers in Policy Option j
* Pi = Price of type of charger i when sold in the box
* Qi = Quantity of type of charger i sold in the box
* SPi = Price of type of charger i when sold as a standalone charger
* SQi = Quantity of standalone chargers sold of type i

Operating costs and conduct of business

Operating costs and conduct of business refer to additional adjustment, compliance or transaction costs on businesses derived from the policy options. It may affect, *inter alia*, the cost or availability of essential inputs, access to finance, the investment cycle, or entail the withdrawal of certain products from the market.

Operating costs include the cost of redesigning products (especially if the policy option applies to existing models), the shortening of the natural lifetime of existing models (if they are not compliant with the new regulation) and associated loss of sales, and the need to have two product lines (e.g. one for the EU market, and another one for the rest of the world).[[93]](#footnote-93)

One of the costs considered is the cost of demonstrating compliance with the standard or regulation in question (conformity assessment). The costs vary substantially depending on the type of regulation (e.g. essential requirement, harmonised standard…) and on the option given to / chosen by manufacturers to demonstrate compliance (e.g. presumption of conformity, or other methods).[[94]](#footnote-94) The impact will also depend on whether the policy options require full compliance with a standard, or compatibility (e.g. essential requirements).

The USB IF has a compliance programme to certify sinks (devices) and sources (EPS) that are compliant with the USB PD 3.0 specification. Manufacturers may also test whether their own products are USB PD compatible.

In addition, mandating certain standards may create market barriers and produce distortions (e.g. if other countries apply different requirements or standards), forcing manufacturers to have different models or designs for each market.

This impact is assessed qualitatively based on information provided by interviewees across all types of stakeholders, and on literature review.

| 1. **Type of stakeholder** | 1. **How they may be affected** |
| --- | --- |
| Manufacturers of mobile phones | All the policy options considered require manufacturers making changes in their devices (e.g. to include USB Type C connectors and/or USB PD as the charging battery protocol), or changes in their packages (to remove the EPS and/or the cable, for those cases where accessories are still included). Manufacturers may also need to demonstrate compliance with standards (USB Type C and/or USB PD) in their devices and the EPS included in the box.  A new logo to advertise the battery charging protocol used in the devices (Option 5) may also have an associated cost for manufacturers. |
| Distributors, retailers and wholesalers | The options that include unbundling may affect distributors, as they may have to look for new suppliers of stand-alone EPS and/or cables. They may also need to upskill their staff to be able to provide advice to consumers on which EPS/cable works with their devices. |
| Manufacturers of chargers (EPS and/or cables) | Manufacturers of chargers of portable devices would also be affected by unbundling and harmonisation initiatives. If unbundling is mandated, they may have to find new intermediaries to sell their EPS/cables. Firms that manufacture the chargers that are currently included in the box with mobile phones and other devices would be particularly affected. In interviews with the industry, it has become apparent that there are some charger manufacturers specialised in designing and producing tailor-made EPS and cables for specific portable devices. Chargers are produced and sold unbranded to manufacturers of portable devices, who incorporate their own brand to the final product.  Harmonisation of EPS, on the other hand, would affect those firms that are currently manufacturing chargers with proprietary charging protocols, as they would need to adapt their processes to incorporate standard protocols (if not incorporated yet). Manufacturers of chargers may need to perform new tests or obtain new certifications on their EPS (e.g. on USB PD compliance). |
| Manufacturers of System-on-Chip (SoC) | A system on a chip (SoC) is an integrated circuit (also known as a "chip") that integrates all or most components of a computer or other electronic system. These components almost always include a central processing unit (CPU), memory, input/output ports and secondary storage, often alongside other components such as radio modems and a GPU – all on a single substrate or microchip. The SoC determines the battery charging protocol used by electronic devices.  Manufacturers of SoC generally include USB PD along with other proprietary solutions. Under option 2, it would be mandatory for manufacturers of SoC to integrate USB PD. |

Costs to public authorities

Costs to public authorities may arise in two ways:

* Cost of adapting standards (e.g. IEC 63002) to the requirements of the EU regulation (e.g. defining minimum requirements that firms need to comply with, based on the standard). This cost is expected to be low / negligible, as existing standards would be used for any policy option.
* Increase in control costs for surveillance authorities to check an additional standard. Given that control and surveillance systems are already in place, the marginal cost for testing any additional requirement is expected to be very low or negligible.

This impact, which is considered to be very minor, is assessed qualitatively.

Impacts on SMEs in the EU

Most of the companies in the supply chain of mobile phones and their chargers are located out of the EU. There are very few manufacturers of mobile phones headquartered in the EU (notably, HMD, and Fairphone, as well as other small companies specialised on mobile phones for specific segments of the population, e.g. people working or living in hard environmental conditions, and old people), and their production lines are located overseas in most cases. The impacts for EU-based SMEs are assessed qualitatively.

Macroeconomic impacts

The market of chargers is fragmented (i.e. formed by a larger number of companies), with some companies manufacturing chargers in the EU. There are around 10,000 companies manufacturing “other electrical equipment” in the EU (NACE 2790)[[95]](#footnote-95), of which we estimate that around 1% (100 firms) manufacture power supply units for telecommunication apparatus.[[96]](#footnote-96) Through our stock model, we estimate that their turnover in 2020 was 154 million EUR (including only turnover from sales of chargers).[[97]](#footnote-97) On average, between 2012 and 2018, there was one person employed in the EU in the manufacture of EPS per 186,177 Euros of turnover.[[98]](#footnote-98) In other words, there were around 1,900 people in the EU employed in the production of chargers.

Regulations that affect the overall number of sales of EPS and cables in the EU would affect the firms’ turnover and, therefore, may have wider macroeconomic implications on production and employment. However, given the small size of the market, our estimation is that the significance of the impact of the policy options on employment in the EU would be low in all policy options (between -100 and +200 jobs). Therefore, this impact is not assessed further.

* 1. Social impacts

Based on the screening undertaken as part of the first IA study, the main social impacts of the initiative are likely to be two-fold:

1. Impacts on consumer convenience from increased harmonisation and/or unbundling of charging solutions[[99]](#footnote-99)
2. Impacts on product safety, in terms of the risk of injury or damage to consumers, from sub-standard and/or counterfeit chargers

Due to the nature and limitations of the available data, both of these types of impacts can only be analysed qualitatively. Below we briefly describe the approach to the assessment of the social impacts. The assessment itself is presented in the following chapter (section 5.3).

* + 1. Consumer convenience

These impacts will be assessed based primarily on the responses to the surveys with representative samples of consumers carried out as part of the previous study as well as this study, which provide relevant insights into the nature and scale of the problems, as well as pointers to how consumers are likely to react to, or be affected by, the different policy options.

There are a number of different dimensions to this issue, which were tested as part of the consumer panel survey undertaken as part of the first IA study report. This showed that the main sources of inconvenience caused by the current situation are: (1) the inability to charge certain devices (as fast) with certain chargers, (2) too many chargers, (3) no access to a compatible charger, and (4) confusion about which charger works with what (see the first IA study report, sections 3.5 and 5.2).

In addition, the consumer panel survey undertaken as part of the present study tested specifically respondents’ attitudes to issues related to unbundling, including their preferences for bundled or unbundled solutions in different circumstances.

* + 1. Product safety and illicit markets

As described in more detail in the first IA study report (sections 3.8 and 3.9), there appears to be a substantial market for substandard and/or counterfeit chargers, which raises concerns in terms of product safety for users, as substandard chargers imply higher electric shock, electrocution and fire risks. If the chargers are counterfeit, this also implies direct and/or indirect economic losses to the holders of the intellectual property rights (usually the large mobile phone manufacturers themselves). These issues are almost always associated with stand-alone chargers (which are very difficult to control effectively, especially if sold online).

It therefore needs to be considered carefully if and how the initiative would affect the market for stand-alone chargers, since an increase in demand could potentially exacerbate the risks. Since the exact scale of the problem is impossible to ascertain (product safety risk alerts in databases such as RAPEX or ICSMS only represent the “tip of the iceberg”, and reliable data on the market for counterfeit chargers does not exist). As part of this study (see section 5.3), we do try to provide an approximation of the size of the counterfeit market, and the frequency of product safety issues, based on the responses to our consumer survey. However, beyond this, the assessment of the impacts of the policy options on product safety and illicit markets can only be qualitative, based on a reasoned examination of the likely effects of any changes in the size and/or characteristics of the stand-alone charger market (for further details see section 5.2 of the first IA study report).

1. Impact assessment for mobile phones
   1. Environmental impacts

The key environmental impacts were introduced in section 4.1 of this report, which set out impacts to be assessed, namely raw material use, e-waste and GHG emissions. The stock model has been used to model the impacts of the baseline and each policy option for each of these environmental impact categories. In addition to the description of policy options presented in chapter 3, a detailed elaboration of the modelling assumptions for each policy option is provided in Annex G.

Summary of impacts

The following table summarises the environmental impacts of the options with a comparison to the baseline. The calculation of each of the environmental impacts is based on the approach presented in Chapter 4.

Table 11 Summary of environmental impacts

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Baseline** | **PO1** | **PO2** | **PO3** | **PO4.a** | **PO4.b** | **PO5** |
|  |  |  | **Harmonise device-end connectors** | **Require mobile phones to be compatible with USB PD** | **"Common" EPS for mobile phones** | **Mandatory unbundling of EPS** | **Mandatory unbundling of EPS and Cable** | **Interoperability labelling / information scheme** |
| **GHG emissions [ktCO2e][[100]](#footnote-100)** | **Total 2024-2030** | **7 838** | **7 963** | **7 767** | **7 944** | **7 139** | **6 271** | **7 762** |
|  | Difference with baseline |  | 125 | -71 | 106 | -699 | -1 567 | -76 |
|  | Annual average | 1 120 | 1 138 | 1 110 | 1 135 | 1 020 | 896 | 1 109 |
|  | Difference with baseline |  | 18 | -10 | 15 | -100 | -224 | -11 |
|  | As % |  | 1.6% | -0.9% | 1.3% | -8.9% | -20.0% | -1.0% |
| **Material Use [tonnes][[101]](#footnote-101)** | **Total 2024-2030** | **152 806** | **155 110** | **151 597** | **154 274** | **143 710** | **119 238** | **151 477** |
|  | Difference with baseline |  | 2 304 | -1 209 | 1 468 | -9 096 | -33 568 | -1 329 |
|  | Annual average | 21 829 | 22 159 | 21 657 | 22 039 | 20 530 | 17 034 | 21 640 |
|  | Difference with baseline |  | 329 | -173 | 210 | -1 299 | -4 795 | -190 |
|  | As % |  | 1.5% | -0.8% | 1.0% | -6.0% | -22.0% | -0.9% |
| **E-waste [tonnes][[102]](#footnote-102)** | **Total 2024-2030** | **133 196** | **134 283** | **132 846** | **133 886** | **129 650** | **119 787** | **132 681** |
|  | Difference with baseline |  | 1 088 | -350 | 690 | -3 546 | -13 409 | -515 |
|  | Annual average | 19 028 | 19 183 | 18 978 | 19 127 | 18 521 | 17 112 | 18 954 |
|  | Difference with baseline |  | 155 | -50 | 99 | -507 | -1 916 | -74 |
|  | As % |  | 0.8% | -0.3% | 0.5% | -2.7% | -10.1% | -0.4% |
| **Of which Untreated [tonnes][[103]](#footnote-103)** | **Total 2024-2030** | **27 365** | **27 580** | **27 302** | **27 504** | **26 677** | **24 786** | **27 266** |
|  | Difference with baseline |  | 215 | -63 | 139 | -688 | -2 579 | -99 |
|  | Annual average | 3 909 | 3 940 | 3 900 | 3 929 | 3 811 | 3 541 | 3 895 |
|  | Difference with baseline |  | 31 | -9 | 20 | -98 | -368 | -14 |
|  | As % |  | 0.8% | -0.2% | 0.5% | -2.5% | -9.4% | -0.4% |
| **Of which Recycled [tonnes][[104]](#footnote-104)** | **Total 2024-2030** | **70 685** | **71 330** | **70 556** | **71 070** | **69 087** | **63 072** | **70 413** |
|  | Difference with baseline |  | 645 | -129 | 386 | -1 597 | -7 613 | -272 |
|  | Annual average | 10 098 | 10 190 | 10 079 | 10 153 | 9 870 | 9 010 | 10 059 |
|  | Difference with baseline |  | 92 | -18 | 55 | -228 | -1 088 | -39 |
|  | As % |  | 0.9% | -0.2% | 0.5% | -2.3% | -10.8% | -0.4% |

**Source:** Own TRI-STOCK-CHARGER model calculations.

* + 1. GHG emissions

The GHG emissions impacts of chargers result from the extraction of resources, manufacture, transport, use and disposal of the charger, i.e. the full life-cycle emissions of the charger. The volume of the effect is highly dependent on the weight of the charger. The main assumptions for chargers were presented in chapter 4 whilst more detailed assumptions per policy option are described in Annex G. The combination of these assumptions, applied to the annual additions to the charger stock are used to calculate the annual GHG emission impact of the options. These are summarised in Figure 5 below.

Figure 5. GHG emissions impact of the policy options 2017-2030, ktCO2e

**Source:** Own TRI-STOCK-CHARGER model calculations. Baseline

In the baseline emissions increase between 2017-2023 despite the decline in the number of EPS and cables added to the stock of chargers each year as smartphone sales decline and unbundling increases. The increase in emissions is driven by the switch to faster, more powerful EPS and the move to USB Type-C cables, both of which are heavier than the previously more common low (<7.5W) power EPS and USB Micro-B cables. The weighted average weight of an EPS + cable combination is modelled to increase by 70% from 57g to 97g between 2017 and 2023 due to these trends. This weight increase drives the observed increase in emissions. The trend in weight increase per charger combination stabilises from 2024 onwards and even declines a little as lighter EPS, e.g. using GaN, become more common. These effects, combined with a continued (small) decline in smartphone and standalone charger sales leads to the observed decline in baseline GHG emissions of 7% between 2023 and 2030.

Baseline annual GHG emissions in 2023 of 1,142 ktCO2e represent approximately 0.03% of EU GHG emissions in 2018.

Option 1

This option requires a change to smartphone connection ports, which leads to the elimination of USB Micro-B and Lightning connectors on new phones, and consequently the cables sold with these phones. Cables with USB Type-C connectors are heavier on average compared to their USB Micro B and Lightning equivalents, as it is estimated that the USB-C cables have 55% more copper content (see Annex G). The results show that this effect is greater than the impact of reduced standalone cable purchases resulting from the reduction in demand for Lightning cables (a 4.8% reduction in sales compared to the baseline is assumed, as detailed in Annex G). The net effect is a small increase in GHG emissions, with emissions 125 ktCO2e higher than the baseline total between 2024-2030, or around 18 ktCO2e per year. This represents a 1.6% increase compared to the baseline.

Option 2

This option leads to the elimination of USB Micro-B connections on new phones, and consequently the cables sold with these phones, as it is not possible to have USB PD compatibility with USB Micro-B. This includes a move away from low power EPS (<7.5W) supplied with smartphones from 2024, with these reduced to zero, as manufacturers produce EPS in the 7.5W <= EPS <=27W category for USB PD compatibility. As for option 1, the switch to heavier USB Type-C connectors and cables leads to an increase in average cable weight and consequent increase in emissions. Similarly, the move to more powerful EPS also increases the weight-related emissions impact. However, in this case, the offsetting impact on standalone sales, through a modelled reduction in standalone charger purchases for the purpose of fast charging (5% reduction in the ratio of people assumed to purchase an EPS), is greater than the weight increase effect. Therefore, the net effect of this policy option is a small decrease in GHG emissions, with emissions 71 ktCO2e lower than the baseline total between 2024-2030, or around 10 ktCO2e per year. This represents a 0.9% decrease compared to the baseline.

Option 3

The requirement for compliance with IEC63002:2021 means that the SuperCharge EPS produced by Huawei and similar high power EPS of Oppo/OnePlus are eliminated. These EPS, based on a modified USB Type-A port to provide higher wattages, are modelled to switch to USB Type-C ports on the EPS and USB Type-C – Type-C cables. These changes both lead to heavier EPS and cables, increasing the weight-related GHG emissions of the option. Similar to Option 2 this option also eliminates EPS <7.5W supplied with smartphones from 2024 as manufacturers produce EPS in the 7.5W<=EPS<=27W category for compatibility. Whilst there is also an offsetting reduction in standalone EPS sales for the purpose of fast charging this effect is not significant enough to fully offset the increased weight of the changes to EPS. The net effect is a small increase in GHG emissions, with emissions 106 ktCO2e higher than the baseline total between 2024-2030, or around 15 ktCO2e per year. This represents a 1.3% increase compared to the baseline.

Option 4.a

This option leads to the elimination of EPS supplied with smartphones, with all EPS unbundled from 2024 onwards. Whilst a significant rebound in standalone EPS purchases is expected ‒in the stock model, i.e. for every smartphone supplied without an EPS, 0.39 standalone EPS sales are added (as described in the Annex G-Baselines additions)‒, the net effect of this option is a significant decrease in EPS added to the stock compared to the baseline. The decrease totals around 250 million fewer EPS added to the stock between 2024 and 2030. The option does lead to an additional 80 million cables being added to the stock, as consumers purchasing standalone EPS as a result of this rebound effect, also in many cases purchase cables at the same time. Nevertheless, the net effect of this policy option is a significant decrease in GHG emissions, with emissions 699 ktCO2e lower than the baseline total between 2024-2030, or around 100 ktCO2e per year. This represents an 8.9% decrease compared to the baseline.

Option 4.b

In addition to EPS as per option 4.a, this option also eliminates cables supplied with smartphones. The rebound effect for cables is significant too, with approximately 0.44 cables purchased standalone for every cable unbundled. This option has the same effect on EPS additions at option 4.a, and additionally leads to around 560 million fewer cables being added to the stock between 2024 and 2030 than in the baseline. As a result the net effect of this policy option is the most significant decrease in GHG emissions of all of the options, with emissions 1 567 ktCO2e lower than the baseline total between 2024-2030, or around 224 ktCO2e per year. This represents a 20% decrease compared to the baseline.

The impact of this option is proportionally higher than option 4.a even though cables are lighter and associated with fewer emissions than EPS. It is due to the fact that in the baseline no cables are unbundled, whilst for EPS more than half of EPS are already assumed to be unbundled in the baseline, reducing the savings possible for option 4.a. This effect applies to all environmental impacts.

1. *Option 5*

The actual impacts of this option are highly uncertain, but are modelled through an assumed reduction in standalone EPS purchases of 1% compared to the baseline as some consumers learn from the labelling and information that they do not need a new charger. This also leads to a small reduction in cable sales (cable sales are assumed to be 0.58% lower than the baseline), from those that would have purchased a cable together with an EPS. The net effect of this policy option is a small decrease in GHG emissions, with emissions 76 ktCO2e lower than the baseline total between 2024-2030, or around 11 ktCO2e per year. This represents a 1.0% decrease compared to the baseline.

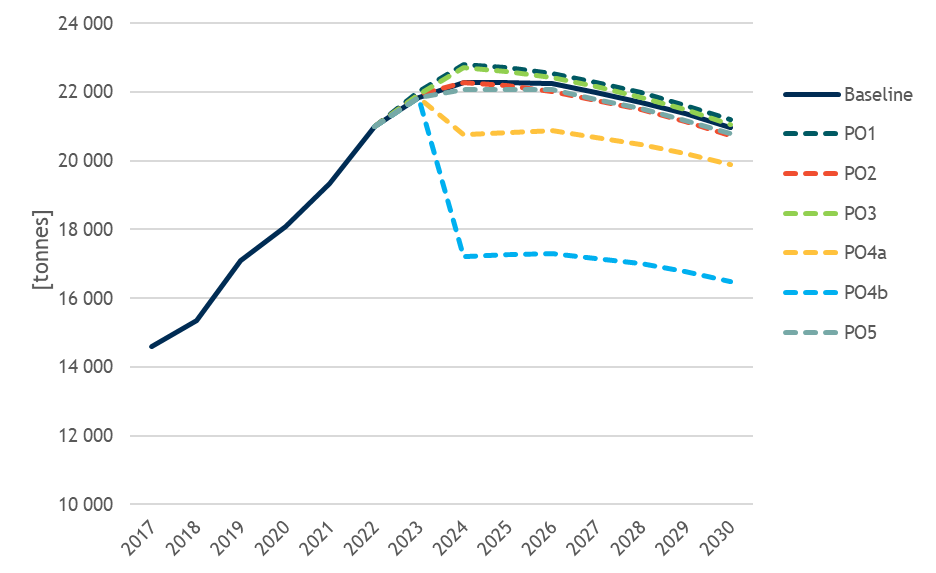
Summary

In summary, policy options 4.a and 4.b result in the most substantial reduction of GHG emissions due to the unbundling of EPS (4.a) and both EPS and cables (4.b) from smartphone sales. The unbundling impact is greater than the rebound effect related to the additional standalone EPS and cables sales, and is particularly significant for 4.b as no cables are expected to be unbundled in the baseline. In contrast, options 1 and 3 show a small increase in GHG emissions mainly due to the increase of cables with USB Type-C connectors, as these are heavier on average than the USB Micro B and Lightning alternatives they replace.

* + 1. Material use

As explained in chapter 4, understanding the material composition of both the EPS and cables is crucial to identifying the main environmental impacts associated with the use of raw materials. Therefore, the stock model predicts the material that is and will be used for the manufacturing of new EPS and cables based on their average composition, as explained in Chapter 4. The detailed assumptions related to material use are described in Annex G. The combination of these assumptions, applied to the additions to the charger stock modelled in the stock model are used to calculate the material use impact of each of the policy options. These are summarised in *Figure* 6 below.

Figure 6. Material use impact of the policy options 2017-2030, tonnes



**Source:** Own TRI-STOCK-CHARGER model calculations. Baseline

In the baseline, material use increases from 14,584 tonnes in 2017 to 20,969 tonnes in 2030. From 2017-2024 there is a steady increase in the material used. The biggest annual increases are observed between 2019 and 2022 (an annual average of 8% increase in material use). This is driven by the switch to heavier EPS and cables, as described for the GHG impact. The increase in material use slows in 2023 and 2024 (4% and 2% increases, respectively). This is then followed by a overall stabilisation of material use until 2026, after which there is an annual decline of 1-2%. This decline is driven by increased adoption of lighter and smaller EPS, for example using GaN, as well as the introduction of new components.

For context, baseline annual material use (based on the 2024-2030 annual average) of 21,829 tonnes represents a negligible proportion (0.0005%) of the 4.5 million kilotonnes of total material used in the EU in 2018. Although it does equate to around 2.6% of the weight of small household appliances put on the market in the EU in 2018, and so within this category is a small but non-negligible contributor.

Option 1

This option requires a change to smartphone connection ports, which leads to the elimination of USB Micro-B and Lightning connectors on new phones, and consequently the cables sold with these phones. This elimination is modelled by a reduction of the baseline share of EPS USB Type-A <7.5W to zero, with this share being redistributed to the EPS USB Type-A 7.5W <= EPS <=27W category from 2024 onwards. Both USB micro-B and Lightning (all Type-C in the baseline from 2021) cables are modelled to be reduced to zero in 2024 on the introduction of the policy. In 2023 these cable types are already reduced by half compared to the baseline as manufacturers begin to adjust, as explained in Annex G. The effect of this elimination is observed after 2024. Before then, there is an annual average increase (4%) in materials use, whereas from 2025 onwards, an average annual decrease of 1% is observed. The net overall effect of these changes is a marginal increase of 2,304 additional tonnes of materials use, compared to the baseline total between 2024-2030. This is equivalent to around 329 tonnes of materials per year or a 1.5% increase compared to the baseline. For this policy option, only minimal changes between 2024-2030 per material type are observed compared to the baseline (2% additional decrease of both the amount of the copper and stainless steel used).

Option 2

This option leads to the elimination (i.e. reduced to zero) of USB Micro-B connections on new phones from 2024 and consequently, the cables sold with these phones, as explained in detail in Annex G. As expected, the main changes in the trends related to the materials used are observed after 2024, when EPS <7.5W supplied with smartphones are assumed to be eliminated. The same as for option 1, the switch to heavier USB Type-C connectors and cables, and more powerful EPS, leads to an increase in average cable and EPS weight and a consequent increase in material use. However, for this option, the offsetting impact of the option in reducing standalone sales is greater than the weight increase effect. Therefore, the net effect of this policy option is a small decrease in material use, with 1,209 fewer tonnes of material used compared to the baseline total between 2024-2030, equivalent to 173 tonnes per year. This represents a 0.8% decrease compared to the baseline. As for option 2, only minimal changes per material type are observed compared to the baseline.

Option 3

The requirement for compliance with IEC63002:2021 leads to a switch to USB Type-C ports on EPS and USB Type-C – Type-C cables. The model assumes that new <7.5W EPS supplied with smartphones are removed from 2024, as well as USB Micro-B cables. Standalone <7.5W EPS are assumed to see a faster reduction than baseline (reducing to 0.5% by 2030). These changes both lead to heavier EPS and cables, increasing the materials required. The reduction in standalone EPS sales for the purpose of fast charging does not have a significant effect and does not fully offset the increased weight of EPS and cables. As a result, the net effect is a small increase in material use, with 1,468 extra tonnes of materials required compared to the baseline total between 2024-2030, equivalent to around 210 tonnes of materials per year. This represents a 1.0% increase compared to the baseline. For this policy option, only minimal changes between 2024-2030 per material type are observed compared to the baseline.

Option 4.a

This option leads to the elimination (i.e. reduced to zero) of EPS supplied with smartphones from 2024 onwards. Whilst a significant rebound in standalone EPS purchases is expected, as in the stock model for every smartphone supplied without an EPS, 0.39 standalone EPS sales are added (as described in the Annex G baseline additions), the net effect of this option is a significant decrease in EPS added to the stock compared to the baseline. The decrease totals around 250 million fewer EPS added to the stock between 2024 and 2030. The option does lead to an additional 80 million cables being added to the stock, as consumers purchasing standalone EPS as a result of this rebound effect, also in many cases purchase cables at the same time. The net effect of this policy option is a decrease in the total materials required, with 9,096 tonnes fewer materials used compared to the baseline total between 2024-2030, or around 1,299 tonnes per year. This represents a 6% decrease compared to the baseline. Between 2024 and 2030, the most substantial changes are observed in ‘plastics’, ‘aluminium and ‘others (EPS)’.

Option 4.b

In addition to EPS as per option 4.a, this option also eliminates cables supplied with smartphones. Next to the effect on EPS additions as described for option 4.a, this option leads to many fewer cables being added to the stock between 2024 and 2030. As a result, the net effect of this policy option is the most significant decrease in materials used of all of the options, with 33,568 less tonnes of materials used compared to the baseline total between 2024-2030, which is equivalent to around 4,795 tonnes per year. This represents a 22% decrease compared to the baseline. Between 2024 and 2030, the most substantial changes are observed in ‘plastics’, ‘aluminium and ‘others (EPS)’.

1. *Option 5*

As detailed in the Annex, this option assumes a reduction in standalone EPS purchases (of 1% compared to the baseline) as a result of additional labelling and information. This also leads to a small reduction in cable sales (0.58% lower than the baseline). The net effect of this policy option is a small decrease in the materials used, 1,329 less tonnes compared to the baseline total between 2024-2030, or around 190 tonnes per year. This represents a 0.9% decrease compared to the baseline. For this policy option, only minimal changes between 2024-2030 per material type are observed compared to the baseline.

Summary

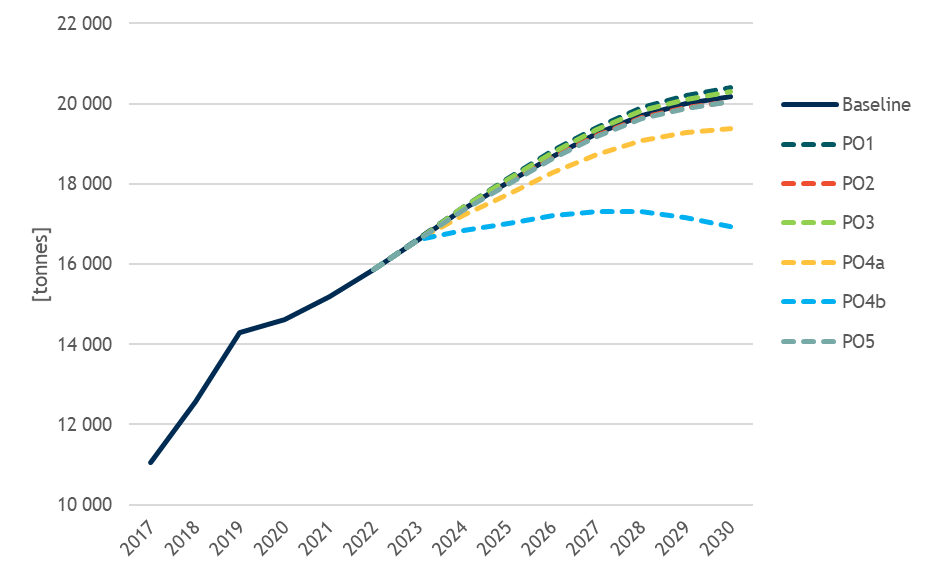
In summary, policy options 4.a and 4.b result in the most substantial reduction of material use due to the unbundling of EPS and both EPS and cables, respectively. In both cases, the rebound effect of the materials required for the additional standalone and cables sales is lower than the materials savings from the unbundling of EPS and cables. Compared to the GHG impact, the difference between the effect of option 4.a and 4.b is bigger in the case of materials used because the life cycle emissions for cables and EPS are different per g of material used, not only the difference in weight.

In contrast, option 1 shows the largest increase in materials used, although a relatively small increase of 1.5% annually. This is mainly due to the increase of cables with USB Type-C connectors that are heavier on average than the alternatives.

* + 1. E-waste, treatment and recycling

We estimated recycling volumes based on the recyclability of the materials found in chargers, the volume of chargers disposed of, the method of disposal, and how disposed chargers are treated. The main assumptions are presented in chapter 4 and the Annex. The combination of these assumptions, applied to the additions to the charger stock modelled in the stock model is used to calculate the e-waste impact of the options (in tonnes). These are summarised in Figure 7 below.

Figure 7. E-waste impact of the policy options 2017-2030, tonnes



**Source:** Own TRI-STOCK-CHARGER model calculations. Baseline

In the baseline, e-waste increases from 12,574 tonnes in 2018 to 20,177 tonnes in 2030 despite the decline in the number of EPS and cables added to the stock of chargers each year. From 2024 onwards, the annual increase in e-waste slows (4% increase until 2026, followed by an average 2% annual increase between 2027 and 2030). Compared to the GHG and materials use impacts, the amount of e-waste generated increases gradually every year, as changes in material use take longer to manifest as changes in e-waste, as disposals are spread over 10 years in the model.

