

Study on the Common Charger 2.0

Final Report

prepared for

**DIGITALEUROPE
MOBILE & WIRELESS FORUM**

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1 Introduction

1.1 Background to the study

Prior to the signature of the MoU in 2009, mobile phones were mostly only compatible with chargers that had proprietary charging connections between the device and the charger, i.e. they could only be charged using specific chargers. It was estimated that at this time there were more than 30 different types of chargers on the market (RPA, 2014).¹

As a result of the 2009 Memorandum of Understanding (MoU), mobile phone manufacturers adopted a common specification based on the USB 2.0 Micro B (Micro-USB) or compatible adaptors for those phones that did not have a Micro-USB interface. The MoU was later extended by two letters of intent.

Following the expiry of the MoU in 2014, the European Commission started fostering a new voluntary agreement and on 20 March 2018, it received a new voluntary agreement from mobile phone manufacturers, which declared their intention to “continue to enable smartphones to be charged through a common charging interface”. However, the European Commission refused to endorse the MoU, stating that it did not “guarantee full interoperability between mobile phones ... as proprietary solutions were proposed together with the previous USB 2.0 Micro B and the new USB Type C solutions.” Owing to this, the Commission has initiated preparatory steps for potential regulatory action. DIGITALEUROPE and the Mobile & Wireless Forum retained RPA to conduct this Common Charger 2.0 study.

1.2 Objectives of the Common Charger 2.0 study

The aim of the study is to generate data and analysis that can input into the discussions on a common charger. This comprises three specific objectives:

- conduct a market analysis from 2014 until now;
- forecast the uptake of the different wired charging solutions over the next 5 years; and
- compare several policy scenarios (the MoU and a regulatory option), including their cost-effectiveness, impacts on consumers, the industry, and the environment.

1.3 YouGov consumer survey

Within the framework of this study, a consumer survey was carried out by YouGov in May and June 2019. A total of 6,120 responses were received from 12 EU countries: Austria, Belgium, Bulgaria, the Czech Republic, France, Germany, Greece, Ireland, Italy, Netherlands, Poland, Spain (between 486 and 568 responses were received from each country).

The results were adjusted to ensure the representativeness of respondents within their own country in terms of age, gender and region, specific weighting has been applied. The statistics on the basis of which the weighting has been done come from Eurostat. Additional weighting has been applied to account for differences in population of the different countries.

¹ See https://rpald.co.uk/uploads/report_files/i829-mobile-chargers.pdf

1.4 Structure of the report

This report is organised as follows:

- Section 2 summarises the current situation (including key market developments since 2014);
- Section 3 estimates future market developments;
- Section 4 assesses the scale of any ‘problem’ in terms of lack of charging interoperability and Section 5 sets out the potential policy options that could address it;
- Section 6 assesses the impacts of these policy options on consumers, Section 7 on safety and innovation, Section 8 on economic operators and Section 9 on the environment; and
- Section 10 provides a summary of the key impacts;
- Section 11 summarises the key issues with regard to a potential extension of any requirements to other mobile devices.

1.5 Glossary of key terms

The key terms used in this study are defined below.

Table 1-1: Main definitions	
Term	Definition
Smartphone	A smartphone is a mobile phone that performs many of the functions of a computer, typically having a touchscreen interface, internet access, multimedia functionality and an operating system capable of running apps downloaded by the user. Its operating systems facilitate significantly more actions than feature phones
Feature phone	A feature phone is a mobile phone that contains a limited set of essential functions beyond voice calling and text messaging, that is not as extensive as a smartphone. It generally cannot download apps from an online marketplace
Charger	A charger is a charging block and a detachable cable; or an integrated charger.
Charging block	A charging block is a power unit that includes a ‘socket’ that can be connected to a detachable charging cable
Charging cable	A charging cable connects a mobile device to a charging block or another electricity source (e.g. a computer or a USB wall socket). It includes a connector to connect to a charging block or other electricity source, a wire and a connector on the other end of the wire to provide power to a mobile device. It does not refer to a cable that connects a mains socket and a charging block.
Integrated charger	An integrated charger is a power unit with a non-detachable cable which ends with a connector for connecting to a mobile device
Connector adapter	A connector adapter is a small device that can be attached to a charging cable’s connector to allow it plug into a socket of a different type
Counterfeit	Counterfeit describes a charging solution that is an illegal copy of one made available by the legitimate manufacturer
Substandard	Substandard is when something does not meet safety or other standards prescribed by law

2 Current situation

2.1 Recent policy developments

2.1.1 First MoU

Prior to the signature of the first MoU in 2009, mobile phones were mostly only compatible with chargers that had proprietary charging connectors. At the time, there were more than 30 different types of chargers on the market. RPA (2014) concluded that the number of the different charging connectors had declined substantially after the MoU came into effect in 2011. The MoU was extended by two letters of intent.

The charging interface agreed upon by the actors involved in the initiative focused on the Micro-USB standard but also allowed manufacturers to make available an adaptor from the Micro-USB connector to another connector. In 2013, 93% of phones in the total stock of active phones were compliant with the MoU. The percentage of compliant data-enabled phones was calculated at 99%. summarises the evolution of the market share of compliant phones between 2011 and 2013.

Table 2-1: Market share of mobile phones compliant with the first MoU (%)			
Parameter	Year		
	2011	2012	2013
Market share of MoU compliant phones (% of data-enabled)	80%	95%	99%
Market share of MoU compliant phones (% of all handsets)	66%	81%	93%

Source: RPA (2014)

The method chosen to promote harmonisation, namely a voluntary agreement, resulted in the attainment of full charging interoperability for data-enabled phones and thus a significant improvement in consumer convenience within a relatively short period of time (several years) and proved to be an effective method for harmonising the whole market since non-signatory manufacturers also moved to Micro-USB charging. This serves to show that a voluntary agreement is an effective tool that can influence the whole market.

2.1.2 Current MoU

A new voluntary agreement was signed in March 2018.

Box 2-1: 2018 MoU
<p>Beginning no later than three years from the date of signing, signatories that introduce new smartphone models to the EU market commit that such Smartphones will be chargeable through a USB Type-C connector or cable assembly.</p> <p>Smartphones chargeable through any one or more of the following cable assemblies shall be considered compliant with this MoU:</p> <ul style="list-style-type: none">• a cable assembly that is terminated on both ends with a USB Type-C plug;• a cable assembly that is terminated on one end with a USB Type-C plug and has a vendor-specific connect means (hardwired/captive or custom detachable) on the opposite end;• a cable assembly that sources power to a USB Type-C connector from a USB Type-A connector.• smartphone models compliant with the technical requirements as laid out in the first MoU (5 June 2009) may still be sold.

Box 2-1: 2018 MoU

The 2018 MoU signals the willingness of many manufacturers to move to USB-C at the device end and/or at the power source and does not preclude innovation (for example in Smartphone and External Power Supply designs, battery and charging technologies, interfaces, adaptors, cables, or improved charging performance).

Source: <https://www.digitaleurope.org/resources/memorandum-of-understanding-on-the-future-common-charging-solution-for-smartphones/>

The 2018 MoU leverages international industry standards: IEC 62680-1-3, USB Type-C™ Cable and Connector Specification, whose language the MoU closely tracks; IEC 62680-1-2, USB Power Delivery specification; and IEC 63002, Identification and communication interoperability method for external power supplies used with portable computing devices. These standards provide for safe, efficient, and fast charging supporting new use cases which, in the words of the 2018 MoU signatories, “will further enhance user experience and will likely facilitate wider adoption for use with other devices. This clearly provides an opportunity to encourage improvements, particularly in the area of electronic waste reduction.”

The 2018 MoU signals the willingness of many manufacturers to move to USB-C at the device and power end whilst retaining some degree of flexibility in terms of the specific charging solutions, not curtailing the sales of legacy devices with Micro-USB sockets and allowing new innovative solutions to be developed.

2.2 Market developments (2013-19)

This section summarises some of the market developments since 2013². Please note that this is not a comprehensive review of all market trends but rather a summary of the key developments that are particularly significant for the assessment in this study. The key developments (which are then analysed in more detail in the remainder of this section) include:

- Broadly similar (but slightly declining) levels of mobile phone sales in Europe;
- Continued reduction in the market share of feature phones;
- Increasing market share of the USB-C receptacle at the device end (see Section 3); and
- Lengthening mobile phone replacement cycle;

Although many other market trends have taken place, these are less relevant to the analysis in this study and are thus not considered here. For more information on the increasing market share of USB-C, please refer to Section 3.

2.2.1 Mobile phone market

Broadly similar (but slightly declining) mobile phone sales

In order to estimate the figures of annual smartphone sales in the EU, different sources of data have been scrutinised and compared, such as Statista, GSMArena and Canalis. The estimates assume that

² The previous RPA study was finalised in 2014 and provided market data up to 2013. A particular attention to the period 2014 – present is also warranted since the first MoU/Letters of Intent expired in 2014 and mobile phone manufacturers were entirely free to implement whichever charging solution they wished to choose.

shipments figures translate directly into sales to end consumers. Sales for year 2019 and 2020 have been estimated on the basis of global forecasts.

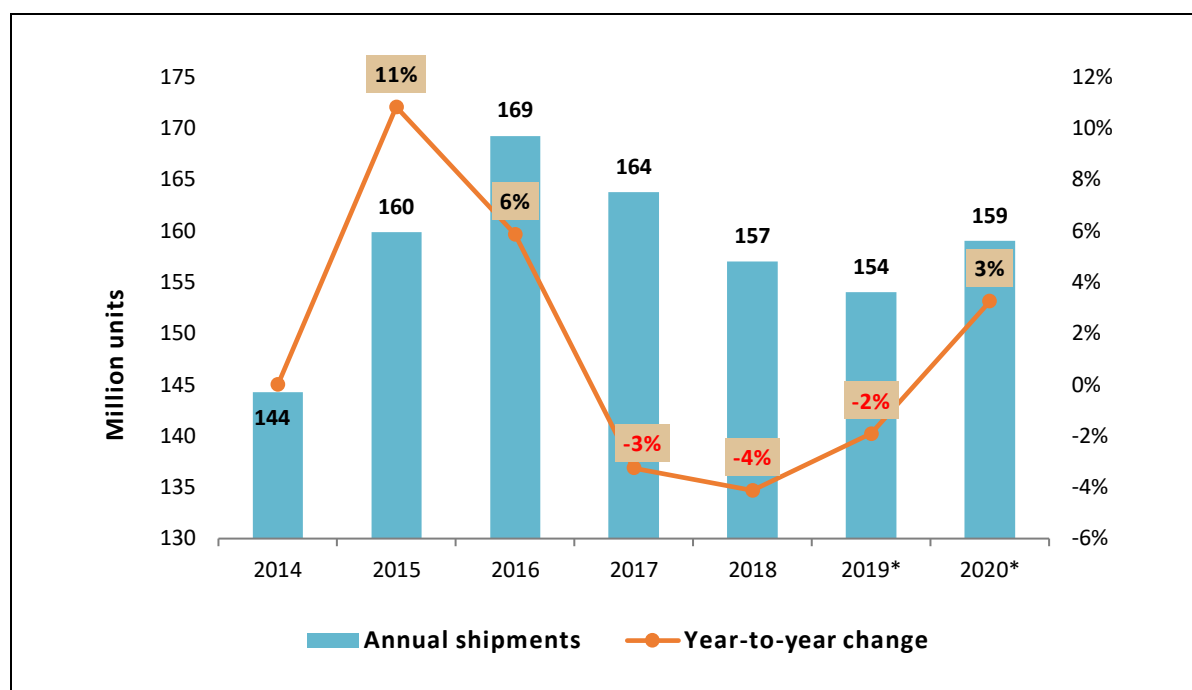


Figure 2-1: Annual shipments of smartphones in the EU, 2014-2018
Sources: Own analysis on the basis of Statista and Canalis data

The available data indicate sluggish sales of smartphones in the last couple of years, which more or less resembles the downward global trend but the overall level of sales is still greater than in 2014. It is noted that the decline in the level of shipments in the EU stems mostly from falling sales in Western Europe due to slowing replacement rates and a high level of saturation.

Continued decline of feature phones

At the time of RPA’s first study on mobile phones and charging solutions, both European and global markets were undertaking a significant structural change as smartphones were gaining market share at the expense of feature phones. This process was already at an advanced stage at the time that RPA completed its first study and continued after the study’s conclusion.

Figure 2-2 presents the split between smartphones and feature phones in terms of their annual shipments of mobile phones in EU27+1 from 2009 to 2013. It shows that in 2010 smartphones and feature phones took up an equal share of the phone market, whereas starting from 2011 the share of smartphones rose substantially, reaching 74% in 2013.

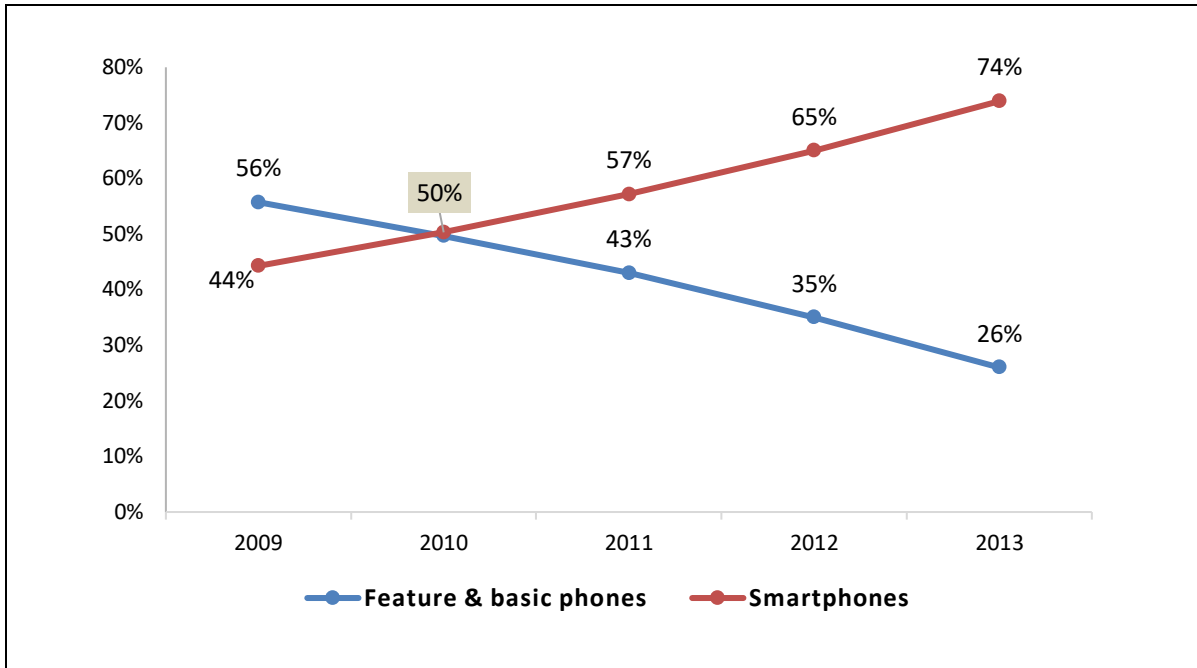


Figure 2-2: EU27+1 annual shipments of mobile phones (smartphones vs. feature/basic phones) in million units (2009 to 2013)

RPA (2014): Estimated based on data for Western Europe in various IDC press releases accessed at <http://www.idc.com/about/press.jsp>. Missing data were extrapolated.

This trend has continued after the study’s conclusion. The survey conducted by YouGov as part of this study confirms the centrality of smartphones over feature phones and the other devices that consumers use to access internet services. 94.3% of all respondents currently own at least a smartphone, whereas only 4.8% of them currently own a feature phone but not a smartphone.³ Among the countries surveyed, the Czech Republic exhibits the largest percentage of feature phone owners, i.e. 22%, whereas the Netherlands with only 2% exhibits the lowest percentage.

This indicates that an MoU⁴ can be effective in harmonising the vast majority of the market even in instances where its scope is aimed at smartphones. In addition, the experience of the previous MoU shows that feature phones tend to follow the overall market trends and among the respondents whose feature phone is their primary phone, the most common solution is charging block with USB Type-A socket and a detachable cable ending in a Micro-USB connector.

Lengthening mobile phone replacement cycle

In RPA (2014), it was assumed the average replacement cycle of a mobile phone was 24 months, i.e. two years. Some recent evidence seems to suggest that consumers habits have changed over the past few years, i.e. the trend highlighted is towards longer replacement rates. For the purpose of modelling in this study, an average replacement cycle of 30 months will be assumed. See Section 3 for a more detailed explanation.

³ Out of all respondents carried out for this study, 8% said they have a feature phone. Among them, 62% have only a feature phone, but not a smartphone, with this representing 4.8% of all respondents.

⁴ It is noted that the scope of the 2018 MoU is defined as follows: “This MoU is limited to wired charging solutions for Smartphones.”

2.2.2 Charger market

The two key trends in the charger market include:

- broadly similar numbers of chargers sold/supplied;
- shift from integrated chargers to charging blocks with a detachable cable; and
- development of USB Type-C and its adoption.

