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A COMMON SENSE APPROACH TO THE 'COMMON CHARGER' PROPOSED EU REGULATION

A full picture of options and impacts of charger regulation, accounting for market evidence and EU consumers' preferences – informing a pragmatic, sustainable and future-proof implementation.

CLIENT: APPLE
FEBRUARY 2022

Copenhagen Economics

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EXECUTIVE SUMMARY

On 23 September 2021, the European Commission (the Commission) published a proposal for 'common charger' regulation – a number of requirements related to the charging of small electronic devices (mobile phones, tablets, digital cameras, headphones, headsets, hand-held video game consoles and portable speakers), designed to improve consumer convenience and benefit the environment.

The proposed regulation includes four policy initiatives that would apply across all of the aforementioned small electronic devices:

1. Unbundling of the sale of the charging brick (external power supply – EPS) from the sale of devices – intended to ensure that consumers can buy a new device without having to also buy a new EPS
2. Standardisation of charging protocols – designed to ensure that chargers provide the same performance to all devices
3. Improved information for consumers – designed to make it easier for consumers to understand which chargers are compatible with which devices
4. Specification of a common device-end port, specifically USB-C (i.e. mandating a 'common charger') – designed to ensure that different devices can use the same charging cable

This study examines the proposed regulation and the supporting evidence. We explore the expected impacts of the proposal and test whether it is possible to identify adjustments to the proposal which would benefit both consumers and manufacturers – as well as the environment.

We find that at least two adjustments to the proposed regulation would greatly benefit both consumers and manufacturers without compromising the overall objectives of the regulation.

First, the currently proposed approach of specifying a certain version of the USB-C standard in law is likely to harm consumers by delaying the introduction of both game-changing (e.g. a 'USB-D' standard) and incremental improvements (updates to the USB-C and USB PD standards, of which there have already been several). Exemplifying this point, the proposal refers to already outdated versions of the USB-C and USB PD standards in its proposal. Although a Delegated Act procedure could be used to update the specification references with which manufacturers must comply, this would likely be associated with a delay of several years relative to market developments.

We recommend that, if policymakers want to mandate a common device-end port, they consider an alternative approach that mandates the principle of standardisation (e.g. allowing a standardisation body such as the USB-IF or a European standardisation body to choose the applicable standard to which manufacturers must conform) rather than specifying the common device-end port by law.[1] We find that this alternative and more future-proof approach to regulation could benefit consumers by at least 10.3 billion EUR, corresponding to 23 EUR per person in the EU.

[1] This implies that the law would mandate a common device-end port for all applicable devices without specifying the exact port type up-front.

Second, the current approach includes specifying a date beyond which all devices entering the market would have to be equipped with a USB-C port, effectively implementing a ban on the sale of existing models with other port types (even if they were already introduced to the market before the specified date).[2] We find that it would be harmful to EU consumers to disallow the continued sale of existing models that pre-dated the regulation *en force* period. This is because some consumers simply prefer to buy older models – typically devices without the most recent features at a lower price point, and because it would be very costly and impractical for manufacturers to redesign/'retrofit' existing models (as well as those already in the design pipeline) with a different device-end port.

Forcing consumers to buy a more expensive device, or alternatively to walk away without buying anything, would be harmful – in economic terms, a loss of consumer surplus.

We recommend that, if policymakers want to mandate a common device-end port, they consider that, for any given *en force* date, so-called 'grandfathering' should be allowed. This provision would balance short-term EU consumer interests with the long-term regulatory aim of achieving device-end interoperability. We find that the benefit to consumers associated with allowing 'grandfathering' (or alternatively, sufficiently extending the transition period), would be at least 0.7 billion EUR, equivalent to approximately 1.40 EUR per person in the EU. Alternatively, policymakers could extend the transition period for all devices, which would achieve similar benefits and allow existing models to phase out naturally.

In conclusion, having gathered the evidence in the Commission's impact assessment and wider market evidence, we find the likely impact of the September 2021 proposal as follows.

Several benefits unlocked. Three out of the four policy initiatives – unbundling of the EPS, standardisation of charging protocols, and improved information to consumers – will deliver positive impacts to consumers and to the environment without causing any large negative effects.

Opportunities to avoid major unintended consequences. It would be more effective to focus on achieving interoperability at the EPS end of the charger rather than specifying a common-device end port (the fourth policy initiative, which has led to the whole package of regulation being referred to as the 'common charger' initiative). In practice, a common device-end port would, according to the available evidence, deliver very few benefits to consumers and no benefits at all to the environment. Specifying that all devices must use USB-C would also undermine manufacturers' incentives and ability to develop and introduce new and better wired charging technologies, an obstacle which would ultimately harm consumers. We find that it would be less intrusive and more impactful to mandate interoperability at the EPS end since there would be fewer constraints for manufacturers associated with integrating any common port to the EPS, and because an EPS produces far more e-waste than a cable.

EU policymakers have a key opportunity to fine-tune the common charger regulation for the greatest benefit of EU consumers and environment. We hope the evidence in this study can be of help.

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[2] More specifically, the regulation implies that non-compliant devices can no longer be shipped to the EU, i.e., older models already stored in EU shops or warehouses can still be sold.

CHAPTER 1

AIMS AND FEATURES OF THE SEPTEMBER 2021 'COMMON CHARGER' PROPOSAL

The European Commission (the Commission) has published a proposal for new regulation related to the charging of small electronic devices, including smartphones.

In this chapter, we provide a brief introduction to the proposal and its underpinning evidence base. First, we provide a brief overview of the history of the proposal and the various sources of evidence that shed light on state of the market and the potential impact of regulation, see section 1.1. Second, we explain the concerns that the proposal aims to address, see section 1.2.

1.1 OVERVIEW OF DEVELOPMENTS LEADING UP TO THIS PROPOSAL

The potential introduction of a 'common charger' has been discussed in the EU for a number of years.

In 2009, the Commission *"requested industry to come forward with a voluntary commitment to solve [the problem of incompatibility of chargers for mobile phones]".*[3] This resulted in industry players signing a Memorandum of Understanding (MoU) which ensured full compatibility across manufacturers – although allowing for an adaptor for phones that did not have a micro-USB device-end port. The MoU resulted in a reduction of the number of device-end port standards from 30 to 3. Industry players signed another voluntary MoU in 2018, this time referencing the newer USB-C standard – although also allowing for proprietary device-end ports so long as charging cables terminated on one end with a USB-C plug.[4] Because micro-USB is expected to be phased out in the coming years, the number of device-end charging ports on the market (for smartphones) is expected to soon decrease to two.[5]

In parallel with the MoUs, which have related to device-end port standards, there has also been a trend towards standardisation on the EPS end of the charger and in relation to power delivery standards.[6]

The Commission reflected in 2017 that: *"The MoU [of 2009] was recognised as a success in terms of consumer convenience."*[7] Despite this, the Commission was not satisfied that the latest MoU is sufficient to *"guarantee full interoperability"*. The Commission therefore announced that it would

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3 European Commission (2009), p. 9.

4 Digital Europe (2018).

5 *"[…] in the baseline scenario, around 80% of phones sold in the EU will come with USB Type-C connectors anyway by 2023, which somewhat limits the marginal benefits of this option."* (i.e. the marginal benefits of specifying a common device-end port). Ipsos (2019), p. 150.

6 *"There is quite a high degree of interoperability of chargers. It is also the case as regard to fast charging, since most manufacturers implement the USB Power Delivery (PD) technology a charging protocol (i.e. in simple terms the communication rules and signals for the device to communicate with a charger)."* European Commission (2021), (a), p 11. See also e.g. IEC standard 63002.

7 European Parliament (2017).

consider legislative action, and thus launched two studies in 2019 and 2020 to assess the potential impacts of various policy options:

- Ipsos (2019)[8]
    - This impact assessment, commissioned by the Commission, aimed to provide input to the Commission's own impact assessment accompanying the initiative to limit fragmentation of charging solutions for mobile phones and similar devices. The focus was on mobile phone chargers, and specifically on technical options for a 'common charger' and the likely social, environmental, and economic impacts. The study incorporated a consumer survey and modelling to estimate key impacts quantitatively where possible.[9] Ipsos found that there was no clear-cut optimal solution and that whether or not the marginal benefits were considered to justify the marginal costs was ultimately a political decision – one which also needed to consider the risks/drawbacks identified in the study.
- Ipsos (2021)[10]
    - This second impact assessment, also commissioned by the Commission, aimed to strengthen the evidence base for a Commission proposal in the context of the 'common charger' initiative. More specifically, its purpose was to refine and fill in the gaps of the 2019 assessment. It focused in particular on how unbundling of chargers can be facilitated or mandated and what the impacts would be, which portable devices could be encompassed by the initiative in addition to mobile phones and included some additional technical analysis on charger features. The approach was similar to the 2019 impact assessment and impacts were quantified where possible.

In parallel, a number of other studies have also collected and presented evidence from the market on this topic:

- Copenhagen Economics (2019)[11]
    - This study focused on assessing the extent of consumer benefits and costs associated with the specification of a common device-end port. Based on evidence from a survey of European consumers, the study found that consumers place a high value on having the best and newest charging technologies in their devices – and thus that it would be harmful if regulation were to block or delay continued innovation in this space. The study also found that consumers generally like to charge many of the different devices in their household simultaneously – and thus that consumers would not substantially reduce the number of cables in their household even if the same cable could be used for different devices.

- RPA (2019)[12], on behalf of DIGITALEUROPE and the Mobile & Wireless Forum
    - This report had three objectives: to conduct a market analysis of key market developments since 2014, to forecast the uptake of different wired charging

8 Ipsos (2019).
9 The study relied on primary data collected via stakeholder interviews and a consumer survey and the Commission's public consultation as well as statistics, market data and relevant literature.
10 Ipsos (2019).
11 Copenhagen Economics (2019).
12 Digital Europe (2019).

solutions and to compare policy scenarios (the MoU and a regulatory option) in terms of cost-effectiveness as well as impacts on consumers, the industry, and the environment. The study found that the migration to new technologies will depend on consumer demand and costs. Based on a consumer survey, the study found that consumer inconvenience due to lack of compatibility of chargers is limited. It also concluded that regulatory intervention could lock the market into the use of a specific technical solution, which would stifle innovation.

1.2 THE PROPOSAL AIMS TO ADDRESS TWO MAIN CONCERNS

Following a data collection and analysis period, the Commission published its proposal for 'common charger' regulation on 23 September 2021. The regulation was supported by the Commission's own impact assessment, drawing on some of the evidence provided by the Ipsos studies, in particular.

As summarised by the Commission in its impact assessment, the 'common charger' initiative aims to address two main concerns – issues related to 1) consumer convenience, and 2) the environment:

"[…] two main problems drive this initiative: the first one is the consumer convenience, as repeatedly called by the European Parliament and the Consumers' associations (see section 1.1.1), the second is the environmental benefits."[13]

In relation to consumer convenience, the Commission has identified that consumers have four main problems relating to chargers:

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

It is essentially some combination, or all, of these consumer convenience issues that the proposed regulation aims to address.