The baseline annual e-waste generated in 2023 of 16,616 tonnes represents approximately 5.4% of the 353,172[[105]](#footnote-105) tonnes of total small household appliances collected from households equipment in 2017.

As explained in section 4.1.2 and detail in Annex G, the model assumes an increase in the recycling rates and recovery rates from recycling of plastics and metals. The changes in these rates result in an increase of 31% in e-waste collected, and 43% in e-waste recovered for recycling between 2024 and 2030.

Option 1

As described above, this option leads to the elimination (i.e. reduced to zero) of USB Micro-B and Lightning connectors on new phones, and consequently, the cables sold with these phones change from 2024. This change has only a small effect on the e-waste generated, with an additional 1,088 tonnes compared to the baseline total between 2024-2030, or around 155 tonnes per year. This represents a 0.8% increase compared to the baseline. The same trend is observed in the amount of untreated and recycled e-waste (0.8% and 0.9% increase compared to the baseline, respectively).

*Option 2*

As outlined in the previous sections, this option leads to the elimination (i.e. reduced to zero) of USB Micro-B connections on new phones from 2024 and consequently, the cables sold with these phones, as explained in detail in Annex G. The effect of the switch to heavier USB Type-C connectors, cables and more powerful EPS on the e-waste generated is more than offset by the impact of reduced standalone sales. Therefore, the net effect of this policy option is negligible, only a very small decrease in the e-waste generated from 2023 onwards: 350 tonnes lower than the baseline total between 2024-2030, or around 50 tonnes per year. This represents a 0.3% decrease compared to the baseline. The same trend is observed in the amount of untreated and recycled e-waste (both with a 0.2% decrease compared to the baseline).

1. *Option 3*

The requirement for compliance with IEC63002:2021 leads to a switch to USB Type-C ports on EPS and USB Type-C – Type-C cables. The model assumes that new <7.5W EPS supplied with smartphones are removed from 2024, as well as USB Micro-B cables. Standalone <7.5W EPS are assumed to see a faster reduction than baseline (reducing to 0.5% by 2030). The net effect of these changes is a small increase in e-waste, with an additional 690 tonnes of e-waste generated compared to the baseline total between 2024-2030, or around 99 tonnes per year. This represents a 0.5% increase compared to the baseline. The same trend is observed in the amount of untreated and recycled e-waste (both with a 0.5% increase compared to the baseline).

1. *Option 4.a*

As explained above, this option leads to the elimination (i.e. reduced to zero) of EPS supplied with smartphones from 2024 onwards. Whilst a significant rebound in standalone EPS purchases is expected, as in the stock model for every smartphone supplied without an EPS, 0.39 standalone EPS sales are added (as described in the Annex G-Baselines additions), the net effect of this option is a significant decrease in EPS added to the stock compared to the baseline. The net effect of this policy option is therefore a decrease in the e-waste generated, with 3,546 less tonnes of e-waste generated than the baseline total between 2024-2030, or around 507 tonnes per year. This represents a 2.7% decrease compared to the baseline. The same trend is observed in the amount of untreated and recycled e-waste (2.5% and 2.3% decrease compared to the baseline, respectively).

1. *Option 4.b*

In addition to EPS as per option 4.a, this option also unbundles the cables supplied with smartphones. As explained above, this option leads to a decrease in EPS additions (as per option 4.a), and cables. The net effect of this policy option is the most significant decrease in e-waste of all of the options, with 13,409 less tonnes of e-waste generated than the baseline total between 2024-2030, or around 1,916 per year. This represents a 10.1% decrease compared to the baseline. The same trend is observed in the amount of untreated and recycled e-waste (9.4% and 10.8% decrease compared to the baseline, respectively).

1. *Option 5*

This option assumes a small reduction in standalone EPS and cables purchases (of 1% and 0.58% respectively compared to the baseline). The net effect of this policy option is a small decrease in e-waste generated, with 515 fewer tonnes of e-waste generated compared to the baseline total between 2024-2030, or around 74 tonnes per year. This represents a 0.4% decrease compared to the baseline. The same trend is observed in the amount of untreated and recycled e-waste (both 0.4% decrease compared to the baseline, respectively).

Summary

In summary, policy options 4.a and 4.b result in the most substantial reduction of e-waste generated due to the elimination of EPS and both EPS and cables, respectively. In both cases, the rebound effect of the e-waste generated due to the additional standalone and cables sales is lower compared to the impact of the e-waste avoided when EPS and cables are no longer supplied with the phones. In contrast, option 1 shows the largest increase in e-waste generated mainly due to the increase of cables with USB Type-C connectors that are heavier on average.

Trends in treatment of waste and recycling follow the trend in e-waste closely, although the underlying improvement in waste collection and recycling common to all options reduces the proportion of untreated waste and increases recycling over time.

* 1. Economic impacts

This section provides an assessment of the economic impacts of the policy options compared to the baseline. The most relevant impacts (impacts on competitiveness of businesses and impacts on consumers) have been quantified through the stock model, following the methodology explained in section 4.2. Macroeconomic impacts on production and employment, including impacts on SMEs, have also been quantified. Other types of economic impacts are assessed qualitatively.

The following table summarises the economic impacts of the options with a comparison to the baseline.

Table 12. Summary of economic impacts

|  | **Baseline** | **PO1** | **PO2** | **PO3** | **PO4.a** | **PO4.b** | **PO5** |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Harmonise device-end connectors** | **Require mobile phones to be compatible with USB PD** | **"Common" EPS for mobile phones** | **Mandatory unbundling of EPS** | **Mandatory unbundling of EPS and Cable** | **Interoperability labelling / information scheme** |
| **Cost to consumers (NPV million EUR)** | | | | | | | |
| Total 2024-2030 | **45,982** | **42,143** | **44,807** | **44,912** | **48,019** | **46,991** | **45,458** |
| Difference with baseline |  | -3,840 | -1,175 | -1,071 | 2,036 | 1,008 | -524 |
| Annual average | 6,569 | 6,020 | 6,401 | 6,416 | 6,860 | 6,713 | 6,494 |
| Difference with baseline |  | -549 | -168 | -153 | 291 | 144 | -75 |
| As % |  | -8.4% | -2.6% | -2.3% | 4.4% | 2.2% | -1.1% |
| **Economic costs for the industry** | | | | | | | |
| **Gross profit for manufacturers of chargers and wholesalers (NPV million EUR)** | | | | | | | |
| Total 2024-2030 | **11,903** | **10,932** | **11,682** | **11,741** | **11,110** | **9,398** | **11,798** |
| Difference with baseline |  | -970 | -221 | -161 | -793 | -2,505 | -105 |
| Annual average | 1,700 | 1,562 | 1,669 | 1,677 | 1,587 | 1,343 | 1,685 |
| Difference with baseline |  | -139 | -32 | -23 | -113 | -358 | -15 |
| As % |  | -8.2% | -1.9% | -1.4% | -6.7% | -21.0% | -0.9% |
| ***Of which profit for EU manufacturers of chargers (NPV million EUR)*** | | | | | | | |
| Total 2024-2030 | **1,519** | **1,389** | **1,471** | **1,471** | **1,725** | **1,844** | **1,498** |
| Difference with baseline |  | -129 | -48 | -48 | 207 | 326 | -21 |
| Annual average | 217 | 198 | 210 | 210 | 246 | 263 | 214 |
| Difference with baseline |  | -18 | -7 | -7 | 30 | 47 | -3 |
| As % |  | -8.5% | -3.1% | -3.1% | 13.6% | 21.4% | -1.4% |
| **Gross profit for distributors and retailers until point of sale [NPV million EUR]** | | | | | | | |
| Total 2024-2030 | **22,177** | **20,278** | **21,444** | **21,429** | **25,799** | **28,194** | **21,863** |
| Difference with baseline |  | -1,899 | -733 | -748 | 3,621 | 6,017 | -315 |
| Annual average | 3,168 | 2,897 | 3,063 | 3,061 | 3,686 | 4,028 | 3,123 |
| Difference with baseline |  | -271 | -105 | -107 | 517 | 860 | -45 |
| As % |  | -9% | -3% | -3% | 16% | 27% | -1% |
| **Impacts on changes in competitive landscape [world / EU]** |  | -/0 | 0/0 | -/0 | 0 | 0 | 0 |
| **Impacts on variations in income from royalties [world / EU]** |  | -/0 | 0/0 | 0/0 | 0 | 0 | 0 |
| **Impacts on innovation [world / EU]** |  | -/0 | 0/0 | --/0 | 0 | 0 | 0 |
| **Other economic costs** | | | | | | | |
| Operating costs [world / EU] |  | -/0 | -/- | -/0 | -/- | -/- | -/- |
| Compliance costs [world / EU] |  | 0/0 | 0/0 | -/- | 0/0 | 0/0 | 0/0 |
| Costs to public authorities |  | 0 | 0 | 0 | 0 | 0 | - |
| Impacts for SMEs |  | - | - | 0 | 0 | 0 | 0 |

**Source:** Own TRI-STOCK-CHARGER model calculations.

* + 1. Competitiveness of businesses (including innovation and research) and costs for consumers

In the baseline, convergence to standards USB PD and USB Type-C is happening naturally, facilitated by the competitive landscape in the industry: first, in high-end devices, for those consumers who can afford and prefer to pay a premium to obtain better charging characteristics, and subsequently cascading to medium and lower-end phones. Since Apple started unbundling their phones in 2020, three other companies have also announced unbundling in some of the product portfolio and/or markets, and more companies are expected to follow suit.

In the baseline, companies are converging towards USB PD while maintaining their proprietary charging technologies. Some firms are launching new products with higher and higher wattage, indicating they are investing in R&D in charging solutions.

The remainder of this section provides a description of the likely effects of the policy options on the competitiveness of businesses, mainly:

* Costs for consumers;
* Gross profit for producers;
* Changes in the competitive landscape;
* Variations in income from royalties; and
* Impacts on innovation.

Option 1: Harmonise connectors on mobile phones

**Costs for consumers**

Under option 1, the price that consumers pay for the charger they acquire decreases by 8.4% (see Table 10). This is the product of the following effects:

* All mobile phones would have USB Type-C connectors, and therefore the cables sold in the box would also have a USB Type-C connector at the device end. This option would rule out Lightning connectors (more expensive than USB Type-C) and USB micro-B (cheaper than USB Type-C). Removing Lightning cables gives a substantive economic gain to consumers. USB micro-B, on the other hand, is being superseded in the baseline by USB Type-C, and therefore the increase in cost of this effect is minor.
* Reduction in number of chargers sold**:** According to the data from the consumer survey, Lightning cables break more frequently than standard USB cables, and consumers buy, on average, more stand-alone Lightning cables than USB cables.[[106]](#footnote-106) The harmonisation towards USB Type-C can therefore be expected to generate a (small) reduction in the number of stand-alone cables bought, which in turn leads to savings for consumers.[[107]](#footnote-107)

**Impacts on competitiveness**

In this option, consumers pay less for the chargers they acquire, which means the profits for manufacturers decrease. The **most affected manufacturers** are Apple and their supply chain. The table below summarises the impacts on competitiveness of Policy Option 1 per type of stakeholder.

Table 13: Impacts on competitiveness of policy option 1 per type of stakeholder

| **Stakeholder** | **Gross profit** | **Changes in competitive landscape** | **Variations in income from royalties** |
| --- | --- | --- | --- |
| Manufacturers of System on a Chip (SoC) | No impact | No impact | No impact |
| Manufacturers of mobile phones | This option generates a small reduction in benefits for Apple due to loss of income from royalties (see column on the right in this table).  This option also increases the manufacturing cost of devices that would otherwise use USB micro-B connectors. This impact, however, is negligible (3 million EUR between 2024-2030), given that most devices in the baseline (excluding Apple’s) will already have transitioned to USB Type-C. | Apple argues that using the Lightning connector allows their phones to be thinner, as this connector is smaller than USB Type-C. In this option, Apple would need to change the design of their phones (cost assessed in section 5.2.2), and their phones might need to be thicker as a result. This would likely damage their competitive position. | Apple would lose its income from royalties of selling third-party devices and accessories using the Lightning connector. In the baseline, the share of standalone sales of Lightning cables is 25% between 2024 and 2030.  For illustration, the difference in retail price between a Lightning to USB Type-C cable, and a cable with USB Type-C at both ends is, on average, 11 Euros (see Table 8). A large part of this difference is explained by the incomes from royalties that Apple receive. This variation in income is accounted for in the impacts presented in Table 10. |
| **Manufacturers of chargers** | This option generates a small reduction in benefits for the industry (-8.5%), a part of which would be assumed by manufacturers of Lightning cables (and part of it by Apple from loss of royalties). | Currently, manufacturers supplying Lightning cables and accessories have a competitive advantage over other suppliers, as they have gone through a process to become Apple suppliers and have adapted their production lines to Lightning connectors. If Lightning is not allowed in the EU market any more, their competitive position may deteriorate. This would be a long-term / permanent cost, as their market share may be absorbed by other manufacturers of chargers.  Overall, the effect for manufacturers based in the EU is negligible, since most of Apple’s supply chain is based in China, Japan, and the US, with very few companies in the EU, notably in Germany, Ireland and Belgium. [[108]](#footnote-108) It is also unclear whether EU companies supply Lightning cables and accessories. | No impacts. These companies would stop paying royalties to Apple for the production and sale of Lightning cables, but this cost was assumed by consumers in the price they pay for Lightning cables and accessories. |
| **Distributors, retailers, and wholesalers** | Relatively significant loss of profit (-9%) due to lower sales of standalone Lightning cables | No impacts | No impacts |

**Impacts on innovation**

This option could potentially have a major negative effect in terms of reducing future **innovation** in phone connectors, both by effectively ruling out any new “game-changing” proprietary connector technology, and by potentially reducing the pace of “incremental” innovation as regards future generations of USB connectors, and limiting the characteristics that this future connector might have. Nonetheless, this needs to be seen in the context of the baseline. In practice, only one company is currently selling phones in the EU that do not use USB connectors at the device end, and even this company has started using USB Type-C connectors in some of its other devices (such as tablets), which makes it seem unlikely it is investing heavily (or sees major potential) in developing a new generation of proprietary connectors. In 2020, Apple invested 18 billion USD (7% of total net sales) in R&D[[109]](#footnote-109); however, it is unknown how much was invested in the development of wired charging technologies. Most of the investment on R&D takes place in the US (the company has committed 430 billion USD in US investments over five years, part of which is on R&D[[110]](#footnote-110)), but it also invests heavily in the EU. In March 2021, Apple announced 1 billion EUR investment in a new facility in Munich (Germany) to focus on 5G and future wireless technologies.[[111]](#footnote-111) The company has not indicated what type of wireless technologies will be developed in Munich, but in the opinion of the study team, it is likely that it will include wireless charging technologies.

Besides Apple, there are no indications that any other company is planning to stop using USB connectors (despite the migration from USB micro-B to USB C).

It should be noted that this option may have implications on innovation on wireless charging if the inclusion of USB Type C connectors is mandatory, and companies are not offered the choice of not including receptacles at all and relying on wireless charging exclusively.

Therefore, overall, we conclude that, in practice, option 1 would be likely to only have a minor constraining impact on innovation for companies all around the world, and no or negligible effect for companies based in the EU. If companies are not given the choice to remove receptacles, it may however have a significant indirect impact on innovation in wireless technologies.

Option 2: Require EPS for mobile phones to be compatible with USB charging technology

Requiring mobile phones to use USB Type-C or USB PD battery charging protocols implies that USB micro-B connectors would not be allowed any more. In this case, however, Lightning connectors and cables would still be permitted, as they are compatible with the USB Type-C specification for connectors.

**Costs for consumers**

In this option, consumers pay a little less for their chargers than in the baseline (168 million EUR less, see Table 10). With the harmonisation of battery charging protocols at the device end, it is hypothesised that the EPS sold bundled with mobile phones would be able to provide fast charge. This would in turn reduce the amount of standalone EPS that consumers buy by 4% by 2030.[[112]](#footnote-112) This effect outweighs the higher cost of USB Type-C in relation to USB micro-B, and the cost of upgrading the battery charging protocol to USB Type-C or USB PD.

**Impacts on competitiveness**

The savings that consumers achieve translate into a very minor decrease of benefits for the industry. The businesses affected by this option would be those who produce and sell standalone fast chargers.

Table 14: Impacts on competitiveness of policy option 2 per type of stakeholder

| **Stakeholder** | **Benefits** | **Changes in competitive landscape** | **Variations in income from royalties** |
| --- | --- | --- | --- |
| **Manufacturers of System on a Chip (SoC)** | Currently, manufacturers of SoC are already including USB PD and/or USB Type-C in most of their chips.  Some chips used in phones still use older technologies (e.g. UBS BC or QC3), but manufacturers of SoC interviewed considered these chips will be almost completely phased out in the baseline by 2024. | The battery charging protocol is only a small component of the chip. It is not expected that the option would produce changes in the distribution of revenue among competitors. | Option 2 allows the use of proprietary charging protocols, as long as USB PD or USB Type-C is also included. Therefore, no losses of income from royalties are expected for SoC manufacturers. |
| **Manufacturers of mobile phones** | Almost all mobile phones already incorporate USB PD or USB Type-C, with the exception of low and some medium tier devices. In principle, according to information provided by interviewees, the cost for mobile phone manufacturers of including USB PD at the device end is minor (0.6 EUR per phone, which totals 9 million EUR between 2024 and 2030 in difference with the baseline). This cost would be passed on to consumers at a total price of 47 million EUR between 2024 and 2030, in difference with the baseline. As explained in section 4.2, this cost could not be included in the stock model as information was incomplete. However, in relative terms, it is negligible (in this option, consumers save 1,175 million EUR, see Table 10). It can be concluded that the cost on the device, in relative terms, is therefore negligible. | The option is not expected to generate major changes in the competitive landscape. Manufacturers who want to continue offering proprietary fast charging solutions along with USB PD could continue to do so, and consumers who value this as a competitive advantage would continue to be willing to pay a premium for this feature.  This option might affect negatively small firms that produce low-end phones and that would have otherwise continued using USB micro-B connectors and/or USB BC protocol. The size of this market is small (9% in the baseline in 2024). | No impact |
| **Manufacturers of chargers** | The benefits for this group would reduce slightly (-221 million EUR between 2024-2030, -1.9%) due to a small reduction in production of standalone chargers as a result of the harmonisation. | No impacts | No impacts |
| **Distributors, retailers, and wholesalers** | The benefits for this group would reduce slightly (-773 million EUR between 2024-2030, -3%) due to a small reduction in sales of standalone chargers as a result of the harmonisation. | No impacts | No impacts |

**Impacts on innovation**

This option would not impact on the capacity of firms to innovate, given that proprietary charging technologies would still be allowed.

Option 3: Require EPS for mobile phones to comply with USB interoperability guidelines

**Costs for consumers**

In practice, the impacts of option 3 are almost identical to option 2. Requiring compatibility of EPS with USB Type-C or USB PD would have a similar effect on reduction of sales of standalone EPS as option 2. This effect outweighs the increase in cost of upgrading all EPS from standard to fast charging. In this option, there is a 2.3% reduction in the total price that consumers pay for the chargers they acquire.

**Impacts on competitiveness**

The reduction in costs paid by consumers translates in a reduction of benefits for the industry. The table below provides a description of the impacts per type of stakeholder.

Table 15. Impacts on competitiveness of policy option 3 per type of stakeholder

| **Stakeholder** | **Benefits** | **Changes in competitive landscape** | **Variations in income from royalties** |
| --- | --- | --- | --- |
| **Manufacturers of System on a Chip (SoC)** | This option only affects EPS, and therefore is not expected to have any direct impact on manufacturers of SoC. | No impact | The firms owning proprietary fast charging technologies are varied: SoC manufacturers (e.g. Qualcomm) and manufacturers of electronic products (e.g. Oppo and Huawei). Their income may be reduced in this option as a consequence of losing income from royalties. In the case of Qualcomm, their latest versions of Quick Charge are already fully compatible with USB PD PPS and it is expected that by 2024 most mobile phones currently using older versions of QC will have already migrated to compliant versions. Huawei manufacture their own products with their proprietary solution, which are not shared with other companies (they are not receiving any royalties in the baseline). Finally, Oppo holds the intellectual property rights of VOOC. Other brands using VOOC (OnePlus and Realme) have very little market share in the EU market. This impact is expected to be minor, and no companies based in the EU would be affected. |
| **Manufacturers of mobile phones** | Direct impacts on benefits for phone manufacturers are negligible (any changes in the costs of chargers they buy/sell would be passed on to consumers). The exception would be those companies that produce their own chargers (these impacts are accounted for in the row below) | Some phone manufacturers argue that their proprietary fast charging technologies offer them a competitive advantage, as they can provide fast charging solutions at a lower cost than USB PD.[[113]](#footnote-113) Under this policy option, the EPS sold along with mobile phones would need to be USB PD compliant, and therefore these companies may lose this advantage. However, they would still have the possibility of unbundling their phones from the EPS and sell the EPS separately to those consumers who value the charging performance provided by proprietary fast charging solutions. |
| **Manufacturers of chargers** | The benefits for manufacturers of chargers would decrease by 1.4%. This is due to reduction of chargers produced and sold resulting from the harmonisation of EPS sold in the box. | This option may trigger a reduction of sales of EPS using proprietary fast charging technologies, which would benefit manufacturers of standard charging solutions. | As explained above, phone manufacturers using proprietary charging technologies do not licence their IP rights. Instead, Huawei and Oppo produce their own chargers. This option, therefore, is not expected to generate variations in income from royalties. |
| **Distributors, retailers, and wholesalers** | The benefits for manufacturers of chargers would decrease by 3%. This is due to fewer standalone chargers sold resulting from the harmonisation of EPS sold in the box. | No impacts | No impacts |

**Impact on innovation**

The main difference between this option and option 2 is the impact on innovation. Option 2 allows the use of proprietary solutions, as long as standard charging protocols (USB Type-C or USB PD) are also incorporated. Option 3, however, rules out this possibility, hence decreasing the incentives of private companies to invest in new battery charging protocols. One of the main companies investing heavily in proprietary fast charging solutions is Huawei, with a market share of 22% in 2018 and 2019 in the EU (in units sold). An option prohibiting the use of their proprietary solution in the EPS would be likely to have a significant effect on their incentives to continue innovating in this space. Nevertheless, it is worth noting that this option affects only to EPS that are sold unbundled. Therefore, Huawei and other companies currently selling EPS with proprietary solutions would still be able to sell them unbundled to consumers.

Option 4.a: Mandatory unbundling of EPS from mobile phones

**Costs for consumers**

This option, paradoxically, is the most detrimental for consumers in terms of economic impacts. Under this option, it is hypothesised that producers would decide to market all their phones unbundled from chargers (as they are obliged to offer this option to consumers). The cost of the phone would decrease slightly, reflecting the savings of not having the EPS (which in the baseline is offered to consumers at wholesale price, i.e. without a margin for manufacturers of mobile phones).

As EPS would not come by default anymore with mobile phones, there would be a rebound effect in the sales of standalone EPS.[[114]](#footnote-114) When bought standalone, consumers pay the retail price, which is 2.2 times the wholesale price (see Table 8). The cost of this rebound effect outweighs the savings of unbundling phones. As a result, costs for consumers increase by 4.4% in relation to the baseline.

**Impacts on competitiveness**

Table 16. Impacts on competitiveness of policy option 4.a per type of stakeholder

| **Stakeholder** | **Benefits** | **Changes in competitive landscape** | **Variations in income from royalties** |
| --- | --- | --- | --- |
| **Manufacturers of System on a Chip (SoC)** | This option only involves unbundling, and therefore it has no impact on manufacturers of SoC | | |
| **Manufacturers of mobile phones** | The unbundling of the EPS would generate savings for this group of stakeholders, as they would not need to include EPS in the box anymore.  Some of these savings may be passed on to consumers through reductions in the price of the device, but some may be absorbed by manufacturers as additional income. Our stock model assumes savings are passed on to consumers. | The competitive position of manufacturers currently using proprietary fast charging technologies may be negatively affected, as they could not offer the complete solution in the box and consumers may prefer to buy EPS that work with other devices. | Manufacturers of mobile phones using third party charging solutions (e.g. Quick Charge) may need to pay lower royalties, as one of the proprietary elements (the EPS) would not be included in the box anymore. The impact on benefits for manufacturers is likely to be minor, as this cost/saving would be passed on to consumers. |
| **Manufacturers of chargers** | Manufacturers of chargers are one of the main stakeholders affected by this option. Overall, their sales would decrease as the number of EPS sold in the EU decreases (-6.7%). On the other hand, however, they would obtain higher margin selling their EPS directly to distributors/consumers than to manufacturers of mobile phones. | Firms who produce chargers to be sold in the box may lose market share if they are not able to adapt their distribution networks rapidly. This share would be won by manufacturers who distribute to retailers/consumers. This effect is however expected to be negligible, as there is already a high degree of unbundling in the baseline. | This option does not affect harmonisation, and therefore no impacts on royalties are expected. |
| **Distributors, retailers, and wholesalers** | Distributors would benefit from the increased sales of stand-alone chargers, from which they would obtain higher margins than when sold along with mobile phones. The benefits for the industry calculated in the stock model (16% increase compared to the baseline). | No impacts | No impacts |

**Impacts on innovation**

Mandatory unbundling is not expected to generate significant impacts on the capacity of firms to innovate, since it does not encompass harmonisation.

Option 4.b: Mandatory unbundling of the entire charger (EPS and cables)

**Costs for consumers**

The economic impacts of unbundling not only the EPS, but also the cable, are a little bit more positive for consumers. In this option, for every phone that is sold without EPS and cable, consumers buy 0.36 EPS and 0.26 cables. The result is that the total price paid by consumers for the chargers they acquire is 2.2% higher than in the baseline.

**Impacts on competitiveness**

Table 17. Impacts on competitiveness of policy option 4.b per type of stakeholder

| **Stakeholder** | **Benefits** | **Changes in competitive landscape** | **Variations in income from royalties** |
| --- | --- | --- | --- |
| **Manufacturers of System on a Chip (SoC)** | This option only involves unbundling, and therefore it has no impact on manufacturers of SoC | | |
| **Manufacturers of mobile phones** | As in option 4.a, unbundling (in this case of both EPS and cable) would generate savings for this group of stakeholders.  Some of these savings may be passed on to consumers through reductions in the price of the device, but some may be absorbed by manufacturers as additional income. Our stock model assumes savings are passed on to consumers. | As in option 4.a, the competitive position of manufacturers currently using proprietary fast charging technologies may be negatively affected. This option would also affect Apple, who could not include their proprietary cable. However, Apple’s market share has been very steady in the last four years and it can be expected that Apple users already have Lightning cables. Therefore, the additional impact of this option compared to option 4.a is negligible. | As in option 4.a, this impact is expected to be minor for mobile phone manufacturers. The unbundling of the cable may reduce slightly the royalties obtained by Apple if fewer Lightning cables are sold. |
| **Manufacturers of chargers** | As in option 4.a, this group of stakeholders is one of the main groups affected. In this case, the unbundling of cables would reduce sales of chargers even further (-21% compared to the baseline). On the other hand, they may obtain higher margins for the EPS and cables they produce if they are able to directly sell to retailers/consumers. | Firms who produce chargers to be sold in the box may lose market share if they are not able to adapt their distribution networks rapidly. This share would be won by manufacturers who distribute to retailers/consumers. In the case of EPS, this is already happening in the baseline, but in the case of cables, this option would generate a major change in the competitive landscape. | This option does not affect harmonisation, and therefore no impacts on royalties are expected. |
| **Distributors, retailers, and wholesalers** | Distributors would benefit from the increased sales of stand-alone EPS and cables, from which they would obtain higher margins than when sold along with mobile phones. The benefits for distributors from the sale of chargers are estimated to increase by 27%, compared to the baseline. | No impacts | No impacts |

**Impacts on innovation**

Mandatory unbundling is not expected to generate significant impacts on the capacity of firms to innovate, since it does not encompass harmonisation.

Option 5: Voluntary interoperability labelling / information scheme

**Costs for consumers**

The economic impacts of this option are overall very minor. The interoperability labelling / information scheme is assumed to lead to a small but positive impact on cable compatibility and consumer understanding. The effect is hypothesised to produce a reduction of standalone sales of EPS by 1% in relation to the baseline. This leads to a small gain for consumers (1.1% of reduction in the prices they pay for chargers in relation to the baseline).

**Impacts on competitiveness**

If the scheme is successful, this option might have a minor impact on the competitive landscape. Consumers might improve their perception of devices with the logo, which may provide a competitive advantage to companies producing devices with standard solutions over companies manufacturing devices with proprietary charging solutions.

Table 18. Impacts on competitiveness of policy option 5 per type of stakeholder

| **Stakeholder** | **Benefits** | **Changes in competitive landscape** | **Variations in income from royalties** |
| --- | --- | --- | --- |
| **Manufacturers of System on a Chip (SoC)** | No impact on quantities/prices of SoC sold. | This option may benefit manufacturers of SoC that incorporate USB charging protocols. In practice, most of the companies in this group already provide standard solutions and therefore impact would be negligible.[[115]](#footnote-115) | No impacts. |
| **Manufacturers of mobile phones** | The option would not affect the market of bundled chargers, and therefore no significant impacts are expected. | Consumers might improve their perception of devices with the logo, which may provide a competitive advantage to companies producing devices with standard solutions over companies manufacturing devices with proprietary charging solutions. | The option would not affect the market of bundled chargers, and therefore no significant impacts are expected. |
| **Manufacturers of chargers** | This option would lead to a small decrease in sales of standalone chargers, therefore having a minor negative effect, practically negligible, on manufacturers of chargers (-0.9%). | This option may have a minor negative impacts on companies who sell standalone chargers, as these would be the most affected. | This option would not have any impact on variations of income from royalties. |
| **Distributors, retailers, and wholesalers** | The impact for distributors on the small reduction of standalone chargers would be practically negligible (-1%). | No impacts | No impacts |

**Impacts on innovation**

Being this a voluntary option, no effects on the capacity of firms to innovation is expected.

* + 1. Operating costs and conduct of business

In the baseline, the transition from USB micro-B to USB Type-C is ongoing. At this stage, all manufacturers have already incorporated USB Type-C in their high and (in most cases) medium range devices, and therefore operating costs for the reminder of the transition are expected to be negligible. Only one manufacturer continues to use proprietary connectors and is currently expected to continue doing so in the future, hence no operating costs are expected in the baseline. We observe a similar situation with the use of USB Type-C / USB PD charging protocols at the device end: all except low and some medium-tier devices already incorporate it.