Broadly similar numbers of chargers sold/supplied

Mobile phone chargers can either come in the box within a new mobile phone, or they can be purchased on a 'standalone' basis for different sorts of reasons (e.g. replacement of damaged chargers, need for a charger to charge multiple devices). No data have been identified to suggest that fewer chargers are supplied nowadays than were supplied in 2014. This is due to two main reasons:

- the sales of new phones and chargers have not decoupled, with a pilot decoupling programme in the UK seeing very limited interest from consumers, who in the main still expect a charger to be provided in the box with a new phone (as confirmed by the results of the survey carried out for this current study);
- sales of standalone chargers appear to be at a broadly similar to pre-2014 levels. RPA (2014) noted that annual sales of standalone chargers (2011-2013) accounted for 9% to 14% of all mobile chargers supplied in any given year. This broadly ties in with 43% of respondents to the survey carried out for this study which purchased an additional charger or cable at least once since obtaining their primary mobile phone and the estimated phone replacement cycle of around 30 months.

Shift from integrated chargers to charging blocks with a detachable cable

The most common 'in the box' charging solution provided to consumers is a charging block with a detachable USB cable. This is particularly relevant to aspects of consumer convenience and environmental impacts, with examples being:

- a separate charging block and cable would enable a consumer to use someone else's block with their own cable or a replacement cable if they had to purchase one (which would be significantly cheaper than buying a new charging block)
- when cables deteriorate, they can be replaced relatively inexpensively, saving cost to the consumer and generating less electrical waste as the block (where the vast majority of electrical components lie) can be re-used

The gradual rise of this charging solution has occurred at the expense of the integrated charger, which used to be a lot more common at the time of the first RPA study (2014). The survey carried out for this study shows that most people use a charging block with a detachable cable or a cable only for charging. The use of integrated chargers is virtually non-existent among Apple users and only 9% of Android smartphone users rely on integrated chargers.

Respondents to the survey were asked to indicate how they normally charge their primary phone. Table 2-2 below reports the percentage of responses corresponding to all the possible sub-options that smartphone users selected. Percentage related to wireless charging is added for the sake of completeness.

Table 2-2: Charging options for smartphone users		
Main options	Sub-options	%
Charging block and detachable cable	Charging block with USB Type - A socket and a detachable cable ending in a Micro-USB connector	32.4%
	Charging block with USB Type-A socket and detachable cable ending with a Lightning connector	9.7%
	Charging block with USB Type - A socket and a detachable cable ending in a USB Type-C connector	7.9%
	Charging block with USB Type - C socket and a detachable cable ending in a USB Type-C connector	3.9%
	Charging block with USB Type - C socket and a detachable cable ending in a Micro-USB connector	2.6%
	Charging block with USB Type-C socket and detachable cable ending with a Lightning connector	3.2%
	Not sure	8.2%
	Other	0.4%
	Integrated charger	Integrated charger with a Micro-USB connector
Integrated charger with a USB Type-C connector		1.7%
Not sure/other		1%
Cable only	USB A to Micro-USB	5.3%
	USB A to C	1.5%
	USB-C to C	1.3%
	USB C to Micro-USB	0.8%
	USB A to Lightning Connector	1.7%
	USB C to Lightning Connector	0.4%
	Not sure/other	5.3%
Wireless charger		3.2%
Not sure/other		4.5%

The most common connector at the device side is the Micro-USB, which was chosen as the standard solutions for the first MoU. The smartphones of almost 50% of respondents need to be connected to a cable ending with a Micro-USB connector type. At the charger side, USB A connector type prevails with 60% of responses.

If all those respondents whose smartphone has a USB-C charging port at least at the device end are pooled together, they would add up to ca. 17% of all respondents whose primary phone is a smartphone.

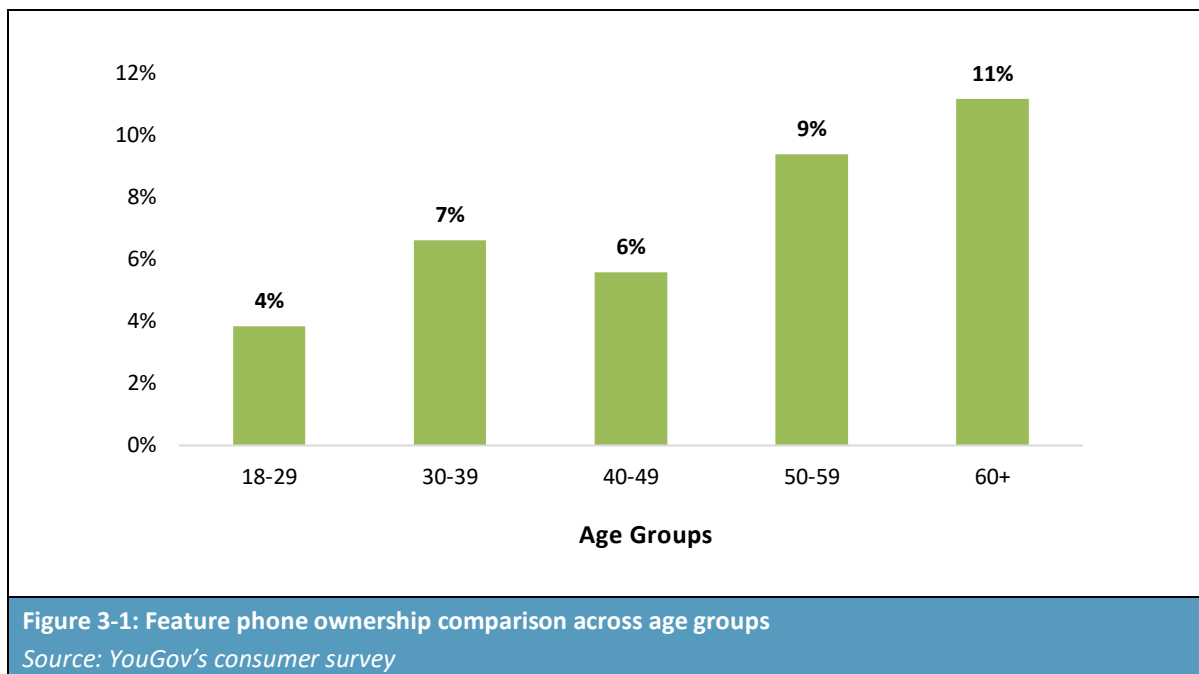
Among the respondents whose feature phone is their primary phone, the most common solution is charging block with USB Type-A socket and a detachable cable ending in a Micro-USB connector, indicated by 37% of them. Not surprisingly, integrated charger with Micro-USB connector ranks second, with 32% of responses.

3 Future market developments

3.1 Mobile phone market

The compound annual growth rate (CAGR⁵) of smartphone adoption is estimated by GSMA to be equal to around 0.4% from the period 2018-2025⁶, with this implying that the share of smartphones will grow to account for 83% of total mobile connections by 2025.

As pointed out in the previous section, feature phones have still retained a small share of the mobile phone market. Nevertheless, they are on an irreversible decline, highlighted also by the fact that percentage of feature phone ownership increases with the consumers' age, as illustrated in Figure 3-1 below. Only 4% of consumers aged 18-29 own a feature phone, whereas 11% of consumers aged 60+ do. This indicates that smartphones are set to dominate the entire phone market in the future. In 2025, feature phones share is foreseen to shrink to 1%.



In terms of share of market by vendors, there are not relevant changes expected in the foreseeable future, with Apple's share likely to float around the 20% of the sales of phones and Android's one around 80%.

3.1.1 Consumer habits

The replacement cycle of a mobile phone refers to the average period at the end of which consumers replace their own device with a new one.

⁵ The CAGR is calculated as follows: $(\text{value at the end of the period} / \text{value at the beginning of the period})^{1/\text{length of period}} - 1$

⁶ GSMA (2019): The Mobile Economy 2019. It can be accessed at <https://www.gsmaintelligence.com/research/?file=b9a6e6202ee1d5f787cfebb95d3639c5&download>

In RPA (2014), it was assumed the average replacement cycle of a mobile phone was 24 months, i.e. two years. Different sources were examined, among which a study by Recon Analytics (2011), a study by the Ellen Macarthur Foundation (2012⁷), information collected through consultation with mobile phones manufacturers.

Some recent evidence seems to suggest that consumers habits have changed over the past few years and the current trend is towards longer replacement rates driven by the improvement in the quality of the devices components and high price tags. According to a Counterpoint article, at the global level, on average people replace their mobile phone every 21 months⁸. However, this rate is considerably longer among European consumers. Recently in the UK, Dixons Carphone have pointed out that consumers hang on to their phones for longer before buying a new device, suggesting that the replacement cycle may have lengthened from 23 months in 2015 to 26 months in 2017⁹. Other sources highlight the same tendency and add that the trend is unlikely to be reversed in upcoming years¹⁰. A study conducted by Hyla Mobile, reported in the Wall Street Journal¹¹, observes that both iPhone and Android users in the US are now waiting longer before they upgrade their phone, with an average of 2.83 years across all phones. As reported in an article by CNBC, users in France, Germany, Great Britain, Italy and Spain are keeping their phones even longer than average American consumers¹².

The replacement cycle greatly affects the pattern of accumulation (stock) of phones in the market. In this way, it has a major impact on the rate at which new charging solutions, like USB-C, spread through the population. For the purpose of this modelling exercise, an average replacement cycle of 30 months will be assumed.

A lengthening replacement cycle also translates into positive environmental impacts while less devices are added to the stock of e-waste every year and a relative lower number of new devices are bought. Environmental impacts will be treated in more detail in Section 9.

3.2 Charger market

The approach to the analysis of the evolution of the market for the charging solutions draws partially upon the results of the market analysis carried out in the previous section. Information relative to the trend in the sales of phones and the EU market shares of the manufacturers will feed into the task of forecasting the evolution of the stock of chargers and breaking it down by the connector type.

Evidence strongly points to the fact that USB-C is going to become the predominant charging interface for smartphones (absent any government or other intervention); it is, however, recognised that Micro-USB may still remain the preferred solution for some low-end smartphones. Many manufacturers have already released models with USB-C charging capacity. On the one hand, the replacement of the Micro-USB at the phone side is already at a quite advanced stage. On the other hand, at the charging

⁷ <https://www.ellenmacarthurfoundation.org/news/in-depth-mobile-phones>

⁸ <https://www.counterpointresearch.com/smartphone-users-replace-their-device-every-twenty-one-months/>

⁹ <https://www.strategyanalytics.com/strategy-analytics/blogs/enterprise/wearables/emerging-devices/2017/08/24/how-often-do-uk-consumers-replace-their-mobile-phones>

¹⁰ https://www.vice.com/en_us/article/43ejej/study-smartphone-iphone-trade-in-age-apple-event-2018

¹¹ <https://www.wsj.com/articles/upgrade-no-thanks-americans-are-sticking-with-their-old-phones-1540818000>

¹² <https://www.cnbc.com/2019/05/17/smartphone-users-are-waiting-longer-before-upgrading-heres-why.html>

block side the diffusion of USB type-C is lagging behind and it might still take some time before it reaches a higher level of uptake. At the charger side, USB type A is expected to hold on to its dominant position for quite some time in the future.

The estimation of USB-C uptake will be carried out exclusively in relation to the connector at the phone side. Limited availability of data makes it hard to attempt a forecast about the uptake of the USB-C at the charger side.

The first task involves estimating the evolution of the stock of chargers and cables within the next few years and specify the proportion of them that are going to adopt a USB-C connector. On the basis of published data, evidence gathered from the consumer survey and specific assumptions about key market developments, an attempt will be made at forecasting the rate at which by 2025 the market will move towards USB-C as the primary charging solution for mobile phones under the baseline scenario, i.e. in the absence of a legislative action by the European Commission. It is also assumed that between now and 2025 no new standard charging solution will step in the market and compete against the wired solutions currently available.

The first aspect to emphasise is the shift to separate charging blocks and cables which was a marginal phenomenon at the time of the first RPA study. Since then, there has been a trend away from integrated chargers. Consumers have now several options ranging from using a charging block with a cable, plugging in the cable to a power source in the wall or to another device (i.e. computer), using a charging block with multiple USB sockets, etc. This also implies that consumers can also buy either a charging block or a cable or both depending on their needs, with this making it extremely hard to estimate what types of charging solutions make up the total stock of chargers. In addition, data on what charging solutions come in the box with a new phone are also limited.

3.2.1 Consumer habits

A few questions of the consumer survey were specifically designed to shed light on consumer habits that can significantly influence the evolution of the stock of chargers over the next years. Respondents were asked to indicate how often they purchase new chargers or cables, either in addition or to replace the ones initially supplied with their device. As Figure 3-2 illustrates, 43% of consumers who own a phone have bought at least one additional charger or cable to charge their phone since purchasing their mobile phone. 28% have bought an additional charger or cable once, 15% more than once. Apple users and Android users exhibit no difference in this regard.

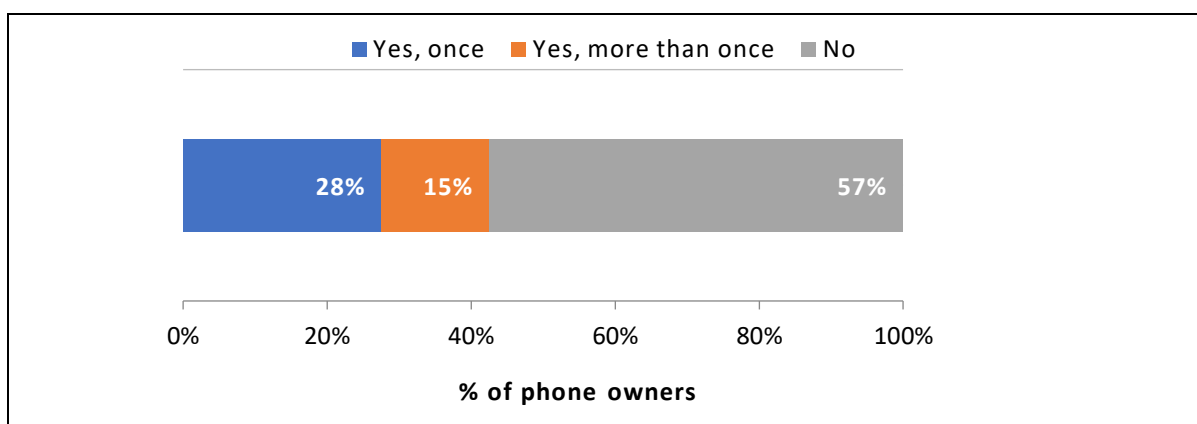
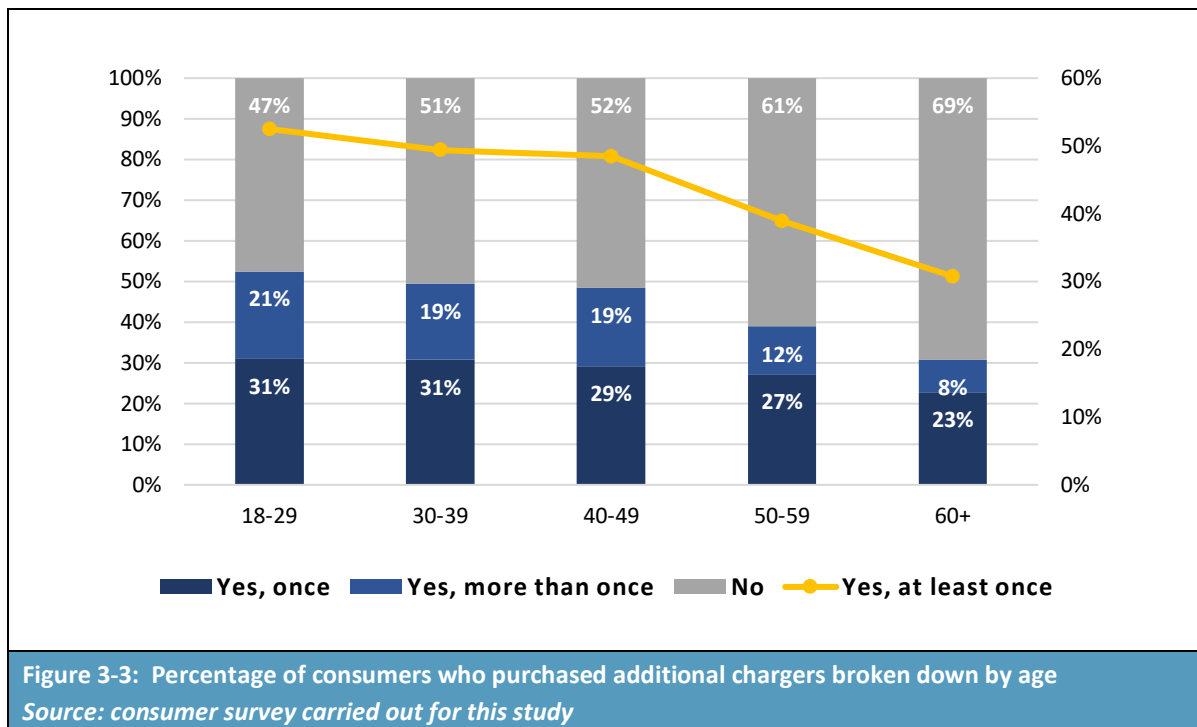


Figure 3-2: Percentage of phone owners who bought additional chargers

In general, as illustrated in Figure 3-3, the percentage of consumers who buy additional chargers or cables dramatically declines together with the age of the consumer (the yellow line with markers

measured in the right-hand side vertical axis groups together those consumers within each age group that have bought an additional charger and or cable at least once). More than half of consumers aged 18-29 have bought at least an additional charger, only 31% of those aged 60+. The difference is more prominent if one focuses on the percentage of those who bought an additional charging solution more than once, suggesting that there is a strong correlation not just between age and whether consumers need an additional or replacement charger but also between age and the number of additional chargers needed. Among the first three youngest age groups, almost one out of five consumers have purchased a charging block or cable more than once, while approximately one out of 10 consumers have done so in the other age groups.