In relation to environmental benefits, the Commission believes that the market currently over-supplies chargers, i.e., that more chargers are produced and provided than consumers need or want:

"[…] there are more chargers in the market than what consumers realistically need or want. Most consumers already have one or more suitable chargers, so do not always need a new one with each phone."[14]

The proposed regulation is thus also meant to reduce the number of chargers on the market in order to benefit the environment by reducing emissions and e-waste. A reduction in the number of chargers could, for example, according to the Commission's impact assessment, be achieved either via increased charger interoperability (meaning that consumers could use the same charger for

[13] European Commission (2021a), p. 8.
[14] European Commission (2021a), p. 9.

more devices) and/or via unbundling (meaning that device manufacturers would not always provide a charger in the box).

We note that the Commission's impact assessment does not define clearly from the outset whether the word 'charger' refers to the charging brick that goes in the wall (the external power supply, or EPS), the cable (which is detachable from the EPS), or both – or whether the word refers to different things in different contexts. In this report, we use the word 'charger' to refer to the combination of both EPS and cable, unless otherwise specified.

1.3 THE PROPOSED REGULATION 'BUNDLES' FOUR POLICY INITIATIVES

The proposed regulation encompasses four policy initiatives that would apply across a wide range of small electronic devices (mobile phones, tablets, digital cameras, headphones, headsets, hand-held video game consoles and portable speakers):

1. Unbundling of the sale of the charging brick (external power supply – EPS) from the sale of devices – intended to ensure that consumers can buy a new device without having to also buy a new EPS
2. Standardisation of charging protocols – designed to ensure that chargers provide the same performance to all devices
3. Improved information for consumers – designed to make it easier for consumers to understand which chargers are compatible with which devices
4. Specification of a common device-end port, specifically USB-C (i.e. mandating a 'common charger') – designed to ensure that different devices can use the same charging cable

In this report, we use the words policy 'bundle' or 'package' to refer to the combination of these four initiatives, as proposed by the Commission.

CHAPTER 2

ASSESSING THE IMPACT OF THE PROPOSAL AND SUGGESTING ADJUSTMENTS TO BENEFIT CONSUMERS AND THE ENVIRONMENT

In this chapter, we assess the expected impact of the different components of the Commission's proposal and make suggestions for adjustments to the regulation which would allow the Commission to achieve its policy objectives without inflicting unintended adverse effects on European consumers and manufacturers.

First, we explain the structure of the Commission's impact assessment and how it is necessary to decompose the net impacts of the package of regulation in order to understand which initiatives are driving the expected effects, see section 2.1.

Second, we explore the expected impact of what is referred to in the Commission's Impact Assessment as 'policy option 3', which includes three of the four policy initiatives that have ultimately been proposed but excludes the fourth (specifying a common device-end port). We find that this combination of policy initiatives would generate benefits to the environment and would not be associated with any large negative impacts, see section 2.2.

Third, we explore the incremental impact of including the fourth policy initiative to specify a common device-end port (USB-C), designed to achieve charger interoperability, i.e., the 'common charger'.[15] We find that the addition of this policy initiative does not generate any clear benefits and could in fact cause substantial consumer harm. We suggest that it would be less intrusive and more impactful to focus on achieving interoperability at the EPS end since this would imply fewer constraints on manufacturers and a greater reduction of e-waste, see section 2.3.

Fourth, we suggest that, if the Commission specifically wants to achieve interoperability at the device-end (rather than at the EPS end), it would be more beneficial to mandate the principle of standardisation rather than specifying a specific version of the USB-C standard in law, as is currently being proposed. Employing a more future-proof approach to achieving a common device-end port would benefit consumers by at least 10.3 billion EUR, as it would allow for the more timely introduction of new and better common standards, see section 2.4.

Finally, we suggest that, even if the Commission wants to disallow the release of new devices that do not have a USB-C port, it should still allow the continued sale of old devices (so called 'grandfathering'). This is because prohibiting the continued sale of old devices would harm consumers who prefer to buy a cheaper device without the most recent features. It would also be very costly and impractical for manufacturers to redesign existing models to include a new device-end port. Allowing 'grandfathering' would benefit consumers by at least 0.7 billion EUR, see section 2.5. An alternative

[15] Together, these policy initiatives form the Commission's preferred option.

to allowing 'grandfathering' would be to extend the transition period further for all devices, which would achieve similar benefits and allow existing models to phase out naturally.

2.1 THE NET IMPACT OF THE PROPOSAL IS A BUNDLE OF FOUR DISTINCT INITIATIVES' IMPACTS

As described in section 1.3, the Commission's proposal for 'common charger' regulation is comprised of four separate policy initiatives.

The headline initiative is undoubtedly the initiative to specify a common device-end port. References to this specific element of the proposal have been prominent in the Commission's communications. The very first paragraph of the press release accompanying the proposal mentions that the goal of the regulation is to *"establish a common charging solution for all relevant devices"*.[16]

Despite this, it is important to note that the net impacts of the proposal cannot be fully ascribed to any one of the four initiatives. In practice, it is difficult to immediately discern which initiatives are driving which effects, because the expected impact of the proposal has been communicated as the net impact of imposing all four initiatives, and because the package of regulation has been branded as the 'common charger' regulation[17] (just one of the four initiatives).

The underlying impact assessment did, however, evaluate several potential combinations of policy initiatives, including the option to impose just three of the four policy initiatives ultimately suggested: unbundling of the EPS, information requirements, and standardisation of charging protocol. This potential combination of policy initiatives is referred to as 'policy option 3'.

Comparing 'policy option 3' to 'policy option 5' (which is the policy option that has ultimately been proposed), it is possible to identify the marginal, or incremental, effect of adding the specification of a common device-end port (the 'common charger' initiative) on top of the three other initiatives, see Table 1.

Table 1
The Commission's policy options combine different policy initiatives

	UNBUNDLING OF THE EPS	INFORMATION REQUIREMENTS	STANDARDISATION OF CHARGING PROTOCOL	SPECIFICATION OF DEVICE-END PORT
Baseline (no regulation but including expected market developments)				
Policy option 3	X	X	X	
Policy option 5	X	X	X	X

Source: Copenhagen Economics based on the European Commission's 2021 impact assessment

16 European Commission (2021d).

17 Referring to the regulation as the 'common charger' initiative is also particularly misleading since the regulation does not in fact mandate a 'common charger' but rather a common device-end port. The regulation does not introduce standardisation of charging in part since the EPS end currently has, and will for the foreseeable future have, two main standards: USB-A and USB-C.

2.2 THREE OF THE FOUR POLICY INITIATIVES WILL DELIVER POSITIVE IMPACTS

The Commission's 'policy option 3', which is considered in the underlying impact assessment, includes three out of the four policy initiatives ultimately proposed in the regulation:

- Unbundling of the EPS
- Information requirements
- Standardisation of charging protocols

Based on the impact assessments, we isolate the impact of imposing these three initiatives – on the environment and on European consumers. We find that this combination of policy initiatives would be beneficial since it would generate benefits to the environment and consumers without causing any large negative impacts.[18]

2.2.1 Unbundling the EPS will benefit the environment

'Policy option 3' is expected to deliver some environmental benefits. These benefits are to a large extent driven by unbundling of the EPS.

While some industry players have already voluntarily begun to unbundle the EPS, some manufacturers would not unbundle the EPS in absence of regulation.[19] 'Policy option 3' is thus expected to generate a reduction in e-waste of around 1,048 tonnes per year (relative to the baseline) in the period 2024-2030[20], see Figure 1.[21]

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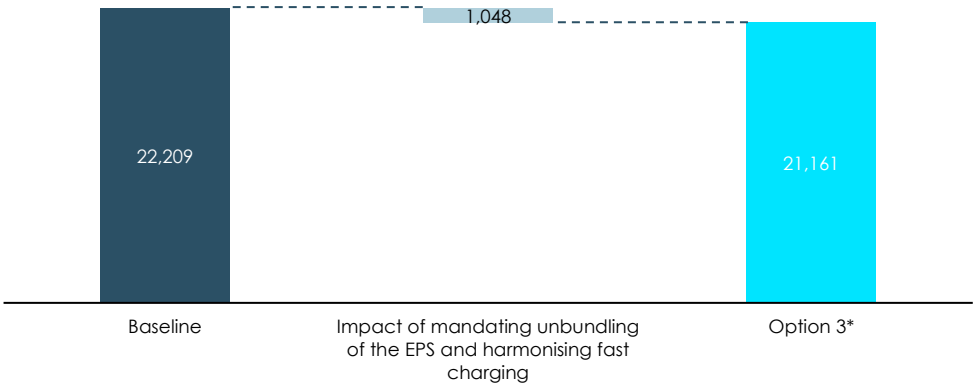
18 Ipsos also explains that its 'package 4', which is equivalent to the Commission's 'policy option 3', has the smallest negative impacts on competition and innovation: *"Package 4 is the one that generates the smallest negative impacts on the competitive landscape, innovation, and operating costs for the industry"*, Ipsos (2021), p. 7.

19 Ipsos estimates that the share of phones sold in the EU that have already unbundled the EPS is around 25% and that this share is expected to increase to around 54% by 2030. Ipsos (2021), p. 32 & 111 / Ipsos (2019), p. 73.

20 Over the past decade, there have been multiple references to the potential to generate e-waste reductions of up to 51,000 tonnes associated with chargers. This number seems to derive from a GSMA statement in 2009. https://www.euractiv.com/section/digital/news/eu-threatens-new-legislation-on-universal-mobile-chargers/

21 We should note that – while any and all benefits to the environment should be considered worthwhile – the impact of this proposed regulation is relatively modest. A reduction of 1,048 tons corresponds to a reduction of approximately 2.3 grams per person in the EU, which is a 0.003% decrease in total annual e-waste production. In terms of CO_2 emissions, the benefits correspond to each person driving approximately 3 km less per year. EU.dk (2021)(2020 pop and EU.dk, 2020 pop: EU population 2021: 447 million, Emissions per km: https://www.eea.europa.eu/ims/co2-performance-of-new-passenger

Figure 1
Option 3 generates a reduction of annual e-waste in the EU
Estimated annual average of e-waste from EPS and cables in the EU, 2024-2030 (tonnes)

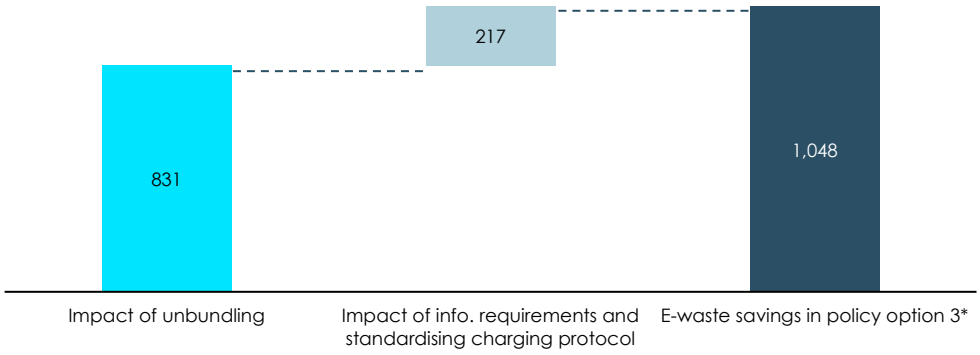


Note: *This corresponds to the broad option 3 in the European Commission's 2021 impact assessment and the broad package 4 in Ipsos' 2021 impact assessment.
Source: Copenhagen Economics based on Ipsos (2021)[22]

The environmental benefits of 'policy option 3' are mainly driven by one of the three initiatives: mandating unbundling of the EPS, see Figure 2.