The situation on unbundling is slightly different. Some manufacturers have started unbundling their phones (EPS only), but most continue to sell all their phones with an EPS in the box, and no manufacturer has removed the cables from the box yet. Transition costs observed are reputational risks and opposition from consumers in some countries.[[116]](#footnote-116)

Currently, interoperability with standards is voluntary and businesses do not need to demonstrate compliance. Information is currently provided through the following documentation:

* The technical product documentation, which provides information on the design, manufacture, and operation of a product and must contain all the details necessary to demonstrate the product conforms to the applicable requirements.
* CE Marking: a self-certification with which the manufacturer or importer affirms its conformity with European health, safety, and environmental protection standards.
* The EU Declaration of Conformity (DoC): The manufacturer or the authorised representative established within the EU must also draw up and sign an EU Declaration of Conformity declaring that the products comply with EU requirements.
* Manufacturers have to meet traceability requirements by indicating their name, registered trade name or registered trade mark and the address where they can be contacted. This information must be displayed on the product, on its packaging or in a document which accompanies the product.

The evaluation of the internal market legislation for industrial products[[117]](#footnote-117), conducted in 2014, aimed to quantify the compliance costs of placing several products in the EU market. The results for laptops, summarised in the table below, may be extrapolated to mobile phones.

Table 19: Summary of main costs of compliance for laptops manufacturing industry

|  |  |  |
| --- | --- | --- |
| Type of cost | Unit of measurement | Unit cost (Euros, 2014) |
| Familiarisation with new requirements | Cost per year per manufacturer | 402,000 |
| Preparation of DoC and technical documentation | Cost per year per manufacturer | 1,206,000 |
| Standards purchase | Cost per standard | 80 |
| R&D and Product design | Model | 800,000 |
| Testing | Model | 5,000 |
| 3rd party Conformity Assessment by notified bodies | Model | 15,000 |

Source: CSES, DG GROW, Panteia (2014) Evaluation of the internal market legislation for industrial products, Appendix C Case study for laptops, available at: https://op.europa.eu/en/publication-detail/-/publication/4fe4ba23-68f6-439f-b982-5f56ef1b135d/language-en (accessed on 7 June 2021)

One of the most significant costs for manufacturers is R&D and product design, which in this study has been classified as operating costs. New requirements affecting the design of the devices/EPS may generate a similar cost for manufacturers of mobile phones. Another significant cost is the preparation of the DoC and technical documentation. The options, however, are not expected to affect this cost, since all companies need to draw up these documents regardless of this specific intervention.

In terms of costs for public authorities, only random market checks are conducted by surveillance authorities to check that mobile phones comply with safety and other requirements in RED.

Option 1: Harmonise connectors on mobile phones

In the baseline, all mobile phones will gradually transition to USB Type-C connectors at the device end. This policy option would only affect Apple’s iPhones, which are likely to continue using Lightning connectors in the absence of intervention. **Operating costs** for Apple would be significant, given the changes that the company would need to perform on their phones (e.g. the space used by the Lightning connector in the phone is smaller than the space used by USB Type-C connectors and pins) and the number of phone accessories, not only cables, that use Lightning connectors. This company has a 18% of the market share in the EU (measured in number of units sold) and mobile phones are their main market segment, representing 50% of total sales in 2020.[[118]](#footnote-118) The significance of this impact cannot be quantified (it is very sensitive commercial information). For reference, the Evaluation of the internal market legislation for industrial products mentioned above quantified this cost at 800,000 Euros per model. Given the size of the market and the necessary changes in product design, we conclude that this option would entail a **significant negative impact** on operating costs for Apple, and for manufacturers of Lightning accessories. It should be noted that the significance of this impact will also depend on whether the policy options apply to all models, or to new models only. The more the policy option can accommodate existing models, the less severe the negative impacts will be.[[119]](#footnote-119)

Most other manufacturers of mobile phones and manufacturers of chargers are already transitioning to USB Type-C and adapting their operations, and therefore the impacts on operating costs for other manufacturers would be negligible.

The difference between Lightning and USB Type-C connectors can be seen with the naked eye, and it is not expected that businesses would need to demonstrate compliance with this policy option (i.e. it would not generate additional **compliance costs**). The option does not require the provision of additional information, and therefore there would not be **administrative costs** linked to it.

Option 2: Require mobile phones to be compatible with USB charging technology

Under this option, manufacturers of low and mid-tier phones (including EU based companies such as HMD, BQ and Fairphone) would be affected. Including USB Type-C and/or USB PD may have some **operating costs** for those manufacturers who currently don’t have any devices yet with USB PD or USB Type-C. HMD, for instance, is the manufacturer of Nokia phones. Currently, most of their portfolio uses USB BC, except for their high and mid-tier phones, which use QC3. Stakeholders interviewed thought that it is likely that phones currently using QC3 will have naturally transitioned to later versions of QC, compatible with USB PD, by 2024. In this scenario, impacts of this option on operating costs are expected to be **minor**.

This option could be implemented via the RED (e.g. via essential requirements), and therefore any new **compliance costs** would be minimal. Manufacturers would need to comply with these new essential requirements as well as other elements of RED, and there would be presumption of conformity. The only compliance costs that companies would incur would be those related to becoming familiar with the new requirements, and potentially purchasing standards (although most companies already purchase these standards regardless and are familiar with them, as have been developed by the USB-IF of which most of them are members).

The option also includes the provision of information to consumers as a “flanking measure”, which may entail additional **administrative costs.** The cost would largely depend on how the option is implemented (e.g. changes in packaging, additional information in their products’ website, additional information in the instruction manual, etc.), but it would likely be minor/negligible in any case. The option would most probably be accompanied by a communications campaign by the Commission, which would also help to communicate the measure to consumers and reduce administrative costs for manufacturers.

This option would not affect other industry stakeholders. Manufacturers of SoC would have to incorporate USB PD/USB Type-C in all their chips for mobile phones, but this is already the case in the baseline.

Option 3: Require EPS for mobile phones to comply with USB interoperability guidelines

Harmonisation of EPS would affect those firms that are currently manufacturing chargers with proprietary charging protocols (e.g. brands with QC, Huawei SuperCharge and VOOC), as they would need to completely change their products (EPS) to be compliant with USB PD or USB Type-C (i.e. **operating costs**). The current market share of EPS that provide fast charging without being compliant with this option is estimated to be around 25%.[[120]](#footnote-120) This option is expected to have **significant negative impacts** on these manufacturers. If they manufacture the EPS themselves and wish to continue doing so, they would have to redesign them (for reference of the scale of this impact, see Table 17). If they start buying their EPS from providers, they would incur costs of finding new providers, establishing new contracts, etc. However, it is important to note that they would also have the option of unbundling their phones and selling their EPS separately, in which case they could continue using proprietary charging protocols and would face similar operating costs as the ones described in option 4.a below (unbundling of EPS).

The option would also affect manufacturers of mobile phones who bundle standard EPS using 7.5W or less. Nevertheless, these phones are transitioning naturally in the baseline towards USB Type-C connectors and charging protocol, and therefore the impact on operating costs is expected to be negligible.

This option requires full compliance of EPS with USB PD or USB Type-C. These standards have already been adopted by CEN-CENELEC. However, this option would require companies to demonstrate compliance. The details of this option are yet to be fully defined, but a priori it is expected that it would have a negative impact on **compliance costs** (which could be significant or not, depending on how it is implemented).

The option does not require the provision of administrative information (beyond what is required to demonstrate compliance), and therefore we conclude that it does not generate **administrative costs**.

Option 4.a: Mandatory unbundling of EPS from mobile phones

Under this option, manufacturers would be obliged to offer phones without chargers. For those phones that are not already unbundled, this generates **operating costs**, such as: changing the packaging for the EU market, adapting the shipment and distribution of phones to the new packaging dimensions, and potentially re-negotiating their contracts or changing their relationships with their EPS suppliers. Manufacturers would also need to design a marketing strategy to communicate unbundling to their consumers.

The most affected by this option would be EPS manufacturers that currently provide the EPS to be sold in the box. They would need to change their business models to provide “out of the box” products, change their distribution channels, and market their products to new clients (wholesalers, retailers or end consumers).

Distributors (wholesalers and retailers) would need to upskill their staff to be able to provide advice to consumers on which EPS/cable works with their devices, and potentially find new distribution networks for stand-alone EPS, to cope with the rebound effect (i.e. the increase in stand-alone sales once EPS are not included in the box anymore).

The market seems to be moving in this direction anyway (unbundling of EPS), and therefore the difference with the baseline will be minor. That is why this option would have a **minor negative effect** on operating costs for all stakeholders.

Compliance with the policy option would not need to be demonstrated, as unbundling would be a requirement in the RED. Therefore, it would not generate **compliance costs**.

In this option, manufacturers of mobile phones and chargers may want to offer additional information to consumers on the charging requirements of their devices so that they can make informed decisions on which charger to buy. However, this information would not be a requirement of the regulation and therefore does not entail additional **administrative costs**.

Option 4.b: Mandatory unbundling of the entire charger (EPS and cables)

The impacts of option 4.b are the same as for option 4.a, although in this case manufacturers of cables would also be affected. They would need to change their distribution channels, and market their products to new clients (wholesalers, retailers or end consumers), generating therefore operating costs for these manufacturers. In practice, the companies manufacturing cables are the same as the companies manufacturing EPS, and therefore option 4.b does not entail operating costs that would be additional to option 4.a.

For manufacturers of mobile phones, this would also imply re-negotiating their contracts with their suppliers of cables. No manufacturers of mobile phones are unbundling cables yet, and therefore the operating impact for mobile phone manufacturers would be a little bit higher than in option 4.a.

All other operating impacts (impacts of changes in packaging for mobile phone manufacturers and impacts for distributors) would be the same as in option 4.a.

This policy option would not generate **compliance costs** or **administrative costs**, for the same reasons as option 4.a.

Option 5: Voluntary interoperability labelling / information scheme

On the one hand, this option may have a minor positive impact on **operating costs** for manufacturers of mobile phones, as it would help to communicate unbundling to consumers for those companies who decide to voluntarily unbundle. On the other hand, however, the insertion of a logo may require re-designing their packages or products. They may also incur some additional costs from being involved in the scheme. On balance, it is likely that the scheme would generate a minor negative impact on manufacturers of mobile phones.

The option would not generate operating costs to other industry stakeholders.

The **compliance and administrative costs** of this option would largely depend on how it is implemented. To be able to use the logo, it is assumed that manufacturers of EPS and mobile phones would need to demonstrate compliance with the relevant USB standards. If this is not implemented via the RED or compliance is not simply assumed through presumption of conformity, it would generate a cost for the industry.

Under this option, it is also assumed that information would be facilitated to consumers, which may also generate **administrative costs** for those who voluntary decide to participate in the scheme.

As an example, to participate in the EU Ecolabel, businesses need to pay a fee, which depends on the size of the business and varies between competent bodies and products. The table below provides an overview of application and annual fees for the EU Ecolabel, broken down by type of applicant.

Table 20: Maximum feed established by the EU Ecolabel regulation

|  |  |  |
| --- | --- | --- |
| Type of applicant | Application fee (€) | Annual fee (€) |
| Micro-enterprises | 200-350 | Max. 18,750 |
| SMEs and firms from developing countries | 200-600 | Max. 18,750 |
| All other companies | 200-2,000 | Max. 25,000 |

Source: European Commission, How to apply for EU Ecolabel, available at : <https://ec.europa.eu/environment/ecolabel/how-to-apply-for-eu-ecolabel.html>.

Note: Further conditions apply. An overview of the conditions is available at: <https://ec.europa.eu/environment/ecolabel/how-to-apply-for-eu-ecolabel.html>, and an overview of costs in different countries is available at: <https://ec.europa.eu/environment/ecolabel/documents/eu-ecolabel_fees.pdf>.

* + 1. Costs to public authorities

As explained in section 4.2, costs to public authorities are basically negligible in most of the options. This is because market surveillance authorities are already testing mobile phones, cables and EPS, and, according to the market surveillance authority interviewed, the marginal cost of conducting any additional tests (if needed) would be negligible. It has not been possible within the scope of this study to quantify this cost, and a previous study commissioned by Digital Europe concluded that “the costs of individual activities are very difficult for MSAs to estimate because they mainly work with a fixed budget that cuts across all their activities and it cannot easily be broken down”.[[121]](#footnote-121)

However, option 5 may have a negative impact on costs to public authorities. According to three stakeholders from different industry sectors / organisations and one public authority interviewed, the scheme would entail setting up essential requirements to obtain the logo (in principle, minor cost), and nominating an organisation to administer it and test the products.

*“Who manages the logo, who verifies it? If the standard is publicly available, and includes the logo, anyone can use it. You need an organisation to manage the logo, people have to be paid… who pays for all this? The customer! The price impact would not be insignificant.” – Public authority*

The cost of administering the labelling scheme is expected to be high, but it largely depends on how the EU establishes and administers it. This cost would need to be paid by consumers in one way or another: either with public funds, or paid by manufacturing companies, who would pass the cost on to consumers. Although there are different labelling schemes currently used in the EU and elsewhere (e.g. the EU Ecolabel or the EU Energy label, or the globally recognised Wi-Fi pictogram), information on costs of such schemes incurred by public authorities does not seem to be available.

* + 1. Impacts for SMEs

We have identified 33 SMEs or medium-size companies based in the EU that would be directly affected by the initiative:

* Manufacturers of mobile phones: Allview (RO), Ano-Phone (DE), Brondi (IT), CPA Halo (CZ), Doro (SE), Emporia (AT), Evolveo (CZ), Fairphone (NL), GSMK Cryptophone (DE), Handheld (SE), Jolla (FI), Just5 (LV), MLS (HR), Mobiwire (FR), mPTech (PL), NGM (IT), Wiko Mobile (FR). Most of the companies that manufacture mobile phones are specialised in devices for specific segments of the population, e.g. people of old age, people with disabilities, consumers who need phones able to support hard conditions, environmentally-aware consumers, etc.
* Manufacturers of charging solutions: Cellularline (IT), Hama (DE)
* Manufacturers of other devices: Archos (Tablets, FR), Obermax (Tablets, PL), Booken (e-readers, France), Hasselblad (cameras, SE), Jabra (hearables, DK), Leica (cameras, DE), Medion (cameras, DE), Obermax (Tablets, PL), Phase One (cameras, DK), Philips (portable speakers, NL), Polar (fitness trackers, FI), Praktica (cameras, DE), Sennheiser (hearables, DE), Urbanista (portable speakers, SE).

The consultations conducted in this evaluation included with two SMEs and one large company headquartered in the EU (all manufacturers of mobile phone or other portable devices). The initiative may also indirectly affect distributors, and an interview with an association of distributors in the EU was also conducted.

Overall, industries in the EU were very aware of the environmental impacts of chargers, and all of them were already unbundling EPS, and/or had tried unbundling schemes in the past. Two manufacturers were also unbundling cables in all or part of their portfolio. The interviewees were all in favour of mandating unbundling and did not report any potential negative effects of options 4.a and 4.b. One interviewee was also in favour of a labelling scheme or similar to inform consumers about unbundling:

*“The Commission could help companies with a statement to endorse the removal of chargers from the box. They could put a stamp and regulate about it.”*

Option 5 is voluntary, and therefore no significant impacts would be expected for SMEs, as they may decide not to participate. In addition, as the quote above suggests, it may help small companies to promote their attributes of their products.

Interviewees did not report any negative impacts either from the harmonisation options considered. However, most of them were not technical experts and could not provide in-depth views on the options that consider harmonisation of battery charging protocols. Many models sold by these companies still use USB micro-B connectors and standard battery charging protocols, and therefore options 1 and 2 might produce minor operating costs for SMEs if they need to adapt their production lines to the new requirements. Option 3 affects the EPS only, and if it entailed significant costs they would still have the choice of unbundling.

The distributors’ association interviewed commented that the effectiveness of the unbundling options will depend on two main aspects: a) the information that is provided to consumers on interoperability and the types of chargers that work with their phones (the association warned that, without additional information, consumers would continue acquiring a new charger when they purchase a phone); and b) the price of the phone when sold unbundled, i.e. the extent to which not including an EPS and/or cable reduces the retail price of the phone.

The distributors’ association also noted that option 4.a may be difficult for retailers to manage if manufacturers ship boxes of phones bundled from the charger, as well as phones unbundled. The interviewee did not refer to any significant impacts deriving from any of the options.

* + 1. Summary

From an economic perspective, the policy options do not generate significant impacts across any of the options analysed for consumers or businesses based in the EU. The option that delivers the best results for consumers is option 1, but this option would have a minor negative impact on the competitiveness of companies located in the rest of the world and negative impact for distributors in the EU (as fewer standalone cables would be sold). Options 2 and 3 are relatively similar in terms of reducing costs for consumers, with option 2 being also more favourable for the industry. Options 4.a and 4.b deliver very similar results, with option 4.b being slightly more advantageous for consumers.

All the policy options reduce the amount of chargers sold in the market, and therefore they all produce negative impacts on the gross profits of manufacturers of chargers. Options 4.a and 4.b, however, have positive effects for distributors, as they will benefit from additional margins of selling more standalone chargers. In addition, a few aspects need to be considered, most notably:

* Option 1 may preclude further innovation in connectors and beyond; it might have an indirect negative effect on innovation in wireless charging technologies if the regulation does not give manufacturers the choice of not including any connector at all. This option would primarily affect Apple (who would suffer important operating costs and would lose income from royalties) and their suppliers of cables and accessories (who would lose a source of competitive advantage). The option, however, is the most favourable for consumers: they would need to buy fewer stand-alone cables, and the cables would be cheaper.
* Option 2 is, in essence, very similar to the baseline, as most of the mobile phones sold today already include USB Type-C or USB PD battery charging protocols. There are, however, a few exceptions (notably, low and some medium tier phones) that do not incorporate USB PD or USB Type-C yet. This policy option would only have some minor operating costs for these manufacturers.
* Option 3 would completely rule out proprietary fast charging technologies at the EPS end (when sold bundled with phones), which would have a significant negative impact on innovation, and would be detrimental for the competitive position of some companies located out of the EU.
* Options 4.a and 4.b, which mandate unbundling, would overall benefit the industry as their profits would increase. The most benefitted would be those distributors and retailers, whereas the most negatively affected would be manufacturers of EPS/cables that are included in the box (they would need to find new commercial routes to reach consumers). However, given that unbundling is also happening in the baseline, the relative effect on the competitive landscape is negligible.
* Option 5 is a voluntary option, and as such it does not have any significant impacts on any of the categories, with the exception of cost for public authorities. As explained above, the costs from designing, implementing, and monitoring the label would be significant.
  1. Social impacts

The most relevant (i.e. potentially significant) social impacts of the initiative, which are discussed in this chapter, are:

* Consumer convenience benefits from increased harmonisation of charging solutions
* Impacts on product safety (in terms of the risk of injury or damage to consumers) and on the illicit market for mobile phone chargers (which is a criminal activity). Note that, since both of these

Please note that two other types of impacts (cost for consumers, employment) that could also be understood as “social” impacts are discussed in the previous chapter instead, since their assessment is closely linked to economic impacts.

* + 1. Consumer convenience

As described in detail in the first IA study[[122]](#footnote-122), our survey of a representative panel of consumers suggests that around eight in ten EU consumers have experienced some form of inconvenience in relation to mobile phone chargers. When considering different sources of inconvenience, between around one third and one half of EU consumers have experienced each of a series of issues causing them inconvenience at least once over the course of the last two years. Broadly speaking, the sources of consumer inconvenience identified via the survey can be divided into **four sets of issues**, with those experienced by the highest number of consumers listed first:[[123]](#footnote-123)

1. Inability to charge certain devices (as fast) with certain chargers
2. Too many chargers
3. No access to a compatible charger
4. Confusion about which charger works with what

Annoyance at having too many chargers for mobile phones and other portable devices, and at the lack of interoperability between them, appear to be the main sources of inconvenience, experienced at least occasionally by around half of consumers. Situations where consumers are unable to gain access to a suitable charger for their phone, or are confused about which charger can be used for which phone or device, occur relatively less frequently (around one in three consumers). Nonetheless, the proportion of respondents who reported having experienced *significant* issues was quite similar across all of the problems listed (between 15% and 22% of all respondents). It therefore appears justified to attach the same significance to each of the four sets of issues for the sake of the impact assessment.

In addition to these four issues, this study considers a **fifth** **source of inconvenience**, namely, the potential convenience losses for consumers who expect / prefer to be provided with a charger along with a new mobile phone they purchase, but have to purchase this separately under the “unbundling” scenarios (including the baseline, where some manufacturers have begun to unbundle voluntarily). According to the consumer survey carried out for this study (for further details see Annex C), even after having been provided with basic information about the environmental impacts and interoperability of chargers, over 70% still responded that it was important for them that the EPS is provided along with the phone (including 27% who responded “very important”). The proportion for whom the provision of a cable was important were even higher (nearly 80%). Among the main reasons respondents gave for this were habit (“I am used to finding a complete product in the box” – 46% for EPS, 54% for cable) and convenience (“This way I do not have to think about how I charge my phone” – 38% for EPS, 37% for cable). In view of this, it is perhaps unsurprising that 50% of respondents strongly agreed (and another 25% tended to agree) that “all mobile phones should be sold with a complete charging solution in the box”.

On the other hand, among the minority of survey respondents for whom the inclusion of a charger was not (very) important, the main reason was convenience (“I already have enough EPS / cables at home”). And in an apparent contradiction to the preference for complete charging solutions in the box, slightly over half of respondents also agreed that “all mobile phone manufacturers / distributors should give customers the option of purchasing (or not) a new EPS and/or cable with new phones”. In summary, the survey results suggest that the majority of consumers considers unbundling primarily as a source of inconvenience; but around half nonetheless agree that consumers should be given a choice.

In the remainder of this section, we consider how the different policy options would be likely to affect consumer (in)convenience of the five main types outlined above. The assessment builds on the analysis already carried out for the first IA study, complemented and updated by the analysis of the present study, including the information gleaned via the consumer survey and stakeholder interviews. The main results are summarised in the table below.

Table 21: Main effects of the policy options on consumer convenience

| **Sources of inconvenience** | **Option 1** | **Option 2** | **Option 3** | **Option 4.a** | **Option 4.b** | **Option 5** |
| --- | --- | --- | --- | --- | --- | --- |
| a) Inability to charge certain devices (as fast) | 1. +   Enhanced ability to charge all phones with the same cables | 1. + 2. Interoperability guaranteed, plus ability to charge all phones with the same cables | +  Interoperability guaranteed, but elimination of very fast charging proprietary EPS | 0  No impact on interoperability as such | | 0/+  No impact on interoperability as such, but better consumer understanding |
| b) Too many chargers | 1. 0   No impact | | | +  Consumers no longer provided with unwanted EPS | ++  Consumers no longer provided with unwanted EPS or cables | 0/+  Could help stimulate voluntary unbundling |
| c) No access to a compatible charger | 1. +   Increases likelihood of finding compatible charger for all users | 0/+  Very minor benefits due to faster elimination of USB micro-B connectors | | 0  No impact on interoperability as such | | 0/+  No impact on interoperability as such, but better consumer understanding |
| d) Confusion about which charger works with what | 1. 0   Negligible impact, as confusion from connectors is very limited (except among the visually impaired) | +  Mainly from effective flanking measures (information requirements) | | 0  No impact on interoperability as such | | +  Minor benefit – could be major if scheme universally used and accepted by consumers |
| e) Absence of charger | 0  No impact | | | --  Major inconvenience for those who prefer to be provided with an EPS | --  Major inconvenience for those who prefer to be provided with an EPS and cable | 0/-  Could help stimulate voluntary unbundling |
| Overall effect on consumer convenience | + | + | + | -/-- | -- | + |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. *++ Major positive impact* | 1. *+ Minor positive impact* | 1. *0 No or negligible impact* | 1. *- Minor negative impact* | 1. *-- Major negative impact* |

Option 1

As described in more detail in the first IA study, common (USB Type-C) connectors at the device end would provide **minor** benefits in terms of enhanced consumer convenience. This option would increase the likelihood that consumers – especially Apple users – who are unable to access their own charger (e.g. because they are travelling) are able to find a compatible third-party charger (problem **c** above) – but as noted in the first IA study[[124]](#footnote-124), this is a relatively infrequent occurrence. It would also enhance convenience to a limited extent by enabling users to charge all phones with the same cables (problem **a**). This option would have no significant effect on the remaining source of inconvenience.

Option 2

This option, by ensuring that all mobile phones incorporate communication protocols that are compatible with USB charging technology (USB Type-C, as well as USB PD for phones that can charge at over 15 W), would have the following impacts on the main sources of consumer inconvenience:

1. **Inability to charge certain devices (as fast)**: Minor positive impact, mainly for users of lower-tier phones. Based on the information at our disposal (for details see Annex B), all “fast-charging” mobile phones that are currently on the market (including those that include proprietary fast charging technology) already display some degree of compatibility with USB PD, meaning they take advantage of this technology when connected to a USB PD EPS. Therefore, it is unlikely that this option would materially alter the status quo in terms of the communication protocols that are incorporated in the current generation of “fast charging” mobile phones, or affect consumers’ ability to charge different phones with different EPS (seeing as interoperability is already near universal) or the speed of charge. However, it would make this interoperability mandatory (as opposed to merely voluntary), thereby ensuring it remains the case for future generations of phones. In addition, it would lead to a significant change in lower-tier, typically non-fast charging phones, which would have to incorporate USB Type-C, meaning all USB micro-B receptacles (estimated to still be used in around 30% of all mobile phones sold in the EU in 2020) would be replaced with USB Type-C ones by the time the rules come into force (i.e. significantly faster than in the baseline scenario). Like option 1, this would enhance convenience to a limited extent (though it would come at a cost, as the additional cost of this technology would be passed on to consumers). If communicated effectively, it could also enhance consumer awareness of the (near) universal interoperability of phones with USB chargers.
2. **Too many chargers**: No impact, as this option per se is not expected to lead to any additional unbundling.
3. **No access to a compatible charger**: Negligible / minor positive impact. In view of the near universal interoperability, access to a compatible EPS is generally not a problem in practice. In situations where consumers require access to a third-party charger, the main interoperability barrier tends to be the connector. Thus, by speeding up the existing trend towards using USB Type-C instead of USB micro-B connectors, this option would enhance convenience, mainly for users of lower-tier phones. However, the number of occasions in which consumers find themselves in this situation, and would benefit from this option (i.e. have a phone with a USB micro-B receptacle, but the only accessible cables have a USB Type-C connector, or vice versa), is likely to be very small, and further decrease over time as the transition continues at its “natural” pace under the baseline scenario. It should be noted again that, under this option, Apple phones could continue to use proprietary (Lightning) connectors.
4. **Confusion about which charger works with what:** Minor positive impact.The confusion is mainly the results of consumers’ lack of awareness of the already near universal compatibility between modern phones and EPS. Thus, any positive effects from this option would be due not to enhanced interoperability per se, but to the accompanying information requirements to highlight the USB Type-C / USB PD compatibility of both phones and EPS. If implemented effectively, the provision of such information (and of the fact that interoperability is *obligatory* for phones) could increase consumer understanding of compatibility (including in terms of safety and speed), and thereby reduce confusion. However, according to many industry stakeholders interviewed for this study, the amount of attention consumers typically pay to this kind of information should not be over-estimated.
5. **Absence of charger:** No impact, as this option per se is not expected to lead to any additional unbundling.

Option 3

This option, by requiring all EPS that are bundled with mobile phones to be compliant with USB interoperability specifications and communication methods (specifically, IEC 63002:2021), would affect consumer convenience in the following ways:

1. **Inability to charge certain devices (as fast)**: Minor positive impact overall, potentially major for some users, but negative for others. Like option 2 above, option 3 would further cement and guarantee the high degree of interoperability that already exists. In addition, it would oblige manufacturers whose EPS currently rely on proprietary fast-charging technology (and revert to basic USB BC when connected to a phone that does not incorporate the same technology) to change to USB PD. This would mean that these EPS could also be used to charge phones from other manufacturers at a significantly higher speed than is currently the case, thereby increasing versatility and consequently convenience for consumers. On the other hand, it is not entirely clear whether USB PD is able to achieve the same very fast charging performance that some of the proprietary technologies can provide (for details see section 2.1). The manufacturers in question argue that their proprietary technologies achieve better performance than USB PD (though some other industry stakeholders disagree, or attribute the higher speeds solely to higher power outputs, which could also be achieved via USB PD). If the manufacturers of proprietary fast charging technologies are to be believed, then this option would deprive customers of certain brands (including Huawei and Oppo) of access to very fast charging EPS, which would obviously inconvenience those customers who value very fast charging.
2. **Too many chargers**: No impact, as this option per se is not expected to lead to any additional unbundling.
3. **No access to a compatible charger**: Negligible / minor positive impact due to the faster elimination of USB micro-B connectors, as outlined under option 2 above.
4. **Confusion about which charger works with what:** Minor positive impact due to the accompanying information requirements to highlight the USB Type-C / USB PD compatibility of both phones and EPS, as outlined under option 2 above.
5. **Absence of charger:** No impact, as this option per se is not expected to lead to any additional unbundling.

Option 4.a

This option would make unbundling of EPS mandatory, and thereby have the following effects on consumer convenience:

1. **Inability to charge certain devices (as fast)**: No impact, as this option per se would not affect the current situation as regards interoperability. It is possible that it would encourage or oblige consumers to pay more attention to charging technology (as they would need to decide whether to acquire a new EPS with their phones, and if so, which), thereby enhancing their understanding of charging interoperability and performance considerations. On the other hand, it could also lead some consumers to continue to use an existing, non-fast charging EPS, or choose to purchase the cheapest available EPS, thereby depriving them of faster solutions that might otherwise be supplied “in the box”. On balance, it appears appropriate to assume these possible effects would more or less cancel each other out, and overall, there would be no significant impact on consumers’ ability to charge certain devices with certain EPS.
2. **Too many chargers**: Minor positive impact. For obvious reasons, mandatory unbundling would provide those consumers who feel they already have too many chargers with the opportunity to continue to use an existing EPS, rather than acquire a new one with their new phone. This would generate convenience benefits for these users, although, given that very few survey respondents classified the inconvenience from having too many chargers as significant, these benefits would be minor rather than major.
3. **No access to a compatible charger**: No impact, as this option is not expected to affect the types of chargers sold / used.
4. **Confusion about which charger works with what:** No impact, for the reasons outlined under point a above.
5. **Absence of charger:** Major negative impact. As noted previously, the majority of consumers surveyed expressed a preference for being provided with a charger along with a new phone. For these consumers, unbundling represents an inconvenience. In view of the survey results, this is likely to be more significant, and affect a larger number of consumers, than the benefits outlined under point b above. Furthermore (as discussed under the economic impacts in section 5.2), some consumers are likely to end up paying slightly more for their EPS, at least in the short term, until competitive market pressures eventually force vendors to “price in” the absence of the EPS and thus lower the price of their phones.