Another question asked what additional types of charging solutions consumers have bought, with the results showing that 47% of them purchased a charging cable alone and 38% a charging block along with a detachable cable. It is remarkable that 54% of consumers aged 18-29 who bought additional chargers purchased a charging cable only, whereas only 37% of older consumers (60+) did. The proportion tends to decline as the age of the consumer increases. Figure 3-4 below reports what specific charging solutions consumers have bought. Only 9% of consumers have bought an integrated charger, further evidence indicative of the downward path of the integrated charger.

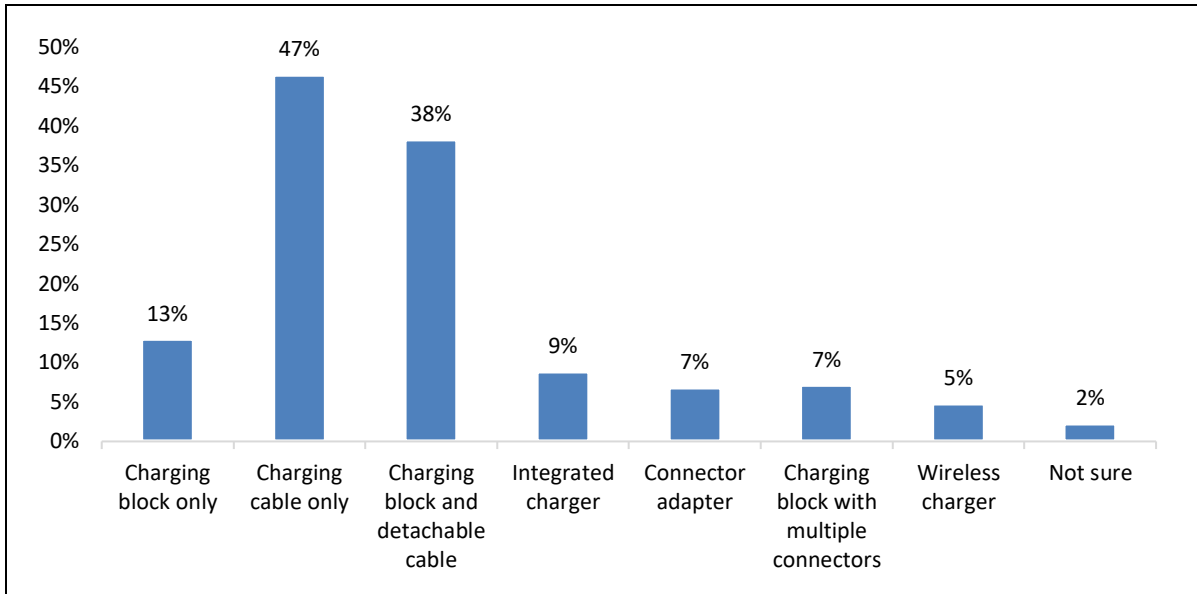


Figure 3-4: Types of additional charging solutions consumers bought since purchasing their primary phone

Source: consumer survey carried out for this study

The most frequent reasons identified by the respondents to the survey for purchasing additional charging solutions (chargers and/or cables) are to replace old or non-working ones (36%) and as a supplemental charging solution, e.g. for use in a different location (34%). Buying a charger/cable due to the need for a different connector (7%) was the least frequent reason selected, followed by the desire for a charger that would enable faster charging (11%).

3.2.2 Estimated stock of wired chargers (2016-2023)

Research carried out for the RPA (2014) study showed that only 0.02% of EU-28 handset shipments between 2011 and 2013 were supplied without a charging solution. On the basis of the new research, there appears to be no evidence that the rate of “decoupling” has accelerated since then.

Figure 3-5 shows the estimated evolution of the stock of charging blocks and cables¹³, which goes hand in hand with the trend in the sales of smartphones. The period considered starts in 2016, when USB-C started to spread, to 2023. The total level of stock is expected to reverse the current declining trend in the next few years and continue rising until 2023, even if uncertainty inevitably grows the more distant the future is. Overall, the level of stock is estimated to remain largely constant in the foreseeable future.

¹³ Figure 3-5 provides totals for chargers or charging blocks and cables, i.e. 1 unit in this figure can include a charging block and a cable.

Explanation of the model

Assumptions:

- i. sales of charging blocks and cables mirror the sales of phones
- ii. 100% of phones are supplied with a charging block and a cable in the box
- iii. average replacement cycle is 30 months
- iv. negative CAGR of 0.1% applied to feature phones and respective charging solutions
- v. only half of the purchases by those who bought additional chargers or cables at least twice were to replace lost or non-working charging solutions

Inflows of chargers and cables (+)

- units equal to new phones purchased every year
- chargers and cables purchased in addition to the ones received when they bought their phone. 28% of consumers have bought them once, 15% twice

e.g.: if in 2018 157 million chargers and cables were sold with smartphones, additional 91 million chargers will be purchased before the end of the average replacement cycle¹, after doubling the 15% of sales to take into account that some consumers have bought two additional charging solutions.

$$0.28 * 157 + 0.15 * 2 * 157 = 91$$

Outflows of chargers and cables (-)

- chargers and cables at the end of their life-cycle
- chargers and cables replaced as non-working anymore before end of life-cycle (36% of consumers)
- chargers and cables lost (12% of consumers)

Applying these percentages to the additional chargers purchased each year, and assuming that only half of the purchases by those who bought additional chargers or cables at least twice actually replaced lost or non-working charging solutions, will give an estimate of a number of chargers and cables that flow out of the stock every year

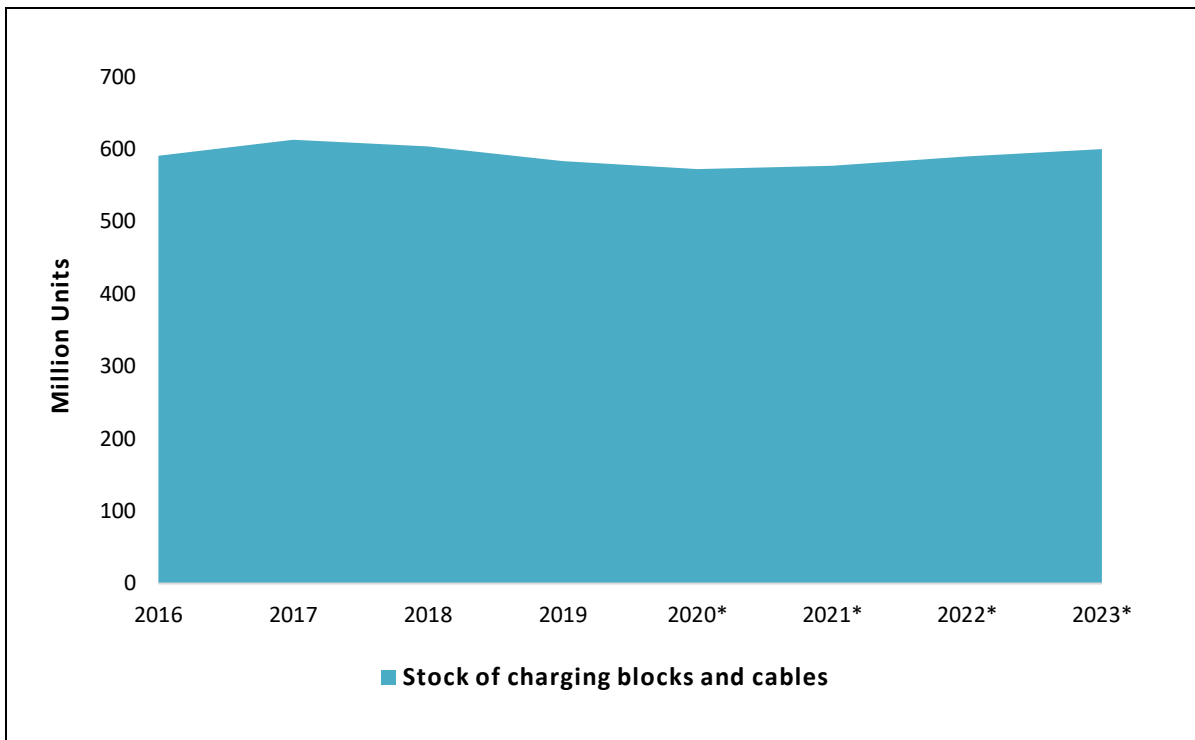


Figure 3-5: Stock of charging blocks and cables
Source: based on information collected on GSMArena

The way the model has been built implies that the units indicated in the graph for each year comprise an equal number of charging blocks and cables (i.e. 1 unit in this figure can include a charging block and a cable), although this is very likely to be an overestimation of the number of charging blocks and an underestimation of the number of cables (due to the fact that not all phones are supplied with a charging block and the fact that people more frequently buy additional cables than additional charging blocks).¹⁴

3.3 Stock of chargers broken down by connector type at the device end

Many smartphone manufacturers have already introduced USB-C sockets in their newest models. Mobile phone manufacturers started equipping their phones with USB-C sockets as early as 2014 and 2015 but the uptake of the USB-C socket at the mobile phone end accelerated significantly from 2016 onwards. Apple phones continue to be equipped with a Lightning socket at the device side (first introduced in 2012).

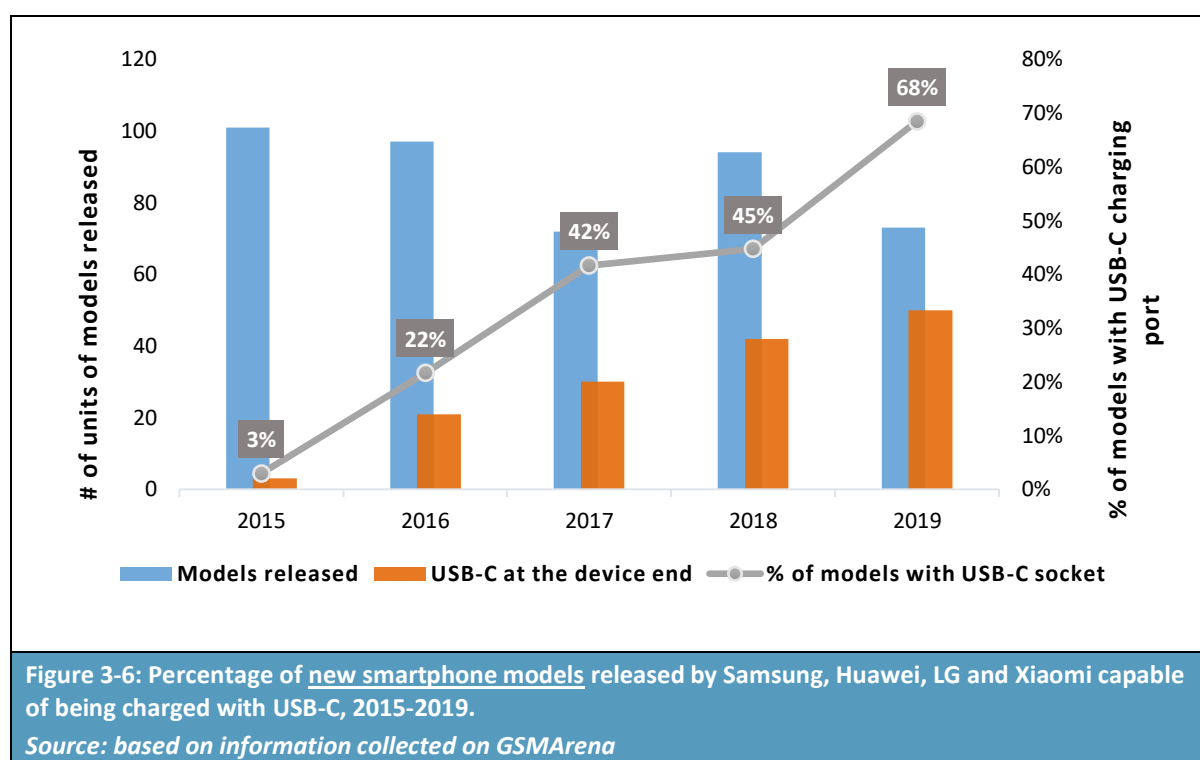
On the basis of the information collected from the GSMA arena, it appears that the percentage of smartphone models released at the global level and equipped with a USB-C charging port has been steadily increasing over the last few years. By looking at the total number of smartphone models released by Samsung, Huawei, LG and Xiaomi (which together make up almost 80% of the Android smartphones sold in Europe in 2018 and 2019¹⁵) and pinpointing the proportion of those equipped

¹⁴ There is too many uncertainties and lack of information to attempt at making any meaningful estimate of share of cables and charging blocks.

¹⁵ Primary data had to be collected. Samsung, Huawei, LG and Xiaomi were chosen as representative of the trends in the Smartphone market in virtue of their share of units sold to final consumers.

with a USB-C charging port, it has been possible to derive a proxy for the share of smartphones with USB-C connectivity. It is expected that the largest market players in the Android smartphone market are indicative of the broader trends thus allowing for data pertaining to them to be extrapolated across the entire Android market. The idea behind this reasoning is that once the largest Android manufacturers have all switched to USB-C charging, the rest of the market is likely to follow.

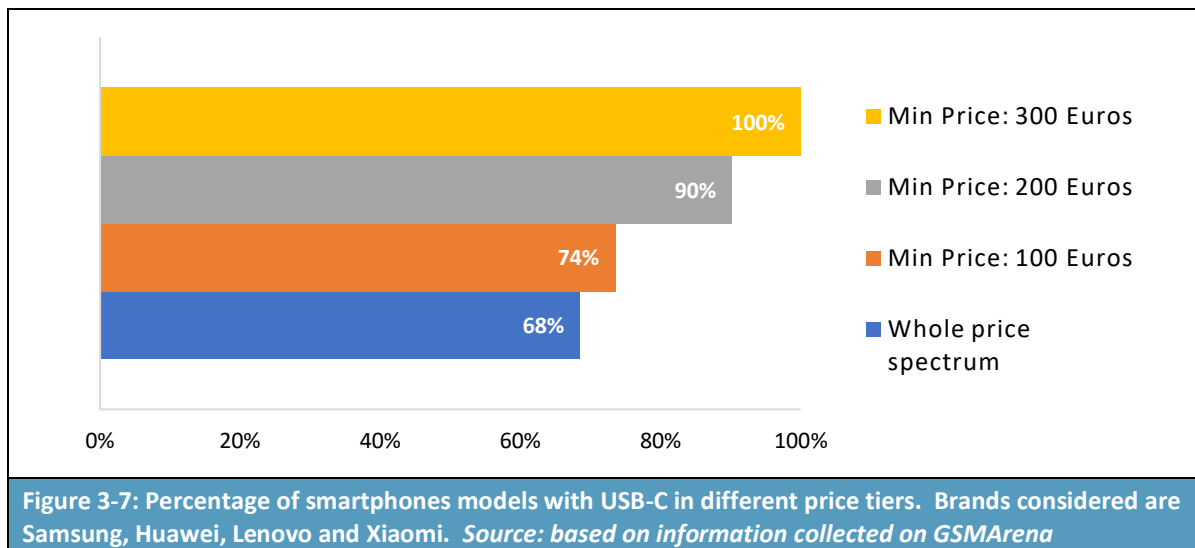
Over the past five years, the proportion of newly launched models with an inbuilt USB-C socket has grown from 3% to 68%. In Figure 3-7 below, the bars illustrate the numbers of models released each year from 2015 and 2019 with and without USB-C charging capability. The line with markers tracks the development of the share of models with USB-C connectivity, measured in percentage terms on the vertical axis on the right-hand side. Under the assumption that the rate of growth of the share of smartphones with a USB-C charging port will be the average of the 2018 and 2019 growth rates (i.e. 1.29), it can be expected that by 2021, almost all new Android models released will be equipped with a USB-C charging port.



The graph focuses on the models released every year in the global market. It is also important to bear in mind that models of smartphones with a USB-C charging port tend to be more expensive than those with a Micro-USB port, with this implying that proportionately more European consumers are likely to have bought a smartphone with a USB-C since its introduction compared to global figures which include consumers in emerging markets.

In theory, as USB-C spreads out across a larger share of consumers, manufacturers can lower the cost and phones with USB-C charging port become increasingly more affordable, with this resulting in a boosting effect on the overall uptake of USB-C (although it is recognised that the cost of the USB-C connector accounts for a very small proportion of the total cost of a handset). Figure 3-7 below reports the percentage of models equipped with a USB-C charging port for the four biggest Android vendors in the EU, i.e. Samsung, Huawei, LG and Xiaomi. Each bar represents the percentage of models with USB-C connectivity out of all models released in 2019 within a price tier. The proportion grows together with the price and 100% of models more expensive than €300 have a USB type C connector.

Along with the fact that in 2017 the weighted average selling price of a phone in the Western and Eastern Europe has been estimated to be ca. €322, this strongly indicates that the penetration of USB-C in the European market of mobile phones is going to increase rapidly in the upcoming years, particularly in Western European countries. According to IDC¹⁶, Android smartphones average selling prices (ASPs) at a global level are estimated to have grown by 5.8% in 2019 to \$269 (€240), up from \$254 (€226) in 2018, which is 30% less than the average price Europeans pay to buy their smartphones.