[22] Ipsos (2021) also states that chargers are responsible for about 11,000 tonnes of e-waste generation per year, referencing its previous impact assessment from 2019. However, this refers to the amount of e-waste generated from phone chargers only (not including other devices), in 2018. In the updated forecast of Ipsos (2021), the amount of e-waste from phone chargers is expected to increase from 12,574 in 2018 to 20,177 in 2030, generating an average annual e-waste generation of 19,028 tonnes over the period 2024-2030. Extending the scope to include more devices implies that the annual e-waste generation is estimated to be 22,209 tonnes annually.

Figure 2
Unbundling the EPS is the main driver of e-waste savings
Estimated annual average of e-waste savings from EPS and cables in the EU, 2024-2030 (tonnes)



Note: *This corresponds to the broad option 3 in the European Commission's 2021 impact assessment and the broad package 4 in Ipsos' 2021 impact assessment.
There is a synergy effect, which implies that the effect of mandating USB PD compatibility is greater unbundling of the EPS is also mandated. The full synergy effect has been attributed to USB PD compatibility in the figure.
Source: Copenhagen Economics based on Ipsos (2021)

It is worth noting that, according to the Ipsos survey, 82% of consumers prefer to receive an EPS in the box with their new smartphone.[23] Interviews with manufacturers also confirm the risk of consumer backlash associated with unbundling the EPS.[24] The policy initiative would thus also come with a cost to consumers.[25]

2.2.2 Ensuring that consumers are informed can benefit consumer convenience

The proposed regulation states that information must be provided to consumers regarding charging performance characteristics and the power delivery of the charging device that can be used with the mobile phone (or similar item of radio equipment). The required information includes the minimum power required for charging and whether the device supports fast charging.[26]

There is some evidence supporting the fact that such an information scheme could provide benefits to consumers since 55% of consumers are not fully aware of existing interoperability (e.g., do not know that the charger for their tablet can also be used for their smartphone).[27] Providing better

[23] European Commission (2021), (a), p. 14.
[24] *"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."* European Commission (2021), p. 18.
[25] Even after being informed about the environmental impacts of chargers, 71% of surveyed repondents still thought it was important to have the EPS in the box: *"Knowing [the environmental impact of chargers] changed slightly the extent to which they think having a charger in the box is important. The number of respondents who thought it is important to have an EPS decreased from 82% to 71%."* European Commission (2021), (a), p. 18.
[26] European Commission's proposal, p. 3 and Annex, p. 1-2.
[27] Ipsos (2021), Annex C.

information to consumers could reduce the frequency of consumer convenience issues and/or lead to consumers buying fewer chargers.

As with unbundling of the EPS, we note that this policy initiative would still need to be designed carefully in order to achieve the intended benefits. The Commission assumes that compliance with information requirements would entail no significant costs for manufacturers.[28] However, no thorough assessment regarding the impacts of mandating information requirements has been conducted[29], and the information requirements could be associated with substantial costs if not implemented carefully.

The regulation should allow information requirements to be satisfied via e-labelling
In practice, allowing information requirements to be fulfilled electronically could prevent significant unintended compliance costs and would ensure that consumers could actually access the information when they need it.

First, it could be very costly to comply with labelling on the packaging across many jurisdictions. The Annex of the proposal specifies that the required information must be printed on the packaging[30] and "*shall be in a language which can be easily understood by consumers and other end-users, as determined by the Member State concerned, and shall be clear, understandable and intelligible.*"[31] Requirements to provide the information in each Member State's language on every package could increase production costs substantially and would create obstacles to the Single Market since manufacturers would have to repackage their products to be able to sell them in another European country.[32] Allowing information requirements to be fulfilled electronically, for instance within the software of the device (a so-called 'e-label') or online, would substantially reduce compliance costs.

Second, labelling on the packaging would in any case not necessarily capture the intended benefits since consumers do not necessarily see or look at the packaging before purchase (e.g. if/when they buy online). Moreover, consumers may throw away the package after the purchase and hence not have the information available when they buy a new charger. In the interviews with various stakeholders conducted by Ipsos as part of its 2021 impact assessment, some stakeholders questioned the effectiveness of information schemes with reference to previous experience and market research showing that *"consumers tend to pay very little attention to logos"*.[33] Allowing information requirements to be fulfilled electronically might thus increase the probability that consumers could access the information when they need it.

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28 *"Adding the measure on providing information to consumer about the charging performance as a flanking measure is expect to have negligible costs. In fact, under the RED, manufacturers are already obliged to provide information (Article 10(8)). Only the costs to make it more visible are to be accounted, but – if sufficient time is provided – this will fall under the business as usual, as new packaging and new instructions are always designed by the industry",* European Commission (2021), p. 40.

29 Ipsos assessed only a voluntary interoperability labelling/information scheme, under which compliant EPS and phones would carry the label but manufacturers would also be free to use proprietary technologies and not participate in the scheme. Ipsos (2021).

30 Or, in the absence of packaging, on a visible label accompanying the radio equipment.

31 European Commission's Annex to the proposal for the Directive, p. 1-2.

32 We note that this added need for repackaging could also have a negative impact on the environment.

33 Ipsos (2021), p. 45.

2.2.3 Standardisation of charging protocols can benefit consumers and the environment

Standardisation of charging protocols would ensure that all mobile phones incorporate communication protocols that are compatible with USB-C (at the EPS or the device) and USB PD, for devices that can charge at over 15 W (fast charging).[34]

There is evidence to suggest that this policy initiative could benefit the environment and consumers. The policy initiative would, according to the impact assessments, benefit the environment by reducing the sales of standalone chargers (EPSs and cables) to consumers. This impact is based on the assumption that the share of chargers that can provide fast charging to any phone would increase and therefore that the number of consumers who buy a new charger because they want faster charging would decrease.[35] According to Ipsos, implementing this policy initiative alone would thus reduce stand-alone EPS sales by 4% by 2030 compared to the baseline scenario. While cables would not be directly affected by this initiative, there is an indirect effect due to the fact that EPSs and cables are often sold in bundles. Cable sales are thus expected to decrease by 3.1% by 2030 compared to the baseline.[36]

The policy initiative could also lead to a small improvement in consumer convenience since 11% of consumers have experienced not being able to charge their phone as fast with other chargers at least on numerous occasions during the two years preceding June 2019.[37] [38]

According to the impact assessments, the main drawback related to mandating a common charging protocol is that it could lead to a significant change in lower tier, typically non-fast charging phones.[39] Since it is not possible to have USB-PD compatibility with Micro-USB ports, this initiative would essentially (even in the absence of the initiative to specify a common device-end port, such as 'policy option 3') eliminate Micro-USB connections on new phones and cables sold with these phones.[40] Furthermore, mandating a common charging protocol could increase costs for manufacturers, even when applied in combination with specification of the device-end port, since not all USB-C cables support USB-PD.[41]

2.3 INTEROPERABILITY AT THE EPS END WOULD DELIVER GREATER BENEFITS THAN A COMMON DEVICE-END PORT

The Commission has ultimately proposed what is referred to in the underlying Impact Assessment as 'policy option 5'. This package (or 'bundle') of initiatives includes not only the three policy initiatives described in the previous section, i.e., those included in 'policy option 3', but also the regulation's headline initiative, which is to specify a common device-end port (USB-C).

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34 Ipsos (2021), p. 36.
35 Ipsos (2021), p. 70, 80, 97 and 103 (pdf).
36 Ipsos (2021), p. 216 (pdf).
37 Ipsos (2019), p. 175.
38 Although we note that the regulation would not necessarily reduce the share of consumers that experience this issue to 0 since the policy initiative would not ensure that all EPSs will deliver the same experience (including e.g. old EPSs).
39 Ipsos (2021), p. 94.
40 Ipsos (2021), p. 65 and European Commission (2021), p. 40-41.
41 Ipsos (2021), p. 26.

By specifying a common device-end port, the proposal aims to achieve charger interoperability, and it does so by focusing on the device end of the charger (whilst manufacturers can still choose which port to install in the EPS).

As described in section 2.2, the three policy initiatives included in 'policy option 3' could potentially generate benefits to consumers and to the environment without generating substantial harm (noting the caveats described in the previous section, e.g., in relation to the careful implementation of information requirements).

In this section, we assess the available evidence and find that adding the initiative to specify a common device-end port would not deliver any meaningful benefits to the environment or to consumers and would in fact lead to substantial consumer harm by undermining innovation in wired charging.

We suggest that it would be less intrusive and more impactful to achieve increased charger interoperability by focusing on the EPS since there would be fewer constraints for manufacturers associated with integrating any common port to the EPS, and because an EPS produces far more e-waste than a cable.

2.3.1 Specifying a common device-end port will not deliver positive impacts

In this section, we evaluate the incremental effect of adding the fourth policy initiative – specification of a common device-end port – on top of the three other policy initiatives, as described in the previous section. We find that adding the initiative to specify a common device-end port generates:

- No substantial benefits to the environment
- No substantial benefits to consumer convenience
- No substantial benefits relating to consumer costs
- A substantial negative impact on innovation which ultimately harms consumers

The limited benefits of this policy initiative were also acknowledged by Ipsos:

"[Specification of a common device-end port] 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."[42]

And by the RSB:

"In particular, the harmonization of the charging connector in the devices would have limited benefits for consumers, combined with negative economic and environmental impacts."[43]

In the following sections, we describe the impacts in more detail.

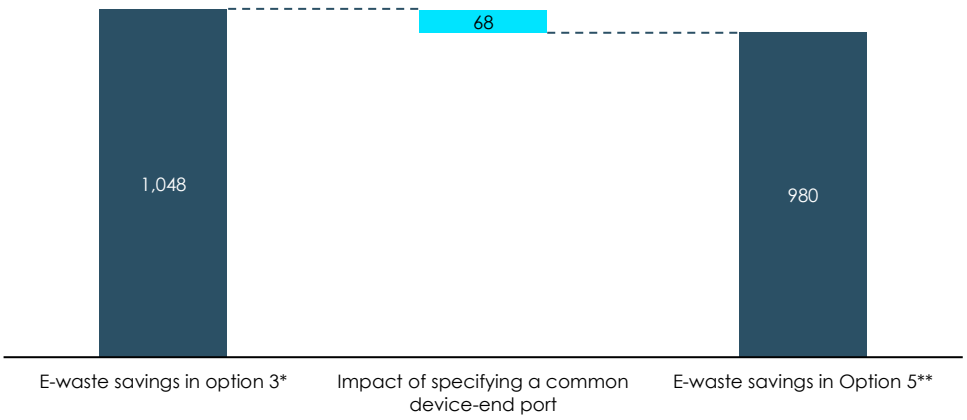
No substantial benefits to the environment

[42] Ipsos (2021), p. 9.
[43] RSB (2021), p. 2.