Option 4.b

This option would extend mandatory unbundling to the cable as well as the EPS. Its impacts on consumers would be very similar to those of option 4.a, but both the positive and the negative impacts would be amplified – both because it would the scope of the intervention would be increased, and because it would affect a much greater number of devices and thus users (the baseline scenario already foresees nearly 50% of phones being shipped without EPS by 2023, but none without cables).

On the positive side (problem b), the fact that consumers would no longer be supplied with new cables by default would further reduce clutter and thus inconvenience for those consumers who feel they have too many chargers. It would also have the added benefit of extending consumer choice to the cables, and avoiding the provision of cables that are not the user’s preferred choice. For example, under the current unbundling initiatives (and probably under option 4.a), most phones are shipped with a USB Type-C to Type-C cable. This means that consumers who may wish to continue to use their old EPS with a USB Type-A receptacle may not be able to do so, and be forced to buy a new one, unless they also have a compatible cable in stock.

On the other hand, the inconvenience for consumers who prefer “bundled” solutions would also be greater than under option 4.a, given the survey shows that consumers find the cable even more important than the EPS (which is likely due to the typically shorter lifespan / higher risk of breakage of cables, and/or the fact that cables can also be used for data transfer). The fact that no major manufacturer has voluntarily unbundled cables from phones to date also suggests that they are more concerned about the reaction from consumers to this than they are about unbundling the EPS only.

Option 5

The impacts of a voluntary interoperability labelling scheme are especially difficult to anticipate, given the uncertainties around the scheme’s exact design features, industry participation and consumer reactions. In the best-case scenario, such a scheme could have a significant positive impact on consumer awareness of which charger works with which devices, and thus their convenience. In the worst-case scenario, the scheme could fail to generate any impacts (if none of the major manufacturer chooses to label their products, and/or the pessimistic view of the amount of attention consumers pay to them turned out to be true). In what follows, we assume a “mid-range” scenario with majority industry participation and a modest effect on

1. **Inability to charge certain devices (as fast)**: Very minor positive impact, due not to enhanced interoperability as such, but to a better consumer awareness of key aspects of interoperability and performance, for those products that are marked with the “USB charging” label.
2. **Too many chargers**: Very minor positive impact, based on the assumption that, over time, an enhanced consumer understanding of interoperability could sway additional manufacturers to offer unbundled solutions, and better enable consumers to take advantage of these (i.e. to continue to use an existing compatible charger).
3. **No access to a compatible charger**: Very minor positive impact – although this option would not affect the supply of compatible chargers as such, the scheme – if applied widely – could enhance consumer confidence to use an available, labelled, compatible charger that they might otherwise have been reluctant to use due to residual interoperability or safety concerns.
4. **Confusion about which charger works with what:** Minor positive impact, as a widely used scheme, with labels on (the packaging of) many EPS and phones could contribute significantly to reducing consumer confusion. On the other hand, it would be over-optimistic to expect a major positive impact, given the labels are unlikely to be used on all products (e.g. manufacturers with proprietary fast charging technology may choose not to label their EPS, rather than with the most basic “USB charging” label), and many consumers are likely to be marginally interested at best.
5. **Absence of charger:** Very minor negative impact, for the reasons outlined under point b above.

Summary

**Overall, options 1, 2, 3 and 5 would provide for minor improvements in consumer convenience.** Each would alleviate certain sources of inconvenience for specific consumer groups – making it difficult to conclude which would bring the greatest benefits overall:

* Option 1 – the full harmonisation of receptacles on the devices would enhance convenience by enabling users to charge all phones with the same cables, and increase the likelihood that those who are unable to access their own charger are able to find a compatible third-party charger.
* Option 2 – requiring phones to be interoperable with USB Type-C and (where relevant) USB PD specifications would mean the already near universal interoperability with USB chargers that exists today remains guaranteed in the future, and would help to enhance consumer awareness of this (if effectively communicated). It would also increase convenience by eliminating USB micro-B connectors faster than would otherwise be the case.
* Option 3 – requiring EPS to be compliant with USB interoperability specifications would have very similar effects to option 2, but would place further restrictions on the use of proprietary charging technology, which would be likely to result in greater convenience for some users, but reduced convenience for others (those who place a high value on *very* fast charging solutions).
* Option 5 – a voluntary labelling scheme could increase consumer convenience by enhancing their awareness of interoperability, and thereby also help stimulate demand for unbundled solutions; but the significance of these effects is subject to a very high degree of uncertainty.

On the other hand, **mandatory unbundling (options 4.a and 4.b) would entail a minor reduction in consumer convenience overall**, given that, although a significant number of consumers find it inconvenient to have too many chargers, a clear majority nonetheless finds it convenient (and therefore prefers) to be provided with a new EPS and cable along with new phones.

* + 1. Product safety and illicit markets

The section assesses the likely effects of each option on product safety and the market for sub-standard and/or counterfeit chargers. It is based on the analysis carried out for the first IA study (which reviewed the most relevant sources of secondary data on these issues), updated with new findings based on the consumer survey and stakeholder interviews carried out as part of the second IA study. As outlined previously (see section 2.1), the problems in this area are primarily a result of the difficulty of effective control of segments of the standalone chargers market, and of enforcing the applicable safety and IPR rules. The “common charger” initiative is not intended to address these problems, but it is nonetheless important to consider if and how it might affect its future evolution.

Most of the impacts in this area stem from changes to the *size* of the stand-alone charger market – essentially, if more stand-alone chargers are sold, the likelihood is high that a part of the increase in sales will be substandard and/or counterfeit. But we have also considered whether any of the options also have the potential to affect the *characteristics* of the stand-alone charger market, i.e. make it inherently more or less difficult, or more or less attractive, to produce or distribute substandard stand-alone chargers.

Regarding the current (baseline) situation, as noted previously, there appears to be a substantial market for substandard and/or counterfeit stand-alone chargers, especially online. However, there are no sources to estimate the *absolute* size of this market with even a minimum amount of precision. However, in *relative* terms, it seems reasonable to assume that any increase in the *size* of the stand-alone chargers market is likely to lead to a comparable increase in the substandard and/or counterfeit market. As such, the growing level of unbundling, and the consequent increase in demand for stand-alone chargers, is expected to already be leading to a minor increase of the risks, compared to previous years.

Based on the consumer survey, it would appear reasonable to assume that in the region of 5-10% of all stand-alone EPS bought separately in the EU, and approximately 10-15% of cables, are counterfeit: of all respondents who had bought a stand-alone EPS within the last 24 months, 5% were either sure or suspected it was fake; 71% were sure or at least confident it was genuine, with the remainder (24%) unsure. Of those who bought a stand-alone cable, 8% were sure or suspected it was fake, 65% were sure or confident it was genuine, and 27% were unsure. If we apply these ratios to the sales estimates in our stock model, the result is approx. 5-10 million counterfeit EPS, and approx. 15-20 million counterfeit cables, sold in the EU per year.

As regards product safety issues, 1% of survey respondents who had bought a stand-alone EPS or cable in the last 24 months reported it had caused safety issues (e.g. electrical shock, fire…), while 3% reported it had damaged their mobile phone. 5% of those who had bought an EPS, and 7% of those who had bought a cable, reported that it broke / become unusable shortly after it was bought. This suggests that problems caused by substandard chargers are not that infrequent, although *serious* product safety issues are relatively rare. Nonetheless, extrapolating from the survey responses, it may well be that hundreds of thousands of EU consumers face product safety risks due to substandard chargers each year.

The remainder of this section outlines the likely effects of the different policy options on the market for substandard and/or counterfeit chargers, and consequently on product safety risks. The main results are summarised in the table below.

|  | **Option 1** | **Option 2** | **Option 3** | **Option 4.a** | **Option 4.b** | **Option 5** |
| --- | --- | --- | --- | --- | --- | --- |
| Impact on product safety & illicit markets | 0/+  Elimination of proprietary connectors likely to lead to a small reduction in stand-alone cable sales | 0/+  Faster in-the-box EPS likely to lead to a small reduction in stand-alone EPS and cable sales | 0/+  Faster in-the-box EPS likely to lead to a small reduction in stand-alone EPS and cable sales | -/--  Higher stand-alone EPS sales imply increased risks | --  Higher stand-alone EPS and cable sales imply increased risks | 0/+  Potential shift towards labelled, and hence safer, stand-alone EPS |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. *++ Major positive impact* | 1. *+ Minor positive impact* | 1. *0 No or negligible impact* | 1. *- Minor negative impact* | 1. *-- Major negative impact* |

Option 1

This option could lead to a small reduction of the sale of substandard cables. According to the consumer panel survey, users of phones with proprietary (i.e. Lightning) connectors purchase slightly (approx. 27%) more stand-alone chargers than users of phones with USB connectors. The elimination of proprietary connectors could be expected to eliminate this difference (given that Apple users would have a bigger pool of cables with USB Type-C connectors to draw from when they need an additional cable), thus leading to a small (about 5%) reduction in sales of stand-alone cables and, by extension, a similar reduction in the substandard market, leading to a small positive impact on overall product safety.

As regards the safety of *in-the-box* chargers, a common universal USB Type-C connector at the phone end would have no impact on product safety. Safety risks from in-the-box cables are negligible to begin with, and there is nothing to suggest this option would make any difference in this respect.

Option 2

This option would be likely to lead to a very small decrease in stand-alone charger sales, given that we expect in-the-box EPS would be slightly more likely to be fast charging (at 15 W or more), thus reducing the need for some consumers to purchase faster stand-alone EPS. We estimate the effect would be a 4% reduction in stand-alone EPS sales, and a 3% reduction in stand-alone cable sales (given that many consumers buy both at the same time, so any reduction in EPS sales is likely to also lead to a reduction in cable sales). This would result in a reduction of substandard and/or counterfeit sales on a similar scale, and thus to a very small reduction in product safety risks.

Option 3

We expect the impact of this option to be identical to that of option 2 above, i.e. a very small reduction in substandard and/or counterfeit EPS and cable sales (based on the expectation that mandatory compliance of in-the-box EPS with IEC 63002:2021 would lead to more of them being fast charging).

It should be noted that, although IEC 63002:2021 also contains information regarding consumer safety, this merely reiterates existing specifications, and is not expected to affect the safety of in-the-box OEM EPS (which are extremely low risk to begin with).

Option 4.a

Higher rates of unbundling would obviously result in increased sales of stand-alone chargers. Our estimate is that, for every EPS that is unbundled (i.e. not purchased along with a new phone), an additional 0.39 are purchased separately (for how this was derived, see section 3.1). A proportion of these are likely to be substandard and/or counterfeit.

The consumer survey provides some pointers to estimate how high this proportion is likely to be. Respondents to the second consumer survey were asked what they would do if offered an optional EPS along with an unbundled phone (at a price of either €14.90 for a basic EPS, or €19.90 for a fast-charging EPS). 10.5% of those who said they would buy an EPS along with the phone[[125]](#footnote-125) (rather than continue to use one they already own) indicated they would not buy either of the ones being offered, but ”look for a cheaper EPS from another provider”. These are the consumers who would be most likely to purchase a substandard and/or counterfeit charger, and the figure thus provides a sense for the increase in the product safety as well as IPR infringement issues that may be caused by greater unbundling.

In other words, based on the survey, around 10% of buyers of additional stand-alone EPS would look for a cheap, non-OEM option – although how many of these would end up actually buying substandard and/or counterfeit products is impossible to say.

Option 4.b

The effects of this option would be the same as those of option 4.a, but also extend to the cables. In other words, mandatory unbundling would be expected to lead to a relatively small increase in the sale of substandard and/or counterfeit EPS and cables.

Option 5

The product safety impacts of this option would depend on how the labelling scheme and logo are managed and “policed”. If the scheme is widely adopted, and the logo is subject to strict compliance tests, then it could contribute to reducing demand for sub-standard and/or counterfeit stand-alone EPS, and thereby reduce product safety risks. This is because, presumably, manufacturers of sub-standard or counterfeit EPS would prefer not to subject their products to compliance / compatibility testing, and could therefore not carry the logo (at least not legally). Assuming significant numbers of consumers are aware of the logo and take it into account in their purchasing decisions, this could shift demand towards legitimate, safe, compatible EPS. However, as noted previously, this is subject to a high degree of uncertainty, given the lack of clarity about the exact parameters of such a scheme and its acceptance by industry and consumers.

Summary

The risks regarding product safety and the counterfeit market are directly related to the size of the stand-alone charger market. This is already growing under the baseline scenario due to the voluntary unbundling measures that have already been adopted by some manufacturers, and are expected to become more widespread going forward. On top of this, options 4.a and 4.b (mandatory unbundling) would lead to significant increases in the stand-alone charger market, and thus generate safety and IPR concerns and risks. By contrast, options 1, 2 and 3 are expected to lead to small reductions in the stand-alone EPS and/or cable sales, and thus have a very small positive impact on product safety. Finally, option 5 is the only option that could lead to a positive change in the *characteristics* (as opposed to the *size*) of the stand-alone charger market, shifting demand towards “safer” EPS that carry the label; but the actual effectiveness of such a scheme is subject to a high degree of uncertainty.

* 1. Considerations for implementation

In this section, we consider a set of other elements that may affect the effectiveness of the policy options, but aren’t directly related to their environmental, economic or social impacts. This includes:

* Technical feasibility: Are there any significant risks, concerns or question marks about the option’s feasibility from a technical point of view?
* Acceptability: How do the relevant key stakeholders view the option? Who would support it, and who would be opposed?
* Scope for voluntary action: Could the option potentially be implemented via self-regulation, i.e. a voluntary industry commitment – and if so, what would be the main advantages as well as disadvantages or risks?

This section builds on and updates, but does not repeat all aspects discussed in section 5.5. of the first IA study.

Option 1 (Harmonise connectors on mobile phones)

Technical feasibility

As discussed in greater detail in the first IA study, defining USB Type-C as the common connector between all mobile phones and the charging cable assembly is entirely feasible from a technical point of view. USB Type-C is a relatively mature technology backed by an international standard (IEC 62680-1-3). There are no doubts it provides a high-quality charging (as well as data transfer) solution for mobile phones, and the fact that (in combination with USB PD) it is capable of providing up to 100W of power leaves ample room for further development of fast charging solutions.

The only significant concern in this respect is precisely the fact that USB Type-C is already at such a relatively mature stage of its likely life cycle. While there are currently no concrete indications of a possible successor to USB Type-C, it appears quite possible that a new generation of connectors will begin to appear around the mid-2020s, if not sooner. This may limit the practical usefulness (and some of the positive impacts) of any attempts to prescribe USB Type-C as the common connector, and means provisions for an eventual shift to a possible successor technology need to be duly considered when pursuing this option.

Acceptability

Based on the responses to the 2019 public consultation, option 1 would be popular among EU citizens, with 76% responding they would be satisfied with a single standard connector on the phone end (and 77% with single standard connectors on both ends).

The stakeholder survey conducted as part of this study also suggests that a majority of stakeholders in each of the main categories would support this option – with support strongest among responding public authorities, followed by civil society organisation; and even a majority of private companies in favour of a common (USB Type-C) connectors, and of the EU legislating to bring this about (for details see Annex C). However, it needs to be noted that views among industry respondents (companies) varied greatly: the majority (around six out of ten) of the 14 mobile phone manufacturers and closely related companies that responded to the survey did *not* agree that all mobile phones should have the same connector (USB Type-C), or that the EU should adopt legislation to this effect (seven out of ten). It was only because of the high levels of agreement among companies from other sectors (such as retail or manufacture of other non-related products) that industry stakeholders as a whole agreed with these options.

The interviews carried out as part of both studies helped shed further light on the positions of the “core” industry stakeholders. While the majority of manufacturers of mobile phone and similar devices were not opposed to USB Type-C as the common device-end connector (and some were actively in favour of any move in this direction), a minority was opposed to this, claiming it would limit their ability to provide customers with the best technical and design solution in each specific case. In any case, even among those in favour of harmonising connectors, there was a strong preference for achieving this via a voluntary approach, due to the widely held concerns among industry of how regulation would constrain future innovation.

Scope for voluntary action

In principle, it would be possible to achieve the desired outcome – namely the exclusive use of USB Type-C receptacles in all mobile phones – via a voluntary commitment by the industry. The 2009 MoU, which was signed by all major mobile phone manufacturers at the time, included a similar commitment. However, in view of the strong opposition from at least one key player (Apple), it seems unlikely at the present time that option 1 could form part of a renewed voluntary agreement. If such an agreement could nonetheless be reached, it would be important to scrutinise in depth a number of key elements to ensure its effectiveness, in particular the signatories, the product scope and timeframe, and the mechanisms to ensure compliance (these elements are discussed in greater detail in the first IA study report).

Options 2 and 3 (Interoperability requirements for mobile phones or EPS)

Technical feasibility

In principle, there are no significant technical concerns or risks as regards either option 2 (regulating to ensure all mobile phones incorporate communication protocols that are compatible with USB Type-C and, where relevant, USB PD specifications) or option 3 (which would require EPS for mobile phones to comply with USB interoperability guidelines). These options are based on internationally recognised standards (IEC 62680-1-3, IEC 62680-1-2 and, in the case of option 3, IEC 63002). The fact that the majority of higher and medium-tier mobile phones are already interoperable with USB PD confirms there are no technical barriers to this option per se. Similarly, the EPS supplied by many major manufacturers are already fully compliant with IEC 63002.

Specifically with regard to option 2, the only issue that would need to be explored and defined in further detail is precisely which parts of the specifications should be made “essential requirements” for all mobile phones. A priori, the intention under this option would merely be to ensure interoperability, not to ban proprietary add-ons. This means *full* compliance with the USB Type-C and USB PD specifications (as is required for USB IF certification) should not be required. It may therefore be necessary to issue a mandate to a body such as CEN-CENELEC to define a new standard that achieves this purpose.

By contrast, under option 3, interoperability of EPS would be ensured via a reference to compliance with the international standard IEC 63002:2021, which provides “interoperability specifications and communication method” for EPS. As noted previously, this standard was updated and strengthened very recently by the USB-IF; its publication was pending at the time of writing, but the study team was provided with (confidential) access to a preview version in mid-April 2021. It would be advisable to subject the final version, once published, to an in-depth expert review in order to ensure it is “fit” for the purpose envisaged here.

It is also important to reiterate that option 3 as defined here would only apply to EPS sold “in the box” with mobile phones. The extent to which it could also serve as the basis for a “universal” EPS (for use with potentially any device) in future would need to be assessed further.

Acceptability

The vast majority (85%) of respondents to the stakeholder survey, including nearly all public authorities, civil society organisations and private citizens, agreed (many of them “strongly”) with the principle that all EPS for mobile phones should be interoperable with all mobile phones, based on compliance with relevant USB (incl. USB PD) standards. Around three quarters also agreed that the EU should legislate to ensure this. Again, the responses of industry (private company) respondents differed significantly from the rest, with most mobile phone manufacturers opposed, while most companies from other, less “core” sectors were in favour (for details see Annex C).

During interviews, representatives of public authorities, consumer and environmental organisations tended to emphasise the benefits of guaranteed interoperability. Most industry stakeholders, on the other hand, expressed opposition to making compliance with USB specifications mandatory, based on the conviction that the near universal interoperability that already exists is proof that market forces are sufficient to ensure compatibility with USB technology, and that regulation was unnecessary, and potentially damaging (because it risked stifling innovation and depriving consumers of access to different, potentially faster, more efficient, or otherwise “better” fast charging technologies). However, there were also marked differences of opinion among phone manufacturers: while those that have invested heavily in proprietary charging technology tended to be most critical of possible regulation, some of those who already rely exclusively on USB PD for fast charging expressed an openness in principle to exploring how interoperability and/or compliance with common communication protocols could be guaranteed and enforced.

Scope for voluntary action

It is worth remembering that, as part of the 2009 MoU, the signatories committed to ensuring that “each EPS […] placed by them on the market for use with Mobile Phones is a Common EPS”, i.e. complied with the technical specifications and standards (in particular IEC 62684) developed as a result of the MoU. A similar commitment to the latest standards could be envisaged in principle. However, the existence of different fast charging technologies complicates matters, and means in particular those manufacturers for whom proprietary fast charging solutions represent an important part of their offer to customers would almost certainly be reluctant to sign up to such a commitment. This is especially the case for option 3, which, by requiring compliance with IEC 63002, would effectively prevent manufacturers from incorporating any fast charging technologies other than USB PD in their EPS.

Option 2 is a slightly different matter. It would require the incorporation of at least USB Type-C in all mobile phones, as well as USB PD in all those that can be charged with more than 15 W. But it would leave open the possibility for including other technologies as well – which is what manufacturers such as Huawei are already doing in many of their phones. Therefore, if the “essential requirements” (see under technical feasibility above) are defined in a way that does not restrict the use of proprietary fast charging solutions alongside USB PD, it may be possible for the industry as a whole to agree to comply with these on a voluntary basis.

Options 4.a and 4.b (Mandatory unbundling)

Technical feasibility

Unbundled solutions (i.e. mobile phones that do not include an EPS) are already being offered by several major manufacturers, so there can be no doubt about the technical feasibility of option 4.a. Unbundling the cables as well (option 4.b) would be another step in this direction; there is currently one niche manufacturer (Fairphone) that offers phones without cables in Europe, and reports no technical difficulties as a result.

Acceptability

The extent to which consumers are prepared to accept mandatory unbundling remains to be seen. As already discussed in section 5.3, the survey conducted for this study shows clearly that the majority of consumers considers it important that an EPS and cable are provided along with new mobile phones they purchase, and agrees that all mobile phones should be sold with a complete charging solution in the box. Fewer than one in three agreed that all mobile phones should be sold with a cable but no EPS (option 4.a), and fewer than one in four agreed they should be sold without an EPS or cable (option 4.b) (for details see Annex C).

On the other hand, while detailed market data for 2021 is not yet available, it is clear that consumers have not entirely stopped buying Apple or Samsung phones that do not include an EPS. And in the consumer survey, a little over half of respondents agreed (and only 15% disagreed) that all mobile phone manufacturers / distributors should give customers the option of purchasing (or not) a new EPS and/or cable with new phones. This suggests that consumer acceptance is partly a question of how such an intervention is perceived – if it is seen as giving customers more choice, it is likely to be far more palatable than if it is seen as the EU “taking away” free chargers. In this context, it is also worth mentioning the fact that in Brazil, the consumer watchdog Procon-SP fined Apple for removing the EPS from its phones, since it considers the charger a “necessary and essential accessory for the phones’ functioning”, and therefore deems its removal constitutes a violation of the country’s Consumer Defence Code.[[126]](#footnote-126)

The majority of stakeholder survey respondents representing public authorities, civil society organisations, and private citizens preferred the option of obliging all manufacturers / distributors to give customers the choice of whether or not to purchase a new EPS and/or cable with a new phone. However, six out of ten industry (private company) respondents felt that each mobile phone manufacturer / distributor should be free to choose how they the sell their phones and chargers (i.e. what to include in the box). None of the other “unbundling” options (all phones to be sold with a complete charging solution, with only an EPS, or with neither EPS nor cable in the box) was supported by a majority of respondents from any stakeholder group.

Following on from this, stakeholder survey respondents were asked to express their agreement or disagreement with a range of policy options. Slightly under half (46%) agreed the EU should adopt legislation to ensure mobile phones are no longer sold with a charging solution in the box. Respondents from public authorities, civil society organisations, and private citizens were very slightly in favour of this, while the majority of private companies were against.

In both their survey responses and in interviews, mobile manufacturers unanimously spoke out against mandatory unbundling. Even those who had already unbundled EPS from (some or all of) their phones opposed regulating to make this mandatory, noting that, while they expected environmental benefits, there were also drawbacks to unbundling. Several described the current voluntary unbundling initiatives as an experiment, and noted that, while they hoped they would be successful, this ultimately depended on the reaction of consumers. Therefore, they reserved the right to re-assess the situation as and when required, and felt that being obliged to unbundle would be an unjustified and unnecessary intervention in the market. Most also felt strongly that unbundling of cables would not be in their or in their customers’ best interest at this point in time.

Scope for voluntary action

Although some major manufacturers have recently begun to offer unbundled solutions, and others reported considering following suit in the near future, it nonetheless seems doubtful an industry consensus to commit to voluntary unbundling could emerge in the near future. At the present time, all major market players appear to be studying the reaction of consumers to the unbundled products that have recently been launched, and considering which approach (bundled or unbundled) is likely to offer them a competitive advantage, commercial and/or reputational benefits. Therefore, it is very unlikely that all major manufacturers would voluntarily commit to unbundle EPS, or even EPS and cables. Of course, this could change quickly, depending on the commercial success of unbundled products – but at present, the information obtained during the interviews conducted for this study suggests that most manufacturers are keen to keep their options open, rather than commit themselves to continue (in some cases) or start (in others) unbundling.

Option 5

Technical feasibility

As discussed previously (see section 3.2), a labelling scheme to raise consumer awareness of the interoperability of EPS and phones with relevant USB specifications, and thereby to stimulate demand for and supply of unbundled solutions, is certainly technically feasible. Nonetheless, its exact design features, and how to maximise both the buy-in from relevant industry stakeholders and the scheme’s effectiveness vis-à-vis consumers, would need to be considered very carefully, in more detail than is possible within the scope of this study, and in close cooperation with stakeholders. This includes questions of the design and placement of the logo / label (potentially including electronic labels); the exact requirements and specifications of products that can carry the label; who runs, and who monitors and polices the scheme. Therefore, it needs to be acknowledged again that, while the *technical* feasibility of such a scheme is not in doubt, its *practical* and *commercial* feasibility would need to be analysed further.

Acceptability

In the consumer survey, more than half (56%) of respondents “strongly agreed” that the public needs more information on chargers, their interoperability and environmental impact; and on top of this, nearly a third (31%) “tended to agree” with this. Very similar proportions of respondents to the stakeholder survey (53% and 29%, respectively) also “strongly agreed” or “tended to agree” that EU citizens should be provided with more information on the fact that most modern chargers are interoperable with all mobile phones (as well as many other devices). However, stakeholder support was less strong for the specific idea of a labelling scheme: around two out of three public authority and civil society organisation respondents agreed that a new labelling scheme should be created to help EU citizens understand which chargers can be used with which devices; but only half of private company respondents felt the same way.

During interviews, several stakeholders from across different groups expressed support for such a scheme. However, mobile phone manufacturers and industry associations were mostly sceptical of the idea, citing concerns around the effectiveness of the scheme – since, according to many, market research shows that consumers pay very little attention to such logos (the many different variations of USB logos that already exist being a case in point[[127]](#footnote-127)), and many products already carry too many logos and labels.

Scope for voluntary action

This is conceived as a voluntary option – manufacturers could freely choose to apply the label to some or all of their eligible products, and would remain free to produce non-compliant EPS and phones that would not be eligible for the label.

It may be worth considering whether there would be scope for a *mandatory* labelling scheme instead. But it is difficult to envisage how this would work in practice: surely, it would not be appropriate to *force* compliant products to carry the label, without also making compliance mandatory?

In view of this, a mandatory scheme could potentially be envisaged in combination with one of the mandatory interoperability options discussed previously (option 2 or 3). In this case, it would essentially become a flanking measure (i.e. part of the information requirements briefly mentioned as part of these options). In this case, all mobile phones (option 2) or EPS sold with mobile phones (option 3) could be obliged to carry the label, in order to convey their compliance with the interoperability requirement. At the same time, it could be envisaged that other products could also use the label, on a voluntary basis.

1. Impact assessment for other portable electronic devices

This chapter considers an initiative with a broader scope, including not only mobile phones, but also suitable other portable electronic devices. It discusses which categories of devices each of the policy options as defined previously could potentially apply to (section 6.1); presents key data on the baseline for other devices (6.2); discusses whether a “narrow” initiative that only applies to mobile phones would nonetheless be likely to have *indirect* impacts on other devices and their chargers (6.3); and finally, assesses the *direct* impacts that would result from broadening the scope of the initiative to (certain types of) other devices (6.4).

* 1. Scope of the impact assessment

During the inception phase, the study team developed a mapping of 186 mobile phones and 192 other portable electronic devices,[[128]](#footnote-128) tracking their charging characteristics and market trends. Based on the mapping, devices were categorised into three priority groups using the following criteria[[129]](#footnote-129):

* The extent to which charging characteristics of other devices are similar to mobile phones, excluding from the analysis those for which the assumptions for mobile phone chargers could not be extrapolated;
* The extent to which unbundling already exists, de-prioritising those that are already sold unbundled;
* The trend of sales of the products, prioritising those devices with a high growth trend.

Based on the mapping and the analysis of market data, tablets and cameras were classified as the devices with the highest priority; hearing devices and hand-held videogame consoles were classified as medium priority; and portable speakers, smartwatches and fitness trackers as low priority.[[130]](#footnote-130)

The classification was used to prioritise the acquisition of market data for other portable devices. As a result, tablets, cameras and hearing devices have been included in the stock model.[[131]](#footnote-131) Impacts for other devices are assessed qualitatively.

Given that other portable devices have different charging characteristics to mobile phones and varied unbundling trends, not all of the policy options are relevant for all the devices. Before assessing impacts, we define below which policy options would potentially be applicable to each device.

Tablets

Of all the devices analysed, tablets are the most similar device to smartphones in terms of battery and charging characteristics. They use similar battery charging protocols, albeit with slightly higher wattage – especially on those tablets that are of bigger size or that incorporate features that are more typical of laptops (e.g. a keyboard). They also use the same types of connectors. In 2019, it is estimated that 40% of tablets had USB micro-B receptacles, 33% USB Type-C, and 27% had proprietary connectors (23% Lightning and 4% other proprietary connectors).[[132]](#footnote-132) All the tablets sold in the market nowadays are bundled with the EPS and cable.

All the policy options could apply to tablets. Currently, there are many tablets that are a hybrid between a tablet and a notebook or laptop, and therefore the scope of any legislation should be carefully defined. The impacts of the policy options on notebooks and laptops have not been analysed.

Digital photo cameras

All the cameras analysed in the mapping of devices (29) have USB connectors. In some cases the connector is only used for data transfer (7/29), whereas in most cases it can also be used to charge the camera (22/29).