Under the assumption that smartphone models on average are available for sale in the market for a period of two years after their release, the rate of growth of the models with USB-C connectivity shown in Figure 3-6 above extrapolated to the whole Android market share can be used to estimate the evolution of the portion of smartphones with a USB-C charging port in the total stock of non-Apple smartphones.¹⁷ Figure 3-8 below shows the trajectory of the proportion of mobile devices capable of being charged with a USB-C cable in the total stock of non-Apple smartphones. While there is a higher degree of confidence about the diffusion of USB-C within the next three years up until 2022, greater uncertainties weigh on the prediction for the more distant future. The margin of uncertainty is represented in Figure 3-8 by the coloured area. Extrapolation of past trends suggests that USB-C will take on the entire share of non-Apple smartphones by 2025. However, there are also valid reasons to believe that there will remain a market for smartphone devices using Micro-USB at the lower end of the price spectrum. In the absence of a more precise estimate, this is represented in the figure by a curve that suggests that Micro-USB can retain up to 5% of the market share of non-Apple smartphones. Nevertheless, it cannot be ruled out without any reasonable doubt that the remaining share of smartphones using Micro-USB cables can be slightly higher than that.

¹⁶ Ibid

¹⁷ The estimates presented here reflect new devices entering the market and does not take into account the possibility that devices remain in use beyond the expected replacement cycle for a second life.

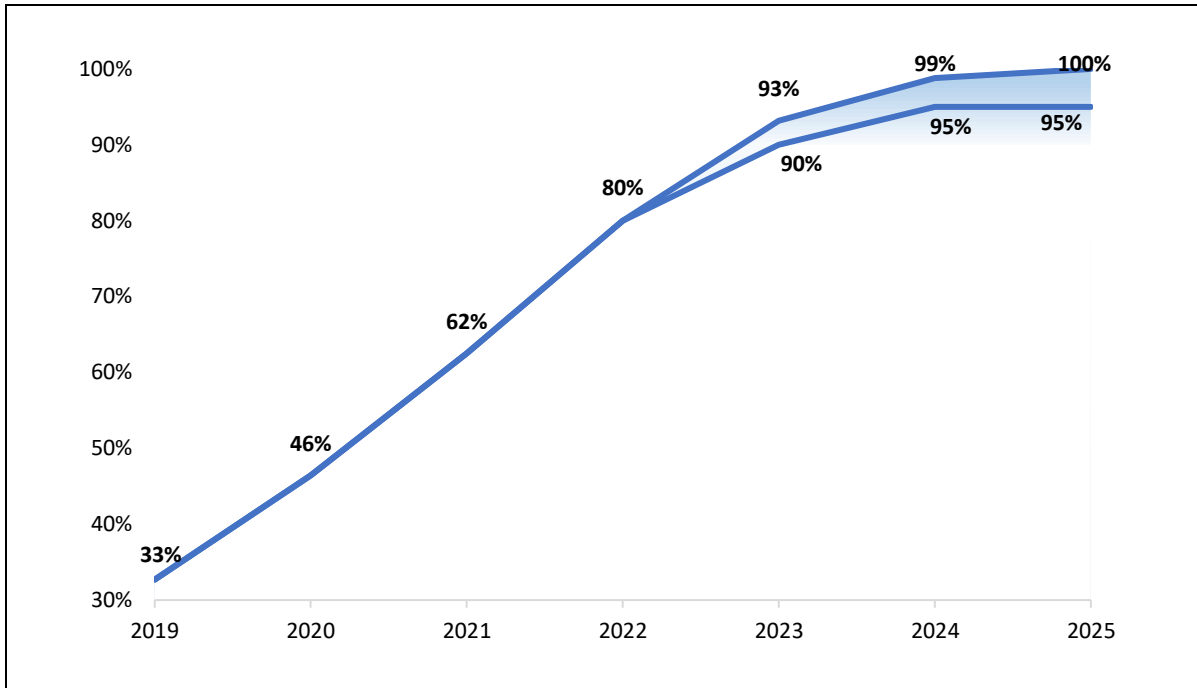


Figure 3-8: Rate of USB-C adoption across non-Apple smartphones Source: RPA modelling

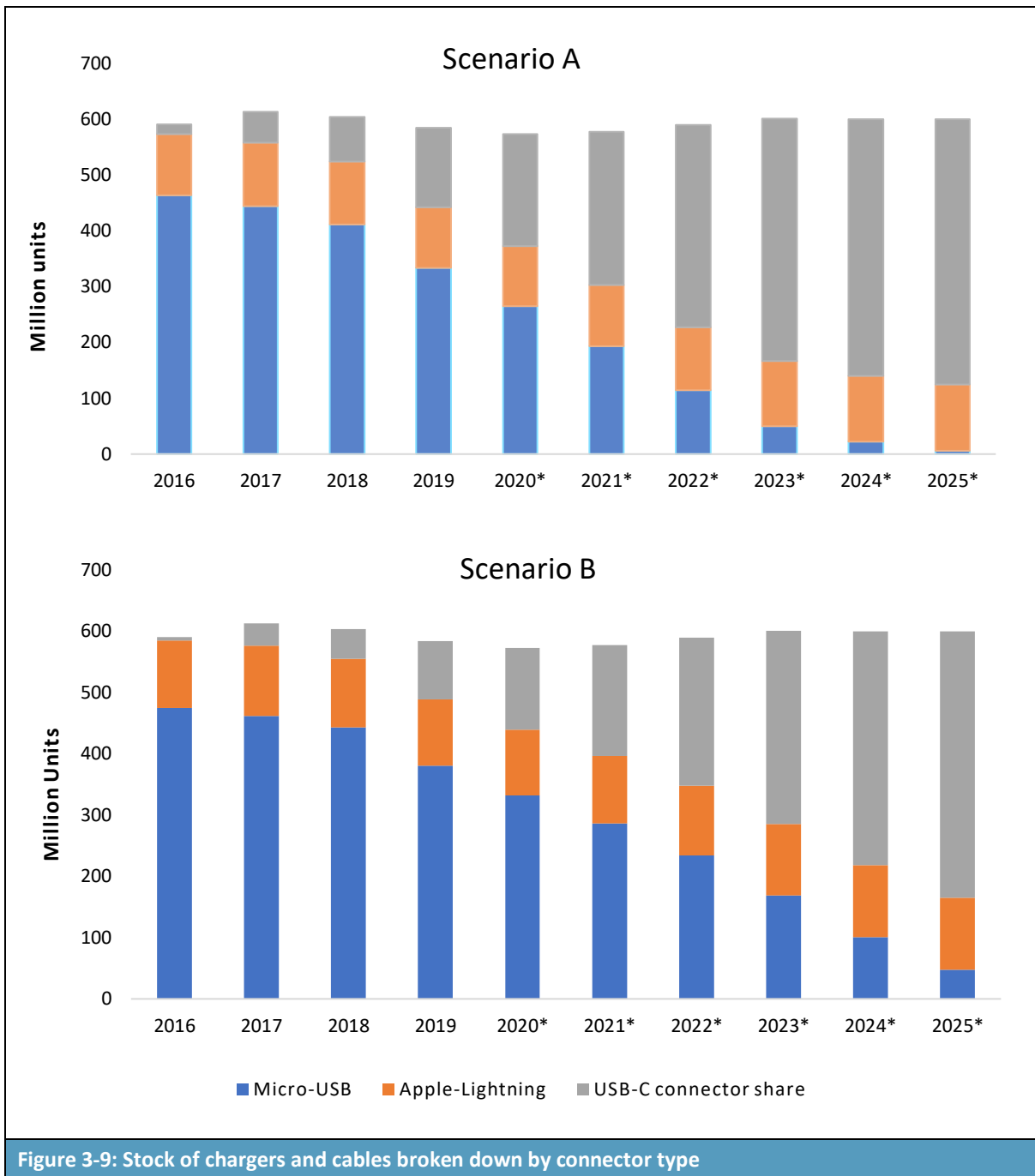
Figure 3-9 below breaks down the total stock of chargers (see Figure 3-5) by connector type at the device end. Two scenarios have been developed, which are both presented in the figure.

In scenario A, USB-C is expected to take on 80% of the share of chargers and cables, while the rest will be almost entirely retained by Apple with its Lightning connector. The share of the Micro-USB connector is estimated to fall down to 1% by 2025 as all non-Apple smartphone models will have switched to the USB-C and feature phones will disappear.

In scenario B, in which a replacement cycle of 3 years and a slower rate of uptake of USB-C across new models (discounted factor 1.5 as compared to scenario 2) are assumed, the share of USB-C is expected to grow to 72% with the rest comprising both the Lightning connector (20%) and Micro-USB (8%).

There are various reasons to believe that the estimates presented above underestimate the pace with which the shift to phones with USB-C charging connectors will occur:

- The estimates presented in this section reflect mobile phone models released globally and European consumers tend to prefer higher-end models which are more likely to rely on USB-C charging;
- European consumers have more than one active SIM and or multiple mobile devices, the number of total connections is higher than the number of unique subscribers. GSMA estimated that the number of SIMs and other connections per user at the global level is approximately 1.8. Although this is not the same as the number of devices, many people own more than one mobile device and there is an incentive at the individual level to shift to having the same charging solution on both devices.



Results show that the market is oriented toward a large degree of harmonisation of the connector at the device side based on USB-C. This would result in a high level of interoperability of charging solutions between different smartphones. The fact that the results of the model are not very sensitive to changes in key assumptions lends further strength to this conclusion. It is also unclear if and to what extent a mandated action can concretely speed up the transition to the USB-C.

4 Problem definition

4.1 Magnitude of the “problem”

The Better Regulation Guidelines and Toolbox¹⁸ require that an Impact Assessment (IA) sets out the nature and extent of the problem and the potential options for addressing it, and assesses and compares the impacts of these options. It is expected that all of these aspects will be considered by the European Commission when deciding whether regulatory intervention is warranted.

The first step in an EU Impact Assessment is the definition of the ‘problem’, i.e. the issue that is to be addressed by the potential regulatory intervention. Where no problem can be identified, it is unlikely that a regulatory intervention can be substantiated.

The absence of an agreement between 2014 and 2018 and the fact that the new MoU from 2018 permits a number of connectors on the charger and device side might be perceived by some people as a ‘problem’. However, as demonstrated below, the available evidence suggests that the scale of any potential problem is likely to be limited.

The first MoU (2009) and the two letters of intent significantly reduced the number of charging solutions on the market and this situation did not change significantly between the expiration of the first MoU in 2014 and the adoption of the second MoU in 2018 or since then. No significant market fragmentation has occurred and the only significant change has been the increasing market share of chargers compliant with the USB-C standard, in particular the increasing market share of mobile phones with the USB-C connector at the device side which has occurred at the expense of mobile phones with the Micro-USB connector.

The 2018 MoU is expected to further contribute to this trend and, as noted in Section 3.3, it is expected that over the next few years USB-C will become the most popular charging connector on the device side. There is thus no evidence to expect a significant market fragmentation or proliferation of many different charging solutions as was the case in 2009. In fact, extrapolation of past trends into the future suggests that already low levels of fragmentation are thus likely to further decrease over the medium term as the market converges on the USB-C standard¹⁹ even in the absence of regulatory intervention.

As shown in Section 6, the current level of consumer inconvenience is fairly limited and is likely to decline even further in the future.

Another issue that is frequently mentioned is e-waste that arises in cases where people cannot reuse their old chargers with their new phone. Although it is recognised that consumers currently receive a new charger whenever they buy a new phone, the analysis in Section 9 shows that a regulatory intervention is unlikely to significantly reduce the scale of this problem.

¹⁸ See https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how/better-regulation-guidelines-and-toolbox/better-regulation-toolbox_en

¹⁹ The Type-C standard itself allows for proprietary connectors on the device side. See IEC 62680-1-3, USB Type-C™ Cable and Connector Specification at Section 3.4.3 (defining a USB-C standard cable assembly to include “a cable assembly that is terminated on one end with a USB Type-C plug and has a vendor-specific connect means (hardwired or custom detachable) on the opposite end.”).

4.2 Multi-faceted nature of charging interoperability

The perceived 'problem' is often related to a lack of consumer convenience that is said to arise from the inability to charge using other people's chargers. In Section 6, this report suggests that there are multiple dimensions to consumer convenience which encompasses a lot more than all mobile phones having the same connector for charging. Similarly, it should be noted that although charging interoperability is often portrayed solely in terms of the connector on the device side, in actuality, interoperability requires compatibility of connectors, cables and power delivery protocol on both the charger block end and the device end in order for any charging to occur. In this regard it is of note that:

- The USB technology interoperability standards define specifications for connectors, cables, power delivery and data protocols to enable compatible charging between power sources (charger-blocks/power adapter and other power sources) and end devices. USB specifications are developed to be both backwards and forwards compatible - this enables different generations of USB technologies to be compatible which protects consumer investments of USB-based products.
- With respect to connector interoperability - the USB standards specify specific connectors for each generation of technology and also specifies adapters for compatibility with legacy USB connectors including allowance for proprietary connectors on the device end. For example, See IEC 62680-1-3, USB Type-C™ Cable and Connector Specification, Section 3.4.3 specifications for USB-C standard cable assembly also includes the following option: "a cable assembly that is terminated on one end with a USB Type-C plug and has a vendor-specific connect means (hardwired or custom detachable) on the opposite end."
- There has been a **standardisation of connectors on the charger side** with these now being either USB-A (currently the majority of the market) or USB-C (for chargers supporting higher power devices). Note: there are also charger solutions available that include both USB-A and USB-C sockets.

IEC standards related to USB charging which have been adopted as EN standards through CELENEC are as follows:

- **EN IEC 62684 "Interoperability specifications of common external power supply (EPS) for use with data-enabled mobile telephones"** (Note: this standard was developed for the original MoU based on legacy USB connectors, cables and battery charging protocols).
- **EN IEC 62680-1-3 "USB Type-C™ Cable and Connector Specification"** - Defines a new USB Type-C™ receptacles, plug and cables that are compatible with existing USB interface electrical and functional specifications. The specification the aspects that are needed to produce and use this new USB cable/connector solution in newer platforms and devices, and that interoperate with existing platforms and devices.
- **EN IEC 62680-1-2 "USB Power Delivery specification"** - Defines a power delivery system covering all elements of a USB system including: Hosts, Devices, Hubs, Chargers and cable assemblies. This specification describes the architecture, protocols, power supply behaviour, connectors and cabling necessary for managing power delivery over USB at up to 100W. This specification is intended to be fully compatible and extend the existing USB infrastructure. It is intended that this specification will allow system OEMs, power supply and peripheral

developers adequate flexibility for product versatility and market differentiation without losing backwards compatibility.

- **EN IEC 63002 “Identification and communication interoperability method for external power supplies used with portable computing devices”** - This standard defines interoperability guidelines for external power supplies used with portable computing devices that implement the IEC 62680-1-2: Universal Serial Bus Power Delivery Specification with the IEC 62680-1-3: Universal Serial Bus Interfaces for data and power-Common Components-Type-CTM Type-C Cable and Connector Specification. It specifies the data objects used by a portable computing system using IEC 62680-1-2 to understand the identity, design and performance characteristics, and operating status of an external power supply. This standard is applicable to external power supplies under 100 watts for portable computing devices, with a focus on power delivery application for notebook computers, tablets, smartphones and other related multimedia devices.

5 Definition of the policy scenarios

Three policy scenarios are considered in the study:

- Policy scenario 1: Baseline (including the 2018 MoU); and
- Policy scenario 2: Regulatory option:
 - Policy scenario 2A– technical solution A: USB-C at the device end and either USB Type A or USB-C at the charging block end (USB-C to USB-C or Type A to USB-C); or
 - Policy scenario 2B – technical solution B (also referred to as the maximum harmonisation option): USB-C at both the device end and charging block end (USB-C to USB-C only).

It is unclear how much flexibility would be tolerated under the regulatory approach. For example:

- would only a USB-Type C connector be allowed for charging or could the device contain multiple sockets?
- would all phones sold after a certain date require a USB-C connector at the device side?
- would adapters be permitted?
- would the requirement only affect new models introduced to the market after that date?
- would sales of phones compliant with the 2009 MoU continue to be allowed?

However, it was not possible to incorporate such complexities into the design of the policy options within the constraints of this study.

6 Impacts on consumers

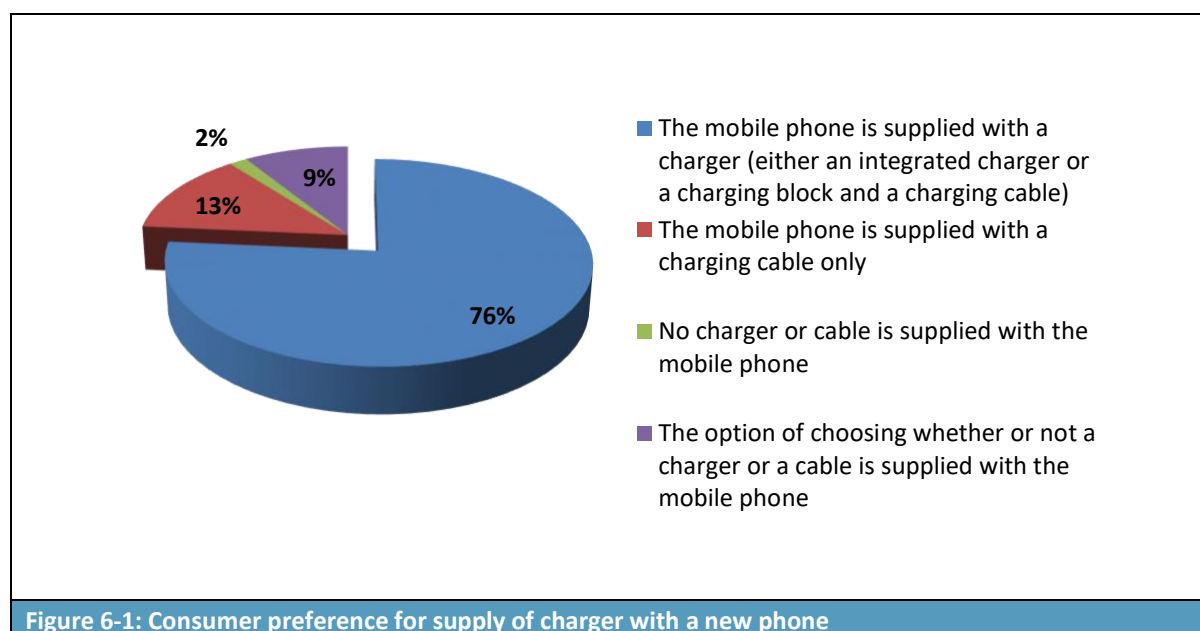
6.1 Impact on charging convenience

One of the main premises behind the argument for introducing regulation for a common charger from a consumer perspective is consumer convenience - that they would be able to use a single charger to charge multiple devices, as well as having the opportunity to charge their own device with, for example, the charger of a colleague or friend in the event that their own charger were not available or working.