In the fact sheet on the 'common charger' proposal published by the Commission, it states that a common charger will reduce e-waste by about a thousand tonnes annually.

However, the 'common charger' part of the proposal – if understood as the initiative to specify a common device-side port – does not contribute to any reduction of e-waste. In fact, adding device-end specification to the proposal implies, according to the Impact Assessment, that the e-waste savings generated under 'policy option 3' are reduced, see Figure 3.

Figure 3
Specification of the device-end port slightly decreases annual e-waste savings
Estimated savings of annual average e-waste from EPS and cables in the EU, 2024-2030 (tonnes)



Note: *This corresponds to the broad option 3 in the Commission's 2021 impact assessment and the broad package 4 in Ipsos' 2021 impact assessment. The option also includes support of the relevant charging protocol on the end-device and informing consumers about charging performance, but the incremental environmental impact of this is close to zero. **This corresponds to policy option 5 in the Commission's 2021 impact assessment, which is equivalent to package 5 in Ipsos' 2021 impact assessment.
Source: Ipsos (2021), table 31 and p. 231 (pdf)

The thousand tonnes of e-waste that the Commission refers to in its fact sheet are thus mainly a result of mandating unbundling of the EPS (see section 2.2.1) and have nothing to do with specifying a common device-end port. This was also recognised in Ipsos' impact assessment:

"From an environmental perspective, unbundling is the only intervention that offers major benefits."[44]

It is unsurprising that this initiative does not bring any environmental benefits since it is not expected to reduce the number of chargers that people have.[45]

Furthermore, Ipsos' estimate of the increase in additional e-waste associated with specifying a common device-end port is likely an underestimate since it does not account for the fact that existing

44 Ipsos (2021), p. 22.
45 Ipsos (2019), p. 79.

accessories with proprietary interfaces (such as Lightning) would prematurely become obsolete.[46] We find that if all iPhone users in the EU were to dispose of their prematurely obsolete Lightning cables, this would generate around 426 tonnes of additional e-waste per year during 2024-2030, see Appendix A for more details on the calculations.[47]

No substantial benefits to consumer convenience

The Commission has identified four main problems relating to consumer convenience. Three out of the four problems are already mainly addressed under the policy initiatives included in 'policy option 3'. Adding the initiative to specify a common device-end port thus addresses only one of the four problems, which is lacking access to a compatible charger, see Table 2.

Table 2
Device-end standardisation mainly addresses one out of the four identified consumer inconveniences

IDENTIFIED INCONVENIENCE	POLICY ISSUE MAINLY ADDRESSED VIA SPECIFICATION OF DEVICE-END PORT?
Inability to charge certain devices (as fast) with certain chargers	No - mainly addressed through the common communication protocol
Too many chargers	No - mainly addressed through unbundling of the EPS
Confusion about which charger works with what	No - mainly addressed through information requirements
No access to a compatible charger	Yes – in certain situations

Source: Copenhagen Economics

Even this inconvenience issue is, according to Ipsos' impact assessment "a relatively infrequent occurrence" and Ipsos acknowledges that addressing the issue would provide only "minor benefits" to consumers.[48] In practice, according to Ipsos' survey (2019), only 4% of consumers have experienced lacking a compatible charger either "on numerous occasions" or "almost daily" within the past two years.

It also is not a foregone conclusion that all consumers would value having a USB-C port on all devices. Indeed, if all consumers did value having a USB-C port on all devices highly enough, then it would be profitable for manufacturers that currently use proprietary or micro-USB ports to make the switch to USB-C even in the absence of regulation. The RSB also noted that it is problematic to disregard these revealed preferences of consumers:

"The report should take into account that consumer preferences are not homogeneous, which is reflected in their buying behaviour. It should justify why it considers some of these revealed consumer preferences as problematic. It should also provide evidence on the problems related to current business models that privilege proprietary solutions over interoperability."[49]

46 European Commission (2021), (a), p. 38. *"The environmental impacts of disposing all accessories with proprietary interfaces, and their replacement by USB-C is unfortunately difficult to estimate because, as highlighted by the surveys, consumers tend to hold on to out-of-use accessories quite a long time before disposing them."*

47 The actual increase in e-waste would likely be even larger since this estimate does not account for the premature obsolescence of other Lightning-compatible accessories, such as headphones.

48 Ipsos (2019), p. 80 and Ipsos (2021), p. 93 and p. 97.

49 RSB (2021), p. 2.

No substantial benefits relating to consumer costs

The Impact Assessment finds that the specification of a common device-end port will generate consumer savings of around €250 million per year.[50][51]

However, upon further inspection, we find that this calculation is flawed for three key reasons.

First, the estimate of consumer cost savings is based on the untenable assumption that Lightning cables break more frequently than USB-C cables. The only source provided for this is the consumer survey conducted by Ipsos in 2019, which showed that iPhone users on average buy more cables than other consumers, and the separate but unrelated finding that the most common reason for buying a new charger in general was a broken cable.[52] However, it should be apparent that there could be many other reasons why iPhone users would buy more cables. It may, for example, be the case that Apple users are more likely to appreciate the convenience of having multiple chargers.[53] It may also be due to Apple having a large ecosystem of Lightning accessories with which Lightning cables are used. Ipsos itself reports that: *"respondents whose main phone was from Apple reported using slightly more chargers than users of other brands: 2.1 EPS (vs. 1.7 for other brands) and 2.5 cables (vs. 2.0 for other brands)"*[54] – which shows that Apple users do actually have 25% more cables than other users.[55] Correcting for the flawed assumption that converting to USB-C ports would lead to fewer cables being bought, the estimated consumer savings of introducing a common device-end port are more than halved to €135 million, see Appendix A for details on the calculations.

Second, the Commission's impact assessment calculation has not accounted for the fact that the specification of a common device-end port would make some existing cables prematurely obsolete – and that consumers would thus face costs from having to replace these cables. The Impact Assessment acknowledges that consumers would face costs from the change of interface, but claims that it is not possible to quantify these costs due to a lack of precise data.[56] While there is indeed no precise data on the exact consumer costs that would be associated with a change of interface, it is nevertheless possible to perform a simple back-of-the-envelope calculation based on the information provided in Ipsos' impact assessment to approximate the consumer costs resulting from the premature obsolescence of Lightning cables. Based on such a calculation, we find that the cost increase for consumers due to the premature obsolescence of Lightning cables would be around €135 million per year, see Appendix A for details on the calculation. In other words, these costs would almost exactly offset the €135 million of consumer cost savings that remained from the Impact Assessment estimation, when correcting for the mistake mentioned in the previous paragraph.[57]

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50 European Commission fact sheet(2021)

51 Specification of the device-end port alone in relation to mobile phones generates cost savings of €549 million. However, the estimated cost savings are lower (€246 million) when device-end specification is implemented in addition to the policy initiatives included in 'policy option 3' and applied to all devices. The components of the €246 million of consumer savings in option 5 are not disclosed.

52 Ipsos (2021), p 78 and Ipsos (2019) p 99

53 Ipsos does not present how many cables Micro-USB users buy on average, which would have offered a relevant comparison.

54 Ipsos (2019), p 99

55 Moreover, even if the Commission were correct in assuming that Apple's cables break more often, there would be no reason to expect that Apple's USB-C cable (which would be provided in the box) would break any less often.

56 In particular, the Impact Assessment acknowledges that the costs will occur but excludes them because it is not possible to determine *when* they will materialise: *"In the absence of precise data it is therefore not possible to quantify at which moment in time the consumers will have a break even between the (temporary) costs incurring from the change of interface and the (permanent) reduction of prices."* European Commission (2021a), p. 37.

57 It should also be noted that the increased cable sales due to premature obsolescence would, in addition to the impact on consumer costs, also have a positive impact on charger manufacturers and distributors' profits. We have not quantified this impact.

Third, the Impact Assessment's savings are in any case based on the relatively thin assumption that the policy initiative would lead to consumers buying cheaper cables – because the average USB-C cable is cheaper than the average Lightning cable.[58] There is no guarantee that the regulation would indeed lead to consumers buying cheaper cables. The current list prices on Apple's website for Lightning and USB-C cables are the same[59], and Apple users might continue to buy more expensive USB-C cables, e.g., if they consider Apple's cables to be of higher quality or if they simply prefer the Apple brand. The consumer savings estimated from the elimination of more expensive Lightning cables are thus likely overestimated.

A substantial negative impact on innovation which ultimately harms consumers

Beyond the more 'direct' impacts mentioned above, there is also the risk that mandating a specific common standard for the device-end port would have a large negative impact on innovation in wired charging technology, which would ultimately harm consumers.

Without the ability to differentiate from competitors by implementing newer and better wired charging technologies, device manufacturers would have a reduced incentive to invest in innovation. This implies that new and improved wired charging technologies would take longer to be developed and reach the market, which would cause substantial consumer harm.

Ipsos recognises in its impact assessment that there would be a risk of a "*major negative effect*" on future innovation in device-end ports by a) preventing game-changing proprietary charging port technology, e.g. the introduction of a 'USB-D' standard, and b) reducing the pace of incremental innovation, i.e. improvements within e.g. USB-C.[60]

Ipsos also notes that USB-C is already at a relatively mature stage of its life cycle, which implies that it is possible that a next-generation standard would appear in the coming years in the absence of regulation:

"The only significant concern [associated with defining USB-C as the common device-end port] 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."*[61] (our emphasis)

While the proposed directive only applies to EU member states, the size of the EU market is large enough that it could preclude or delay manufacturers from investing (as heavily) in the developing new wired technologies.[62]

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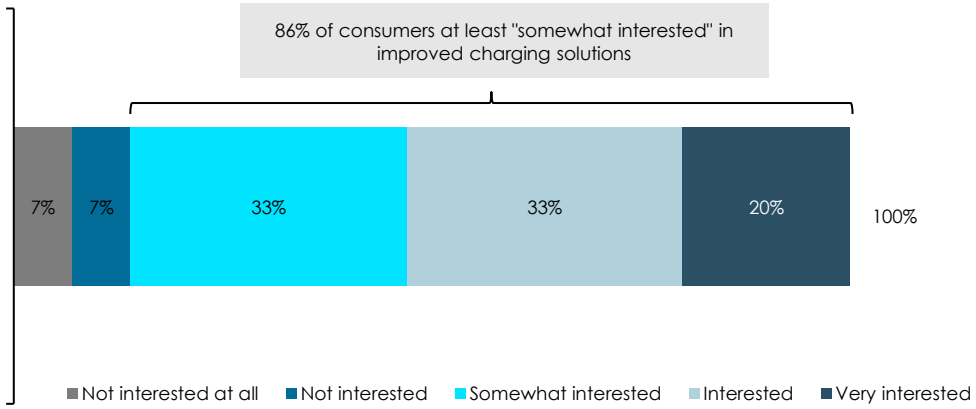
58 European Commission (2021a), p. 37 and Ipsos (2021), p. 140 (pdf).
59 Apple: power and cables,
60 Ipsos (2021), p 79.
61 Ipsos (2021), p 105.
62 Ipsos (2021), p 61.