There are two main types of digital cameras: cameras with built-in lenses (e.g. action cameras and compact cameras) and cameras with interchangeable lenses (e.g. Reflex and mirrorless cameras). Cameras with built-in lenses are normally smaller and are charged via USB connectors (USB micro-B or USB Type-C). Larger cameras (Reflex and mirrorless) generally have removable (proprietary) batteries that are charged with external battery chargers. These chargers are proprietary and do not use USB cables or connectors. Only the newest and/or premium models of this type of cameras have a USB Type-C receptacle that allows not only data transfer, but also battery charging (i.e. some of these cameras can be charged either with a USB Type-C cable and EPS, or removing the battery and charging it separately using the proprietary charger). Out of the 29 cameras analysed:

* 20 were charged via a USB connection (either USB micro-B or USB Type-C);
* 7 could only be charged by removing the battery, using the proprietary charger;
* 2 could be charged either via USB Type-C charging, or via the proprietary charger (i.e. removing the battery).

Option 1 harmonises the receptacles to USB Type-C. This option could be applied to cameras, adding that the receptacle should provide both data transfer and charging via USB standards.

Cameras use significantly lower wattage than mobile phones. In the mapping of devices conducted, all the cameras analysed (29) required under 10W. The options to harmonise battery charging protocols considered in this impact assessment (options 2 and 3) require minimum 7.5W; however, most cameras use less than that. In the few cases where the cameras require more power, the mapping indicates they already use USB Type-C charging. Cameras that allow charging through the USB connector may already be charged safely with EPS that use USB PD and USB Type-C battery charging, as they provide backwards compatibility with other USB standards. Therefore, as the market stands nowadays, options 2 and 3 would not deliver the best technical option for cameras, as they would increase production costs and retail prices without producing any significant benefit for the consumers or the environment. In the future, if cameras evolve towards more powerful battery charging protocols, these options may be considered.

Out of the 29 cameras mapped, 12 included an EPS in the box, 9 included an external battery charger[[133]](#footnote-133), and 26 included a cable. Options 4.a and 4.b could therefore apply to cameras.

Hearing devices

The types of connectors used by hearing devices (headphones and earbuds) are similar to the ones used in mobile phones and tablets: Lightning (48% of the units sold in the EU in 2019), USB micro-B (41%) and USB Type-C (12%).[[134]](#footnote-134) Option 1, therefore, could apply to hearing devices.

This category of device has two subproducts: headphones and earbuds. Some earbuds are charged wirelessly in their box, and the box connects to an EPS via a USB cable. For the purpose of this study, we have treated the earbuds' box as part of the product, and have mapped and analysed the connector in the box.

All the devices mapped (34) require less than 10W, and most require less than 5W. Therefore, similar to the case of cameras, as the market stands nowadays, options 2 and 3 would not provide the best technical option to charge hearing devices, as they would increase production costs and retail prices without producing any significant benefit for the consumers or the environment. This market may be analysed again in the future, and options 2 and 3 applied should hearing devices evolve towards fast charging solutions.

Of the devices analysed, none of them included an EPS (hence making option 4.a unnecessary for hearing devices). However, almost all included a cable along with the hearing device. Options 4.b and 5 could therefore apply to hearing devices.

Similar to the case of tablets, hearing devices should be carefully defined so as to avoid including hearing aid devices and other potential devices that are different to the ones referred to in this study.

Hand-held videogame consoles

Nine consoles were mapped, of which five used USB micro-B connectors, three used USB Type-C connectors, and one used a proprietary connector (Sony PS Vita). The wattage used by consoles ranged from 4W (e.g. Nintendo 2DS) to 39W (e.g. Nintendo Switch). There were two devices using 15W or more, of which one was USB PD enabled and the other used Quick Charge. All the devices except two (for which there was no information) were sold along with an EPS and cable.

Option 1 (harmonisation of connectors), and the unbundling options (4.a and 4.b) could apply to hand-held videogame consoles. Options 2 and 3, which harmonise the use of battery charging protocols, may be applied to these devices. However, most devices use low wattage and harmonisation already exists for those using 15W or more. In addition, these devices and their EPS could take part in the interoperability labelling scheme (option 5).

Portable speakers

All of the 26 portable speakers mapped in our analysis used USB connectors (15 used USB micro-B and 11 used USB Type-C connectors). Most of the speakers required low wattage (under 10W), although the sample included six devices accepting 15W or more. All of these used USB Type-C connectors and either USB Type-C or USB PD battery charging protocols.

Given that there is no fragmentation of charging solutions in the market (proprietary solutions do not exist and USB micro-B connectors are naturally transitioning towards USB Type-C), harmonisation options are not strictly necessary. However, the Commission may want to extend the scope to portable speakers in order to ensure new models continue using standard charging solutions. A voluntary option may however be explored to convey the existing interoperability to consumers via policy option 5.

Five out of 26 devices included an EPS along with the portable speaker and all of the devices included a cable. The unbundling options (4.a and 4.b) could therefore apply to portable speakers.

E-readers

Most of the e-readers analysed (6 out of 8) use USB micro-B connectors and a minority (2 out of 8) use USB Type-C connectors. All of them are charged at 5W using the USB BC specification. As in the case of portable speakers, it is not proportionate to include e-readers within the scope of any regulatory harmonisation option (options 1, 2 and 3) as it would not deliver any benefit to the consumer or the environment. Nonetheless, e-readers could of course also carry the interoperability labels (option 5).

None of the devices analysed included EPS along with the e-readers, but all included a cable. Therefore, only option 4.b could be applicable to e-readers.

Smartwatches and fitness trackers

All the devices analysed are charged via wireless and/or proprietary connectors. These wearables are often designed to be water resistant and support hard conditions, therefore USB connectors may not offer the best technical solution. The wattage accepted by the devices was below 10W in all cases. Applying the harmonisation options (options 1, 2 or 3) to smartwatches and fitness trackers would deliver sub-optimal charging solutions. Nonetheless, those devices that do use the relevant USB charging technologies could take part in the voluntary labelling scheme (option 5). However, given that wireless is the most common charging method for these devices, it may be more appropriate to use the labelling scheme to communicate wireless charging protocols instead.

Five out of the 11 devices analysed included an EPS. All included a cable, and most included a wireless charger. Option 4.a could be applied to mandate unbundling of EPS. With regard to the cable, given that many of these devices use proprietary connectors (and USB Type-C do not offer the right technical option), mandating unbundling of the cable (option 4.b) is not recommended.

Summary of policy options for other portable electronic devices

The table below summarises the devices for which each policy option is relevant. ‘Yes’ indicates that the policy option could apply to that device, and the impact assessment in the remainder of this chapter explores the likely effects of this; ‘No’ indicates that, based on the information at our disposal, it is recommended that the policy option does not apply to the device because it is not the best technical option (based on the charging characteristics of the portfolio of devices analysed) and/or the negative impacts would clearly overweight the positive impacts; ‘Unnecessary’ indicates that the option is feasible technically, but would not provide any benefits in relation to the baseline scenario.

Table 22: Summary of scope of policy options applied in the study

| Device | Option 1: Harmonise connectors | Option 2: Device inter-operable | Option 3: EPS inter-operable | Option 4.a: Unbundling of EPS | Option 4.b: Unbundling of cable | Option 5: Voluntary labelling |
| --- | --- | --- | --- | --- | --- | --- |
| Tablets | Yes | Yes | Yes | Yes | Yes | Yes |
| Cameras | Yes | No(1) | No | Yes | Yes | Yes |
| Hearing devices | Yes | No(1) | No | Un-necessary | Yes | Yes |
| Hand-held video game consoles | Yes | Yes | Yes | Yes | Yes | Yes |
| Portable speakers | Yes | Yes | Yes | Yes | Yes | Yes |
| E-readers | No | No | No | Un-necessary | Yes | Yes |
| Smartwatches & fitness trackers | No | No | No | Yes | No | More appropriate for wireless |

(1) As the market stands now, Option 2 is not advisable for either cameras or hearing devices. However, should the market evolve towards fast charging solutions using 7.5W or more, Option 2 could be applied.

* 1. Baseline

Overall, other devices tend to be much smaller markets for EPS and cables than those supplied with smartphones or standalone. The market of mobile phone chargers is much larger than any other market of portable devices (see Table 20), and in some of these markets (e.g. e-readers, earwear) most devices are sold unbundled from their EPS.

Table 23: Estimated sales in the EU per category of portable electronic devices

| Type of device | Year | Sales in the EU27 (thousand units) | Estimated % sold bundled with EPS in 2020[[135]](#footnote-135) | Estimated % sold bundled with cable in 2020 | Source |
| --- | --- | --- | --- | --- | --- |
| Mobile phones | 2019 | 128,968 | 83% | 100% | IDC (2020)[[136]](#footnote-136) |
| Tablets | 2019 | 22,350 | 100% | 100% | IDC (2020)[[137]](#footnote-137) |
| Hearables | 2019 | 24,914 | 0% | 100% | IDC (2020) [[138]](#footnote-138) |
| Digital cameras | 2019 | 5,428 | 37% | 85% | CIPA (2021) and Prodcom (2021)[[139]](#footnote-139) |
| Handheld video games | 2018 | 18,598 | 100% | 100% | Comtrade (2019)[[140]](#footnote-140) |
| E-readers | 2020 | 11,838 | 0% | 100% | Comtrade (2021)[[141]](#footnote-141) |
| Smartwatches and fitness trackers | 2020 | 7,658 | 45% | 100% | Comtrade (2021) |
| Portable speakers | 2020 | 1,639 | 19% | 100% | Comtrade (2021)[[142]](#footnote-142) |
| **TOTAL** |  | **221,393** |  |  |  |

The graphs overleaf present the estimated evolution of the stock of EPS and cables for the baseline, split by market/device. Taken together, the chargers (EPS as well a cables) for these three categories of devices account for less than 20% of the stock of mobile phone EPS and cables (including those purchased on their own).

The absolute numbers and relative weights of the environmental impacts of the chargers of a subset of devices in the baseline scenario are shown below – providing an indication of the scale of magnitude of the impacts to be expected from the inclusion of these devices in the various policy options.

Table 24: Environmental impacts from chargers for different devices in the baseline scenario

|  |  | **Baseline** | **Baseline** | **Baseline** | **Baseline** |
| --- | --- | --- | --- | --- | --- |
|  |  | **Mobile phones + standalone** | **Tablets** | **Earwear** | **Cameras** |
| **GHG emissions [ktCO2e]** | **Total 2024-2030** | **7 838** | **853** | **342** | **19** |
|  | As % of phones |  | 10.9% | 4.4% | 0.2% |
|  | Annual average | 1 120 | 122 | 49 | 3 |
|  | As % of phones |  | 10.9% | 4.4% | 0.2% |
| **Material Use [tonnes]** | **Total 2024-2030** | **152 806** | **16 484** | **9 643** | **437** |
|  | As % of phones |  | 10.8% | 6.3% | 0.3% |
|  | Annual average | 21 829 | 2 355 | 1 378 | 62 |
|  | As % of phones |  | 10.8% | 6.3% | 0.3% |
| **E-waste [tonnes]** | **Total 2024-2030** | **133 196** | **14 595** | **6 815** | **857** |
|  | As % of phones |  | 11.0% | 5.1% | 0.6% |
|  | Annual average | 19 028 | 2 085 | 974 | 122 |
|  | As % of phones |  | 11.0% | 5.1% | 0.6% |
| **Of which Untreated [tonnes]** | **Total 2024-2030** | **27 365** | **3 003** | **1 362** | **184** |
|  | As % of phones |  | 11.0% | 5.0% | 0.7% |
|  | Annual average | 3 909 | 429 | 195 | 26 |
|  | As % of phones |  | 11.0% | 5.0% | 0.7% |
| **Of which Recycled [tonnes]** | **Total 2024-2030** | **70 685** | **7 737** | **4 030** | **448** |
|  | As % of phones |  | 10.9% | 5.7% | 0.6% |
|  | Annual average | 10 098 | 1 105 | 576 | 64 |
|  | As % of phones |  | 10.9% | 5.7% | 0.6% |

**Source:** Own TRI-STOCK-CHARGER model calculations.

Figure 4: Evolution of the stock of chargers for tablets, earwear and cameras in the baseline scenario

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1. **Tablets stock [units]** | 1. **Earwear stock [units]** | 1. **Cameras stock [units]** |
| 1. **EPS** |  |  |  |
| 1. **Cables** |  |  |  |

1. **Source:** Own TRI-STOCK-CHARGER model calculations.  
   **Note:** The “No EPS” area in the stock graph does not decline as there are no disposals assumed (unlike other EPS); for this reason, the total accumulates.
   1. Indirect impacts

In this section, we consider whether, if the scope of the initiative was kept narrow – meaning it would apply to mobile phones only – this might nonetheless have indirect impacts on the markets for other portable electronic devices. Even though these would not be directly affected (i.e. would not be obliged to comply with the new rules and regulations), it is nonetheless possible that certain options would have an effect on the markets for other certain devices, due to voluntary changes in manufacturer / vendor behaviour, shifts in consumer demand, or other relevant mechanisms.

A summary of the indirect impacts per policy option and device is presented at the end of this section.

Option 1

As already outlined in the first IA study (section 5.6), even if the scope of application of the mandatory USB Type-C receptacles / connectors remained limited to mobile phones only, it appears highly probable that this would have indirect effects on the markets for other portable devices. The fact that such a high proportion of consumers own a mobile phone means these tend to have a certain amount of influence on the market for other devices. Therefore, the adoption of a common connector across all mobile phones could be expected to also contribute to a greater and/or faster adoption of this in other electronic devices in which this makes technological, practical and commercial sense, reinforcing the existing trend of a gradual increase in the take-up of USB Type-C technology and standards, although the extent of this is impossible to predict with any certainty.

If this were the case, it would reinforce and extend the consumer convenience benefits of option 1 to users of other devices, as it would increase their ability to use the same cables across a wider range of devices. The environmental effects of this would likely be negligible (for the reasons described in section 5.1). Indirect negative economic impacts are not expected, as the adoption of USB Type-C for other devices would remain purely voluntary, and thus limited to those devices where the cost implications are not overly significant.

Option 2

This option requires all mobile phones to be interoperable with USB Type-C and (for phones that charge at more than 15 W) USB PD, thus making sure they can be charged with all common EPS. In practice, this also means that USB micro-B connectors would not be allowed anymore and would be replaced by USB Type-C connectors faster than in the baseline. As a result, the cost of including USB Type-C connectors could reduce at a faster pace due to economies of scale, potentially accelerating the pace at which other devices are moving from USB micro-B to USB Type-C. Like in option 1, this would reinforce consumer convenience, although to a lesser extent, as proprietary connectors would still be part of the market.

However, this option is not expected to have a significant influence on the types of EPS that are sold (whether along with phones or separately). These would likely continue to incorporate USB charging technology wherever the manufacturer deems this makes commercial sense (as is already the case), but there is no reason to assume it would lead to any shifts in battery charging protocols for other electronic devices.

Option 3

The compliance of all EPS for mobile phones with the IEC 63002 standard, as required by option 3, would provide guaranteed interoperability (including backward compatibility with older USB devices), which is expected to also lead to greater consumer awareness of the interoperability of EPS, and confidence in the ability to charge different devices with the same EPS. This would provide indirect convenience gains for users of other devices (e.g. in terms of reduced confusion) and could lead to a reduction in the sales of standalone EPS acquired to charge other devices. It could potentially also reinforce the existing trend to ship certain devices without an EPS (with the requisite benefits in terms of reduced environmental impacts), although the recent trend towards voluntarily selling mobile phones without EPS makes this less likely (for more on this, see option 4 below). For those devices that would continue to be sold with an EPS, more manufacturers might choose to voluntarily comply with the relevant standards anyway (since, as noted above, the mobile phone market has a certain influence on the market for other devices), which would further enhance the benefits in terms of guaranteed interoperability of chargers across different categories of portable devices (though this is of course highly uncertain). Any potential economic costs are expected to be minimal, since manufacturers of other devices would continue to be free to choose the EPS they consider most appropriate (if any) for each device.

Option 4

Mandatory unbundling of chargers (EPS and possibly also cables) from mobile phones could potentially increase demand for chargers to use with other devices. This is because of the very high penetration of mobile phones. According to several interviewees, the decision of some manufacturers to ship their devices (e.g. e-readers, wearables or sport cameras) without a complete charging solution (usually with a cable, but without an EPS) is partly motivated by the assumption that nearly all consumers own and are able to use their mobile phone chargers. Therefore, it is worth considering whether more phones being shipped without chargers might lead some manufacturers not to unbundle, or even to “re-bundle” (i.e. to re-introduce chargers in the box with certain products) because consumers can no longer rely on the ones provided with their phones.

However, this seems very unlikely. After all, nearly all consumers will still own a mobile phone, and will still need to have access to an EPS and cable to charge this. If, as a result of unbundling, an increasing number has to re-use the charger that came with an old phone, or purchase a new one separately, this does not change the fact that all mobile phone users have access to a suitable charger, which they can also use to charge other devices. Therefore, we do not expect this option to have a negative impact on unbundling rates for other devices. In fact, if consumers come to accept unbundled phones, then it may well be that the proportion of other devices that are sold without chargers also increases as a result, as more manufacturers feel confident in removing chargers.

Option 5

If the scope of the voluntary interoperability labelling scheme remained closed to mobile phones and their chargers only, then it would be unlikely to have any indirect effects on other portable electronic devices, their users or manufacturers. However, there would be no reason to limit the scope to only these devices – since it would be voluntary, it would be unnecessary and counterproductive to prevent manufacturers of other devices who wish to participate from doing so. Hence, in this case, the assessment of *indirect* impacts is of little relevance; the likely *direct* impacts are discussed in the ensuing section.

Summary of indirect impacts

Following the rationale explained above for the expected indirect impacts of each policy option, the table below provides a summary of potential indirect impacts per policy option and device. The scale of impacts is compared to the impacts presented in section 5, indicating whether impacts are expected to increase, decrease, or remain the same.

Table 25: Potential indirect impacts per policy option and device

| Device | Option 1: Harmonise connectors | Option 2: Device inter-operable | Option 3: EPS inter-operable | Option 4.a: Unbundling of EPS | Option 4.b: Unbundling of cable | Option 5: Voluntary labelling |
| --- | --- | --- | --- | --- | --- | --- |
| Tablets | It is very likely that the transition to USB Type-C connectors would be accelerated, increasing the scale of impacts of Option 1 | It is very likely that more manufacturers would voluntarily comply with standards, increasing the scale of impacts of these options. | | Unbundling of EPS/cable from mobile phones may affect unbundling rates of tablets. However it may either increase the number of chargers sold bundled (as consumers would have fewer chargers at their disposal) or decrease it (as consumers become used not to get a charger in the box when they buy a new device). Hence, likely indirect impacts are unknown. | | No indirect effect for any device. |
| Cameras | Transition to USB Type-C connectors may be accelerated, increasing the scale of impacts of Option 1 | Transition to USB Type-C connectors may be accelerated (increasing impacts of Option 2), unlikely to impact battery charging protocols | More EPS would be interoperable with cameras, which may increase unbundling rates (increasing impacts of Option 3) | Many cameras are already sold unbundled, therefore these options would be expected to further increase unbundling rates for cameras, hence increasing the impacts of Options 4.a and 4.b. | |
| Hearing devices | Transition to USB Type-C connectors may be accelerated and proprietary connectors (Lightning) might be displaced, increasing the scale of impacts of Option 1 | No impacts expected | No impacts expected | No impacts expected | It could increase unbundling rates of cables, hence increasing the impacts of Option 4.b |
| Hand-held video game consoles | Transition to USB Type-C connectors may be accelerated, increasing the scale of impacts of Option 1. However, proprietary connectors would still exist. | It would reinforced the use of USB PD among consoles using over 15W, hence increasing impacts of Options 2 and 3, respectively. Option 3 might also lead to higher unbundling rates on gaming consoles. | | Unbundling of EPS/cable from mobile phones may affect unbundling rates of gaming consoles. However, it may either increase the number of chargers sold bundled (as consumers would have fewer chargers at their disposal) or decrease it (as consumers become used not to get a charger in the box when they buy a new device). Hence, likely indirect impacts are unknown. | |
| Portable speakers | Transition to USB Type-C connectors may be accelerated, increasing the scale of impacts of Option 1 | It would reinforced the use of USB PD among speakers using over 15W, hence increasing impacts of Options 2 and 3, respectively. Option 3 might also lead to higher unbundling rates on portable speakers. | | Most portable speakers are already sold unbundled. Therefore, these options would be expected to further increase unbundling rates for speakers, hence increasing the impacts of Options 4.a and 4.b. | |
| E-readers | Transition to USB Type-C connectors may be accelerated, increasing the scale of impacts of Option 1 | No impacts expected | No impacts expected | No impacts expected | It could increase unbundling rates of cables, hence increasing the impacts of Option 4.b |
| Smartwatches & fitness trackers | No impact | No impact | No impact | It could increase unbundling rates of EPS, hence increasing the impacts of Option 4.a | No impact |

* 1. Direct impacts

In this section, we consider the likely impacts if the scope of the options were defined more broadly, and its application extended beyond mobile phones to other portable electronic devices.

The two tables overleaf present, respectively, the environmental and economic impacts of a subset of devices that includes mobile phones, tablets, earwear and cameras, as these are the devices that have been included in the stock model.[[143]](#footnote-143) The impacts of including other devices are assessed qualitatively, providing where possible a scale of the impact in comparison with the quantitative estimates for mobile phones and/or other devices.

Table 26: Environmental impacts of the policy options for mobile phones, tablets, earwear and cameras

|  |  | **Baseline** | **PO1** | **PO2** | **PO3** | **PO4.a** | **PO4.b** | **PO5** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Harmonise device-end connectors** | **Require devices to be compatible w/ USB PD** | **"Common" EPS for devices** | **Mandatory unbundling of EPS** | **Mandatory unbundling of EPS and Cable** | **Interoperability labelling / information scheme** |
| **GHG emissions [ktCO2e][[144]](#footnote-144)** | **Total 2024-2030** | **9,052** | **9,226** | **8,995** | **9,171** | **8,047** | **6,667** | **8,976** |
| Difference with baseline |  | 174 | -57 | 119 | -1,005 | -2,385 | -76 |
| Annual average | 1,293 | 1,318 | 1,285 | 1,310 | 1,150 | 952 | 1,282 |
| Difference with baseline |  | 25 | -8 | 17 | -144 | -341 | -11 |
| As % |  | 1.9% | -0.6% | 1.3% | -11.1% | -26.3% | -0.8% |
| **Material Use [tonnes][[145]](#footnote-145)** | **Total 2024-2030** | **179,371** | **183,033** | **178,459** | **181,136** | **165,619** | **126,707** | **178,043** |
| Difference with baseline |  | 3,662 | -913 | 1,764 | -13,752 | -52,664 | -1,329 |
| Annual average | 25,624 | 26,148 | 25,494 | 25,877 | 23,660 | 18,101 | 25,435 |
| Difference with baseline |  | 523 | -130 | 252 | -1,965 | -7,523 | -190 |
| As % |  | 2.0% | -0.5% | 1.0% | -7.7% | -29.4% | -0.7% |
| **E-waste [tonnes][[146]](#footnote-146)** | **Total 2024-2030** | **155,463** | **157,419** | **155,382** | **156,422** | **149,645** | **133,692** | **154,948** |
| Difference with baseline |  | 1,957 | -81 | 959 | -5,817 | -21,770 | -515 |
| Annual average | 22,209 | 22,488 | 22,197 | 22,346 | 21,378 | 19,099 | 22,135 |
| Difference with baseline |  | 280 | -12 | 137 | -831 | -3,110 | -74 |
| As % |  | 1.3% | -0.1% | 0.6% | -3.7% | -14.0% | -0.3% |
| **Of which Untreated [tonnes][[147]](#footnote-147)** | **Total 2024-2030** | **31,914** | **32,301** | **31,905** | **32,107** | **30,782** | **27,720** | **31,815** |
| Difference with baseline |  | 388 | -8 | 193 | -1,132 | -4,194 | -99 |
| Annual average | 4,559 | 4,614 | 4,558 | 4,587 | 4,397 | 3,960 | 4,545 |
| Difference with baseline |  | 55 | -1 | 28 | -162 | -599 | -14 |
| As % |  | 1.2% | 0.0% | 0.6% | -3.5% | -13.1% | -0.3% |
| **Of which Recycled [tonnes][[148]](#footnote-148)** | **Total 2024-2030** | **82,899** | **84,103** | **82,929** | **83,443** | **80,180** | **70,451** | **82,627** |
| Difference with baseline |  | 1,204 | 30 | 544 | -2,719 | -12,447 | -272 |
| Annual average | 11,843 | 12,015 | 11,847 | 11,920 | 11,454 | 10,064 | 11,804 |
| Difference with baseline |  | 172 | 4 | 78 | -388 | -1,778 | -39 |
| As % |  | 1.5% | 0.0% | 0.7% | -3.3% | -15.0% | -0.3% |

**Source**: Own TRI-STOCK-CHARGER model calculations.

Table 27. Quantitative economic impacts of the policy options for mobile phones, tablets, earwear and cameras

|  | **Baseline** | **PO1** | **PO2** | **PO3** | **PO4.a** | **PO4.b** | **PO5** |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Harmonise device-end connectors** | **Require devices to be compatible with USB PD** | **"Common" EPS for devices** | **Mandatory unbundling of EPS** | **Mandatory unbundling of EPS and Cable** | **Interoperability labelling / information scheme** |
| **Cost to consumers (NPV million EUR)** | | | | | | | |
| Total 2024-2030 | **49,960** | **45,619** | **48,795** | **48,900** | **52,247** | **49,934** | **49,436** |
| Difference with baseline |  | -4,341 | -1,165 | -1,061 | 2,287 | -26 | -524 |
| Annual average | 7,137 | 6,517 | 6,971 | 6,986 | 7,464 | 7,133 | 7,062 |
| Difference with baseline |  | -620 | -166 | -152 | 327 | -4 | -75 |
| As % |  | -8.7% | -2.3% | -2.1% | 4.6% | -0.1% | -1.0% |
| **Competitiveness of businesses** | | | | | | | |
| **Benefit for manufacturers of chargers and wholesalers (NPV million EUR)** | | | | | | | |
| Total 2024-2030 | **14,176** | **12,919** | **13,960** | **14,020** | **12,890** | **9,987** | **14,071** |
| Difference with baseline |  | -1,257 | -215 | -155 | -1,285 | -4,189 | -105 |
| Annual average | 2,025 | 1,846 | 1,994 | 2,003 | 1,841 | 1,427 | 2,010 |
| Difference with baseline |  | -180 | -31 | -22 | -184 | -598 | -15 |
| As % |  | -8.9% | -1.5% | -1.1% | -9.1% | -29.5% | -0.7% |
| ***Of which benefit for EU manufacturers (NPV million EUR)*** | | | | | | | |
| Total 2024-2030 | **1,519** | **1,389** | **1,471** | **1,471** | **1,793** | **1,960** | **1,498** |
| Difference with baseline |  | -129 | -48 | -48 | 274 | 441 | -21 |
| Annual average | 217 | 198 | 210 | 210 | 256 | 280 | 214 |
| Difference with baseline |  | -18 | -7 | -7 | 39 | 63 | -3 |
| As % |  | -8.5% | -3.1% | -3.1% | 18.0% | 29.0% | -1.4% |
| **Benefit for distributors and retailers until point of sale [NPV million EUR]** | | | | | | | |
| Total 2024-2030 | **21,609** | **19,781** | **20,874** | **20,859** | **26,466** | **29,961** | **21,294** |
| Difference with baseline |  | -1,828 | -735 | -750 | 4,857 | 8,352 | -315 |
| Annual average | 3,087 | 2,826 | 2,982 | 2,980 | 3,781 | 4,280 | 3,042 |
| Difference with baseline |  | -261 | -105 | -107 | 694 | 1,193 | -45 |
| As % |  | -8% | -3% | -3% | 22% | 39% | -1% |

**Source:** Own TRI-STOCK-CHARGER model calculations.

Option 1

As explained above, the obligatory use of USB Type-C receptacles could potentially be applied to tablets, cameras, hearing devices, hand-held video consoles, and portable speakers, but not the other two categories of devices (see section 6.1).

The impacts of this would mirror the impacts of this option on mobile phones, with the following specific considerations:

* Tablets: The impacts on the environment, consumers, and manufacturers of tablets are very similar to the impacts described in section 5 for mobile phones. Manufacturers of tablets and mobile phones are in most cases the same companies, and the battery charging technologies and connectors used are also the same. Including this device would increase slightly the negative environmental impacts of this option (as USB Type-C cables and connectors produce more negative environmental impacts than Lightning or USB micro-B). On the other hand, it would improve the economic impacts, with slightly more savings for consumers and similar impact on profits for the industry. The inclusion of tablets would not worsen the impact on innovation, since most of the innovation activity in charging solutions is placed on mobile phones.
* Cameras: Given the low volume of cameras sold in the EU, any environmental impacts associated to the chargers sold bundled with cameras is minimum. The inclusion of this device has minor negative environmental effects produced by the accelerated transition of USB micro-B connectors and cables to USB Type-C, as the latter is heavier and uses more materials. The economic impacts are negligible, with very little variation in the stock model figures when impacts for cameras are added to the scope of the initiative. Some small manufacturers may face some operating costs, but it is expected that most cameras will include USB Type-C connectors by 2024.
* Hearing devices: As with tablets and cameras, the inclusion of hearing devices within the scope of option 1 also increases the negative environmental impacts of this option. Including hearing devices increases further the savings for consumers, while also decreasing the profit for the industry. As indicated in section 6.1, for the purpose of this study we have assumed that the wireless charger that is frequently shipped with earbuds is considered part of the product (this type of earbuds do not have any connectors and can only be charged via wireless). It is important that any future regulation on Option 1 is designed in a way that does not mandate the inclusion of USB Type-C (or any other type of connector) on devices that are designed to only be charged via wireless.
* Hand-held video consoles: This market is relatively large (see Table 20), and therefore it is to be expected that the impacts of option 1 would increase significantly (by up to 5%)[[149]](#footnote-149) across all variables analysed if consoles are included within the scope. Applying the option to gaming consoles may also increase the operating costs for manufacturers who currently use proprietary connectors (e.g. Sony in the PS Vita console).
* Portable speakers: The market of portable speakers is very small and it is likely that by 2024 most devices will already incorporate USB Type-C connectors regardless. Therefore, impacts of including this device would be insignificant.