This situation as described already exists with consumers having easy access to compatible charger/cables. The vast majority of locations have multiple charging accessories available to support the popular market device connectors. Consumers may also wish to carry multiple accessories to charge different devices. E.g. different power capabilities, different charging speeds, different charger form factors or AC side connector, charging multiple devices at the same time etc.

6.1.1 Current situation regarding purchasing of chargers/cables

Key influences on whether the number of chargers/cables consumers will want could be reduced are their motivations and behaviour when buying chargers. The consumer survey carried out as part of this study is revealing in that it clearly demonstrates a preference among consumers for mobile phones being supplied with a charger (either a charging block with a detachable cable or an integrated charger). Figure below shows that 76% of respondents to the consumer survey preferred new phones to be supplied with either an integrated charger or a charging block and cable, and that only 2% said that they would prefer no charger or cable to be supplied with a new phone.



The majority of respondents in the consumer survey (57%) indicated that they had not purchased any charger in addition to the one that came with their phone. Moreover, as can be seen in Figure , more respondents indicated that they had purchased an additional cable than had bought a complete charging block and cable or an integrated charger.

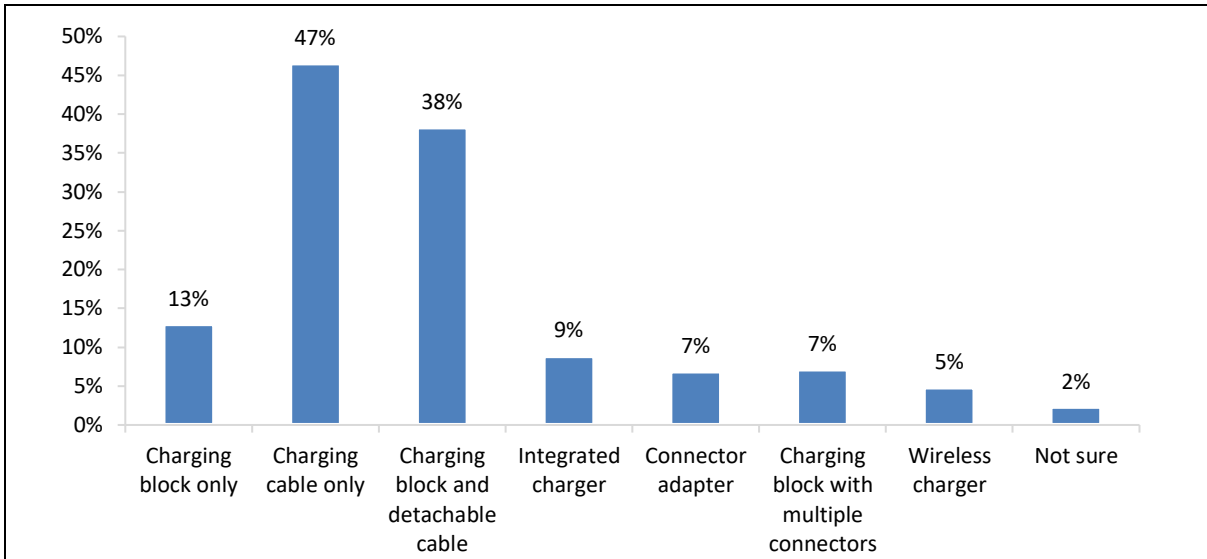


Figure 6-2: Types of charger purchased by survey respondents after purchasing their phone (more than one option could be selected)

Given the fact that a higher percentage of respondents indicated that when they did buy an additional charger, they purchased a charging cable only (i.e. one of the cheaper options), the overall costs incurred by consumers buying chargers for reasons of compatibility are not likely to be significant. It is noted that there were numerous reasons for purchasing additional chargers/cables (as described Figure below).

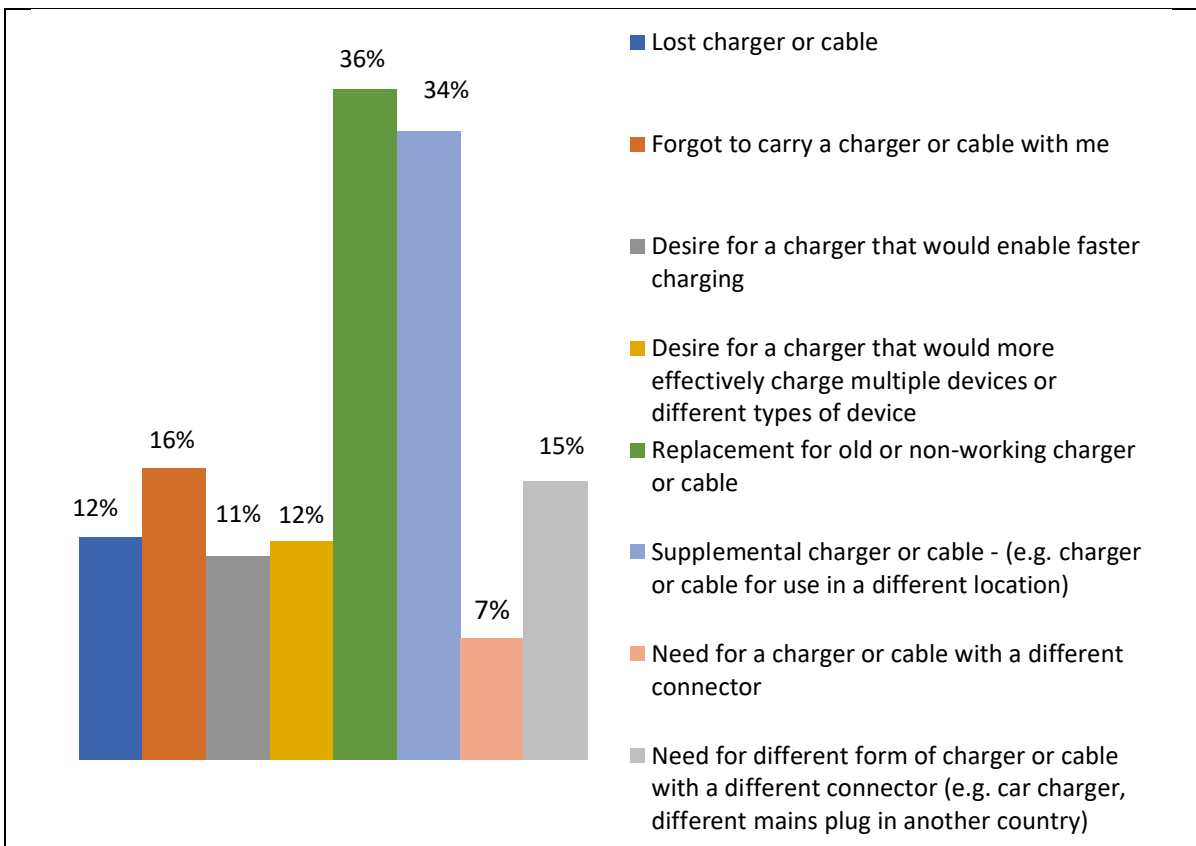
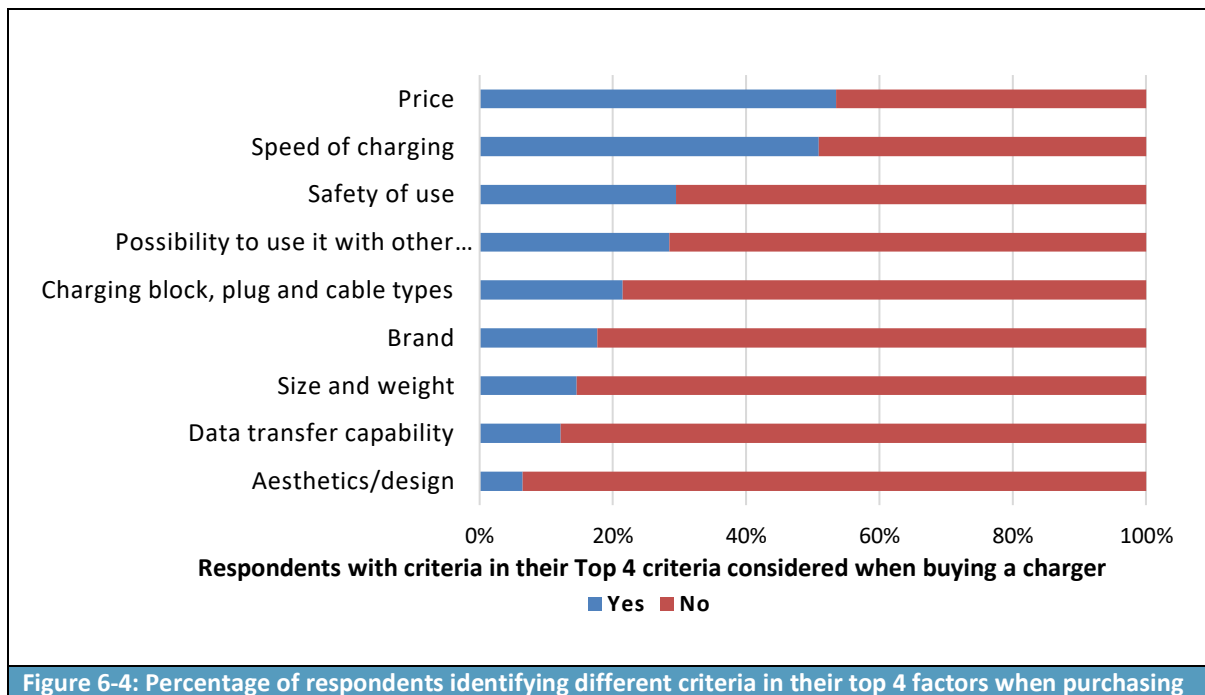


Figure 6-3: Reasons for purchasing additional chargers/cables

The development of smart and fast charging technology provides the opportunity (subject to power requirements, functionality and protocols being supported) to charge smartphones much faster than previously, and it is to be expected that consumers, particularly those that regularly update their phones to the latest technology, will also be keen to have the most up-to-date chargers. Hence, innovation is important to consumers. It is shown in Figure below that 51% of respondents to the consumer survey included the speed of a charger as being in their top 4 criteria when purchasing a charger (only below 'price', which was the criteria included in the top 4 criteria selected by the most respondents, 54%). Criteria such as the charging block, plug and cable (21%) and the possibility to use it with other devices (28%) were identified by significantly lower proportions of respondents as being in their top 4 criteria.

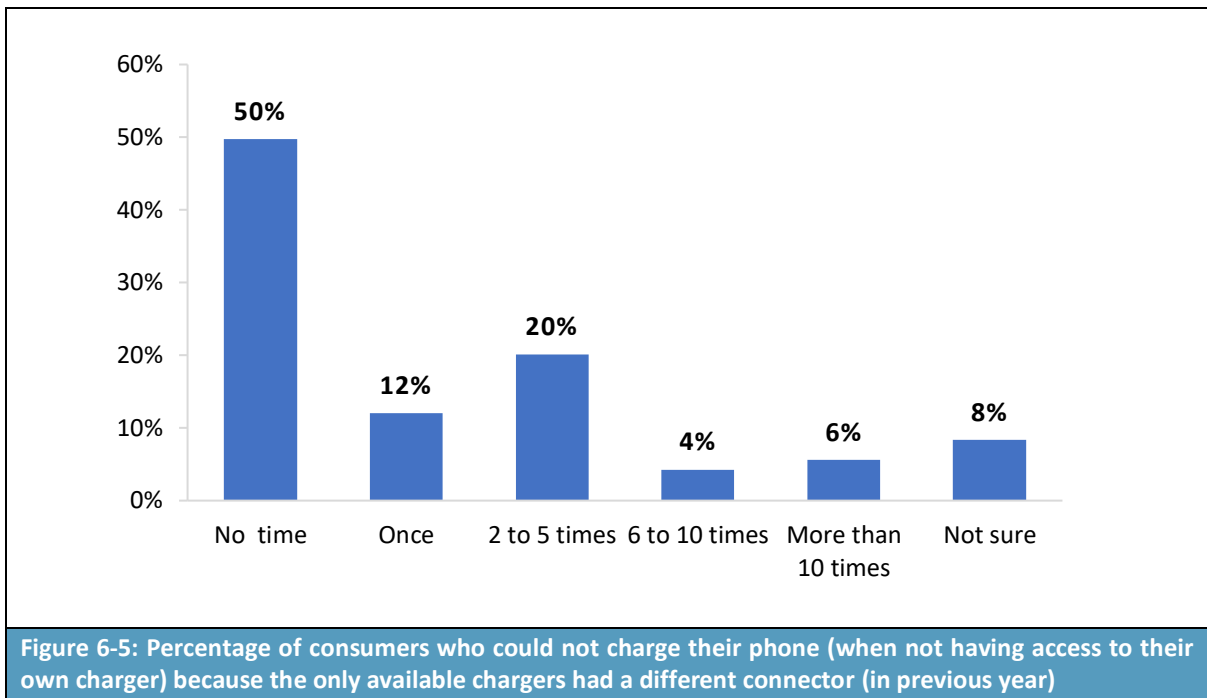


6.1.2 Ability of consumers to charge their phones

In order to assess whether the introduction of a common charger would be beneficial to consumers, it is first necessary to establish what the extent of any problem is.

The consumer survey asked respondents how many times in the past year they were unable to charge their phone because the only other charger(s) or cable(s) they could access from someone else had a different connector. As shown in Figure , 50% of respondents said there were no occasions at all, 12% and 20% of respondents indicated that they had hardly (only once, or 2-5 times) experienced this problem. Importantly, only 10% indicated that this had been a difficulty on 6 or more occasions, with the overall conclusion being that only a very few respondents indicated that not being able to charge their phone was a particular problem.

Similar results arose when respondents were asked whether someone else wanted to charge their mobile phone using the respondent's charger and/or cable but was unable to do so, with 45% indicating there were no occasions where this was the case and only 12% indicating that it was a problem on 6 or more occasions.



6.1.3 Impacts under the different scenarios

Scenario 1 (baseline)

Consumers would continue to be able to purchase additional chargers that can be used with their existing devices for a range of reasons. Due to a high level of preference to receive a charger with a new phone, decoupling would appear to be unlikely in the short to medium term.

Section 3 shows a strong and rapid trend transitioning towards USB-C technology in mobile phone charging solutions adopted for new models over the period 2015-2019. Under the baseline scenario, where the current MoU between mobile phone manufacturers promotes USB-C, this trend would be expected to continue further into the future. It is, however, likely that Micro-USB connectors on phones will continue to be sold for some time in the future (in particular for cheaper phones due to the fact that component and technology licensing costs for USB-C connectors are higher, based on consultation with a mobile phone manufacturer), although these sales could be expected to reduce gradually over time.

The high level of convergence in charging solutions, coupled with the fact that mobile phone ownership is very high would suggest that the majority of consumers would not face significant difficulties in being able to access a charger in the event that they did not have access to their own charger.

Scenario 2A

The introduction of legislation to require a common charger would be unlikely to have any impact on the number of chargers that consumers buy for reasons such as replacing an old/faulty charger or to be able to have a charger in multiple locations. Consumers may prefer/need chargers with different power capabilities/charging speeds, form factors or AC-side connector, multiple chargers to charge multiple devices at the same time etc.

Consequently, there would be little increase in consumer convenience or cost savings for consumers in this area.

Under this scenario where a USB-C connector at the device end is required by legislation, it is noted as set out above that, at most, only a very limited number of people might benefit from being able to charge their devices when they would previously have been unable to do so.

In fact, obliging all phones to be equipped with a USB-C socket (whether or not the connector at the charging block end is USB-C or USB-A) might actually have the effect of reducing consumer convenience and increasing cost. In this scenario, all new cables sold with devices could not be used with consumers' existing devices equipped with a Lightning connector or a Micro-USB connector. It is noted that Apple's market share of European smartphone sales is estimated at approximately 27% in 2018 and Micro-USB equipped devices remain prevalent. There would also be a significant number of Lightning and Micro-USB chargers in the EU stock which could no longer be used with new devices required to have a USB-C socket, meaning owners could not easily re-use these chargers.