A Copenhagen Economics survey (2019) found that innovation in charging is something that is otherwise valued by European consumers. 86% of consumers have an interest in innovation and improvements to the charging experience for mobile phones, and 20% of consumers are very interested in such innovation, see Figure 4.

Figure 4
Consumers are interested in future charging innovation and improvements
Share of respondents



Note: Survey question: Consider your current enjoyment and convenience of using mobile devices. How interested are you in more innovation and improvements in your charging experience of mobile devices in the future?
Source: Copenhagen Economics (2019)

The same survey showed that European consumers place a large value on innovations in wired charging. The average consumer would require an 18% discount to buy a device, which was exactly the same as his/her current device with the exception that it had an older device-end port (e.g. a new phone but with micro-USB instead of USB-C). This discount implicitly reveals consumers' willingness to pay for further improvements in wired charging.

Based on these results, the total consumer value of modern device-end ports compared to older ports generated during 2012-2018 is estimated to €14 billion in the EU.[63] This indicates that the potential consumer harm which would be derived from blocking or delaying innovation in wired charging technologies would be substantial.

As a side point, we note that the regulation of wired charging in a way that prohibits the use of proprietary technology also sends a signal to the market that there could be similar regulatory intervention in other areas. If manufacturers are worried that innovation in wireless charging technologies will be subject to regulation in the future, then this regulation thus already impacts their incentives to invest in developing wireless technologies today (i.e., an indirect chilling effect on innovation in wireless charging technologies).

63 Copenhagen Economics (2019), p. 38-39.

2.3.2 Focusing on the EPS end would be less intrusive and more impactful

The Commission's proposal aims to achieve more interoperability and/or compatibility of chargers with various devices by focusing on the device end of the charger. This contrasts with the Commission's other policy initiative of unbundling, which applies to the EPS but not to the cable, see Figure 5.

Figure 5
The Commission's proposal imposes restrictions on different parts of the charger

	EPS	CABLE & DEVICE-END PORT
UNBUNDLING	X	
STANDARDISATION		X

Source: Copenhagen Economics

There are currently two parallel standards for the EPS-end port: USB-A and USB-C. In terms of achieving increased charger compatibility, it would be both less intrusive and more impactful for the Commission to focus its efforts on the EPS end, see Figure 6.

Figure 6
A more impactful and less intrusive approach would focus on the EPS end

	EPS	CABLE & DEVICE-END PORT
UNBUNDLING	X	
STANDARDISATION	X	

Source: Copenhagen Economics

First, focusing on achieving standardisation at the EPS end would be less intrusive for device manufacturers because any standard could more easily be integrated into any device (since manufacturers have fewer concerns on the EPS end in terms of space, form factor, water resistance, durability, etc.). Standardisation at the EPS end thus would not as substantially undermine innovation in wired charging technologies or drive as many additional costs.

Second, focusing on the EPS end would bring more benefits to the environment as the EPS is the heaviest part of the charger. It is thus more impactful to reduce the number of EPSs per household rather than the number of cables per household – something implicitly acknowledged by the fact that the Commission pursues unbundling of the EPS and discards the idea of unbundling the cable (an option otherwise considered by Ipsos).

Third, by focusing on the EPS, charger interoperability could potentially apply to an even broader set of devices, including, for example, laptops.

2.4 CONSUMERS WOULD BENEFIT FROM A MORE FUTURE-PROOF APPROACH TO ACHIEVING A COMMON DEVICE-END PORT

As explained in the previous section, we find that the specification of a common device-end port would bring few benefits but would be associated with substantial consumer harm.

In this section, we explain how, if the initiative to specify a common device-end port continues to be developed despite the evidence discussed in the previous chapter, an adjustment to the regulation approach could in any case be made to further the policy objectives and reduce negative consequences to consumers and the market.

The currently proposed approach of achieving a common device-end port by specifying a certain version of the USB-C standard in law is likely to harm consumers by delaying the introduction of both game-changing innovation (e.g. a 'USB-D' standard) and incremental improvements (updates to the USB-C and USB PD standards, of which there have already been several) for several years, relative to market developments around the world. In this section, we suggest an alternative and more future-proof approach to regulation which could benefit consumers by at least 10.3 billion EUR, equivalent to 23 EUR per person in the EU.

2.4.1 The current approach will delay the introduction of both game-changing and incremental improvements

The September 2021 proposal – which is to specify a certain version of the USB-C standard in law via an Annex to the regulation – is likely to harm consumers by substantially delaying the introduction of both game-changing innovation (e.g. a 'USB-D' standard) and incremental improvements (e.g. updates within the USB-C standard).

This concern was also noted by the RSB:

"The report should better explain how the options are future proof. It should be more specific on how the imposed standards will be kept up to date. It should be specific on what USB power delivery standard it will include, as the newest standard supports higher power use than described in the report."[64]

The RSB also requested more clarity on how standards would stay up to date to avoid impeding innovation:

"The options [...] remain vague on the way to ensure that imposed standards stay in line with technological developments and do not prevent innovation."[65]

64 RSB (2021)
65 RSB (2021)

As it is today, the standardisation body USB-IF regularly provides technical updates to the specification of standards, such as USB-C, via engineering change notices (or 'ECNs'). Updates to the standards improve, among other things: reliability, performance, interoperability, electromagnetic compatibility, backwards and forwards compatibility, and cost-effective implementation. Once a sufficient number of ECNs have been accumulated, USB-IF releases a new revision of the standard. There have been seven revisions of the USB-C standard since 2014. Device and accessory manufacturers can incorporate updated specifications as soon as they are published.

As per the September 2021 proposal, industry players would not be allowed to incorporate any updates to the standard immediately. Instead, the industry would have to wait for the update to first be transposed from USB-IF to the international standards body IEC, then to the European standards body EN, and then finally for the Commission to update the Annex to the regulation via a Delegated Act procedure. This process could take several years.

Indeed, the September 2021 proposal is poorly aligned with the principles of standardisation more generally since the regulation does not state that manufacturers must comply with the entire USB-C standard but focuses more narrowly on achieving the same device-end port. As noted by the standardisation body USB-IF in its consultation response, this means that the proposed approach will not be effective.[66]

Device manufacturers would, due to the regulation, in the meantime be forced to comply with an outdated version of the standard for the European market while waiting for the Commission to update the law. Moreover, there would be no guarantee that all revisions to the standard made at USB-IF would make it through the entire IEC to EN to Delegated Act process.

As explained by European standards organisation CENELEC:

"By making compliance mandatory to two specific dated versions of EN IEC 62680-1-2 and EN IEC 62680-1-3, there might be, in the future, a risk of disconnection between the latest versions of the standards and the editions referenced in the legislation. Therefore, there is a risk that users may not benefit from products that would apply the latest state of the art. […] referring to specific dated standards in the proposal could create a gap between the most recent technology and the regulation and, therefore, with a risk of becoming an obstacle for innovation, or resulting in an outdated regulation."

The issue of this legal process causing a delay in innovation reaching the market is exemplified by the fact that the September 2021 proposal is already outdated. It refers to Revision 2.0 of the USB-C standard, published in August 2019, whilst Revision 2.1 was released in May 2021.

If this regulation had been imposed over ten years ago when a 'common charger' was first being discussed, the market would most likely have been stuck with Micro-USB for a longer period, even after USB-C had become available.

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66 *"The proposal focuses on only certain aspects of the USB standards (e.g., the physical USB Type-C® receptacle, charging protocol only for over 15W). However, the USB-IF standards are meant to be implemented in their entirety to ensure common charging interoperability and backwards compatibility unless an optional feature is defined in the standards. Given that USB-IF's standards are holistic documents that exist in a larger framework of other standards, <u>any requirements derived from them must remain in their complete context in order to be effective.</u>"* (our emphasis underlined)

In practice, the proposed approach to achieving standardisation would thus be associated with two main sources of harm:

1. **Delayed introduction of a new standard:** A next-generation common standard (e.g. a 'USB-D' standard) would take longer to reach the market[67]

2. **Delayed incremental improvements within a standard**: Gradual improvements within a standard (e.g. the USB-C standard) would take longer to reach the market

2.4.2 Instead of specifying USB-C in law, the Commission could mandate the principle of standardisation

The proposal could – instead of micro-managing the industry by legally specifying the device-end port which must apply – choose to mandate the broader principle of standardisation, e.g. by appointing a standardisation body (such as USB-IF, or a European standardisation body) to identify the common charging standard (including a common device-end port) with which all manufacturers must conform – allowing for this common standard to be flexibly updated over time.

Although new wired charging technologies would likely still take longer to reach the market in this case relative to the baseline with no regulation (in which competition between manufacturers would incentivise continued investment and innovation in wired charging technologies), this approach would at least allow any innovation that does take place to reach the market with less delay.

European standards organisation CENELEC suggests such an approach:

"CENELEC supports the use of the New Legislative Framework approach (i.e. citation of ENs in the OJEU to provide presumption of conformity) through the use of voluntary standards to demonstrate presumption of conformity with the legal requirements (in particular to cope with the evolution of the ENs)."

2.4.3 The consumer benefits associated with a more future-proof approach to regulation would be over 10bn EUR

In this section, we estimate the consumer benefits associated with implementing the approach described in section 2.4.2 relative to the currently proposed approach. This is a novel, initial calculation based on market data, existing literature and own assumptions, all reported below. We welcome further research and suggested evolutions to this initial calculations and believe that quantifying this type of impact is necessary for a full impact picture of these policy proposals.

We estimate the consumer benefits associated with the more future-proof approach to achieving standardisation to be **10.3 bn EUR**. This estimate of consumer benefits is conservative as it accounts only for the benefits of avoiding delayed innovation for mobile phones. Extending the calculation to include other devices would lead to even greater benefits.

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[67] A new standard would be delayed both because it would have to go through the same legal process as an incremental update but also because this legal process might be even more cumbersome in the case of an entirely new standard, where the Commission might have to also implement a transition period and/or make an administrative decision on when/whether to implement the new standard.

In the following, we describe the calculations, data and assumptions used for the estimation of consumer benefits in three steps.

Step 1: Consumer value of innovation
Consumers place a significant value on having the most modern chargers for their devices. When asked about what discount consumers would require for them to choose to purchase a mobile device that uses an older charger type instead of a modern one, 92 per cent stated that they would require at least some discount. On average, consumers would require an 18 per cent discount to accept an older charger type.