From a consumer perspective, the more devices are included within Option 1, the greater convenience consumers would get, as they could charge more devices with the same cable.

Option 2

The mandatory interoperability of the device (option 2) with USB Type-C and (where relevant) USB PD would be appropriate to apply to tablets and, potentially, to portable speakers and hand-held video consoles. In addition, should the market of cameras and hearing devices evolve towards fast charging solutions, the Commission might want to add these devices in future revisions of the scope. Below, the expected impacts of extending the scope to each of these devices is summarised:

* Tablets: Given that tablets use similar battery charging protocols to mobile phones, albeit often with slightly higher wattage, and many of the major market players are the same (including Samsung, Apple and Huawei), there would be no major risks or concerns around applying either of these options to tablets, beyond those outlined regarding mobile phones in section 5. The environmental and economic impacts should also be broadly similar, albeit on a smaller scale (given the size of the tablet market compared with mobile phones).
* Portable speakers: Most speakers charge at between 5 and 10W, and therefore the USB Type-C protocol (1.5A, 5V) is likely to be a suitable option for these devices. Applying option 2 would do no harm (other than potentially increasing costs for lower end devices), but it would not deliver significant benefits either, since interoperability already exists (none of the devices analysed in this study used proprietary charging solutions). The impact of including this device would therefore be neutral.
* Hand-held video consoles: The sample of devices analysed in this study is very varied, with devices ranging from 5W (Sony PSP, Nintendo DS) to 39W (Nintendo Switch). One device using 24W uses Quick Charge, and therefore there may be benefits in harmonising the battery charging protocol in terms of consumer convenience and environmental impacts. However, it may also generate costs for industry and consumers for devices that still use 5W or less.
* Cameras and hearing devices: As explained in section 6.1, most devices within these categories require under 7.5W, and therefore, as the market stands nowadays, USB Type C and USB PD battery charging protocols do not provide the best technical solution. In these cases, it would be more beneficial for consumers and the environment to seek harmonisation towards standard battery charging protocols that require less power, specifically, USB Battery Charging. Should the market evolve towards fast charging solutions (i.e. the majority of these devices requiring 7.5W or more), Option 2 could then be applied. The expected impacts in such hypothetical scenario would be:
  + Cameras: Applying such option would generate some operational costs for manufacturers of cameras, as not all use standard battery charging solutions. The option would be beneficial for consumers and the environment, since it would likely lead to fewer chargers and cables in the market.
  + Hearing devices: The application of option 2 to hearing devices would be mostly neutral, since most hearing devices already use USB battery charging protocols.

Overall, the impacts of option 2 are very minor (whether considering mobile phones only, or mobile phones and other devices). However, when in combination with other measures (see Chapter 7), it may create synergy effects and reduce the number of standalone chargers that consumers buy, hence having a positive significant effect on environmental, economic and social impacts.

Option 3

Option 3 delivers negative environmental impacts due to the “upgrade” of chargers (EPS and cables) that it entails, which is not compensated by the reduced amount of chargers produced and sold due to increased interoperability. Overall, it produces some minor savings to consumers and costs to the industry, and gains in consumer convenience. The inclusion of additional devices (tablets, portable speakers and hand-held video consoles) would impact in the following ways:

* Tablets: The inclusion of tablets produces a small increase in GHG emissions, material use, and e-waste, in proportion to the size of this market (see quantitative results in Table 23). It would also produce an increase in consumers’ savings and costs for the industry. Other economic impacts (innovation, operating costs, compliance costs…) would be similar to the ones explained in Chapter 5.2 for mobile phones. This option delivered consumer convenience benefits when applied to mobile phones due to increased interoperability and access to fast charging. When extending the scope to tablets, consumer convenience would increase as interoperability also increases, but the fast charging feature is less relevant for tablets given that these (unlike mobile phones) do not typically have to be charged on a daily basis.
* Portable speakers: This option would have a negligible effect on portable speakers, since most of them are sold without an EPS (see Table 20). The obligation to include fast charging in the EPS through either USB Type-C or USB-PD might incentivise those manufacturers who still bundle the EPS to unbundle it. Given the size of the market, this effect would be negligible.
* Hand-held videogame consoles: The inclusion of this device would increase the impacts of Option 3 by a similar proportion to the size of the market, i.e. by around 9%, compared to the impacts of mobile phones only. However, consumers would save less and the costs for the industry would be higher than in the case of mobile phones. This is because, unlike with mobile phones, most videogame consoles use low power (<7.5W). This option would however increase consumer convenience due to the improved interoperability and fast charging. On balance, the negative impacts of including this device within the scope of option 3 are likely to outweigh the positive impacts.

Option 4

The unbundling options could potentially be applied to all categories of devices discussed previously – although hearing devices and e-readers already routinely come without an EPS (and so mandatory unbundling is arguably unnecessary), while for smartwatches and fitness trackers, unbundling of cables is not recommended due to the frequent (justified) use of proprietary connectors (for details see section 6.1).

The main environmental and economic effects of unbundling the different devices would mirror those for mobile phones – though the scale would obviously be adjusted to account for the size of the different markets, and the already existing unbundling rates (for EPS only). The smaller the market, and the higher the current unbundling rates, the more limited the environmental benefits as well as other impacts. This includes the effects on consumer convenience – the inconvenience would be significant e.g. for users of tablets (all of which currently come with an EPS), but much less so for portable speakers (most of which are already unbundled).

Given that unbundling of EPS already exists to some extent in all devices, no operating costs, costs of doing business, costs for public authorities, or impacts on SMEs would be experienced beyond those explained in Section 5.2 for mobile phones. Both options (4.a and 4.b) would reduce the number of chargers that are sold bundled, hence reducing the profits for manufacturers of chargers. Interestingly, increasing the scope of option 4.b would deliver small savings for consumers (+0.1% when the scope includes tablets, cameras, and earwear, vs. -2.2% when the scope includes only mobile phones).

Essentially, the impact of extending this option to other devices would mostly be noticeable in the environmental impacts (with considerable further reduction of GHG emissions, material use and e-waste beyond the reduction achieved by unbundling mobile phones). By extending the scope, costs for consumers would also increase, profits for manufacturers of chargers decrease, and profits for distributors increase.

The quantitative impacts of extending **option 4.a** to tablets, cameras and earwear are presented in Table 23 and Table 24. Extending the scope of the option to these three devices would deliver a reduction of 1,005 ktonnes of CO2 emissions between 2024 and 2030 (compared to -699 ktonnes if only mobile phones are included), a reduction of 13,752 tonnes of material use (compared to -9,096 tonnes), and a reduction of 5,817 tonnes of e-waste (compared to -3,546 tonnes) within the same period. Extending the scope to more devices would increase these figures, approximately, as follows:[[150]](#footnote-150)

* Portable speakers: no change, given reduced size of the market and low percentage of devices sold bundled with EPS.
* Hand-held videogame consoles: reduction of environmental impacts by -9%, compared to mobile phones and standalone market.
* E-readers: no change, as e-readers are already sold unbundled from EPS.
* Smartwatches and fitness trackers: reduction of environmental impacts by -2%, compared to mobile phones and standalone market.

On the other hand, the wider the scope the more consumer convenience is reduced.

Unbundling cables (**option 4.b**) would be a new development for all product categories, and as such, the impacts (both the positive environmental impacts and the negative impacts on consumers) would be significant across the entire range. The quantitative impacts of extending **option 4.b** to tablets, cameras and earwear are presented in Table 23 and Table 24. Extending the scope of the option to these three devices would deliver a reduction of 2,385 ktonnes of CO2 emissions between 2024 and 2030 (compared to -1,567 ktonnes if only mobile phones are included), a reduction of 52,664 tonnes of material use (compared to -33,568 tonnes), and a reduction of 21,770 tonnes of e-waste (compared to -13,409 tonnes) within the same period. Broadly speaking, approximately 45% of the environmental impacts correspond to unbundling the EPS, and 55% to unbundling the cable. This is because although EPS have higher environmental impact, many models are already sold unbundled.

Extending the scope to more devices would increase these figures, approximately, as follows:[[151]](#footnote-151)

* Portable speakers: reduction of environmental impacts by -1%, compared to mobile phones and standalone market.
* Hand-held videogame consoles: reduction of environmental impacts by -9%, compared to mobile phones and standalone market.
* E-readers: reduction of environmental impacts by -3%, compared to mobile phones and standalone market.
* Smartwatches and fitness trackers: reduction of environmental impacts by -3%, compared to mobile phones and standalone market.

Option 5

Finally, as noted above (see section 6.3), for this voluntary option, it seems rather obvious that, the wider its scope of application, the more effective it is likely to be. In other words, a priori there is no reason to exclude any product categories. If a tablet, camera, hearing device, etc., and/or its corresponding EPS (or even stand-alone EPS) complies with the requirements of the labelling scheme, and the manufacturer wants it to carry the label, then the scheme should not create any artificial barriers to prevent this.

As such, it also seems likely that, the more widely the scheme is used, the more consumers will notice and potentially begin to pay attention to it. Following on from this, the positive impacts on the mobile phone market could be enhanced by a widespread application to other portable electronic devices and their EPS, and vice versa.

However, as discussed previously (see section 3.2), the reaction of both manufacturers / vendors and consumers is very difficult to predict at this stage, as the exact design parameters and implementation modalities of the scheme have not been discussed among stakeholders and defined in detail. Therefore, any qualitative or quantitative estimates of its impacts are subject to a high degree of uncertainty.

Our stock model assumes that this scheme would mainly affect the standalone market of EPS and cables, and therefore the expected impacts of including more devices would not deliver significant environmental or economic impacts compared to applying the scheme to mobile phones only. It would, however, increase consumer convenience significantly.

1. Combinations of measures

As noted previously (see section 3.2), the policy options as defined for this study comprise individual “measures” that would harmonise or address certain technical aspects related to chargers, or the way in which they are marketed. These options are not necessarily mutually exclusive, but could potentially be combined into a “package” of measures. This chapter explores if and how different options could be combined, and assesses the likely main impacts of the resulting “packages”.

* 1. Compatibility between different options

The individual policy options address different elements related to charging, namely the connectors on the device (option 1), (fast) charging technology / communication protocols (options 2 and 3), unbundling (options 4.a and 4.b), and the provision of information on interoperability (option 5). A possible legislative or non-legislative initiative could obviously seek to address more than one of these elements. In broad terms, each of the options could potentially be combined with others as follows:

* **Option 1 (Harmonise connectors on mobile phones)**: The obligation for all mobile phones to have USB Type-C receptacles could be pursued alongside interoperability requirements for either phones (option 2) or EPS (option 3), which would provide a more holistic approach to harmonisation, encompassing both the device-end connectors as well as the communication protocols. This option could also be taken forward together with an obligation to give consumers the option of buying phones without chargers (option 4).
* **Option 2 (Require mobile phones to be compatible with USB charging technology)**: In addition to option 1 (see above), this option could also be pursued alongside any of the unbundling options (4.a or 4.b). However, it would be inappropriate to pursue both option 2 and option 3 at the same time, since both of these are means to the same end (interoperability of phones with EPS), and regulating for both at the same time would be unnecessary, seeing as either of these measures on their own could achieve this objective.
* **Option 3 (Require EPS for mobile phones to comply with USB interoperability guidelines)**: As noted already, this option could be combined with option 1, but not with option 2. It would also be inappropriate to pursue alongside option 4. This is because option 3 applies to EPS sold with mobile phones, so if unbundling of EPS was made mandatory, it would lose its legal bindingness and hence most of its effectiveness.
* **Option 4 (Mandatory unbundling of EPS (option 4.a) or of EPS and cables (option 4.b)):** As already outlined, either option 4.a or option 4.b could be pursued alongside options 1 or 2 individually, as well as alongside options 1 and 2 together.
* **Option 5 (Voluntary interoperability labelling / information scheme)**: Finally, the voluntary labelling scheme to raise awareness of interoperability could be implemented as a flanking measure to any of the other options. As discussed above (see section 5.4), in combination with options 2 or 3, it would also be possible to make such a scheme mandatory, i.e. use it as part of the information requirements to convey the mandatory interoperability that these options would imply.

In summary, these considerations lead to the list of possible packages of options shown in the table below.

Table 28: Possible packages of options

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Summary | PO 1 | PO 2 | PO 3 | PO 4 |
| Package 1 | Phones required to include USB Type-C connectors and be compatible with USB Type-C or USB PD charging technology | ✓ | ✓ |  |  |
| Package 2 | Phones required to include USB Type-C connectors, in-the-box EPS to comply with USB interoperability guidelines | ✓ |  | ✓ |  |
| Package 3 | Phones required to include USB Type-C connectors, plus mandatory unbundling | ✓ |  |  | ✓ |
| Package 4 | Phones required to be compatible with USB Type-C or USB PD charging technology, plus mandatory unbundling |  | ✓ |  | ✓ |
| Package 5 | Like package 1, plus mandatory unbundling | ✓ | ✓ |  | ✓ |

In the remainder of this chapter, we consider the likely impacts of these packages, in particular whether they would be equal to, greater or smaller than the cumulative impacts of the individual options, and whether there are any specific additional benefits or risks from combining options.

Please note that, for the sake of clarity and concision, and in order to keep the scope of the analysis manageable (in line with the principle of proportionate analysis), we do not explicitly address the following minor elements:

* Since option 5 could serve as a flanking measure to *any* of these combinations, it is not included in the table above, and its effects are not assessed separately. We expect that its marginal effects when combined with any of the packages would always be in line with those of the scheme individually (see chapter 5 for details).
* As regards the sub-options 4.a and 4.b, either of these could be included in packages 3, 4 or 5. The differences between them would follow closely those described under the individual options (see chapter 5). We have therefore not created separate packages for these, but focused on sub-option 4.a (unbundling of EPS). If this were replaced by sub-option 4.b (unbundling of EPS as well as cables) in any of the packages in question, the additional impacts that would be generated are in line with those described in chapter 5 (i.e. the differences between options 4.a and 4.b individually).
  1. The impacts of the packages of options – mobile phones only

For each of the five packages of measures defined above, we proceed to discussing if and how their impacts would be likely to differ from those of the options individually – in the first instance, if applied to mobile phones only (the impacts of the inclusion of other devices are assessed in section 7.3 below). In particular, we consider whether there would be synergy effects that could mean the impacts of the package would be greater than the sum of the impacts of the individual options it includes; and whether there are any additional (positive or negative) effects that would be likely to arise from combining the options. Following this, we provide estimates for the main quantifiable impacts of each package.

Package 1

This package of measures would require phones to both include USB Type-C connectors, and be compatible with USB Type-C and (for phones that charge at more than 15 W) USB PD charging technology.

The overall impacts of this package would be slightly smaller than the sum of the impacts of options 1 and 2 individually. This is because both of these options entail the replacement of all remaining USB micro-B receptacles in phones with USB Type-C receptacles (and the corresponding connectors at the device end of cables), speeding up the transition process that is already ongoing, but will not be completed under the baseline scenario by 2024 (which is when we assume the new rules would come into force). This effect is built into the modelling assumptions, and hence impacts, of both options individually, but it would of course only accrue once if the options are combined.

Therefore, both the positive and the negative environmental, economic and social impacts that correspond with the elimination of USB micro-B connectors of this package would be smaller than the sum of these impacts generated by the options individually. All other impacts of this package would be equal to the sum of the impacts of the two options. The elimination of proprietary (Lightning) connectors and receptacles on the one hand, and making the incorporation of communication protocols that are compatible with USB specifications mandatory on the other hand, are technically separate elements. We therefore see no reason to expect any significant synergy effects – or specific risks or concerns – to arise from their combination.

Package 2

Like package 1, this package would require phones to include USB Type-C connectors. But rather than impose any additional requirements on phones, it would oblige in-the-box EPS to comply with USB interoperability guidelines (IEC 63002:2021).

As regards the cumulative impacts of this package, the exact same considerations apply as for package 1 – namely, the fact that both option 1 and option 3 individually would lead to the elimination of USB micro-B connectors and receptacles, and therefore, this effect must not be counted twice when these options are combined into a package.

Beyond this, the other impacts of this package would be equal to the sum of the impacts of the two options, as there are no significant synergy effects, risks or concerns from combining the two measures.

Package 3

This package combines the harmonisation of receptacles on all phones with mandatory unbundling of EPS. The potential interactions and interdependencies between these two measures merit careful consideration.

In the survey carried out as part of this study (for detailed results see Annex C), stakeholders were asked inter alia whether “to enable unbundling, there needs to be a common connector at the device end for all mobile phones”. Around seven in ten respondents agreed with this, including six out of ten private companies. However, mobile phone manufacturers were less convinced of this relationship (only one in three agreed). The fact that Apple is now selling all of its mobile phones without an EPS (but with a cable with a proprietary connector) demonstrates that harmonisation is certainly not a *conditio sine qua non* for unbundling (at least not as regards the EPS).

On the other hand, it does appear sensible to assume that harmonised receptacles in phones (and hence connectors on cables) could enhance the success of unbundling, in the sense that they would reduce the need for additional stand-alone cables to be bought. As such, we would expect the proportion of consumers who choose to buy a cable when they buy a standalone EPS to be reduced slightly (from 62% to 56%) in this scenario, meaning the environmental benefits would be slightly higher than the sum of the two options individually.

If this package included option 4.b (unbundling of EPS and cables), then the consumer inconvenience resulting from no longer being supplied with a cable along with a new phone would also be reduced slightly, as most consumers would have a larger pool of compatible cables with harmonised connectors to draw from and re-use.

Package 4

In this package, all phones are required to be compatible with USB Type-C or USB PD charging technology, and unbundling of EPS is made mandatory. Similarly to the previous package, there would be synergy effects, and these are likely to be more pronounced since the harmonisation affects the communication protocols (and hence the interoperability with different EPS).

In the stakeholder survey, again, around one in seven respondents agreed that “to enable unbundling, there needs to be a common EPS that is interoperable with all mobile phones”. However, again, core industry stakeholders (mobile manufacturers) disagreed almost unanimously. In interviews, they tended to point to the already very high (near universal) degree of interoperability between phones and EPS from all major manufacturers, which makes such an initiative unnecessary. Those that have already unbundled the EPS from (some of) their phones typically recommend the use of their own branded chargers, but acknowledge that any EPS from a reputable manufacturer that is compliant with at least the most basic USB battery charging specifications can be used to charge their phones (albeit not necessarily at a high speed, depending on the communication protocols and power output).

Nonetheless, it seems clear that the fact that option 2 would *guarantee* the interoperability of all phones not just with any USB charging modes, but with the most modern ones (USB Type-C and USB PD), has potential synergy effects with mandatory unbundling – especially if it is communicated effectively. If consumers were reassured that whatever new phone they purchase can be charged with any USB EPS – and that it can take advantage of the main features of “modern” USB EPS (i.e. receive 7.5 W or 15 W from a USB Type-C EPS, and more than 15 W from a USB PD EPS) – it appears safe to assume that this would increase the proportion that choose to re-use an existing EPS, and therefore reduce the number of new EPS sold (compared with the rates we have assumed under option 4 alone). At the same time, one should not expect an overly dramatic effect on the demand for stand-alone EPS: there are certain to continue to be consumers who choose not to engage with the finer details of charging technology; and there will also be consumers who do understand the basics about charging, and choose to buy a new EPS because they deem the one they got with their previous phone two or more years ago is not as fast, energy-efficient, or otherwise convenient as the newer ones on offer. Therefore, we have assumed that the combination of measures in this package would reduce the proportion of consumers who choose to purchase an EPS along with an unbundled new phone by 10%, from 57% under the baseline scenario (and all the options individually) to 51%.

In summary, some of the impacts of this package would be slightly greater than the sum of those of options 2 and 4.a, due to the synergy effect from the harmonisation of communication protocols in phones, which would be expected to lead to a small reduction in demand for stand-alone chargers.

Package 5

The final package combines all the features of packages 1 and 4, as discussed previously. The same considerations to apply – namely, a minor reduction in certain impacts (compared to the sum of the impacts of the individual options) because the effects of the elimination of USB micro-B connectors under options 1 and 2 do not “stack”; and a small increase in certain other impacts due to the synergy effects between harmonised communication protocols and unbundling of EPS.

This means that Package 5 is expected to generate environmental benefits that are greater than those of option 4.a alone (since option 4.a means all consumers would have the option of buying new phones without EPS, and the proportion of those who choose to purchase an EPS anyway would be reduced by options 1 and 2). Its main economic impacts would lie in between those generated by its component parts individually (seeing as options 1 and 2 alone generate savings for consumers but costs for the industry, while the opposite is true of option 4.a). In a similar vein, the social impacts would lie in between those of the options in question individually – in particular, the negative effects on consumer convenience from unbundling (option 4.a) would be alleviated but not necessarily fully offset by the minor positive effects of options 1 and 2.

Quantified impacts of the packages of options for mobile phones

The tables below provide quantitative estimates of the main quantifiable environmental and economic impacts of each of the packages. These were calculated using the same considerations outlined in sections 4.1 and 4.2. The differences between the impacts of the packages, and the cumulative impacts of the individual options comprising each package, are due to the synergy and duplication effects outlined above (for further details see Annex G).

As can be seen (Table 29), Package 3, 4 and 5 are likely to generate significant environmental benefits, mainly due to the fact they entail mandatory unbundling of EPS, the effects of which are increased by the synergy effects mentioned previously. The most favourable combination from an environmental perspective is Package 5: combining unbundling (option 4.a) with harmonisation of both connectors (option 1) and communication protocols in mobile phones (option 2) is estimated to lead to reductions in GHG emissions, material use and e-waste that are around 50% higher than those that would result from mandatory unbundling alone.

Table 29: Environmental impacts of the packages for mobile phones

|  |  | **Baseline** | **Package 1** | **Package 2** | **Package 3** | **Package 4** | **Package 5** |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Package combining PO 1 & 2** | **Package combining PO 1 & 3** | **Package combining PO 1 & 4a** | **Package combining PO 2 & 4a** | **Package combining PO 1, 2 & 4a** |
| **GHG emissions [ktCO2e][[152]](#footnote-152)** | **Total 2024-2030** | **7,838** | **7,783** | **7,959** | **7,031** | **6,887** | **6,810** |
| Difference with baseline |  | -55 | 121 | -807 | -951 | -1,028 |
| Annual average | 1,120 | 1,112 | 1,137 | 1,004 | 984 | 973 |
| Difference with baseline |  | -8 | 17 | -115 | -136 | -147 |
| As % |  | -0.7% | 1.5% | -10.3% | -12.1% | -13.1% |
| **Material Use [tonnes][[153]](#footnote-153)** | **Total 2024-2030** | **152,806** | **151,831** | **154,508** | **141,645** | **139,452** | **137,862** |
| Difference with baseline |  | -975 | 1,702 | -11,161 | -13,354 | -14,944 |
| Annual average | 21,829 | 21,690 | 22,073 | 20,235 | 19,922 | 19,695 |
| Difference with baseline |  | -139 | 243 | -1,594 | -1,908 | -2,135 |
| As % |  | -0.6% | 1.1% | -7.3% | -8.7% | -9.8% |
| **E-waste [tonnes][[154]](#footnote-154)** | **Total 2024-2030** | **133,196** | **133,010** | **134,050** | **129,020** | **128,094** | **127,549** |
| Difference with baseline |  | -186 | 854 | -4,175 | -5,102 | -5,647 |
| Annual average | 19,028 | 19,001 | 19,150 | 18,431 | 18,299 | 18,221 |
| Difference with baseline |  | -27 | 122 | -596 | -729 | -807 |
| As % |  | -0.1% | 0.6% | -3.1% | -3.8% | -4.2% |
| **Of which Untreated [tonnes][[155]](#footnote-155)** | **Total 2024-2030** | **27,365** | **27,335** | **27,536** | **26,561** | **26,381** | **26,277** |
| Difference with baseline |  | -30 | 171 | -805 | -985 | -1,088 |
| Annual average | 3,909 | 3,905 | 3,934 | 3,794 | 3,769 | 3,754 |
| Difference with baseline |  | -4 | 24 | -115 | -141 | -155 |
| As % |  | -0.1% | 0.6% | -2.9% | -3.6% | -4.0% |
| **Of which Recycled [tonnes][[156]](#footnote-156)** | **Total 2024-2030** | **70,685** | **70,645** | **71,159** | **68,794** | **68,325** | **68,005** |
| Difference with baseline |  | -40 | 474 | -1,891 | -2,359 | -2,680 |
| Annual average | 10,098 | 10,092 | 10,166 | 9,828 | 9,761 | 9,715 |
| Difference with baseline |  | 172 | 4 | 78 | -388 | -1,778 |
| As % |  | 1.5% | 0.0% | 0.7% | -3.3% | -15.0% |

**Source:** Own TRI-STOCK-CHARGER model calculations.

As for the economic impacts (Table 30), the savings for consumers would be most significant under Packages 1 and 2 (which do not entail mandatory unbundling). In Packages 3, 4 and 5, the combination with options 1 and 2 is also estimated to offset the additional costs for consumers that would result from option 4.a in isolation, by reducing the need for consumers to purchase standalone chargers. As a result, Package 4 would be neutral as regards the cost to consumers, while Package 5 would result in minor savings for consumers, as well as additional benefits for distributors and retailers of chargers, at the expense of charger manufacturers and wholesalers, who would see their benefits significantly reduced.

Table 30. Quantitative economic impacts of the packages for mobile phones

|  | **Baseline** | **Package 1** | **Package 2** | **Package 3** | **Package 4** | **Package 5** | |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Package combining PO 1 & 2** | **Package combining PO 1 & 3** | **Package combining PO 1 & 4a** | **Package combining PO 2 & 4a** | **Package combining PO 1, 2 & 4a** | |
| **Cost to consumers (NPV million EUR)** | | | | | | |
| Total 2024-2030 | **45,982** | **40,944** | **41,049** | **42,674** | **45,966** | **44,505** | |
| Difference with baseline |  | -5,038 | -4,933 | -3,309 | -16 | -1,478 | |
| Annual average | 6,569 | 5,849 | 5,864 | 6,096 | 6,567 | 6,358 | |
| Difference with baseline |  | -720 | -705 | -473 | -2 | -211 | |
| As % |  | -11.0% | -10.7% | -7.2% | 0.0% | -3.2% | |
| **Competitiveness of businesses** | | | | | | |
| **Benefit for manufacturers of chargers and wholesalers (NPV million EUR)** | | | | | | |
| Total 2024-2030 | **11,903** | **10,693** | **10,752** | **9,850** | **10,725** | **10,216** | |
| Difference with baseline |  | -1,210 | -1,150 | -2,053 | -1,178 | -1,686 | |
| Annual average | 1,700 | 1,528 | 1,536 | 1,407 | 1,532 | 1,459 | |
| Difference with baseline |  | -173 | -164 | -293 | -168 | -241 | |
| As % |  | -10.2% | -9.7% | -17.2% | -9.9% | -14.2% | |
| ***Of which benefit for EU manufacturers (NPV million EUR)*** | | | | | | |
| Total 2024-2030 | **1,519** | **1,342** | **1,342** | **1,536** | **1,642** | **1,608** | |
| Difference with baseline |  | -176 | -176 | 17 | 123 | 89 | |
| Annual average | 217 | 192 | 192 | 219 | 235 | 230 | |
| Difference with baseline |  | -25 | -25 | 2 | 18 | 13 | |
| As % |  | -11.6% | -11.6% | 1.1% | 8.1% | 5.9% | |
| **Benefit for distributors and retailers until point of sale [NPV million EUR]** | | | | | | |
| Total 2024-2030 | **22,177** | **19,559** | **19,544** | **22,974** | **24,516** | **24,072** | |
| Difference with baseline |  | -2,618 | -2,633 | 796 | 2,339 | 1,895 | |
| Annual average | 3,168 | 2,794 | 2,792 | 3,282 | 3,502 | 3,439 | |
| Difference with baseline |  | -374 | -376 | 114 | 334 | 271 | |
| As % |  | -11.8% | -11.9% | 3.6% | 10.5% | 8.5% | |
|  |  |  |  |  |  |  | |

**Source:** Own TRI-STOCK-CHARGER model calculations.

* 1. The impacts of the packages of options – mobile phones and other portable electronic devices

This section considers the likely impacts of the packages if applied with a wider scope, including not just mobile phones but also certain other portable electronic devices. The assessment builds on the elements described in chapter 6, in particular the groups of devices listed therein, and the explanation of why not all options are equally relevant for / applicable to all groups of devices (see section 6.1). The same considerations also apply to the packages of options – it is clear that some are not or only partly relevant for certain devices, given that they include component parts (i.e. individual options) that we have concluded would be unnecessary, or even not advisable, for certain devices. For example:

* If any of the packages that include unbundling of EPS (i.e. Packages 3, 4 or 5) are applied to hearing devices, the impacts on this particular market would be close to zero, since they are already routinely sold without an EPS.
* All of the packages include at least one of options 1, 2 or 3. For the reasons described in section 6.1, these options would be disproportionate or even counterproductive in the case of both e-readers, and smartwatches and fitness trackers.

The only group of devices for which all options – and therefore also all packages – are applicable without reservations is tablets. For two others (e-readers, and smartwatches and fitness trackers), it does not appear advisable to apply any of the packages to these types of devices (given the issue outlined above). For the other four groups of devices (digital cameras, hearing devices, hand-held video game consoles, and portable speakers), all packages could be applied, but it should be noted that certain components (i.e. options) may appear unnecessary (mainly unbundling, for devices where this is already the norm) or could be seen as disproportionate (mainly for devices that charge at very low wattage, including most digital cameras and hearing devices, as option 2 would effectively ‘bump up’ all devices to charge at a minimum of 7.5 W, which would increase their cost but not necessarily generate any clear benefits).

With these provisos, the main environmental, economic and social impacts of each package would essentially be equal to the sum of the impacts of its component parts. The only exception from this is that, as already outlined in section 7.2 above, options 1, 2 and 3 all entail the replacement of USB micro-B receptacles with USB Type-C receptacles; where any two of these options are combined (i.e. in Packages 1 and 2), the impacts of this would of course only accrue once (meaning that the cumulative impacts – both positive and negative – are slightly lower than the sum of those of the options individually).

It should be noted that, in this case, no additional synergy effects are expected (beyond those already discussed under mobile phones above. This is because, as described previously (section 7.2), any such synergy effects affect the *standalone* charger market (rather than that for chargers that are bundled with devices). The standalone market has been modelled as part of the charger stock for mobile phones, and hence any such synergy effects are already included in the results presented in section 7.2.