Requiring USB-C connectors under this option would also prevent any sales of new phones with Lightning and Micro-USB connectors. The latter are particularly important for cheaper devices and could result in increased costs for consumers (although these would be expected to reduce over time as economies of scale develop for a widely expanding market for USB-C equipped phones and connectors). It is noted that the increased functionality of USB-C connectors and charging is not necessarily as important for consumers who purchase cheaper phones where price is their main determining factor, and as a result, the benefit to these consumers in terms of convenience from requiring USB-C charging might be limited.

It is noted that the Apple Lightning ecosystem extends beyond mobile phones. Manufacturers in Europe and other regions of the world produce devices and accessories that use the Lightning connector to receive power and transmit data. In the event that new phones are unable to incorporate Lightning connectors, this will likely impact the sales of companies that sell products and accessories that rely on the Lightning connector, as well as cause problems for consumers who buy and use them.

There are also other devices and accessories that depend on Micro-USB connectors for charging and data transfer (e.g. speakers, smart watches etc.) and similar problems for consumers and manufacturers/traders of products using these connectors would likely arise.

Scenario 2B

Under this scenario, all of the impacts identified under Scenario 2A would occur in the same way since the scenario involves mandating a USB-C connector. As noted, there would be little benefit to consumer convenience in terms of the ability to charge their phones when they do not have their own charger with them due to the already widespread availability of common charging solutions as described under the MoU.

In addition however, the requirement for USB-C sockets on charging blocks under this scenario could potentially have further negative impact on consumer convenience as existing charging blocks having a USB-A socket on the charging block could no longer be used with new cables having USB-C connectors at both ends and consumers would not be able to use their existing USB-A cables on the new charging blocks.

6.2 Impact on other aspects of consumer convenience

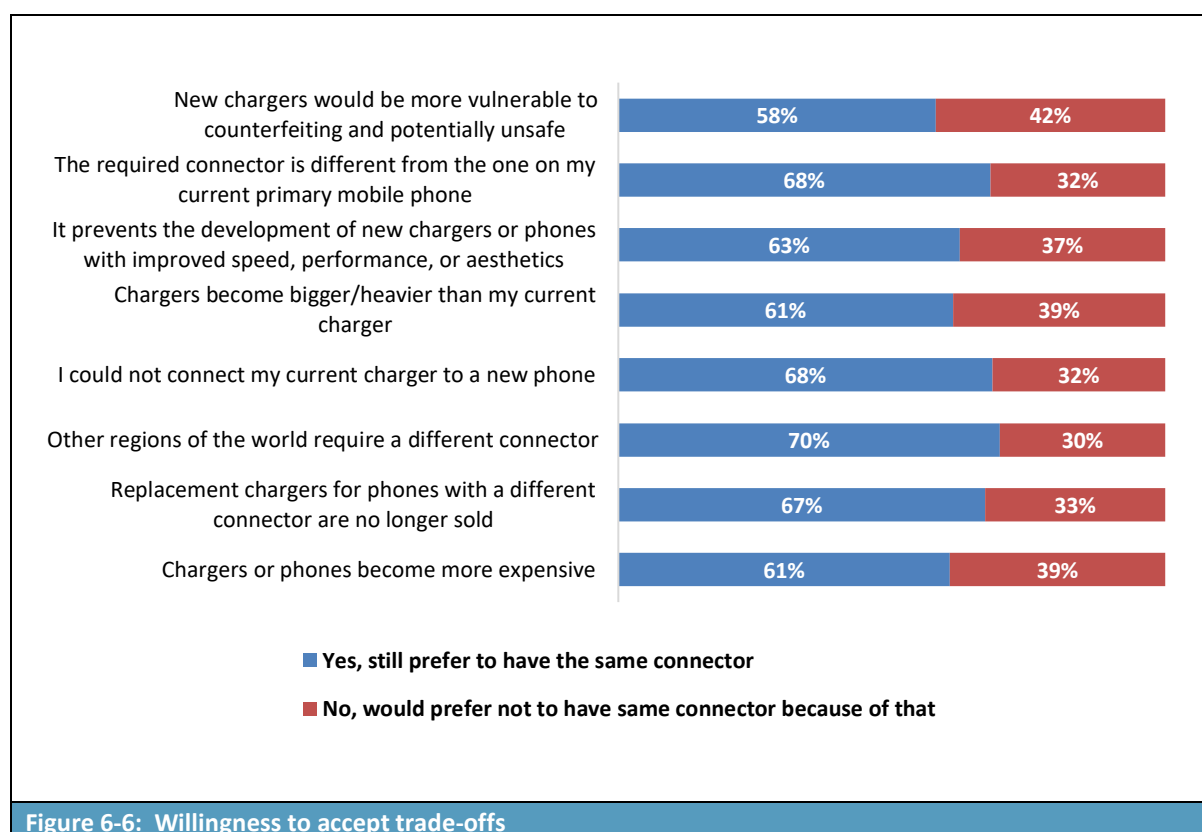
Consumer convenience is not only influenced by the connector to the device and the charger. There are numerous other aspects of consumer convenience which may be affected by the adoption of a common charger and which would involve different trade-offs for consumers.

6.2.1 Trade-offs associated with a common charger

The introduction of a common charger, whilst harmonising the charging block and connectors (also on the device end), is likely to have implications for consumers in areas other than simply enabling users to charge their phones.

The consumer survey asked consumers to identify whether they would be willing to accept a number of trade-offs in order to have a common charger and these are set out in the following figure. As Figure below shows, whilst more people were willing to accept each trade-off than were not, there were still significant numbers of respondents that said they would not be willing. For example, 42% of respondents said they would not be willing to accept chargers being more vulnerable to counterfeiting and potentially unsafe, 39% said they would not be willing to accept phones or chargers becoming more expensive and 37% said they would not accept it if it prevented the development of new chargers or phones with improved speed, performance or aesthetics.

Significantly, only 31% of respondents said that they would be willing to accept ALL trade-offs.



6.2.2 Impacts under the different scenarios

Baseline/MoU

Under the baseline/MoU scenario, a limited number of widely used existing charging solutions would remain available, meaning that manufacturers could continue providing the most appropriate charging solutions for their phones (and potentially other devices), pursue solutions that incorporate innovation to provide better charging and other outcomes for consumers. Whilst some of the existing charging solutions will likely experience reduced availability, they would all remain available and none of the identified trade-offs would be likely to arise for a significant number of consumers.

Scenario 2A and 2B

Under both of the regulatory scenarios, it is possible that a number of consumers would experience some of the trade-offs identified. Legacy devices using Lightning, Micro-USB and proprietary connectors would be affected as owners of these devices may face difficulties obtaining compatible chargers in the longer term.

Only permitting sales of charging blocks with USB-C sockets under Scenario 2B would mean that if a consumer needed to replace a charging block or wanted to purchase an additional block, they would be forced to purchase a new cable if they only had USB-A to USB-C cables. These numbers could be significant as this is the most commonly used cable for phones with USB-C connectors currently, and the number of charging blocks with USB-C sockets remains low.

The fact that USB-C connectors are more expensive than Lightning and Micro-USB connectors would imply that costs would also increase under these scenarios.

6.3 Cost of chargers

The extent to which benefits and/or costs would arise for consumers under a scenario where a common charger is mandated will depend, to a large degree, on the extent to which consumers face a 'problem' charging their phones and other devices and how willing they are to incur any costs (not just financial) that might arise. Potential costs arising include those relating to having to purchase a replacement charger in the event that they do not have access to their own or another compatible charger or higher costs of different types of chargers/cables that they may be forced to purchase (due to lack of availability or a particular charger having been mandated).

6.3.1 Introduction

Costs (or cost savings) arising to consumers under the different scenarios relating to charging solutions will be determined by the following elements:

- Costs arising from needing to purchase chargers/cables in the event that consumers do not have access to a compatible charger and need to charge their phone
- The need to purchase additional chargers when purchasing a new device or switching from their existing one
- Additional costs arising from higher prices when the current connectors are cheaper than those that might be mandated under potential regulation

6.3.2 Impacts under the different scenarios

Impacts under the baseline/MoU Scenario

Under the baseline/MoU scenario, consumer demand for including chargers with new phones is likely to continue at the same level (with very little decoupling of phones from chargers as a result) and consumer purchasing of chargers for reasons other than device compatibility (e.g. to have a charger in another location, replace a lost charger etc.) are also likely to continue at the same level. Consequently, there will be very little cost savings to consumers arising from sales of phones without a charger. In any event, the cost of a charger is a relatively small proportion of the overall cost of a phone (a charger can be purchased for a few €), representing very limited savings for any consumers who did choose this option.

Consumers may potentially incur additional costs in situations where they do not have access to their own charger and cannot make use of one provided by someone else whose charger is not compatible (e.g. with a different connector). However, as indicated above, this does not occur to any great extent due to the limited number of charging solutions on the market, public availability of different cables/chargers in hotels, public facilities etc. and widespread ownership of mobile phones, meaning that the likelihood of being able to access/borrow a compatible charger is relatively high.

In the relatively rare event that a consumer is unable to charge their phone using someone else's charger, a number of options are available, not all of them requiring the consumer to purchase a whole new charger. Options include:

- Purchasing an adapter so that they can use a different charger/cable (with a different connector, either their own or borrowed from someone else)
- Purchasing a cable only (and using a charging block from someone else or a USB port on a computer, laptop or other device)
- Purchasing a charger and cable

In many cases, the purchase of an additional cable rather than a charging block would be all that is necessary under these circumstances, which would be a significantly lower cost than having to purchase an additional charging block. Adapters can be purchased for a few € in the case of Micro-USB to Lightning connectors and <€10 for USB-C to Lightning adapters. Similar prices apply to Micro-USB and Lightning to USB-C adapters and cables for both types of connectors are available for similar and slightly higher prices. Overall, costs are limited, particularly in relation to the average price of mobile phones in 2018 (€674 for phones with a Lightning connector and €442 for phones with a USB-C connector).

Impacts under Scenario 2A

As with the baseline/MoU scenario, consumer preference is for a charger to be supplied with a new phone, and consequently, there will be very limited savings to consumers from not purchasing a charger alongside a new phone. Purchasing chargers for reasons other than compatibility will also continue at similar levels and since most consumer can already charge their phone with someone else's charger, there would be very limited need for additional purchasing of chargers/cables to enable consumers to charge their phones when they do not have access to their own charger. Consequently, any cost savings to consumers through purchasing fewer chargers would be very limited.

It is noted that the cost of USB-C connectors is currently higher than both Lightning and Micro-USB connectors, and since little decoupling of chargers from phone sales is anticipated due to consumer

preference, the actual cost to consumers might actually increase under this scenario where a USB-C connector is mandated.

According to the consumer survey, the majority of mobile phone owners (68%) have opted for a charging block with a detachable cable or a cable only (11% for Lightning users and 18% for non-Lightning users). Under this scenario, consumers who own devices that would not be compatible with a USB-C connector could continue to use their current charging block and purchase a separate cable, (i.e. one of the cheaper options), although this would still represent an additional cost over the baseline/MoU situation.

It is noted that those consumers who have purchased additional chargers/cables with a Lightning or Micro-USB connector would no longer be able to use these with new phones equipped with USB-C connectors. Once any devices that their existing chargers/cables could be used for fall out of the stock of mobile phones, they will become electronic waste as well as a wasted cost for consumers, particularly those that purchase a new device with USB-C and prefer to have multiple chargers/cables in different locations who be obliged to replace at least the cable in them all.

Impacts under Scenario 2B

Impacts would be similar those identified under Scenario 2A, However, in addition, consumers making use of detachable cables with a USB-A connector to the charging block on one end and a USB-C connector at the device end would find that their cables are no longer compatible with new charging blocks which have a USB-C connector at the charging block end, requiring them to purchase new cables in order to use a new charger. Consequently, costs would be higher than under Scenario 2B.

It is noted that the 2018 MoU avoids the premature (and artificial) obsolescence of chargers by explicitly allowing the sale of (1) smartphones chargeable through a cable assembly that sources power to a USB Type-C connector from a USB Type-A connector; and, separately, (2) smartphone models compliant with the technical requirements as laid out in the 2009 MoU.

6.4 Summary of impacts on consumers

The key impacts identified above under the different options are summarised in Table 9-1 below.

Table 6-1 Summary of main impacts on consumers	
Scenario	Description of impacts
Baseline scenario: Memorandum of Understanding	A limited range of charging solutions coupled with widespread availability of mobile phones and popular cables means that people generally do not and will not experience significant problems being able to charge their phones. Continued availability of required chargers and cables for vast majority of phones, including legacy ones with Micro-USB connectors. Very limited decoupling of phones from chargers in the future due to consumer preference.
Policy scenario 2A: Regulatory option USB-C at the device end and either USB Type A or USB-C at the charging block	Consumers cannot use their existing Micro-USB charging solutions to charge their new phone which has USB-C (without adapters). Very limited additional benefit arising from consumers being able to use other people’s chargers to charge their phone in the event they do not have access to their own. Over 60% surveyed had no difficulty charging their phones (i.e. no times or only once in the last year) if they had not brought their charger with them and only 10% surveyed indicated difficulty on 6 or more occasions. Consumers with phones with Micro-USB and Lightning connectors will not be able to use current chargers/cables with new phones.

Table 6-1 Summary of main impacts on consumers

Scenario	Description of impacts
	<p>Price of phones and chargers/cables likely to increase as USB-C connectors more expensive than Lightning and Micro-USB.</p> <p>Very limited decoupling of phones from chargers in the future due to consumer preference.</p> <p>Consumers potentially experience trade-offs from having common charger in areas such as limited development of new chargers or phones with improved speed, performance or aesthetics that would be available to consumers in other global markets. Almost 70% surveyed would not accept at least one of the trade-offs in order to have a charger with a common connector.</p>
<p>Policy scenario 2B: USB-C at both the device and charging block end</p>	<p>Consumers cannot use their existing Micro-USB charging solutions to charge their new phone which has USB-C (without adapters).</p> <p>Very limited additional benefit arising from consumers being able to use other people’s chargers to charge their phone in the event they do not have access to their own. Over 60% surveyed had no difficulty charging their phones (i.e. no times or only once in the last year) if they had not brought their charger with them and only 10% surveyed indicated difficulty on 6 or more occasions.</p> <p>Consumers with phones with Micro-USB and Lightning connectors will no longer be able to purchase new chargers/cables for their current phones or use current chargers/cables with new phones.</p> <p>In addition, consumers currently using chargers with USB-A sockets on charging blocks will need to purchase a new charging block when need to replace cables and will not be able to use charging block with new phones.</p> <p>Very limited decoupling of phones from chargers in the future due to consumer preference.</p> <p>Consumers potentially experience trade-offs from having common charger in areas such as limited development of new chargers or phones with improved speed, performance or aesthetics that would be available to consumers in other global markets. Almost 70% surveyed would not accept at least one of the trade-offs in order to have a charger with a common connector.</p>

7 Impacts on safety and innovation

7.1 Impact on innovation

A regulatory intervention would lock the market into the use of a specific technical solution and thus discourage innovation. Although mandating a specific connector at the device end would not preclude the market from moving to wireless charging or advanced fast charging solutions, it would act as a disincentive to companies that would otherwise carry out research and development to identify new, innovative, wired solutions. Although companies may still try to develop innovative solutions for non-European markets, these solutions would be primarily tailored to non-EU markets and their introduction to the EU would be delayed until they are allowed by the regulator.

If mandated by legislation, any change to the common standard is likely to be a protracted process which, by definition, is not well suited to sectors which are characterised by fast-paced innovation. It is entirely possible that, should a regulatory intervention have taken place five years ago when USB-C was in its infancy, Micro-USB and all USB charging standards existing at that time would have been mandated for all mobile phones in the EU. In such a hypothetical scenario, it is conceivable that the regulator would only be switching from Micro-USB to USB-C at the time of the publication of this report, meaning that the EU market would be several years behind the rest of the world in terms of benefitting from the advantages that USB-C has to offer. Extended over a longer period of time, it is conceivable that locking a large market such as the EU into a specific solution could have meant that the Lightning and USB-C standards may not have been developed at all.

One of the key advantages of an MoU is that, whilst providing certainty to manufacturers who do not want to invest money in the development of proprietary solutions, it does not prevent the development of new innovative solutions.

7.2 Impact on safety

7.2.1 Introduction

The safety of mobile phone chargers, particularly those sold as standalone items separately from the phones they are intended to charge, has been identified as an issue of concern for consumers. However, it is tempting for consumers to purchase cheap chargers and cables when buying replacement or additional chargers. The consumer survey carried out for this study showed that 54% placed price in their top 4 criteria when buying a charger, whereas only 30% placed safety of use in their top 4 criteria.

7.2.2 The extent of the problem

Every year, a number of mobile charging products are reported to the authorities in Member States and included in the EU rapid alert system database for dangerous non-food products²⁰ as a result of failing to meet safety standards.

²⁰

https://ec.europa.eu/consumers/consumers_safety/safety_products/rapex/alerts/repository/content/pages/rapex/index_en.htm

A search of the database²¹ over the period 2014 – 2019 shows the alerts most likely relating to mobile phone chargers ranged in number from 12 in a year to 25, representing a range from 8% to 23% of all alerts for serious risks in the electrical appliances and equipment category. Details on the numbers and reasons for notification are presented in Annex 1.

Whilst the absolute number reported to the alert system are small in comparison to the overall volume of chargers sold, these are likely to represent only a very small percentage of the total number of sub-standard chargers/cable in circulation as they are only the ones which are detected and reported. Furthermore, the search carried out for this study only covered ‘products with serious risks’, with other products potentially having been alerted under ‘other risk levels’ and ‘other types of alerts’.