This discount implicitly reveals consumers' willingness to pay for an improvement upon a previous standard, e.g. the benefits of moving from micro-USB to USB-C. We assume that this willingness to pay is comparable to the benefits that will/could be achieved by moving from USB-C to an as-of-yet unspecified next-generation 'USB-D' standard. This implies that consumers place a 21.5 percent[68] value on getting access to a more modern type of device-end port (where the 21.5 percent corresponds to total increase of the willingness to pay for a device with a newer charging technology, or alternatively the higher consumer surplus from getting a device with newer charging technology at the same price).

We do not have direct evidence regarding the willingness to pay for incremental improvements within a standard, i.e., the extent to which consumers would be willing to pay more for a device which employed a newer iteration of the USB-C standard (which might be associated with improved reliability, improved dust resistance, etc.). It is likely that the willingness to pay for such an incremental innovation within a standard would be much lower than the full 'jump' in value from one standard to the next of 21.5 percent.

In this analysis, we assume that the value of the sum of all incremental innovations within a standard is equal to half of the value associated with the larger jump from one standard to the next, i.e. 10.7 percent. This 10.7 percent value would be achieved across multiple smaller steps over the life cycle of a standard as it is updated multiple times via multiple revisions. Based on the life cycle of standards in the past, we assume that a standard life cycle is 8 years, resulting in an average 1.3 percent increment in device value per year due to incremental wired charging innovations. In other words, holding the price of the device constant, we assume that devices become 1.3 percent more valuable per year due to incremental improvements in charging technology.

Step 2: Consumer value of innovation over time in the baseline scenario
In order to calculate the difference in consumer value between the Commission's proposed approach and the alternative future-proof approach to regulation it is necessary to define:

- The relevant time horizon
- The timing of the introduction of new game changing innovation in each scenario (and most importantly, the *difference* in timing)
- The timing of the introduction of incremental innovations in each scenario (and most importantly, the *difference* in timing)

[68] The 18 percent refers to the willingness to pay (WTP) for an old charger compared to the current charging solution. Conversely, the WTP for a new charger is 21.5 percent (= [100/82.3]-1).

We set the relevant time horizon for our assessment to 2024-2030, corresponding to the time horizon used in the Commission's and Ipsos' impact assessments.[69] We assume that the regulation becomes applicable in 2024.

The timing of new game-changing innovation and incremental innovations differs between the currently proposed approach and our alternative approach. For the purposes of our analysis, we make assumptions on when innovations would be introduced for each approach, see Table 3.

Table 3
Overview of assumptions for assessed regulated approaches

	ALTERNATIVE APPROACH: MANDATED STANDARDISATION	CURRENTLY PROPOSED APPROACH: SPECIFYING DEVICE-END PORT BY LAW
Introduction of a new standard	*Assumption:* The next-generation wired charging standard ('USB-D') is assumed to reach the market **in 2028**. *Explanation:* Although innovation is delayed relative to the counterfactual of no regulation (due to a lack of competition between manufacturers that are no longer incentivised to invest in new wired charging technologies), there are no administrative or legal hurdles associated with delivering a new standard to the market.	*Assumption:* The next-generation wired charging standard ('USB-D') is assumed to reach the market **in 2030**. *Explanation:* The new standard, developed in 2028, would take two additional years to reach the market due to the legal process of transposing the standard to the relevant standardisation body and implementing it via a Delegated Act. In the meantime, device manufacturers would be forced to comply with USB-C (in Europe, at least).
Incremental improvements	*Assumption:* Incremental improvements (of 1.3 percent per year) occur on a yearly basis **from 2024.** *Explanation:* Incremental innovation is generated and released annually.	*Assumption:* Incremental improvements are captured in one go in 2027 – two years late – when the version of the USB-C standard which was otherwise available in 2025 finally makes it into law. *Explanation:* The Commission only decides to implement one batch of incremental updates to the USB-C standard. The 2025 version of the USB-C standard (according to the USB-IF documentation) makes it into law in 2027. The next update that the Commission implements is the 'USB-D' standard (described above). Our approach is conservative in assuming that the version of the USB-C standard which was available in 2024 is implemented in the regulation – when in fact the initial version of the regulation might already be outdated.

Note: The introduction of a new standard 'USB-D' arrives later in both cases since there is no competition between manufacturers. Hence, we assume that the new innovation is introduced in 2028 instead of "mid-2020s" as projected by Ipsos in the no regulation outcome.
Source: Copenhagen Economics

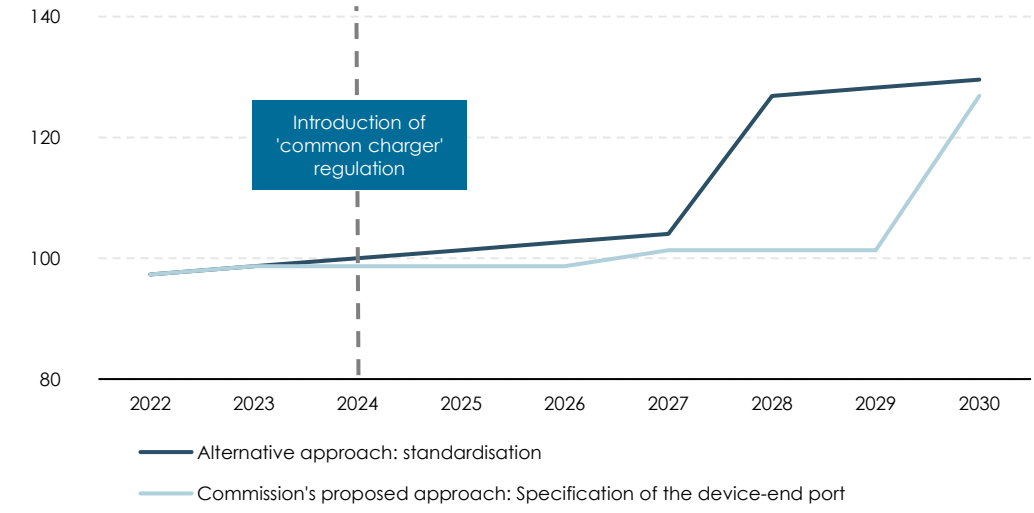
[69] Ipsos (2021)

In Ipsos' impact assessment, it is stated that without regulation a new game-changing innovation might be introduced in the mid-2020s.[70] For the purposes of our modelling, we have assumed that the lack of competition between manufacturers due to the specification of a common standard in both scenarios would undermine the incentives to innovate, meaning that a new standard would not be introduced until 2028 at the earliest. Furthermore, we assume that the legal process of transposing the new standard to the regulation would take a further two years, meaning that under the currently proposed approach, a standard which could be developed by 2028 would not reach the market until 2030 – i.e., a two-year delay.

We stress that the assumption of when, exactly, a new standard would be developed and released in a world where there is regulation mandating a common standard is not a central assumption to the scale of our modelling results.[71] The central assumption concerns the *delay*, i.e., how much longer consumers have to wait for 'USB-D' due to the regulatory approach, where we have assumed two years.

Since the new game-changing innovation is introduced earlier when mandating the principle of standardisation relative to specifying the device-end port in law, consumers are better off in the counter-factual with a more future-proof regulation. The benefit associated with ensuring that innovation reaches the market can thus be illustrated by the (discounted value of the) difference between the two time series, see Figure 7.

Figure 7
Consumer value of new devices accounting for innovation in wired charging technologies (holding device price constant)
Index (100 = 2024)



Source: Copenhagen Economics

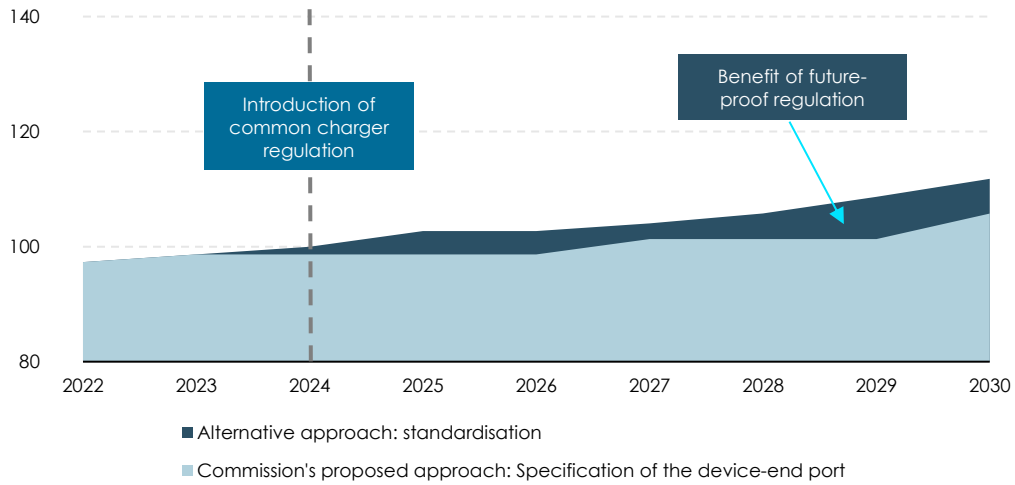
[70] Ipsos (2021), p.101.
[71] For instance, holding the two-year delay constant and assuming that USB-D could be released by 2027 under the future-proof regulation approach, and 2029 under the currently proposed approach, would yield very similar results.

This index is informative for the change in indexed consumer value of the best and newest devices available over time in both scenarios, as a function of innovation in wired charging technologies. However, this index does not capture the fact that it would take time for new innovations to reach all smartphones sold in the market – even when these new innovations are available. This index would thus overestimate the experienced benefits of applying future-proof regulation.

To adjust for this, we weight the index by the share of phones sold with the old standard and the new standard. The share of phones sold with the old and new standard is calculated based on the historical speed of adoption of the USB-C standard relative to Micro-USB. This means that for the total volume of sold smartphones i) consumer value is added to phones with the old standard based on the accumulated incremental innovations in the past, and ii) the 21.5 percent in consumer value and future incremental innovations is added to phones with the new standard.

The weighted index is illustrated in Figure 8 below.

Figure 8
Weighted total consumer value of new devices accounting for phase-in of new innovation (holding device price constant)
Index (100 = 2024)



Note: The index is normalised to 100 in 2024 for mandated standardisation. Since there is no incremental innovation for the Commission's proposed approach its index starts at 99 in 2024.
Source: Copenhagen Economics

Starting from the implementation of the regulation in 2024, the consumer value of innovation is consistently higher with the alternative of mandated standardisation (dark blue area). Hence, for all smartphones sold after 2024, there is on average a higher consumer value of innovation attributed to those phones with mandated standardisation than under the Commission's proposed regulation. This is what drives the benefits of the future-proof approach.

Step 3: Estimation of consumer benefits

In the following, we estimate the consumer benefits associated with implementing the future-proof version of regulation which mandates the principle of standardisation rather than specifying the device-end port in law.

First, we calculate the consumer value generated by smartphones over time, discounted to its net present value. The consumer value of smartphones generated in a given year is calculated as the product of smartphones sales and the average price of smartphones. We assume that the number of smartphones sold is 120 million per year on average for our relevant time period.[72] The average price of smartphones in the EU was EUR 373 in 2019. We assume that prices have remained constant during 2020 and 2021. All prices thereafter are discounted to its present value using a social discount rate of 4%. The parameters used in our calculation are shown in Table 4 below.