Quantified impacts of the packages of options for mobile phones and other portable electronic devices

The tables overleaf present the quantitative results of applying the packages of options to those devices that we were able to include in the stock model: mobile phones, tablets, hearing devices and digital cameras. For the reasons already outlined previously (see section 6.2), the bulk of the additional quantifiable impacts from including these devices is due to tablets, which currently account for far more EPS than either digital cameras (which is a very small market) or hearing devices (which represent a sizable market, but do not include EPS to begin with).

Table 31: Environmental impacts of the packages for mobile phones and other portable devices

|  |  | **Baseline** | **Package 1** | **Package 2** | **Package 3** | **Package 4** | **Package 5** |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Package combining PO 1 & 2** | **Package combining PO 1 & 3** | **Package combining PO 1 & 4a** | **Package combining PO 2 & 4a** | **Package combining PO 1, 2 & 4a** |
| **GHG emissions [ktCO2e][[157]](#footnote-157)** | **Total 2024-2030** | **9,052** | **9,046** | **9,227** | **7,991** | **7,799** | **7,767** |
| Difference with baseline |  | -6 | 175 | -1,062 | -1,253 | -1,286 |
| Annual average | 1,293 | 1,292 | 1,318 | 1,142 | 1,114 | 1,110 |
| Difference with baseline |  | -1 | 25 | -152 | -179 | -184 |
| As % |  | -0.1% | 1.9% | -11.7% | -13.8% | -14.2% |
| **Material Use [tonnes][[158]](#footnote-158)** | **Total 2024-2030** | **179,371** | **179,754** | **182,496** | **164,959** | **161,409** | **161,130** |
| Difference with baseline |  | 383 | 3,125 | -14,412 | -17,962 | -18,242 |
| Annual average | 25,624 | 25,679 | 26,071 | 23,566 | 23,058 | 23,019 |
| Difference with baseline |  | 55 | 446 | -2,059 | -2,566 | -2,606 |
| As % |  | 0.2% | 1.7% | -8.0% | -10.0% | -10.2% |
| **E-waste [tonnes][[159]](#footnote-159)** | **Total 2024-2030** | **155,463** | **156,146** | **157,223** | **149,868** | **148,127** | **148,604** |
| Difference with baseline |  | 683 | 1,761 | -5,595 | -7,336 | -6,859 |
| Annual average | 22,209 | 22,307 | 22,460 | 21,410 | 21,161 | 21,229 |
| Difference with baseline |  | 98 | 252 | -799 | -1,048 | -980 |
| As % |  | 0.4% | 1.1% | -3.6% | -4.7% | -4.4% |
| **Of which Untreated [tonnes][[160]](#footnote-160)** | **Total 2024-2030** | **31,914** | **32,056** | **32,265** | **30,834** | **30,493** | **30,594** |
| Difference with baseline |  | 143 | 352 | -1,080 | -1,421 | -1,320 |
| Annual average | 4,559 | 4,579 | 4,609 | 4,405 | 4,356 | 4,371 |
| Difference with baseline |  | 20 | 50 | -154 | -203 | -189 |
| As % |  | 0.4% | 1.1% | -3.4% | -4.5% | -4.1% |
| **Of which Recycled [tonnes][[161]](#footnote-161)** | **Total 2024-2030** | **82,899** | **83,418** | **83,951** | **80,440** | **79,437** | **79,750** |
| Difference with baseline |  | 519 | 1,052 | -2,459 | -3,462 | -3,149 |
| Annual average | 11,843 | 11,917 | 11,993 | 11,491 | 11,348 | 11,393 |
| Difference with baseline |  | 74 | 150 | -351 | -495 | -450 |
| As % |  | 0.6% | 1.3% | -3.0% | -4.2% | -3.8% |

**Source:** Own TRI-STOCK-CHARGER model calculations.

Table 32. Quantified economic impacts of the packages for mobile phones and other devices

|  | **Baseline** | **Package 1** | **Package 2** | **Package 3** | **Package 4** | **Package 5** | |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Package combining PO 1 & 2** | **Package combining PO 1 & 3** | **Package combining PO 1 & 4a** | **Package combining PO 2 & 4a** | **Package combining PO 1, 2 & 4a** | |
| **Cost to consumers (NPV million EUR)** | | | | | | |
| Total 2024-2030 | **49,960** | **44,421** | **44,538** | **46,413** | **50,202** | **48,236** | |
| Difference with baseline |  | -5,540 | -5,422 | -3,547 | 242 | -1,724 | |
| Annual average | 7,137 | 6,346 | 6,363 | 6,630 | 7,172 | 6,891 | |
| Difference with baseline |  | -791 | -775 | -507 | 35 | -246 | |
| As % |  | -11.1% | -10.9% | -7.1% | 0.5% | -3.5% | |
| **Competitiveness of businesses** | | | | | | |
| **Benefit for manufacturers of chargers and wholesalers (NPV million EUR)** | | | | | | |
| Total 2024-2030 | **14,176** | **12,679** | **12,746** | **11,348** | **12,507** | **11,713** | |
| Difference with baseline |  | -1,497 | -1,430 | -2,828 | -1,669 | -2,463 | |
| Annual average | 2,025 | 1,811 | 1,821 | 1,621 | 1,787 | 1,673 | |
| Difference with baseline |  | -214 | -204 | -404 | -238 | -352 | |
| As % |  | -10.6% | -10.1% | -19.9% | -11.8% | -17.4% | |
| ***Of which benefit for EU manufacturers (NPV million EUR)*** | | | | | | |
| Total 2024-2030 | **1,519** | **1,342** | **1,342** | **1,603** | **1,710** | **1,675** | |
| Difference with baseline |  | -176 | -176 | 85 | 191 | 156 | |
| Annual average | 217 | 192 | 192 | 229 | 244 | 239 | |
| Difference with baseline |  | -25 | -25 | 12 | 27 | 22 | |
| As % |  | -11.6% | -11.6% | 5.6% | 12.6% | 10.3% | |
| **Benefit for distributors and retailers until point of sale [NPV million EUR]** | | | | | | |
| Total 2024-2030 | **21,609** | **19,062** | **19,046** | **23,717** | **25,189** | **24,811** | |
| Difference with baseline |  | -2,546 | -2,563 | 2,108 | 3,580 | 3,202 | |
| Annual average | 3,087 | 2,723 | 2,721 | 3,388 | 3,598 | 3,544 | |
| Difference with baseline |  | -364 | -366 | 301 | 511 | 457 | |
| As % |  | -11.8% | -11.9% | 9.8% | 16.6% | 14.8% | |
|  |  |  |  |  |  |  | |

**Source:** Own TRI-STOCK-CHARGER model calculations.

1. Comparison of options

This chapter provides a summary of the various impacts of the options and packages, as analysed previously. For the environmental and some economic impacts, we are able to provide quantitative estimates based on the stock model. The types of impacts for which this is not possible are assessed in qualitative terms. To facilitate comparison, we have used a multi-criteria analysis (MCA) approach, and converted all effects into a common “currency” (from a “major positive” to a “major negative” impact). These are shown in the summary table below, which shows the impacts of the individual policy options, applied to mobile phones only, relative to the baseline. For the detailed assessments, quantitative estimates, considerations and assumption underlying these, please refer to chapters 4 and 5.

Table 33: Summary of the main impacts of the policy options

| **Impacts** | | **Option 1** | **Option 2** | **Option 3** | **Option 4.a** | **Option 4.b** | **Option 5** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Harmonise connectors on mobile phones | Require phones to be compatible with USB technology | Require EPS for phones to comply with USB interop. guidelines | Mandatory unbundling of EPS | Mandatory unbundling of EPS and Cable | Interopera-bility labelling / information scheme |
| **Environ-mental** | GHG emissions | 0/- | 0/+ | 0/- | +/++ | ++ | 0/+ |
| Material use | 0/- | 0/+ | 0/- | +/++ | ++ | 0/+ |
| Electronic waste | 0/- | 0/+ | 0/- | + | +/++ | 0/+ |
| **Economic** | Cost to consumers | +/++ | + | + | - | - | 0/- |
| Gross profit of manufacturers of chargers | -/-- | 0/- | 0/- | - | -- | 0/- |
| Gross profit of distributors and retailers | -/-- | - | - | ++ | ++ | 0/- |
| Innovation | - | 0 | -/-- | 0 | 0 | 0 |
| Other impacts on competitiveness | - | 0 | 0/- | 0 | 0 | 0 |
| Operating costs and conduct of business | - | 0/- | - | 0/- | 0/- | 0/- |
| Costs to public authorities (EU) | 0 | 0 | 0 | 0 | 0 | -/-- |
| Impacts on SMEs (EU) | 0/- | 0/- | 0 | 0 | 0 | 0 |
| **Social** | Consumer convenience | + | + | + | -/-- | -- | + |
| Product safety & illicit markets | 0/+ | 0/+ | 0/+ | -/-- | -- | 0/+ |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. *++ Major positive impact* | 1. *+ Minor positive impact* | 1. *0 No or negligible impact* | 1. *- Minor negative impact* | 1. *-- Major negative impact* |

To briefly explain the main impacts shown in the table:

* **Environmental impacts:** As can be seen, options 1, 2, 3 and 5 only have very minor, potentially negligible (no more than 1.5% change compared with the baseline) impacts on the environment, as they are expected to lead to very small changes in the *number* of chargers sold, as well as, in some cases, to changes in the *types* of chargers sold (with very minor impacts on their weight and composition). From an environmental perspective, unbundling is the only intervention that offers major benefits. However, compared with the estimates in the first IA study, these benefits are smaller than anticipated (between 3 and 9% reduction in environmental impacts for option 4.a, and between 10 and 20% for option 4.b, compared to the baseline) due to the fact that a part of the market has begun to sell phones without EPS voluntarily.
* **Economic impacts**: From an economic perspective, the option that generates the most savings for consumers is option 1, due to the savings from switching from (more expensive) Lightning cables to USB Type-C cables, and the reduction in standalone sales of cables (Lightning cables are replaced more frequently than standard cables, according to the results of the consumer survey). This option delivers relatively high economic costs for manufacturers and distributors, and may slightly constrain innovation.[[162]](#footnote-162) It may also entail minor economic costs for SMEs in the EU. Options 2 and 3 are relatively similar in terms of reducing costs for consumers, and generate similar costs for the industry. However, option 2 affects the competitive landscape less and does not constrain innovation. Options 4.a and 4.b deliver similar results, including small cost increases for consumers. Both options, but especially option 4.b, generate a loss of gross profit for manufacturers of chargers, given the reduced number of EPS and cables that would be sold in the EU.
* **Social impacts**: Options 1, 2, 3 and 5 are all expected to result in minor convenience benefits for consumers (each of them addresses the different sources of inconvenience to varying extents), as well as very small improvements in terms of product safety and illicit markets (mainly due to the expected very small reduction in stand-alone charger sales). For the mandatory unbundling options, the conclusion is the opposite: these would reduce consumer convenience overall (especially option 4.b), since the convenience gains for consumers who are keen to have fewer chargers are outweighed by the inconvenience for the majority of consumers for whom the provision of a charger along with new phones is important. They would also lead to higher stand-alone charger sales, some of which are likely to be counterfeit and/or substandard.

Combinations / packages of options

The policy options as defined for this study are not necessarily mutually exclusive, but could potentially be combined into a “package” of measures. As analysed in chapter 7, there are five main combinations: option 1 can be combined with either option 2 or 3, as well as with option 4; option 2 could also be combined with option 4.

By and large, when combined, the impacts of the different options would “stack”, meaning the cumulative impacts of the packages of options can be expected to be equal to the sum of the impacts of the options individually. However, there are some exceptions to this, namely:

* Options 1, 2 and 3 would all lead to the elimination of USB micro-B connectors from all mobile phones (among other effects). When combined, the specific effects of this would obviously only accrue once, meaning the (positive as well as negative) impacts of the package would be slightly smaller than the sum of the impacts of the relevant options individually.
* If any of the “harmonisation” options 1, 2 or 3 is combined with mandatory unbundling (option 4.a or 4.b), there would likely be synergy effects that enhance the overall benefits of the relevant package to slightly beyond those of the options individually, as the enhanced interoperability and/or consumer awareness of this lead to a small reduction in demand for stand-alone chargers, because slightly fewer consumers would be likely to choose to purchase an EPS along with a new unbundled phone (options 2 and 3), and/or a new cable along with an EPS bought separately (option 1).

Option 5 (an interoperability labelling / information scheme) could serve as a flanking measure to *any* of the options or packages. We expect that its marginal effects when combined with any of these would always be in line with those of the scheme individually.

The table below provides a summary of the main impacts of the five packages, applied to mobile phones only, again using an MCA approach to combine impacts that have been estimated quantitatively and others that have been assessed qualitatively:

* **Environmental impacts**: Packages 3, 4 and 5 provide significant environmental benefits. These would be highest for package 5. Although they are in the same broad range as those of the other two (‘+/++’ for GHG emissions and material use, ‘+’ for e-waste), the estimated reductions (see chapter 7) are around 10% higher than for package 4, 30% higher than for package 3, and 50% higher than those that would result from mandatory unbundling (option 4.a) alone.
* **Economic impacts**: All packages except package 4 would lead to savings for consumers; these would be most significant under packages 1 and 2 (which do not entail mandatory unbundling). All packages (especially package 3) would reduce the benefits for charger manufacturers and wholesalers; packages 1 and 2 would also lead to reduced benefits for charger distributors and retailers, while packages 3, 4 and 5 would increase their benefits (due to the higher standalone charger sales). Package 4 is the one that generates the smallest negative impacts on the competitive landscape, innovation, and operating costs for the industry, whereas package 2 is the most disruptive, with significant impacts on innovation and operating costs. All the packages may generate small costs for SMEs in Europe as they all imply the move from USB micro-B connectors to USB Type-C.
* **Social impacts**: While packages 1 and 2 would have a minor positive effect on consumer convenience and lead to very small improvements in terms of product safety and illicit markets (for the same reasons as options 1, 2 and 3 individually), packages 3, 4 and (to a slightly lesser extent) 5 would have minor negative impacts. This is because the improvements from options 1 and/or 2 and would be likely to alleviate, but not entirely offset the consumer inconvenience and increased demand for standalone EPS generated by mandatory unbundling.

Table 27: Summary of the main impacts of the packages of options

| **Impacts** | | **Package 1** | **Package 2** | **Package 3** | **Package 4** | **Package 5** |
| --- | --- | --- | --- | --- | --- | --- |
| Package combining PO 1 & 2 | Package combining PO 1 & 3 | Package combining PO 1 & 4a | Package combining PO 2 & 4a | Package combining PO 1, 2 & 4a |
| **Environ-mental** | GHG emissions | 0/+ | 0/- | +/++ | +/++ | +/++ |
| Material use | 0/+ | 0/- | +/++ | +/++ | +/++ |
| Electronic waste | 0 | 0/- | + | + | + |
| **Economic** | Cost to consumers | +/++ | +/++ | +/++ | 0 | + |
| Gross profit of manufacturers of chargers | -/-- | -/-- | -- | -/-- | -/-- |
| Gross profit of distributors and retailers | -/-- | -/-- | + | +/++ | +/++ |
| Innovation | 0/- | -- | 0/- | 0 | 0/- |
| Other impacts on competitiveness | - | -/-- | - | 0 | - |
| Operating costs and conduct of business | - | -/-- | - | - | -/-- |
| Costs to public authorities (EU) | 0 | 0 | 0 | 0 | 0 |
| Impacts on SMEs (EU) | 0/- | 0/- | 0/- | 0/- | 0/- |
| **Social** | Consumer convenience | + | + | - | - | 0/- |
| Product safety & illicit markets | 0/+ | 0/+ | - | - | 0/- |

Other portable electronic devices

As discussed in chapter 6 of this report, all of the options could potentially also affect certain types of other portable electronic devices beyond mobile phones (in particular tablets, headphones and earbuds, hand-held video game consoles, portable speakers, e-readers, smartwatches and fitness trackers):

* **Indirectly**, due to voluntary changes in manufacturer / vendor behaviour, shifts in consumer demand, or other relevant mechanisms that would “spill over” from mobile phones to the chargers of other devices (even though these would not be obliged to comply with the same rules or regulations).
* **Directly**, if the scope of the initiative was broadened to also apply to certain other devices. Not all options (and hence packages) are equally well suited to all categories of devices considered in this study. In particular:
  + Making USB Type-C connectors mandatory (option 1) would not be appropriate for smartwatches and fitness trackers due to their specific form and uses.
  + Harmonising communication protocols (options 2 and 3) would be problematic for devices that routinely charge at low wattages (including earwear and e-readers), or for devices with removable batteries (mainly digital cameras), as there would be insufficient benefits to justify the costs.
  + Making unbundling of EPS mandatory (option 4.a) for devices where this is already the norm (in particular earwear) would be possible, but would not result in any positive or negative impacts.
  + Out of the seven groups of portable electronic devices that were considered as part of this study, the three for which all options appear applicable without giving rise to any significant concerns (other than the negative impacts that also apply to mobile phones) are tablets, hand-held video game consoles, and portable speakers. Hearing devices and digital cameras could also be included in the future, if the market evolves towards fast charging solutions.

Overall, these indirect as well as potential direct effects would amplify the positive as well as negative impacts of the initiative as outlined above. The key drivers of impact are very similar to those that apply to mobile phones and their chargers, albeit with certain nuances for specific options and device categories. As regards the scale of these additional impacts, this would be smaller than for mobile phones, based mainly on the simple fact that far fewer such devices are sold and used in the EU than mobile phones (for details see chapter 6).

Concluding remarks

Based on the analysis presented in this report, the only option for which the balance of benefits vs costs is relatively unambiguously positive is **option 2**. It provides modest benefits for consumers, as well as some very minor environmental benefits, with only very small cost implications for economic operators. Although, as discussed in detail previously, this option would only require phone manufacturers to make relatively small changes to their products (many of which are already fully compliant), and would not significantly enhance interoperability as such, it would nonetheless represent a step forward in terms of cementing the already existing, near universal interoperability of phones and chargers, as well as raising consumer awareness of this fact (if accompanied by effective flanking information requirements).

**Option 3** pursues a similar objective as option 2, but would be less effective overall, given that it would place more restrictions on proprietary fast charging solutions, and that it becomes less effective the more unbundling takes place (since it could only apply to “in the box” EPS). Nonetheless, the imminent publication of IEC 63002:2021 means this option is potentially worth exploring further in a broader context, as the basis for a possible future “universal EPS” initiative.

Regarding **option 1**, it is important to reiterate that, while option 2 would also imply the mandatory adoption of USB Type-C connectors at either the device or the EPS end (or both), option 1 would go beyond this by requiring USB Type-C connectors at the device end, and banning proprietary connectors entirely.[[163]](#footnote-163) As already described in the first IA study, this would generate both positive and negative impacts: it would imply minor benefits for consumers, but at a non-negligible cost for manufacturers, including a possible constraining effect on future innovation. When considering the option in isolation (i.e. not in a package), it also delivers negative environmental impacts. However, when combined with unbundling, we expect there to be small synergy effects that would improve the environmental performance (see below).

As regards the **unbundling options**, these imply very clear and obvious trade-offs – most importantly, significant environmental benefits vs a significant financial cost and loss of convenience for consumers. Whether the benefits outweigh and justify the costs is a political decision. Nonetheless, it is perhaps worth asking whether now is the ideal time to make unbundling mandatory, when significant parts of the market are already moving in this direction voluntarily, to some extent risking negative reactions from their customers. In the view of the study team, it could be argued that it might be more politically and practically expedient for the EU to observe the markets further, and consider regulating in due course, if unbundling does not progress as hoped, rather than step in now, and risk becoming the target of negative sentiment among consumers that would otherwise be directed at manufacturers.

As regards **option 5** (the voluntary interoperability labelling scheme), this would have the potential to bring non-negligible benefits, either on its own or in combination with any of the other options. It therefore seems worth pursuing further, i.e. launching consultations with relevant stakeholders to further explore if and how such a scheme could be designed, launched, managed and monitored, and potentially carrying out market research to test its likely acceptance by consumers, and what design features could help maximise its effectiveness.

When considering the packages of options, **package 5** would provide the best environmental results of all options and packages (except option 4.b), due to the expected synergy effects resulting in lower demand for standalone EPS as well as cables. It would result in minor savings for consumers, as well as additional benefits for distributors and retailers of chargers, at the expense of charger manufacturers and wholesalers, who would see their gross profits significantly reduced. Mobile phone manufacturers would face increased operating costs, in particular those that have invested in proprietary connectors as well as manufacturers of lower tier phones, and would have to re-design their products, packaging and/or business models (though this cost would be reduced if, as envisaged here, the new rules only apply to new models launched on the market after a given date, providing for an adequate transition period). Consumers would still be likely to be inconvenienced by this package, but the harmonisation elements it includes would alleviate the negative impact of unbundling to some extent.

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[Catalogue number]

1. Ipsos, Trinomics, Fraunhofer and Economisti Associati (on behalf of the European Commission): Impact Assessment Study on Common Chargers of Portable Devices, December 2019. URL: <https://op.europa.eu/en/publication-detail/-/publication/c6fadfea-4641-11ea-b81b-01aa75ed71a1/language-en/format-PDF/source-172887101> [↑](#footnote-ref-1)
2. It should be noted that exploratory work on a genuinely “universal” EPS is currently ongoing within the context of the Ecodesign and Energy Labelling Working Plan 2020-2024; it would not be appropriate to duplicate or anticipate the results of this here. [↑](#footnote-ref-2)
3. As discussed in greater detail in chapter 5.2 of this report, as well as in the first IA study (see footnote 1), this is because option 1 would rule out the adoption of any new “game-changing” connector technology, thereby reducing the incentives for firms to invest in research and development to seek to gain a competitive advantage, which in turn also risks reducing the pace of “incremental” innovation as regards future generations of “common” (USB) connectors. [↑](#footnote-ref-3)
4. In other words, under option 2, Apple’s current practice of providing cables with a USB Type-C connector on one end and a Lightning connector at the other could continue, whereas under option 1, all manufacturers would be obliged to switch to USB Type-C receptacles in their phones and matching cables. [↑](#footnote-ref-4)
5. For more information on the Commission’s campaign, as well as the text of the 2009 MoU, see: <https://ec.europa.eu/growth/sectors/electrical-engineering/red-directive/common-charger_en> [↑](#footnote-ref-5)
6. The MoU was originally signed by 10 companies, and four other companies signed it later. Original signatories: Motorola, LGE, Samsung, RIM, Nokia, Sony Ericsson, NEC, Apple, Qualcomm and Texas Instruments. Subsequent signatories: Emblaze Mobile, Huawei Technologies, TCT Mobile and Atmel. [↑](#footnote-ref-6)
7. RPA (2014): Study on the Impact of the MoU on Harmonisation of Chargers for Mobile Telephones and to Assess Possible Future Options [↑](#footnote-ref-7)
8. Memorandum of Understanding on the future common charging solution for smartphones, 20 March 2018, available at URL: <https://www.digitaleurope.org/resources/memorandum-of-understanding-on-the-future-common-charging-solution-for-smartphones/> [↑](#footnote-ref-8)
9. Letter to Commissioner Elżbieta Bieńkowska RE: Common charger for mobile radio equipment. Brussels, 5 October 2018. Ref. Ares(2018)5123708 [↑](#footnote-ref-9)
10. Ipsos, Trinomics, Fraunhofer and Economisti Associati (on behalf of the European Commission): Impact Assessment Study on Common Chargers of Portable Devices, December 2019. URL: <https://op.europa.eu/en/publication-detail/-/publication/c6fadfea-4641-11ea-b81b-01aa75ed71a1/language-en/format-PDF/source-172887101> [↑](#footnote-ref-10)
11. European Parliament resolution of 30 January 2020 on a common charger for mobile radio equipment ([2019/2983(RSP)](https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?lang=en&reference=2019/2983(RSP))) [↑](#footnote-ref-11)
12. Adjusted Commission Work Programme 2020. COM(2020) 440 final [↑](#footnote-ref-12)
13. https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how/better-regulation-guidelines-and-toolbox\_en [↑](#footnote-ref-13)
14. More information on types of connectors can be found in Annex B, pages 17-18 [↑](#footnote-ref-14)
15. More information on the interoperability of EPS and different types of battery charging protocols can be found in Annex B, pages 5-16 [↑](#footnote-ref-15)
16. Source: Consumer survey [↑](#footnote-ref-16)
17. Impact assessment study on common chargers of portable devices, pages 6-8, available at: <https://op.europa.eu/en/publication-detail/-/publication/c6fadfea-4641-11ea-b81b-01aa75ed71a1>, last accessed 23 March 2021. [↑](#footnote-ref-17)
18. Directive 2014/53/EU (Radio Equipment Directive) [↑](#footnote-ref-18)
19. Impact assessment study on common chargers of portable devices, page 7, available at: <https://op.europa.eu/en/publication-detail/-/publication/c6fadfea-4641-11ea-b81b-01aa75ed71a1>, last accessed 23 March 2021. [↑](#footnote-ref-19)
20. Impact assessment study on common chargers of portable devices, page 6, available at: <https://op.europa.eu/en/publication-detail/-/publication/c6fadfea-4641-11ea-b81b-01aa75ed71a1>, last accessed 23 March 2021. [↑](#footnote-ref-20)
21. This assessment is based on information provided by interviewees and the study team’s own judgement. [↑](#footnote-ref-21)
22. The USB-IF is a non-profit industry group. It defines itself as “the support organization and forum for the advancement and adoption of USB technology as defined in the USB specifications”. [↑](#footnote-ref-22)
23. IEC 62680-1-1 was first published in 2015; IEC 62680-1-2 and IEC 62680-1-3 were first published in 2016. [↑](#footnote-ref-23)
24. It has been reported that Huawei SuperCharge achieves up to 96% of energy efficiency during the charge, whereas USB PD reaches up to 80% of energy efficiency. [↑](#footnote-ref-24)
25. Source: <https://www.androidauthority.com/fastest-charging-phones-1013806/> [↑](#footnote-ref-25)
26. Sources: <https://www.phonearena.com/news/Phones-fast-charging-speeds-comparison_id125026>; <https://www.phonearena.com/news/apple-iphone-12-pro-magsafe-vs-20w-vs-18w-vs-5w-charging-speeds_id128110>; https://www.gsmarena.com/apple\_iphone\_se\_2020-review-2108p3.php [↑](#footnote-ref-26)
27. https://www.phonearena.com/news/Phones-fast-charging-speeds-comparison\_id125026 [↑](#footnote-ref-27)
28. Charging times depend on multiple factors (e.g. battery capacity, EPS and cable used, room temperature…). This data should be interpreted with caution. [↑](#footnote-ref-28)
29. Only one small manufacturer (Fairphone) offered consumers the option of buying phones without chargers [↑](#footnote-ref-29)
30. Apple (2020), Apple introduces iPhone 12 Pro and iPhone 12 Pro Max with 5G, available at: <https://www.apple.com/newsroom/2020/10/apple-introduces-iphone-12-pro-and-iphone-12-pro-max-with-5g/>, last accessed 23 March 2021. [↑](#footnote-ref-30)
31. Samsung (2021), Why isn’t Samsung including earphones and a charger plug in the box?, available at: <https://www.samsung.com/uk/support/mobile-devices/why-does-samsung-not-include-a-charger-in-the-box/>, last accessed 23 March 2021. [↑](#footnote-ref-31)
32. Nokia (2021) Keeping our phones in your hands longer, available at: <https://www.nokia.com/phones/en_gb/promise>, last accessed 14 April 2021. [↑](#footnote-ref-32)
33. Nokia (2021) Press Release: New Nokia X-series brings extended warranty, security and software updates to Europe, 6 April 2021. In it, HMD announced that: “The wall charger and headphones have been removed from the sales box, helping to tackle the 12,000 tonnes of e-waste generated by mobile phone chargers in the EU. If needed, wall chargers can be purchased from [Nokia.com](https://urldefense.com/v3/__https:/www.nokia.com/phones/nokia-fast-wall-charger-18w__;!!Gajz09w!U0mxaIyvHqOjDKxeJvjLigAHbCpLAV5WRvrLPwClL2lE1Xr7Lsc-ZbR6Jl_tCYPz$). The money raised will be donated to [CLEAR RIVERS](https://www.clearrivers.eu/), a charity that works to clear plastic waste out of International waterways.” [↑](#footnote-ref-33)
34. For more information on the mapping of devices conducted, see Annex H. [↑](#footnote-ref-34)
35. Source: <https://www.procon.sp.gov.br/procon-sp-multa-apple/> [↑](#footnote-ref-35)
36. RPA (2014), Study on the impact of the MoU on harmonisation of chargers for mobile telephones and to assess possible future options, available at: <https://op.europa.eu/en/publication-detail/-/publication/4b3e4ea8-4f44-4687-96e4-cd3264407c5b>, last accessed 14 April 2021. [↑](#footnote-ref-36)
37. *Ibid*., page 51. [↑](#footnote-ref-37)
38. European Commission (2020), Commission Staff Working Document Counterfeit and Piracy Watch List SWD(2020) 360 final, page 35, available at: <https://trade.ec.europa.eu/doclib/docs/2020/december/tradoc_159183.pdf>, last accessed 14 April 2021. [↑](#footnote-ref-38)
39. RAPEX is the EU rapid alert system for dangerous non-food products. The analysis included alerts for products with serious risks or other risks. The dataset was searched based on the keywords “USB charger” (the terms under which the relevant alerts are commonly logged by Member States’ authorities) from 1 January 2014 to 31 March 2021. The sample was further refined by retaining only alerts that referred to standalone chargers (EPS and/or cable) or to the USB charging assembly of electronic devices. Alerts submitted by the United Kingdom until 31 January 2021 are included in the sample. Power banks and non-USB chargers are not included in the sample. The data is not statistically significant as it is affected by selection bias (e.g. reporting may differ across Member States). [↑](#footnote-ref-39)
40. European Commission (2020), Commission Staff Working Document Counterfeit and Piracy Watch List SWD(2020) 360 final, page 35, available at: <https://trade.ec.europa.eu/doclib/docs/2020/december/tradoc_159183.pdf>, last accessed 14 April 2021. [↑](#footnote-ref-40)
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42. Electrical Safety First, Counterfeit and imitation Apple chargers 98% Safety Test Failure Rate, available at: <https://www.electricalsafetyfirst.org.uk/media/1119/counterfeit-and-imitation-apple-chargers.pdf>, last accessed 14 April 2021. [↑](#footnote-ref-42)
43. Only five case was found where the product did not have the risk of electric shock or causing a fire. The risk associated with these five products was environmental, due to the presence of lead (five cases), cadmium (two cases) and chlorinated paraffins (one case) in excess of the regulatory limits. [↑](#footnote-ref-43)
44. Source: Preview of standard IEC 63002 provided by IEC to Ipsos for internal use only. [↑](#footnote-ref-44)
45. Lightning connectors are compatible with this standard. [↑](#footnote-ref-45)
46. Estimation based on market data provided by IDC, triangulated with the mapping of mobile phones conducted by the study team [↑](#footnote-ref-46)
47. It should be noted that some Apple and Samsung phones are USB PD enabled, but were sold along with a standard EPS in 2019. This is why the share of phones that are USB PD enabled is higher than the share of USB PD EPS sold along with phones. [↑](#footnote-ref-47)
48. There are some exceptions. For instance, Google Pixel 4 cannot be charged with Huawei cables, according to tests conducted by Android Authority, Source: <https://infogram.com/2020-usb-fast-charging-tests-1h8n6mdkqjxm6xo> [↑](#footnote-ref-48)
49. To use USB PD, the cable must be USB Type C compliant and support up to 3A or 5A. [↑](#footnote-ref-49)
50. Projection made by the study team based on market data provided by IDC and interviews with mobile phone manufacturers. [↑](#footnote-ref-50)
51. For more information on the ‘rebound effect’ of standalone sales of EPS in the baseline, see Annex G. [↑](#footnote-ref-51)
52. Estimation made by the study team based on market data provided by IDC. [↑](#footnote-ref-52)
53. Google Pixel phones cannot be charged with Huawei cables, according to the tests conducted by Android Authority. [↑](#footnote-ref-53)
54. The problem was experienced once or twice by 14% of respondents. 14% reported that the problem occurred a few times, for 10% it occurred on numerous occasions, almost daily for 9%. 53% of participants experienced no problems of this nature. [↑](#footnote-ref-54)
55. 19% experienced this issue once or twice, 15% on a few occasions, 3% on numerous occasions and less than 1% almost daily. 63% did not face problems relative to interoperability of other chargers. [↑](#footnote-ref-55)
56. The problem occurred once or twice for 14% of respondents, a few times for 20%, 10% of respondents on numerous occasions and 5% nearly daily. Half of those participating reported no experience of problems occurring. [↑](#footnote-ref-56)
57. The problem occurred had occurred once or twice for 15% of respondents, a few times for 13%, on numerous occasions for 7%, and almost every day for 4%. [↑](#footnote-ref-57)
58. The problem occurred once or twice for 17% of consumers, on a few occasions for 20%, on numerous occasions for 12%, and for 5% almost on a daily basis. [↑](#footnote-ref-58)
59. First IA study, page 55. [↑](#footnote-ref-59)
60. *Ibid.*, page 55. [↑](#footnote-ref-60)
61. In France, manufacturers are obliged to **bundle** headphones to mobile phones for safety reasons [↑](#footnote-ref-61)
62. In view of the critical importance of this variable for any intervention that involves unbundling, we have carried out sensitivity analysis, to test how variations in the assumptions would affect the results. For details see Annex G. [↑](#footnote-ref-62)
63. Specifically, USB PD 2.0 or higher. It should be noted that USB PD 3.0 requires USB Type-C cables and connectors (at both ends), as the latest specification has deprecated USB Type-A and Type-B. However, for USB PD 2.0, USB Type-A connectors can still be used, meaning that this option as defined here would not imply that all EPS would have to use USB Type-C receptacles. [↑](#footnote-ref-63)
64. It may be worth considering whether a standardisation mandate should be issued (to a standardisation body such as CEN-CENELEC or ITU) to limit the compliance verification to the ‘essential requirements’ needed to ensure interoperability, rather than full compliance with USB Type-C and USB PD (which, in order to be eligible for USB-IF certification, rules out the presence of proprietary “add-ons”). [↑](#footnote-ref-64)
65. Programmable Power Supply (PPS), which uses dynamic voltage increments, would be optional, not mandatory. [↑](#footnote-ref-65)
66. European Commission (2020) Draft report. Preparatory study for the Ecodesign and Energy Labelling Working Plan 2020-2024 (Task 3, preliminary analysis of product groups and horizontal initiatives) Retrieved from: https://www.ecodesignworkingplan20-24.eu/documents [↑](#footnote-ref-66)
67. For example, as of 18 January 2021, customers purchasing an iPhone 12 from the Apple online shop in Spain (<https://www.apple.com/es/shop/buy-iphone/iphone-12>) were offered a 20W USB-C EPS as an optional accessory for €25. Similarly, customers pre-ordering a Galaxy S21 from the Samsung online shop in Spain (<https://www.samsung.com/es/smartphones/galaxy-s21-5g/buy/>) were offered a 25W USB-C EPS for €24.90. During interviews, both Apple and Samsung reported they had reduced the price of these EPS as part of their recent unbundled launches. [↑](#footnote-ref-67)
68. The only exception is Fairphone, which has been selling mobiles without any accessories for years, albeit on a very small scale. For details see <https://www.fairphone.com/en/>. [↑](#footnote-ref-68)
69. USB Implementers Forum, Inc. is a non-profit corporation founded by the group of companies that developed the Universal Serial Bus specification. The USB-IF was formed to provide a support organization and forum for the advancement and adoption of USB technology. The USB-IF has a “core” membership of seven “Promoter members” who sit on its Board of Directors (Apple, HP, Intel, Microsoft, Renesas, STMicroelectronics, and Texas Instruments), as well hundreds of “Contributor members”. [↑](#footnote-ref-69)
70. The USB specification defines the product design targets at the level of interfaces and mechanisms. To complement the specification and enable measurement of compliance in real products, the USB-IF has instituted a Compliance Program that provides reasonable measures of acceptability. The Compliance Program uses multiple test specifications along with a Test ID (TID) to track and define the test criteria used to evaluate a product. Products that pass this level of acceptability are considered USB-IF certified and are added to the Integrator's List and have the right to license the USB-IF Logos. For further details see: URL: <https://www.usb.org/compliance> [↑](#footnote-ref-70)
71. Based on IDC (2021); the combined 2019 European market share of Huawei and Xiaomi mobile phones was 27%. [↑](#footnote-ref-71)
72. Ipsos (2019), p. 58 [↑](#footnote-ref-72)
73. Fraunhofer IZM (for the European Commission, 2021): Assessment of the Status of Wireless Charging Technologies used for Mobile Phones and Similar Electronic Equipment and next expected Main Technological Developments [↑](#footnote-ref-73)
74. European Commission (2020) Draft report. Preparatory study for the Ecodesign and Energy Labelling Working Plan 2020-2024 (Task 3, preliminary analysis of product groups and horizontal initiatives) Retrieved from: https://www.ecodesignworkingplan20-24.eu/documents [↑](#footnote-ref-74)
75. According to a recent JRC study, the accessories (charger and headset) only account for around 2% of a mobile phone’s carbon footprint. European Commission (2020): JRC Technical Report –Guidance for the Assessment of Material Efficiency: Application to Smartphones, p. 109. URL: <https://ec.europa.eu/jrc/en/publication/guidance-assessment-material-efficiency-application-smartphones> [↑](#footnote-ref-75)
76. The absolute direct energy consumption of mobile phones per device and year of use is only in the range of roughly 6 to 16 kWh/a, according to Fraunhofer for the European Commission (2020): Ecodesign preparatory study on mobile phones, smartphones and tablets. Draft Task 7 Report, p. 25 [↑](#footnote-ref-76)
77. Ibid. [↑](#footnote-ref-77)
78. European Commission (2020): Inception Impact Assessment on the Environmental impact of mobile phones and tablets. URL: <https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12798-Environmental-impact-of-mobile-phones-and-tablets-Energy-Labelling> [↑](#footnote-ref-78)
79. A potentially relevant example is provided by the recent revision of the methodology for calculating the energy efficiency of screen displays (See URL: <https://www.eceee.org/static/media/uploads/site-2/ecodesign/products/televisions/tv-energylabelling-mars2019.pdf>). This provides that if a (necessary) external EPS was not supplied with the display, the product could be assessed without the EPS (and its consequent energy losses), and the label would indicate the unbundling. However, this approach would almost certainly not work for mobile phones given their low power consumption, the relatively high charging efficiency of wired chargers, and the proposal to base the efficiency ratings on battery endurance (which is obviously unaffected by the presence or absence of an EPS in the box). As far as we can see, this only leaves one option – namely an ‘artificial’ bonus for chargeless phones, so that, for example, a phone that would normally earn a “C” rating based on its battery endurance (in accordance with the approach proposed by the Ecodesign preparatory study) would be ‘bumped up’ to a “B” if it was marketed without an EPS (or alternatively, phones that include an EPS could be penalized with a lower rating). This could provide an incentive for unbundling – although it would need to be considered if this would be sufficiently significant to be effective in practice. [↑](#footnote-ref-79)
80. Based on the 5.3V 2A Mobile Phone Charger Reference Design developed by TexasInstruments.DOE-6 standard requirement. See complete list of features: https://www.ti.com/tool/PMP4432 [↑](#footnote-ref-80)
81. 1. Based on the 5.3V 2A Mobile Phone Charger Reference Design by Texas Instruments. https://www.ti.com/tool/PMP4432