Whilst the overall number of unsafe chargers is difficult to determine, a 2016 report²² by EUIPO-ITU estimated that in 2015, “14 million smartphones fewer were sold by the legitimate industry across the EU than would have been the case in the absence of counterfeiting”. The report calculated that this represented in the region of €4.2 billion in lost revenue to phone manufacturers, equivalent to 8.3% of the sector’s sales.

Given that in the vast majority of cases, mobile phones are sold with a charger, it can be assumed that a similar number of counterfeit (or at least low quality, cheaply manufactured chargers) were put onto the EU market alongside the counterfeit phones. This represents a significant number of chargers that have the potential to be unsafe, with there being a high degree of correlation between safety levels and chargers that are counterfeit. Electrical Safety First, a UK-based campaigning organisation focused on improving electrical safety, reported testing a range of counterfeit chargers and found that “98% of them had the potential to cause a lethal electric shock or start a fire”²³.

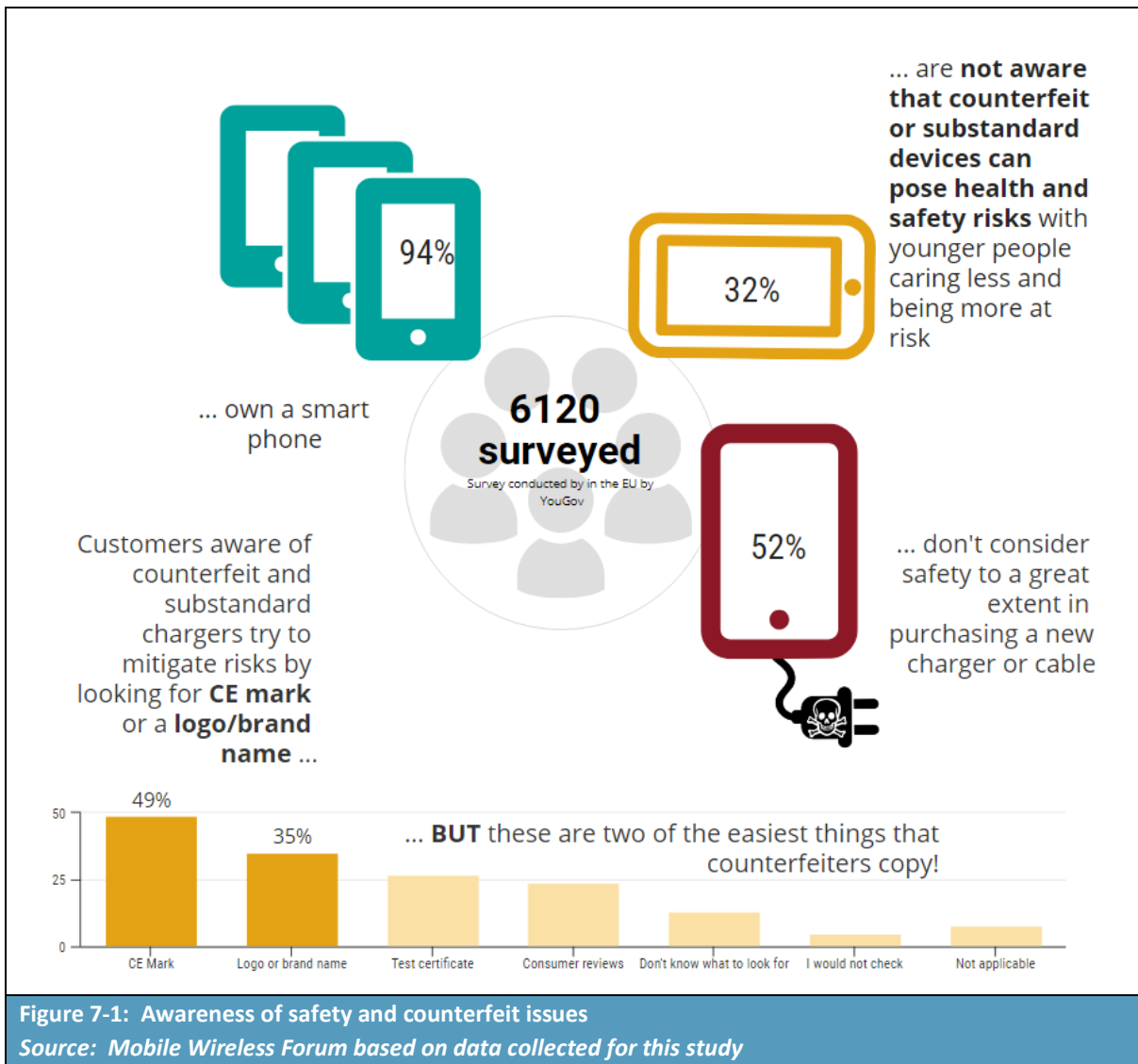
7.2.3 Consumer awareness and attitudes towards safety

As indicated above, safety concerns do not appear to be at the top of consumers’ list of priorities when making decisions to purchase a mobile phone charger, with aspects such as price and speed of charging being of greater concern. Figure below shows that the majority of respondents to the survey do not consider safety at all when purchasing a new charger/cable.

²¹ The search focussed on a subset of alerts in the database (electrical appliances and equipment > products with serious risks) and were filtered using terms most likely to relate to mobile phone chargers: charger, charger kit, Micro-USB charger, mobile phone charger, USB cable, USB charger, USB power supply, USB travel charger etc.

²² The Economic Cost of IPR Infringement in the Smartphones Sector

²³ <https://www.electricalsafetyfirst.org.uk/guidance/product-safety/chargers/>



7.2.4 Impacts on safety under the Baseline/MoU scenario, Scenario 2A and Scenario 2B

Anticipated impacts on safety under the different scenarios are set out below.

Baseline/MoU

Under the baseline, there will be limited changes to the current situation. As the predicted move towards USB-C consolidation (supported by the current MoU signed by mobile phone manufacturers) progresses, the supply of USB-C chargers in terms of both sales and stock will increase. Resulting economies of scale are likely to lead to decreases in costs over time and this, combined with greater competition as potential new market entrants eager and able to exploit the market due to greater harmonisation, would suggest that prices would decrease in the medium to longer term.

However, as prices fall, the incentive to cut costs further grows larger as profits are squeezed. This would encourage unscrupulous manufacturers to cut corners in the design and manufacturing of USB-C chargers (which are more expensive to manufacture than Micro-USB ones), with the potential for greater numbers of counterfeit/sub-standard chargers coming onto the market.

It is noted though that the market is currently shifting from a place where there is already a large degree of convergence towards the Micro-USB connector and that such incentives to cut costs already exist, albeit when manufacturing a different type of charger.

Scenario 2A

Under Scenario 2A, the pace of harmonisation is of course accelerated. This will provide additional incentives to cut costs in order for products to be attractive to consumers by means of a lower price. Under these circumstances, the likelihood of manufacturers cutting corners and failing to adhere to safety standards and product regulation is likely to be greater as price will be the main route to product differentiation.

Scenario 2B

As under Scenario 2A, the pace of harmonisation will be increased over the Baseline/MoU scenario and incentives to cut costs and cut corners will be increased. However, whilst Scenario 2A permits both USB-A and USB-C connections on the charging block, Scenario 2B only allows USB-C connections. This represents an increase in harmonisation over Scenario 2A. More importantly, it increases harmonisation within the block itself, which consists of greater numbers of components and where there is increased risk in terms of potential hazards. As such, potential safety risks are likely to be higher under this option.

7.2.5 Summary of impacts on safety

The key impacts identified above under the different options are summarised in Table 9-1 below.

Table 7-1 Summary of main impacts on safety	
Scenario	Description of impacts
Baseline scenario: Acceptance of Memorandum of Understanding	Increased USB-C consolidation over time under the MoU will see reductions in costs of phones, chargers and cables, providing incentives to unscrupulous manufacturers to cut corners, leading to greater numbers of counterfeit and sub-standard chargers/cables.
Policy scenario 2A: Regulatory option USB-C at the device end and either USB Type A or USB-C at the charging block	Accelerated convergence of charging technologies and greater incentives to produce counterfeit and sub-standard chargers/cables. Given the limited attention consumers pay to safety of chargers when making purchases, there will be an increased risk to consumers' health and safety over that arising under the baseline/MoU scenario.
Policy scenario 2B: USB-C at both the device and charging block end	Accelerated convergence of charging technologies and greater incentives to produce counterfeit and sub-standard chargers/cables. Additional regulation on the charging block will provide further incentives and given the limited attention consumers pay to safety of chargers when making purchases, there will be an increased risk to consumers' health and safety over that arising under scenario 2A.

8 Impacts on economic operators

8.1 Introduction

The possible impacts on economic operators include direct impacts on manufacturers of mobile phones, chargers, cables, converters, etc. and indirect impacts in the wider supply chains, including those on importers/distributors/retailers of mobile phones and/or chargers, app developers, accessory makers, mobile phone repair shops, and recyclers of mobile phones and chargers.

Although the direct impacts will largely fall on companies that are headquartered/have production facilities outside the EU, it can be expected that some these impacts will filter through to their EU operations or to companies further downstream in their supply chain, such as their distributors and vendors in the EU, i.e. to companies that generate a significant turnover and employment in the EU.

8.2 Impacts on manufacturers of mobile phones and chargers

The types of impacts that may be experienced include:

- Cost of redesigning existing products/designing new products that meet the requirements;
- Lost sales due to earlier than planned phase-out of non-compliant products;
- If redesign is impossible within the timeframe required or not commercially viable, temporary or permanent cessation of shipments of certain products;
- Potential need for two product lines, one for EU and another one for the rest of the world;
- Costs associated with providing alternative (more expensive) chargers/connectors;
- Lost sales of proprietary chargers or revenue from licencing;
- Breach of long-term contracts and potential penalties;
- Impaired innovation and building to the lowest common denominator (see Section 7);
- Impacts on safety and reliability – performance, warranty and liability issues (see Section 7);
- Negative effects on competitiveness of EU companies; and
- Negative impact on competition should the intervention disproportionately affect companies that rely on the Lightning or Micro-USB connector in all or some product categories.

The extent to which any of these impacts will arise will depend on the precise design of the regulatory intervention.

EU manufacturers of mobile phones

Smartphones and chargers are largely produced outside the EU by companies that are headquartered outside the EU. However, there are EU-based companies (many of which appear to be SMEs/start-ups) that sell their own brand mobile phones. These companies would have to bear the compliance costs even in instances where some or all of their product design and manufacture operations are based outside the EU. Around 30 such companies have been identified within the framework of internet searches for this study.²⁴ These are mainly concentrated in niche market segments, such as easy to use phones for the elderly, heavy duty, luxury, ethical, safety or secure products. Other EU-

²⁴ Emporia, Evolveo, CPA Halo, Prestigio, Lumigon, Jolla, Nokia HMD, Archos, Twig Com (ex-Benefon), Mobiwire, Thomson Téléphonie/Technicolor, Wiko Mobile, MLS, Gigaset, GSMK Cryptophone, Online Solution Ano-phone, Brondi, NGM, Olivetti, Just5, Fairphone, Yarvik, Overmax, mPTech (MyPhone, Allview, BQ, Doro, Handheld, Fonerange, TTfone (TTsims), Grundig, Bullitt Group, Vodafone, Wileyfox

based companies do not market niche products, but may instead be trying to capitalise on the popularity of brand names that were well known in the past. The business strategy of these companies is typically based on local brand recognition in specific countries, niche products such as rugged, fair-trade, or modular phones or tailoring of the operating system, etc. These business strategies target customers with niche requirements and their sales appear to be limited compared to major market players, thus suggesting that their small size would mean that any costs associated with measures such as redesign would have comparatively more significant implications for these companies. It is of note that the handsets sold by these companies rely on a mixture of Micro-USB and USB-C approaches and some of the products sold by these companies appear to have a relatively long market life. The dynamic and more precarious nature of the start-up sector, together with the fact that their capacity to weather costs is more limited than for large companies, suggests that any impacts would be comparatively more pronounced.

Disproportionate impact on companies that rely on the Lightning connector

Mandating a USB-C connector on the device under Policy Scenarios 2A and 2B would disproportionately affect companies that rely on the Lightning connector, including Apple and producers of iPhone accessories, whilst the impacts on its competitors would be comparatively more limited due to the fact that a large-scale shift to USB-C is expected even in the absence of regulatory intervention.

Timing of the new requirements

The magnitude of the potential impacts depends on the timing of the requirements and on their precise definition, notably on whether the potential requirements would apply only to new models or to all mobile phones sold in the EU after a certain date. If the regulatory intervention were to affect existing models and the lead time were not long enough for these products to phase out naturally and for manufacturers to introduce new products with USB-C connectors, a disruption with significant economic impacts can be expected, even in instances where the cessation of sales is relatively short. The potential for significant negative costs is linked to sheer value of mobile phone ecosystem for the EU economy. For example, over 1.5 million jobs in Europe are attributable to the Apple App Store ecosystem²⁵ and even a short-lived disruption to the supply of the products that use iOS has the potential to have a significant negative impact on the EU economy. It should also be noted that the curtailment of the sales of existing stocks of older products could result in losses for manufacturers and/or distributors since it is reasonable to expect that these products would have to be sold at a discount in other markets.

IP losses due to counterfeiting

A 2016 report²⁶ by EUIPO-ITU estimated that in 2015, “14 million smartphones fewer were sold by the legitimate industry across the EU than would have been the case in the absence of counterfeiting”. The report calculated that this represented in the region of €4.2 billion in lost revenue to phone manufacturers, equivalent to 8.3% of the sector’s sales. This shows that the extent of losses from counterfeiting is already very high and any changes that may increase the prevalence of counterfeiting (see Section 7.2) have the potential to result in significant IP losses for companies.

²⁵ See <https://www.apple.com/uk/job-creation>

²⁶ EUIPO (2016): The Economic Cost of IPR Infringement in the Smartphones Sector, available at https://euipo.europa.eu/tunnel-web/secure/webdav/guest/document_library/observatory/resources/research-and-studies/ip_infringement/study11/smartphone_sector_en.pdf

8.3 Indirect impacts along the supply chain

Negative impacts on major smartphone manufacturers may be felt in the in the EU even in instances where the majority of their operations are based outside the EU if they reverberate throughout the supply chains and affect companies like importers, distributors and retailers in the EU. In addition, any disruption to the supply of mobile phones, even a very short-lived one, can affect the wider ecosystem of some of the relevant manufacturers, such as third-party accessory makers and app developers.

Examples of the potential impacts include:

- Lost sales due to earlier than planned phase-out of non-compliant products;
- If redesign impossible within the timeframe required or not commercially viable, temporary or permanent cessation of shipments of certain products;
- Breach of long-term contracts and potential penalties; and
- Negative impact on competition should the intervention disproportionately affect companies that rely on the Lightning or Micro-USB connector in all or some product categories.

In some cases, the impacts on these companies can be more significant in relation to their size than the impacts on mobile phone manufacturers. For example, the cost of redesign is likely to be more significant for a niche accessory maker than for a large mobile phone manufacturer. Similarly, the cost of using a different, more expensive, connector is likely to have a greater impact on a producer of an accessory that is sold at a lower price than a mobile phone. The actual impact on these companies, of course, depends on their ability to pass any cost increases on to consumers.

With regard to waste disposal and recycling, the policy scenarios can be expected to have a very limited impact on e-waste generation (see Section 9) and, as a result, no real impact.

Scenario	Description of impacts
Baseline scenario: Memorandum of Understanding	Limited impact, companies adapt to the requirements at their own pace, based on market/consumer demand and cost, meeting consumer market needs and minimise any negative impacts
Policy scenario 2A: USB-C at the device end and either USB Type A or USB-C at the charging block	Impacts depend on the timing and definition of the regulation but potential for negative direct and indirect impacts across the supply chains
Policy option 2B: USB-C at both the device and charging block end	As above but magnitude of impacts expected to be greater

9 Environmental impacts

One of the arguments brought forward in support of a mandatory use of a standardised charging solution is that it would help to reduce electronic waste and by this means the economic and environmental cost associated with its disposal. The quantity of e-waste generated from chargers and cables is driven by the level of sales, the total stock and consumer habits (i.e. how often they replace their phone, how often they buy a new charger or cable, how long they keep their old charger before they throw it away).

If all phones and other devices had the same connector, the idea is, consumers would be able to use the same charger or cable with different devices, or re-use an old charger or cable when they purchase a new phone. Although speculative, this could reduce the number of new chargers purchased as well as the number of chargers held by consumers. The hypothetical benefits associated with these potential reductions could be the saving of raw materials and reduction in CO₂ emissions produced across the entire life cycle of a charger or cable.

As concluded in a report on the potential environmental benefits of a mandated action²⁷, cables appear to be considerably less impactful than charging blocks, in all the examined aspects, except for the impact category abiotic depletion. This entails that even if realized, the hypothetical benefits of a reduction in the sales of new charging blocks and cables might be limited.

The gradual detachment of the cable from the charging block, that was documented in Section 3, has resulted in a decline of integrated chargers and the possibility to reuse a charging block with other cables or to plug a cable directly into a power source (i.e. USB socket in a computer, on the wall, etc.). This has reduced consumers' need to buy a new charging block whenever they just need to replace their cables, that are considerably more consumable than the blocks. In this way, the detachment has effectively brought about a reduction in raw material consumption and consequently in e-waste generation when compared with a situation where cables cannot be separated from the mains block.