Table 4
Parameters in the calculation of consumer benefits

PARAMETER	VALUE	DESCRIPTION
A. Annual sales volumes of smart phones in the EU	120 million	The sales volumes are based on Ipsos (2021) which forecasts annual sales volumes slightly above 120 million on average for the period 2024-2030. We assume constant annual sales for the period 2024-2030.
B. Average price for smartphones in the EU	€373	The average price for smartphones in the EU is based on Statista (2019). We assume that prices have remained constant until 2021, and will remain constant going forward, although we discount the average prices on a yearly basis using the social discount rate, see below.
C. Social discount rate	4%	The social discount rate is based on the EU Better Regulatory Toolbox 61

Source: A. Ipsos (2021); B. Statista (2019); C. EU Better Regulatory Toolbox 61

Second, we calculate the total consumer value of innovation by combining the insights of all three steps. The total consumer value is the product of the net present value generated by smartphones and the weighted consumer value of innovation index per year for the period 2024-2030. The difference in total consumer value between the future-proof alternative of mandated standardisation relative to the value under the September 2021 proposal constitutes the **consumer benefit that a common-sense approach to implementing common charger regulation can unlock**.

The total difference in consumer value between the two approaches amounts to EUR 10.3 bn for smartphones alone, in net present value for the period 2024-2030, which is equivalent to approximately EUR 23 per person in the EU. This value derives from the fact that the average EU consumer would buy one or two new phones during the regulatory period and that there is a reasonable likelihood that their phone(s) would provide a better wired charging experience under the future-proof approach.

Since this initial calculation accounts only for smartphones and because the regulation also encompasses other devices than smartphones, the above estimate is a lower bound for the consumer benefits of avoiding delayed innovation in wired charging technologies.

[72] This is in line with Ipsos (2021) which estimates that smartphone sales are declining towards 120 million sold units in 2030.

We do not have direct evidence of the consumer value of innovations for other devices than smartphones. Nonetheless, assuming consumers put the same relative value on new and incremental innovations within wired charging for other devices, it is possible to appraise the size of benefits also for other devices. We estimate that **the consumer benefits from minimising the delay of innovation for other devices (tablets etc.) would be an additional EUR 4.8 bn, yielding a total consumer benefit of approximately EUR 15.1 bn when including all devices**.

This is based on the same method as the one used for smartphones, scaled by prices and volumes for other devices, see Table 5 below. The weighted average of the indexes for prices and volumes for other devices than smartphones is 47 percent.[73] This scaling factor is thereafter directly applied to the total consumer benefit of avoiding a delay in the implementation of charging innovations for smartphones.

Table 5
Price and volume relation of other devices to smartphones

TYPE OF DEVICE	PRICE INDEX (INDEXED TO SMARTPHONES)	SHARE OF TOTAL SALES VOLUME
Smartphones	100.0	64%
Tablets	68.5	11%
Hearables	13.0	12%
Digital cameras	95.3	3%
Handheld video game consoles	53.9	9%
Portable speakers	18.3	1%

Note: Due to limited data accessibility, the price relation index is benchmarked for Germany and applied for the entire EU.
Source: Ipsos (2021) and Statista (2019)

2.5 CONSUMERS WOULD BENEFIT FROM BEING ALLOWED TO BUY OLD DEVICES ('GRANDFATHERING')

As explained in the section 2.3, we find that the specification of a common device-end port would bring few benefits but would be associated with substantial consumer harm.

In this section, we explain how, if the initiative to specify a common device-end port continues to be developed despite the evidence discussed in the previous chapter, a second adjustment should in any case be made to further the policy objectives and reduce the negative consequences.

The September 2021 proposal includes specifying a date beyond which all devices entering the market would have to be equipped with a USB-C port. Disallowing the continued sale of old devices (so-called 'grandfathering') in this way would harm consumers because:

[73] The formula for calculating the weighted average is: $\frac{(\sum Price\ index_i \times \sum Volume\ index_i)}{\sum Volume\ index_i}$, where i denotes other devices than smartphone.

a) some consumers simply prefer to buy older models – typically devices without the most recent features, available at a lower price point, and
b) it would be very costly (or practically challenging) for manufacturers to redesign/'retrofit' existing models (as well as those already in the design pipeline) with a new device-end port.

Allowing 'grandfathering' would benefit consumers by at least 0.7 billion EUR, equivalent to 1 EUR per person in the EU.

2.5.1 Disallowing the continued sale of old devices will force consumers to buy more expensive devices

The proposed regulation mandates that, once the regulation enters into force, all devices entering the market must have a USB-C device-end port. Our understanding is that this would effectively prohibit the continued sales of existing models that do not have a USB-C device-end port (e.g. devices that have a Lightning or Micro-USB port).

Disallowing the continued sale of existing devices would harm both manufacturers and consumers.

First, some manufacturers would – absent regulation – continue to sell existing models with non-USB-C ports for a certain amount of time. The regulation implies that these manufacturers would be unable to do so unless significant adaptations were made to existing product lines. The cost of such changes would be significant for those manufacturers, and potentially insurmountable.[74]

Second, some consumers simply prefer to buy older models without the most recent features – typically at a lower price point. Disallowing older models to be placed on the market would mean that not all consumers would be able to buy their preferred device – and would be forced to either buy a newer and more expensive new device than what they need, or alternatively not buy a new device at all. Both potential outcomes would be harmful to consumers.

2.5.2 The final common charger implementation should allow 'grandfathering'

Allowing the continued provision of existing, older models ('grandfathering'), at least until their natural phasing out of the market, would benefit both manufacturers and consumers.[75]

We thus propose an alternative specification of the regulation where, if the Commission does decide to impose a common device-end port, it at least allows for the continued sale of existing models that do not comply with the standard applicable to new devices.

Allowing 'grandfathering' would be particularly necessary given that the regulation could enter into force as early as in 2024 and that manufacturers would have less than two years of warning from the passing of the regulation.

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74 Ipsos (2021), p.85-86

75 Not allowing 'grandfathering' may also be harmful for the environment as new phones typically are larger in size, especially the screen. If consumers are forced to buy larger phones this may in turn offset any environmental benefits of the regulation.

Even if two years' time would be considered sufficient for manufacturers to adjust their supply chain in order to ensure that new models, released after the regulation kicks in, can incorporate USB-C, it would not necessarily provide sufficient time to adjust devices released in the two-year transition period. Hence, many devices released in the period leading up to the regulation would use a non-USB-C port (and would have to quickly exit the market again unless 'grandfathering' were allowed or they could be updated/changed).

An alternative to allowing 'grandfathering' would be to extend the transition period to e.g. 4-5 years. This would avoid the impact on existing models and ensure that the market could transition towards a common device-end port while allow existing models to phase out naturally.

2.5.3 The consumer benefits associated with allowing 'grandfathering' would be at least 0.7 bn EUR

To illustrate the impact of allowing 'grandfathering', we quantify the harm to consumers of being forced to buy more expensive new devices. This estimated consumer harm amounts to 0.7 bn EUR, which thus conversely corresponds to the benefit of allowing 'grandfathering'. This estimate covers the benefit of allowing 'grandfathering' for smartphones – which is a lower bound as it does not account for the other device types affected by the regulation.

The sales of models with device-end ports other than USB-C

The September 2021 proposal assumes that the share of sold smartphones with charging solutions other than USB-C would decline even absent regulation, driven by the transition from Micro-USB to USB-C.

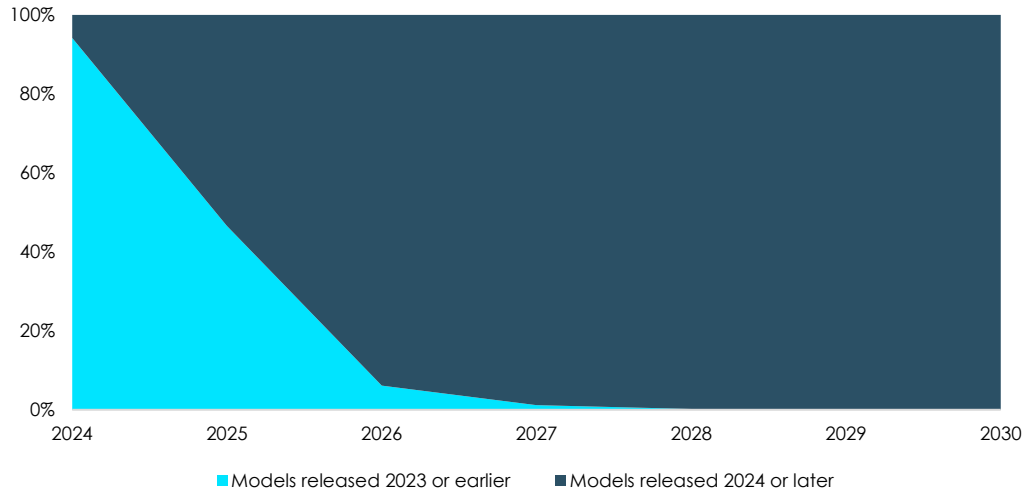
However, Apple smartphones continue to use Lightning, meaning that a sizeable portion of the market has not signalled any transition to USB-C in the absence of regulation. Furthermore, the transition from Micro-USB to USB-C is not yet concluded: a significant number of Android phones are still launched with the Micro-USB port. In 2021 alone, a total of 83 models (17.8% of all phones launched) had a Micro-USB device-end port, including devices from brands such as Samsung, Xiaomi, Motorola, Nokia and Vivo.[76]

Some consumers would, at the time that the regulation could be expected to become applicable – 2024 – and in the following years, still be buying phones released in 2023, 2022, or even earlier.

To calculate the harm associated with disallowing grandfathering (and conversely the benefit associated with allowing it), we first need to consider the share of smartphones sold each year from 2024 onwards that would be 'older models' (released in 2023 or earlier). For the purposes of our analysis, we assume that from 2028 onwards there are no older models sold, see Figure 9.

[76] GSMARENA search results for phones with 'Micro USB' released in 2021

Figure 9
The share of phones sold released before and after regulation, 2024-2030
% of total phones sold



Note: Numbers are assumptions which have been cross-checked against industry sources.
Source: Copenhagen Economics

For the purpose of identifying the benefit of allowing grandfathering, it is relevant to consider only the share of older models which have device-end ports other than USB-C – since older models with a USB-C port could still be sold without issue regardless of 'grandfathering' rules. We assume that this share is constant at 20% (reflecting the share of 2023 or earlier models sold from 2024 onwards that are either Lightning or Micro-USB)[77].

Estimation of consumer harm of not allowing grandfathering
In the following, we estimate the consumer harm of not allowing grandfathering, i.e. the currently proposed approach.