    [↑](#footnote-ref-81)
82. Key studies used as sources for this estimation, are Balde et al (UNITAR) (2020) In-depth review of the WEEE collection rates and targets in the EU-28, Norway, Switzerland and Iceland; and Balde et al (UNITAR) (2020) The Dutch WEEE flows 2020, what happened between 2010 and 2018? [↑](#footnote-ref-82)
83. SustainablySMART (2019) Regulation of Common Chargers for Smartphones and other Compatible Devices: Screening Life Cycle Assessment. Policy Brief No. 2. [↑](#footnote-ref-83)
84. Ercan, M. (2013), Global Warming Potential of a Smartphone Using Life Cycle Assessment Methodology; Charles River Associates (2015) Harmonising chargers for mobile telephones Impact assessment of options to achieve the harmonisation of chargers for mobile phones [↑](#footnote-ref-84)
85. Regarding the end-of-life (EoL) emissions, Task 5 notes a positive GWP based on high recycling rates (of packaging material) and high rates of devices being reused. For this study, we favoured a conservative approach and, therefore, did not consider the value suggested by Task 5 for the EoL phase. Nonetheless, given that the contribution of the EoL phase to the overall emissions is very small compared to the other phases (<1%), it does not have a major influence on the overall results. [↑](#footnote-ref-85)
86. Based on SustainablySMART (2019) Regulation of Common Chargers for Smartphones and other Compatible Devices: Screening Life Cycle Assessment. Policy Brief No. 2; Ercan, M. (2013), Global Warming Potential of a Smartphone Using Life Cycle Assessment Methodology; Charles River Associates (2015) Harmonising chargers for mobile telephones Impact assessment of options to achieve the harmonisation of chargers for mobile phones; Schischke, K et al (2021) Eco-design preparatory study on mobile phones, smartphones and tablets- Task 5. [↑](#footnote-ref-86)
87. GHG emissions per unit of EPS>27W will slightly decrease between 2020-2030 as a consequence of the modelled decrease in weight for EPS>27W (See section 4.1.1 Material use). [↑](#footnote-ref-87)
88. We have identified 33 SMEs or medium-size companies based in the EU that would be directly affected by the initiative:

    Manufacturers of mobile phones: Allview (RO), Ano-Phone (DE), Brondi (IT), CPA Halo (CZ), Doro (SE), Emporia (AT), Evolveo (CZ), Fairphone (NL), GSMK Cryptophone (DE), Handheld (SE), Jolla (FI), Just5 (LV), MLS (HR), Mobiwire (FR), mPTech (PL), NGM (IT), Wiko Mobile (FR).

    Manufacturers of charging solutions: Cellularline (IT), Hama (DE)

    Manufacturers of other devices: Archos (Tablets, FR), Obermax (Tablets, PL), Booken (e-readers, France), Hasselblad (cameras, SE), Jabra (hearables, DK), Leica (cameras, DE), Medion (cameras, DE), Obermax (Tablets, PL), Phase One (cameras, DK), Philips (portable speakers, NL), Polar (fitness trackers, FI), Praktica (cameras, DE), Sennheiser (hearables, DE), Urbanista (portable speakers, SE). [↑](#footnote-ref-88)
89. The costs classified as administrative burden in the first IA have been reclassified as operating costs, as they refer to compliance with standards. [↑](#footnote-ref-89)
90. As of 18 January 2021, customers purchasing an iPhone 12 from the Apple online shop in Spain (<https://www.apple.com/es/shop/buy-iphone/iphone-12>) were offered a 20W USB-C EPS as an optional accessory for €25. Similarly, customers pre-ordering a Galaxy S21 from the Samsung online shop in Spain (<https://www.samsung.com/es/smartphones/galaxy-s21-5g/buy/>) were offered a 25W USB-C EPS for €24.90. During interviews, both Apple and Samsung reported they had reduced the price of these EPS as part of their recent unbundled launches. [↑](#footnote-ref-90)
91. This standard does not exist. It is included here merely as an illustration of hypothetical future standards. [↑](#footnote-ref-91)
92. A study commissioned by the industry calculated the loss of consumer welfare from a 3-year delay in the introduction of a charging solution innovation, attributing 18% of the phone value to the innovation in the charging technology. Source: Copenhagen Economics (2019) United in diversity, page 42, available at: <https://www.copenhageneconomics.com/dyn/resources/Publication/publicationPDF/3/523/1579859102/united-in-diversity_copenhagen-economics.pdf> [↑](#footnote-ref-92)
93. These impacts are also cited in a report commissioned by the industry: RPA (2019) Study on the Common Charger 2.0, page 38, available at: <https://www.digitaleurope.org/wp/wp-content/uploads/2019/12/RPA-Study-Common-Charger-2.0-final.pdf> [↑](#footnote-ref-93)
94. More information on conformity assessment is available at: <https://ec.europa.eu/growth/single-market/goods/building-blocks/conformity-assessment_en> [↑](#footnote-ref-94)
95. Source: Structural Business Statistics (SBS), Annual detailed enterprise statistics for industry (NACE Rev. 2, B-E) [sbs\_na\_ind\_r2]. Extracted on 8 March 2021 for NACE 2790 Manufacture of other electrical equipment. [↑](#footnote-ref-95)
96. This estimation is based on trade volumes from PRODCOM code 27904140 [↑](#footnote-ref-96)
97. Chargers’ manufacturers turnover is estimated by multiplying the amount of chargers in the baseline that are produced in the EU (26% of standalone chargers, according to PROCOM data) by the wholesale price of chargers. [↑](#footnote-ref-97)
98. Source: Structural Business Statistics (SBS) Extract for NACE 2790 Manufacture of other electrical equipment. [↑](#footnote-ref-98)
99. The effects on the cost of chargers to consumers are analysed as part of the assessment of economic impacts. [↑](#footnote-ref-99)
100. GHG emissions [tonnes] are calculated in the stock model as life-cycle emissions (cradle-to-grave) per charger component type, accounted in the year of sale. Emissions are calculated on the basis of component specific emission profiles multiplied by additions to the charger stock, as explained in section 4.1. [↑](#footnote-ref-100)
101. Material use [tonnes] are calculated in the stock model by multiplying additions to the charger stock by a profile of the materials used. The profiles vary per EPS and cable type (weight and material content), and over time, as explained in section 4.1. [↑](#footnote-ref-101)
102. E-waste [tonnes] are calculated in the stock model as the weight of chargers disposed of each year. This is calculated by multiplying the number of units disposed by the material and weight composition of the charger component type. Sub-indicators on volumes of e-waste left untreated or recycled are also calculated, as explained in section 4.1. [↑](#footnote-ref-102)
103. Untreated e-waste [tonnes] are calculated in the stock model based on the share of e-waste generated (tonnes) that is untreated (incorrectly disposed), considering the values presented in Table 4 in section 4.1 [↑](#footnote-ref-103)
104. Recycled e-waste [tonnes] are calculated in the stock model based on the share of e-waste generated (tonnes) that is recycled, considering the values presented in Table 4 in section 4.1. [↑](#footnote-ref-104)
105. Based on Eurostat – Waste electrical and electronic equipment statistics. Waste collected from households for EU27. See: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env\_waselee [↑](#footnote-ref-105)
106. The results of the consumer survey show that, on average, Apple users bought 0.73 cables in the last 24 months, whereas the average for users of all brands was 0.51 cables. [↑](#footnote-ref-106)
107. A reduction of 27% is applied to the share of the market of Apple (17.8%) to model this effect, which effectively reduces the 0.41 cables per person per year ratio to 0.39 (i.e. 4.8% reduction in sales compared to the baseline) [↑](#footnote-ref-107)
108. The list of top 200 Apple suppliers can be found here: <https://www.apple.com/supplier-responsibility/pdf/Apple-Supplier-List.pdf> (accessed on 22 April 2021) [↑](#footnote-ref-108)
109. Source: Apple Inc. Annual Report 2020, available at: <https://s2.q4cdn.com/470004039/files/doc_financials/2020/ar/_10-K-2020-(As-Filed).pdf> (accessed on 11 May 2021) [↑](#footnote-ref-109)
110. Source: <https://www.apple.com/newsroom/2021/04/apple-commits-430-billion-in-us-investments-over-five-years/> (accessed on 11 May 2021) [↑](#footnote-ref-110)
111. Source: <https://www.apple.com/uk/newsroom/2021/03/apple-to-invest-over-1-billion-euros-in-germany-with-new-munich-campus/> (accessed on 11 May 2021) [↑](#footnote-ref-111)
112. In the consumer survey, 5% of those who bought a standalone charger did it for the purpose of fast charging capabilities. This effect is applied in the stock model through a 5% reduction in the ratio of people assumed to purchase an EPS (0.31 per person/per year in the baseline), which results in a 4% reduction of sales of standalone EPS by 2030. [↑](#footnote-ref-112)
113. It should be noted that this is a small source of competitive advantage in the EU market. The survey conducted for the first IA revealed that consumers give little importance to the charging speed when buying a new EPS. For more information, see a summary of the results of the conjoint experiment conducted in the first IA study in page 186 of the final report. [↑](#footnote-ref-113)
114. It is estimated that for each phone sold unbundled, 0.39 standalone EPS are bought. For more detail, see Annex G. [↑](#footnote-ref-114)
115. Huawei and Oppo manufacture their own SoC, however these companies are categorised as manufacturers of mobile phones. [↑](#footnote-ref-115)
116. See, for instance, consumer associations’ reactions in Brazil: <https://www.engadget.com/apple-brazil-fine-over-iphone-12-charger-171754262.html?guce_referrer=aHR0cHM6Ly93d3cyLnNtYXJ0YnJpZWYuY29tLw&guce_referrer_sig=AQAAAKqtc2BHHwiLs3rMY0SKCrmUkyx5Q1vX4mx1DGNftiwJJv7iVLEnTZ59Eu6HwrGBoIaj410Q9k615LK2llxO_GqNwtPQGS6_1sFpBnWmMjolioWopsEsPhtPadZBzpS0Enz9cXi_WimTevGO0jOFYsbS8L-tM8gpUXkqymqJ7KnW&_guc_consent_skip=1616713903> [↑](#footnote-ref-116)
117. CSES, DG GROW, Panteia (2014) Evaluation of the internal market legislation for industrial products, Appendix C Case study for laptops, available at: <https://op.europa.eu/en/publication-detail/-/publication/4fe4ba23-68f6-439f-b982-5f56ef1b135d/language-en> (accessed on 7 June 2021) [↑](#footnote-ref-117)
118. Source: Apple Annual Report 2020, available at: <https://s2.q4cdn.com/470004039/files/doc_financials/2020/ar/_10-K-2020-(As-Filed).pdf> (accessed on 11 May 2021) [↑](#footnote-ref-118)
119. The RPA (2019) study commissioned by the industry noted the following: “If the regulatory intervention were to affect existing models and the lead time were not long enough for these products to phase out naturally and for manufacturers to introduce new products with USB-C connectors, a disruption with significant economic impacts can be expected, even in instances where the cessation of sales is relatively short […] It should also be noted that the curtailment of the sales of existing stocks of older products could result in losses for manufacturers and/or distributors since it is reasonable to expect that these products would have to be sold at a discount in other markets”. Study available at: <https://www.digitaleurope.org/wp/wp-content/uploads/2019/12/RPA-Study-Common-Charger-2.0-final.pdf> (page 39). [↑](#footnote-ref-119)
120. Estimation based on market data provided by IDC [↑](#footnote-ref-120)
121. VVA (2018) Study for the introduction of an e-labelling scheme in Europe, available at: <https://www.digitaleurope.org/wp/wp-content/uploads/2019/01/Study%20for%20the%20introduction%20of%20an%20e-labelling%20scheme%20in%20the%20EU%20-%20CBA%20-%20final%20report%2021062018.pdf> [↑](#footnote-ref-121)
122. Ipsos (2019), section 3.5 [↑](#footnote-ref-122)
123. For a summary of how these sources of inconvenience relate to the survey responses, and how frequently they were experienced by consumers, please see Ipsos (2019), section 5.2. [↑](#footnote-ref-123)
124. Ipsos (2020), p. 77-80 [↑](#footnote-ref-124)
125. This is equivalent to 6% of *all* survey respondents. The proportion was much higher among younger consumers (8% of 18-34 year olds) than among older ones (4% of those aged 55 or older). [↑](#footnote-ref-125)
126. For further details see URL: <https://www.procon.sp.gov.br/procon-sp-multa-apple/> [↑](#footnote-ref-126)
127. For a, not necessarily comprehensive, view of all the logos currently being managed by the USB Implementers Forum, see URL: <https://www.usb.org/compliance> [↑](#footnote-ref-127)
128. The sample includes: 29 cameras (including action cameras), 10 handheld videogame consoles, 9 e-readers, 11 smartwatches / fitness trackers, 30 headphones/earbuds, 14 laptops, 15 radio-controlled toys, 2 smartglasses, 26 portable speakers, 45 tablets. [↑](#footnote-ref-128)
129. For more information on the prioritisation exercise conducted, see Annex H. [↑](#footnote-ref-129)
130. Laptops and radio-controlled toys were also mapped and analysed, and excluded from further analysis. Laptops were excluded because they use significantly higher wattage than mobile phones, and therefore it would not be possible to extrapolate data and assumptions from smartphones to laptops (different impacts on safety and the environment). Radio-controlled toys were excluded because their charging characteristics also differ from mobile phones; they generally use lower current (0.1-1A vs 1-2A used in mobile phones) and, most importantly, use different types of batteries (Ni-MH / Ni-Cd, instead of Li-Ion or Li-Polymer used in mobile phones). [↑](#footnote-ref-130)
131. Data for Tablets and hearing devices was acquired from IDC; data for cameras has been retrieved from PRODCOM and CIPA. [↑](#footnote-ref-131)
132. Estimates made by the study team, based upon triangulation of mapping of devices and IDC data for Tablets. [↑](#footnote-ref-132)
133. The proprietary external charger to charge removable batteries is not considered an EPS. This type of charger is significantly different to mobile phone EPS and therefore it is not possible to use the same assumptions in our estimations and the stock model. The unbundling of this type of chargers could be explored by the Commission, and it will be assessed qualitatively in the final report of this IA study. [↑](#footnote-ref-133)
134. Estimate made by the study team based upon triangulation of mapping of devices with IDC data for hearing devices. It should be noted that IDC only includes premium categories of hearing devices, as it only includes devices that are considered “smart”, i.e. include at least one of the following features: track health/fitness; modify audio beyond blanket noise cancellation; provide language translation; enable smart assistants. Non smart hearing devices normally use USB micro-B receptacles. [↑](#footnote-ref-134)
135. Based on the mapping of devices conducted by the study team (see Annex I) [↑](#footnote-ref-135)
136. Source: IDC Quarterly Mobile Phone Tracker, Q3 2020 Final Historical, November 5, 2020. Original data provided by IDC did not include some EU countries. Our estimation has been weighted by population in order to include the EU MS for which IDC did not have data. [↑](#footnote-ref-136)
137. Source: IDC Quarterly Personal Computing Device Tracker, Q3 2020 Final Historical, November 18, 2020 [↑](#footnote-ref-137)
138. Source: IDC Quarterly Wearable Device Tracker, Q3 2020 Final Historical Release, November 27, 2020. Original data provided by IDC did not include some EU countries. Our estimation has been weighted by population in order to include the EU MS for which IDC did not have data. [↑](#footnote-ref-138)
139. Authors’ calculations based on CIPA (2021), Digital Cameras and Prodcom 26701300 - Digital cameras (PRODQNT + IMPQNT – EXPQNT). [↑](#footnote-ref-139)
140. Several assumptions have been made to obtain these figures. Comtrade code for videogame consoles (HS 950450) includes both portable and non-portable consoles. According to a report published by Goldstein Research (<https://www.goldsteinresearch.com/report/europe-gaming-console-market-share-analysis>), in 2016, 91% of revenue from videogame consoles came from TV gaming consoles. We have assumed that 9% of all imports of consoles are handheld. We have checked these figures against COMTRADE code “264060650 Video game consoles” for which data on production, imports and exports is available in monetary terms, but not in quantity. Assuming a price of 50 Euros per video game console, we obtained a similar market size (57 million consoles in 2019). [↑](#footnote-ref-140)
141. As Comtrade only provides monetary values for code “854370 Electrical machines and apparatus; having individual functions, not specified or included elsewhere in this chapter, n.e.c. in heading no. 8543”, the figure was obtained by calculating an average price for e-readers sold on Amazon.fr in January 2021 and using an EUR/USD exchange rate of 1.22, which were then used to transform the Comtrade import values into units. [↑](#footnote-ref-141)
142. Share of portable speakers obtained by applying an assumption of 43% market share of ‘portable’ speakers (as opposed to ‘wired’ speakers). For further details on the methodology, please refer to Annex I. [↑](#footnote-ref-142)
143. For more information on the selection of devices, see section 6.1. [↑](#footnote-ref-143)
144. GHG emissions [tonnes] are calculated in the stock model as life-cycle emissions (cradle-to-grave) per charger component type, accounted in the year of sale. Emissions are calculated on the basis of component specific emission profiles multiplied by additions to the charger stock, as explained in section 4.1. [↑](#footnote-ref-144)
145. Material use [tonnes] are calculated in the stock model by multiplying additions to the charger stock by a profile of the materials used. The profiles vary per EPS and cable type (weight and material content), and over time, as explained in section 4.1. [↑](#footnote-ref-145)
146. E-waste [tonnes] are calculated in the stock model as the weight of chargers disposed of each year. This is calculated by multiplying the number of units disposed by the material and weight composition of the charger component type. Sub-indicators on volumes of e-waste left untreated or recycled are also calculated, as explained in section 4.1. [↑](#footnote-ref-146)
147. Untreated e-waste [tonnes] are calculated in the stock model based on the share of e-waste generated (tonnes) that is untreated (incorrectly disposed), considering the values presented in Table 4 in section 4.1 [↑](#footnote-ref-147)
148. Recycled e-waste [tonnes] are calculated in the stock model based on the share of e-waste generated (tonnes) that is recycled, considering the values presented in Table 4 in section 4.1. [↑](#footnote-ref-148)
149. The market of video-game consoles is 9% of the market of mobile phones. Five out of nine of the consoles mapped used USB micro-B connectors (i.e. almost half of the market assuming similar market shares across the devices analysed), which represents a bit over half of the market. [↑](#footnote-ref-149)
150. Percentages have been calculated according to the size of the market of each device when sold bundled with EPS, in relation to number of chargers sold bundled with mobile phones and number of standalone chargers sold (in the stock model, the number of EPS sold in the EU in 2020 is 210 million). [↑](#footnote-ref-150)
151. Ibid. (see previous footnote). [↑](#footnote-ref-151)
152. GHG emissions [tonnes] are calculated in the stock model as life-cycle emissions (cradle-to-grave) per charger component type, accounted in the year of sale. Emissions are calculated on the basis of component specific emission profiles multiplied by additions to the charger stock, as explained in section 4.1. [↑](#footnote-ref-152)
153. Material use [tonnes] are calculated in the stock model by multiplying additions to the charger stock by a profile of the materials used. The profiles vary per EPS and cable type (weight and material content), and over time, as explained in section 4.1. [↑](#footnote-ref-153)
154. E-waste [tonnes] are calculated in the stock model as the weight of chargers disposed of each year. This is calculated by multiplying the number of units disposed by the material and weight composition of the charger component type. Sub-indicators on volumes of e-waste left untreated or recycled are also calculated, as explained in section 4.1. [↑](#footnote-ref-154)
155. Untreated e-waste [tonnes] are calculated in the stock model based on the share of e-waste generated (tonnes) that is untreated (incorrectly disposed), considering the values presented in Table 4 in section 4.1 [↑](#footnote-ref-155)
156. Recycled e-waste [tonnes] are calculated in the stock model based on the share of e-waste generated (tonnes) that is recycled, considering the values presented in Table 4 in section 4.1. [↑](#footnote-ref-156)
157. GHG emissions [tonnes] are calculated in the stock model as life-cycle emissions (cradle-to-grave) per charger component type, accounted in the year of sale. Emissions are calculated on the basis of component specific emission profiles multiplied by additions to the charger stock, as explained in section 4.1. [↑](#footnote-ref-157)
158. Material use [tonnes] are calculated in the stock model by multiplying additions to the charger stock by a profile of the materials used. The profiles vary per EPS and cable type (weight and material content), and over time, as explained in section 4.1. [↑](#footnote-ref-158)
159. E-waste [tonnes] are calculated in the stock model as the weight of chargers disposed of each year. This is calculated by multiplying the number of units disposed by the material and weight composition of the charger component type. Sub-indicators on volumes of e-waste left untreated or recycled are also calculated, as explained in section 4.1. [↑](#footnote-ref-159)
160. Untreated e-waste [tonnes] are calculated in the stock model based on the share of e-waste generated (tonnes) that is untreated (incorrectly disposed), considering the values presented in Table 4 in section 4.1 [↑](#footnote-ref-160)
161. Recycled e-waste [tonnes] are calculated in the stock model based on the share of e-waste generated (tonnes) that is recycled, considering the values presented in Table 4 in section 4.1. [↑](#footnote-ref-161)
162. As discussed in greater detail in chapter 5.2, as well as in the first IA study, this is because option 1 would rule out the adoption of any new “game-changing” connector technology, thereby reducing the incentives for firms to invest in research and development to seek to gain a competitive advantage, which in turn also risks reducing the pace of “incremental” innovation as regards future generations of “common” (USB) connectors. [↑](#footnote-ref-162)
163. In other words, under option 2, Apple’s current practice of providing cables with a USB Type-C connector on one end and a Lightning connector at the other could continue, whereas under option 1, all manufacturers would be obliged to switch to USB Type-C receptacles in their phones and matching cables. [↑](#footnote-ref-163)