First, we calculate the cost to consumers caused by the lack of grandfathering. To be conservative, we assume that 25% of the consumers who would have bought an older phone model (with a non-USB-C port) if grandfathering were allowed, instead choose to walk away without buying anything if that is not possible.[78] These consumers are excluded from the calculation and thus do not generate any harm in our model, which is conservative since they would in fact also be harmed (by not being allowed to buy what they wanted). We assume that the remaining 75% choose to buy a new phone but are forced to buy something more expensive than what they needed or wanted. The additional cost that they pay is the price difference between the older model that they would have liked to buy (launched 2023 or prior) and the new model that they have to buy instead (released 2024 or later). We give the benefit of the doubt and assume that some of these consumers are not very upset about the forced upgrade (since they also like the features of the newer phone). On average, we assume that only half of the price difference can be considered consumer harm (where the other half is

77 These 20% would be largely driven by Apple's market share but would also include some smaller percentage of micro-USB Android phones.
78 In practice, only some consumers would have the option to postpone the purchase of a new device, i.e. only those consumers whose previous device is not broken or in need of immediate replacement.

offset by the fact that the consumer values having a newer and better device). See Table **6** for an overview of parameters used in the calculations.

Table 6
Parameters for estimation of consumer harm of disallowing grandfathering

PARAMETER	VALUE	DESCRIPTION
A. Average price for new smartphones in the EU	€373	The average price for smartphones in the EU is based on Statista (2019). We assume that prices have remained constant until 2021, thereafter we discount the average prices on a yearly basis using the recommended social discount rate.
B. Average price of older smartphone models (from 2023 or earlier) in the EU	€317	The average price for models released 2023 or earlier is based on market research of the relative prices used by manufacturers Samsung, Huawei and Apple for their 1 and 2 year-old models vis-à-vis their newest model. We apply a 15% discount on average for all models released 2023 relative to the average price of new smartphones.
C. Share of consumers who 'walk off' and don't buy a new model	25%	At least some consumers will choose not to buy a new more expensive model. Although these consumers are also harmed, they are not included in the estimation of harm. We assume 25% of consumers choose not to buy a new model.
D. Share of consumers who buy a new model	75%	The consumers who buy a new model are harmed since they would have preferred to buy an old model.
E. Share of price increase that is considered consumer harm	50%	We assume half of the additional cost of the new model compared to the old model constitutes consumer harm. This is based on the assumption that preferences are uniformly distributed among consumers who choose to buy a new phone, i.e. a proportional amount of consumers suffer the full harm and no harm – and all combinations in between.

Source: Copenhagen Economics and market research.

Second, we calculate the total net present value of disallowing grandfathering by multiplying the additional cost by the sold volume of old smartphones per year. The total harm of not allowing grandfathering amounts to 0.7 bn EUR for smartphones. Thus, conversely, the benefit of allowing grandfathering is also 0.7 billion EUR. This is a conservative estimate since our model captures only the harm associated with disallowing grandfathering for smartphones. This means that our calculation substantially underestimates the total benefits of allowing grandfathering, when considering also tablets, cameras, gaming consoles, etc.

The harm for other devices can be approximated with a scaling factor of 47% as described in section 2.4.3. In the case of 'grandfathering', it is necessary to assume a) that the relative price differential between old and new models (15%) is approximately the same as for smartphones and b) that the proportion of old models with a device-end port other than USB-C is the same as for smartphones.

This is conservative if either a) the transition to USB-C is less progressed (larger share of current and/or upcoming devices use Micro-USB or proprietary standards) and/or b) consumers tend to buy older models of devices (e.g. digital cameras, portable speakers).

Using these assumptions, the consumer benefit of also allowing grandfathering for other devices amounts to 0.3 bn EUR, bringing the total to approximately 1.0 billion EUR across all devices.

We note that our model calculates an EU average but that the average masks variation between countries, and consequently the benefit of allowing grandfathering is larger in countries or regions where a larger share would buy older versions of either Micro-USB or Lightning port devices.

2.5.4 Many manufacturers would in any case benefit from an extended transition period

The proposal currently includes a transition period of two years from the time when the regulation is passed to the time when all devices must be equipped with a USB-C port.

This timeline is important not only because it would have an impact on recently-released existing models (in the event that grandfathering is not allowed) but also because it would provide industry players with very little time to adapt their design cycles for new devices that would have to incorporate USB-C.

As highlighted by the RSB, the draft final preceding the September 2021 proposal has not done enough to consider the potential benefits associated with prolonging the transition period – a remark valid even in the September 2021 proposal itself. The RSB stated:

The report also needs to discuss possible options on transition periods and analyse their merits."[79]

In practice, manufacturers must consider several aspects when integrating a new device-end port, including integration of the port in a way that is consistent with the design and form factor of the specific model, and the combination of metals that is required to ensure high performance with USB-C (e.g., in terms of corrosion and water resistance).

These aspects could in turn warrant changes throughout the supply chain, for example adjustments in terms of relocation of manufacturing, packaging and contracting new suppliers. These adjustments are not only costly but would also require a sufficiently long transition period to avoid disruptions in the market. Ipsos explains that the costs of implementation could be offset by allowing for a sufficient implementation period:

*"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**)."* (our emphasis)

[79] RSB (2021)

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APPENDIX A

SUPPORTING CALCULATIONS

CALCULATION OF ADDITIONAL E-WASTE DUE TO PREMATURE OBSOLESCENCE OF LIGHTNING CABLES

We perform a simple back-of-the-envelope calculation to estimate the potential additional e-waste caused by the premature obsolescence of Lightning cables.

Table 7
Calculation of additional e-waste caused by the premature obsolescence of Lightning cables

PARAMETER	VALUE
Population of the EU	447 million
Smartphone penetration rate in Europe	75%
Apple's market share	17.8%
Apple users' loyalty rate (share of users who would purchase a new phone from the same brand)	90%
Number of cables that would become obsolete due to regulation*	1.5*
Average weight of a Lightning cable (estimated by Ipsos)	37 grams
$447\ million\ consumers * 75\% * 17.8\% * 90\% * 1.5 * 37\ grams = 2981\ tonnes$	
$\frac{2981\ tonnes}{7\ years} = 426\ tonnes/year$	

Note: *According to Ipsos' consumer survey, Apple users have 2.5 cables on average. Accounting for the fact that consumers receive one additional cable anyway when buying a new device, regardless of whether a common device-end port has been specified, we consider 1.5 cables per user to constitute the number of cables that could be reused in the absence of regulation, and which would become obsolete due to regulation.
Source: Copenhagen Economics based on Ipsos (2021), p. 46, 74 and 163 (pdf), Eurostat population data (2021), Statista: Forecast of the smartphone penetration in Europe from 2010 to 2025 and CIRP: Apple tops users loyalty chart in the US (2021).

The population of the EU was around 447 million in 2020 and smartphone penetration rate in Europe in the same year was around 75%.[80] According to Ipsos, Apple's market share is 17.8%.[81] This implies that there are around 60 million iPhone users in the EU.

Some iPhone users might have chosen to purchase a phone from a different manufacturer anyway and hence faced a change of the device-end port, even in absence of regulation. However, Apple users' loyalty rate, i.e. the share of consumers who purchase a new phone of the same brand, is estimated to be around 90%.[82] 90% of iPhone users would thus have an additional 1.5 cables of e-waste due to the regulation.

[80] Eurostat population data (2021), and Statista,
[81] Ipsos (2021), p. 46 and 74.
[82] CIRP: Apple tops users loyalty chart in the US (2021),

Ipsos estimates that the average weight of a Lightning cable is 37 grams.

We find that if all iPhone users in the EU were to dispose of 1.5 cables prematurely, this would correspond to around 2,981 tonnes of additional e-waste. Assuming this e-waste was spread equally across the 7-year period modelled by Ipsos (2024-2030, both years included), this corresponds to 426 tonnes per year.[83]

CALCULATION OF REDUCED COST SAVINGS BASED ON CORRECTION OF IPSOS' UNSUBSTANTIATED ASSUMPTION

The separate impacts on consumer costs for the three policy initiatives[84] included in 'policy option 5' do not sum to the total consumer savings estimated for this option and Ipsos does not disclose the components of the €246 million in consumer savings that it has estimated.

Since unbundling of the EPS is estimated to have a negative impact on consumer savings when implemented alone, we assume that the consumer savings in 'policy option 5' can be attributed to specification of the device-end port and standardisation of charging protocol in proportion to the consumer savings the policy initiatives generate individually ($\frac{620}{(620+166)} = 79\%$ of the consumer savings result from specifying a common device-end port).

We also assume that the proportion of consumer savings that are due to consumers buying fewer chargers is the same for the broad scope of the regulation as for the narrow scope of the regulation ($\frac{4.8\%}{8.4\%} = 57\%$ of consumer savings from specification of the device-end port are due to expected lower cable sales).[85]

Hence the remaining consumer savings due to Lightning cables being more expensive is €246 million – (€246 million * 79% * 57%) = €135 million.

CALCULATION OF ADDITIONAL CONSUMER COSTS DUE TO PREMATURE OBSOLESCENCE OF LIGHTNING CABLES

We perform a simple back-of-the-envelope calculation based on the information provided in Ipsos' impact assessment to approximate the consumer costs resulting from the premature obsolescence of Lightning cables.

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83 This calculation considers only the e-waste from Lightning accessories that are made prematurely obsolete. This could be considered conservative since specification of the device-end port would also make micro-USB accessories prematurely obsolete. However, to remain conservative, we have excluded Micro-USB from this calculation since a) Micro-USB would be eliminated anyway under 'policy option 3' (due to standardisation of the charging protocol) and b) because micro-USB is to a greater extent being phased out in the absence of regulation anyway.

84 Unbundling of the EPS, standardization of charging protocols and specification of a common device-end port. In Ipsos' impact assessment, the combination of these three initiatives are referred to as 'Package 5'.

85 Ipsos (2021), p. 73-74 and p. 124 (pdf).

Table 8
Calculation of additional consumer cost caused by the premature obsolescence of Lightning cables

PARAMETER	VALUE
Population of the EU	447 million
Smartphone penetration rate in Europe	75%
Apple's market share	17.8%
Apple users' loyalty rate (share of users who purchase a new phone from the same brand)	90%
Number of cables that would become obsolete due to regulation*	1.5*
Average retail price of a USB-A to USB-C cable	€9.5
Average retail price of a USB-C to USB-C cable	€14
$447\ million\ consumers * 75\% * 17.8\% * 90\% * 1.5 * \frac{(€9.5 + €14)}{2} = €947\ million$	
$\frac{€947\ million}{7\ years} = €135\ million/year$	

Note: We assume an equal split between USB-A to USB-C and USB-C to USB-C cables.
*According to Ipsos' consumer survey, Apple users have 2.5 cables on average. Accounting for the fact that consumers receive one additional cable anyway when buying a new device, regardless of whether a common device-end port has been specified, we consider 1.5 cables per user to constitute the number of cables that could be reused in the absence of regulation, and which would become obsolete due to regulation.

Source: Copenhagen Economics based on Ipsos (2021), p. 57, 74 and 163 (pdf), Eurostat population data (2021), Statista: Forecast of the smartphone penetration in Europe from 2010 to 2025 and CIRP: Apple tops users loyalty chart in the US (2021)