As already pointed out in the RPA study from 2014, environmental benefits would most effectively materialise in a scenario in which the sale of phones is decoupled from that of charging solutions, at least when it comes to charging blocks. From a theoretical point of view, this would provide consumers with more incentive to reuse their charging solutions with their new devices, thus reducing drastically the annual flow of new charging blocks and cables into the total stock. However, contrary to expectations, harmonisation of charging solutions has not brought about large-scale decoupling. The level of decoupling is still very marginal and is unlikely to rise over the next few years. In 2019, manufacturers are still providing chargers and or cables together with new mobile phones, in large part in order to meet consumers' expectations to find them in the box. 76% of respondents to our survey have said to prefer that new phones are supplied along with a charger (either an integrated charger, or a charging block and a cable) in the box.

43% of consumers, according to the survey, have bought, at least once, an additional charger or cable since purchasing their main phone (Figure 3-2 in Section 3). It also appears that younger consumers are more likely to purchase an additional charger (Figure 3-3 in Section 3), independently of the type of phone they have. On the other hand, it is also remarkable that 57% of consumers have not purchased additional chargers, which might be indicative of many consumers' habits of reusing old chargers and cables.

²⁷ Policy Brief No.2 (Brussels, 30/01/2019): Regulation of Common Chargers for Smartphones and other Compatible Devices: Screening Life Cycle.

As further shown in Section 3, the most common reason for buying additional chargers identified by the respondents to the consumer survey include replacement for old or non-working charger or cable, i.e. 38% of respondents. A relatively higher percentage of young consumers, aged 18-29, have bought additional chargers or cables compared to all other age groups, which suggests that this is probably more related to specific consumer habits that would not be impacted by a regulatory intervention mandating a specific charging solution. Young consumers tend to use their phone more often thus finding themselves more frequently in the need to charge it, with the result that the charging solutions wear out more quickly and need to be replaced. It might also be plausible that young consumers can only afford cheaper chargers and cables that have a shorter life-cycle. Mandating a specific charging solution would thus generate only a partial, if any, impact on these purchases. Only a part of these annual purchases might be potentially avoided if harmonisation makes it easier to reuse old chargers and cables across all smartphones. Mandating USB-C for all smartphones would reduce the possibility to reuse older charging blocks and cables with Micro-USB (and USB Type A).

Similarly, harmonisation of standard solutions does not eliminate consumers' needs to have different chargers or cables in more locations. In other words, consumers would still need more than one charger or cable for their device even in a scenario of complete or almost complete harmonisation.

The same reasoning seems to apply to those cases whereby consumers have bought additional chargers or cables because they forgot to carry theirs or because they lost them, respectively 15% and 13% of respondents. Probably a small proportion of these consumers might not have to buy a new charger or cable, since it would be more likely that they will find ones to reuse if there were a complete or almost complete harmonisation.

Only 7% of respondents attributed their purchase of additional chargers or cables to the need for a charger or cable with a different connector, which signals that a lack of compatible connectors is not a key driver of purchases of charging solutions and cables.

In Scenario 1, transition to USB-C will be almost complete for non-Apple smartphones within the next few years, although some, in particular low-end smartphone manufacturers may choose to continue to rely on Micro-USB connectors (see Section 3). Apple users would be able to continue using their chargers and cables, with this implying the possibility for them to reuse some cables ending with a Lightning connector. Apple and non-Apple users would still not be able to borrow from each other their complete charging solutions to use for their respective devices, unless they were using an adaptor; only the charging block with USB Type-A socket could be used while the charging cable would still be incompatible.

Under Policy Scenario 2A, some limited benefits might materialise in the long run if interoperability of chargers between iPhone and Androids encourages reuse. However, only 7% of respondents currently attribute their purchase of additional chargers or cables to the need for a charger or cable with a different connector and these gains are thus likely to be limited.

The 'maximum harmonisation' option (Policy Scenario 2B) would mandate USB-C at both ends of the charging cable. According to the results of the consumer survey, this represents a very minor proportion of smartphone users, considering that less than 6% of them charge their device with a cable that has a USB-C connector at both ends. Such a regulatory option would then put a lot of cables and charging blocks out of use before the end of their natural life cycle.

Independently of the differences between the policy scenarios, cables ending in a Micro-USB connector would not be compatible with new devices, so some are expected to be put out of use before the end of their life cycle thus increasing e-waste. Yet, even in the absence of a regulatory intervention, the Micro-USB connector is set to disappear.

Note also that this analysis does not account for the differences in material in USB-C connectors and cables as compared to alternatives. For example, USB-C cables and connectors are thicker and bigger than Lightning cables and connectors. USB-C is designed to meet the needs of a wide range of portable electronic devices whereas Lightning has been optimized for use in the iPhone. If USB-C is mandated, more material will be required to make those cables and connectors than is required to make Lightning or Micro-USB cables and connectors. Potential environmental impacts that would arise due to regulation as compared to the baseline scenario are summarised in Table 9-1 below.

Table 9-1: Summary of the main environmental impacts	
Scenario	Description of impacts
Baseline scenario: Memorandum of Understanding	<p>Natural transition from Micro-USB to USB-C based on consumer demand and cost Maximal reuse of existing Micro-USB charging solutions. Use of USB-A socket in charging block enables reuse of charging blocks even between Apple and non-Apple smartphones</p> <p>No relevant additional negative environmental impacts are to be expected compared to current situation.</p>
Policy scenario 2A: Regulatory option USB-C at the device end and either USB Type A or USB-C at the charging block	<p>All cables and chargers used by Micro-USB phone and iPhone users could not be re-used with new devices, but these. All Apple users would need to buy new cables for their new smartphones. Alternatively, they could buy adaptors for old cables.</p> <p>Micro-USB (and Lightning cables) would become redundant much faster than in the baseline scenario, increasing e-waste.</p> <p>Interoperability of charging blocks and cables between Android and Apple phones might encourage reuse and reduce e-waste.</p> <p>In the short term, additional e-waste would be created due to forced market transition (before natural end of useful life).</p> <p>In the medium run, a common device side connector would likely generate minimal net benefits. However, low decoupling and continued consumer demand for additional chargers would still be the cause of the majority of e-waste produced.</p>
Policy option 2B: USB-C at both the device and charging block end	<p>All cables and many chargers used by Micro-USB phone and iPhone users could not be re-used with new devices.</p> <p>Today, only 6% of Android users charge their device with a cable that has USB-C at both ends. The rest would not be able to use their cables and charging blocks with new devices.</p> <p>A lot of excess e-waste would be produced. All charging blocks with USB Type A socket would not be able to be used with C to C USB cables. Many can be expected to be thrown away before the end of their useful life and would have to be replaced by new ones.</p>

10 Comparison of key impacts

The absence of an MoU between 2014 and 2018 and the fact that the new MoU from 2018 permits a number of connectors on the charger and device side might be perceived by some people as evidence of a 'problem'. However, only a limited number of charging solutions are currently used and the market is converging on USB-C charging with an increasing uptake of USB-C connectors first at the device and later at the charger end. It is expected that the majority of smartphones sold will soon be equipped with a USB-C charging connector while Micro-USB will still be used in low-end smartphones for some years due to lower cost. On the charging block side, USB-A will stay relevant for long time due to its superior legacy compatibility, even with other consumer electronics devices. The migration to new technologies will take its natural course based on consumer demand and cost. Thus, there is no evidence of future market fragmentation, apart from natural migration to new technologies.

As set out in Section 6, one of the main premises behind the argument for introducing regulation for a common charger from a consumer perspective is consumer convenience - that they would be able to use a single charger to charge multiple devices, as well as having the opportunity to charge their own device with, for example, the charger of a colleague or friend in the event that their own charger were not available or working. However, the consumer survey carried out for this study asked respondents how many times in the past year they were unable to charge their phone because the only other charger(s) or cable(s) they could access from someone else had a different connector. 50% of respondents said there were no occasions at all, 12% and 20% of respondents indicated that they had hardly (only once, or 2-5 times) experienced this problem. Significantly, only 10% indicated that this had been a difficulty on 6 or more occasions, with the overall conclusion being that only a very few respondents indicated that not being able to charge their phone was a particular problem. The extent of the 'problem' in terms of consumer inconvenience thus appears to be limited.

As discussed in Section 7, regulatory intervention would lock the market into the use of a specific technical solution and thus discourage innovation. Accelerated convergence of charging solutions would create greater incentives to produce counterfeit and sub-standard chargers/cables. Additional technology convergence on the charging block side will provide further incentives and given the limited attention consumers pay to the safety of chargers when making purchases, there will be an increased risk to consumers' health and safety over that arising under the regulatory scenarios. This is particularly significant since safety concerns do not appear to be at the top of consumers' list of priorities when making decisions to purchase a mobile phone charger, with aspects such as price and speed of charging being of greater concern.

Section 8 indicates a range of negative impacts on manufacturers and the wider supply chains are also possible due to regulatory intervention, including knock-on effects on economically significant sectors in the EU. Absent a government mandate, no decoupling of phone and charger sales is likely to occur and no significant environmental gains can thus be expected, as discussed in Section 9.

The table overleaf provides a comparison between the different options in relation to the scale of impact for a selection of the key impacts likely to arise.







Table 10-1: Comparison of key impacts				
Criteria	Option 1	Option 2A	Option 2B	Description
Convenience – new devices	0	✓	✓	Widespread availability of phones and chargers with a limited range of different charging solutions under the baseline means that consumers rarely have difficulty charging their devices. Consequently, there would be very limited additional consumer convenience arising from a common charger under Options 2A and 2B
Convenience – legacy devices	0	⊗⊗	⊗⊗	Widespread availability of phones and chargers with a limited range of different charging solutions under the baseline means that consumers rarely have difficulty charging their devices. However, phones with Micro-USB and Lightning connectors could not be charged with new chargers/cables under Options 2A and 2B, reducing consumer convenience
Costs – new devices	0	⊗	⊗⊗	USB-C connectors are more expensive than Lightning and Micro-USB connectors so chargers and cables would be more expensive for consumers. Option 2B requires an additional USB-C socket on the charger so would be slightly more expensive than Option 2A
Costs – legacy devices	0	⊗⊗	⊗⊗	Consumers would need to purchase additional cables to use existing charging blocks under Option 2A and additional charging blocks and cables under Option 2B. USB-C connectors are more expensive than Lightning and Micro-USB connectors so chargers and cables would be more expensive for consumers.
Trade-offs	0	⊗	⊗⊗	All charging solutions under the MoU would continue to be available under the baseline, so there would be no trade-offs for consumers. However, under Options 2A and 2B, consumers may be forced to accept some trade-offs.
Innovation	0	⊗⊗	⊗⊗	Market locked into a specific solution, innovative solutions prevented or delayed
Risks to health and safety from counterfeit and sub-standard chargers	0	⊗	⊗⊗	Unification leading to reduced costs and prices of chargers and cables under all scenarios leads to increased incentives for manufacture of counterfeit and sub-standard chargers/cables under all scenarios. These incentives increase with greater harmonisation under Scenario 2A and even further harmonisation
Redesign/ new products	0	⊗	⊗⊗	Cost of redesigning existing products/designing new products
Lost sales	0	⊗	⊗	Lost sales due to earlier than planned phase-out of products
Cessation of shipments	0	⊗	⊗	If redesign impossible or not commercially viable, temporary or permanent cessation of shipments
Key:				
 = Small positive impact  = Positive impact  = Large positive impact  = Small negative impact  = Negative impact  = Large negative impact				

Table 10-1: Comparison of key impacts

Criteria	Option 1	Option 2A	Option 2B	Description
Two product lines	0	⊗	⊗⊗	Potential need for two product lines, one for EU and one for the rest of the world
More expensive connectors	0	⊗	⊗⊗	Costs associated with providing alternative (more expensive) chargers/connectors
Contracts	0	⊗	⊗	Breach of long-term contracts and potential penalties
Competitiveness	0	⊗	⊗	Negative effects on competitiveness of EU companies
Competition	0	⊗⊗	⊗⊗	Negative impact on competition should the intervention disproportionately affect companies that rely on the Lightning connector
E-waste	0	✓	⊗	Without decoupling, substantial reductions in e-waste is extremely unlikely Minimal net benefits might materialise in the long run only in Scenario 2A if interoperability of chargers between iPhone and Androids encourages reuse. Currently, only 7% of respondents attributed their purchase of additional chargers or cables to the need for a charger or cable with a different connector Under Option 2B, legacy waste would be created
Key: ✓ = Small positive impact ✓ = Positive impact ✓✓ = Large positive impact ⊗ = Small negative impact ⊗ = Negative impact ⊗⊗ = Large negative impact				

11 Other devices

The survey conducted by YouGov as part of this study confirms the centrality of smartphones over feature phones and the other devices that consumers use to access internet services. 94.3% of all respondents currently own at least a smartphone, whereas only 4.8% of them currently own a feature phone but not a smartphone. The percentage of smartphone ownership is highest among young consumers as 98% of respondents aged 18 to 29 own a smartphone, as opposed to 93% of respondents aged 60+. This is indicative of the fact that feature phones will still be present in the European market in the next upcoming years, but their share in the mobile phone market is set to further shrink. This consideration will feed into the estimation of the stock of chargers and its breaking down by charging solutions.

Concerning other devices, 47% said that they also use a tablet, while 58% also use a laptop. There are some hints that regulation to mandate a common charger might be extended to cover laptops and tablets. Nevertheless, such an extension of the scope of the legislation presents risks and challenges that can hardly be solved.

In general, it is to be noted that:

- Different power requirements for smartphones, tablets and laptops can generate serious safety issues if unsafe or inadequate chargers are used to deliver energy to different devices in terms of voltage and power;
- Charging blocks used for smartphones need to be bigger in size to meet power requirements of all tablets and laptops, with this generating extra costs for consumers and manufacturers as well as negative environmental impacts;
- Reduction of e-waste might not be significant;
- Laptops have a longer life cycle, rate of adoption of new technologies cannot proceed at the same rate as for smartphones and tablets

11.1 Overview

The two other devices within the scope of this study are tablets and laptops. Laptops, also known as notebooks, refer to portable personal computers suitable for mobile use. The results from the survey on the Digital Economy conducted by the European commission in 2016²⁸ showed that 64% of the regular internet users said that they accessed the internet by means of a laptop or netbook, while 44% said that they used a tablet. These figures are broadly consistent with the results of the consumer survey that YouGov has carried out as part of this study. Out of all respondents of the sample (which can be taken to be representative of internet users as they received and could only answer the questionnaire online²⁹), 47% use a tablet, whereas 58% use a laptop.

²⁸ https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Archive:Internet_access_and_use_statistics_-_households_and_individuals&oldid=379591#Main_statistical_findings

²⁹ It is to be noted that the respondents to the YouGov sample are divided in age groups: 18-29, 30-39, 40-49, 50-59, 60+. Therefore, respondents aged 16 and 17 are not covered in the sample.

11.1.1 Tablets

Difference sources, such as IDC³⁰, reported a decline in the global tablet shipments, a negative trend that has been registered over the last four years.

The penetration of the USB-C as a charging solution has gone deeper through the tablet market than for the mobile phone one. Therefore, the uptake might be expected to grow exponentially over the next years. This mostly comes down to the fact that Apple has equipped some of its latest iPads with a USB Type-C charging port. Looking at the GSMArena global database, it appears that two out of five models of iPads released throughout 2018 and 2019 can be charged by a USB-C charging cable. The correspondent proportion for Samsung tablets is six out of nine. According to Statcounter³¹, Samsung and Apple together account for approximately 88% of the all European market of tablets. Huawei which is usually listed as the fourth biggest vendor of tablets, with a share in the European market of approximately 3.2%, have equipped six of the eight models of tablets released so far in 2018 and 2019 with a USB Type-C charging port. In general, more expensive models tend to all have a USB-C charging port. Amazon is ranked third having a market share of about 4.2%. Its latest tablets date back to 2017 and none of them did not have a USB-C socket.

11.1.2 Laptops

Analogously to the tablet market, the level of shipments of laptops has struggled to return to the peaks registered in 2012 at the global and EU level. However, in contrast to the case for tablets, the market has shown stronger signs of recovery in the recent years. There is almost no harmonisation and manufacturers tend to prefer proprietary charging ports, although there seems to be a nascent trend towards USB-C.

11.1.3 Impacts of the regulatory option

Table 11-1 below compares charging requirements correspondent to smartphones, tables and laptops.

The first thing to note is that there are differences with regard to power needs between smartphones and tablets on one side and laptops on the other and that chargers are optimised to support specific device power level requirements.

Table 11-1: Charging requirements			
Device	Current	Voltage	Power
Smartphones	1A-2A	5V-12V	5W-15W
Tablets	2.4-3.25A	5.1V-9V	12W-44W
Laptops	2.5A-3A	19V-20V	30W-65W

Different power requirements, with a smartphone usually requiring from 5W up to 15 while laptops from 30W up to 60W, imply that there is no charger that can work equally well for these two devices. Assuming connectors were to be completely harmonised, a charger designed to charge a smartphone would charge a laptop battery very slowly. On the other hand, a laptop charger can potentially charge a smartphone owing to the modern technologies that enable the charger and phone battery to automatically adapt to the fastest possible charging with no harm to the smartphone. However, and

³⁰ <https://www.idc.com/getdoc.jsp?containerId=prUS44191918>

³¹ <http://gs.statcounter.com/vendor-market-share/tablet/europe>

here comes the first and biggest concern, serious safety issues can arise in the presence of counterfeit chargers. If charging solutions were to be completely harmonised, counterfeit chargers will likely proliferate and risks are higher when unsafe chargers are used to deliver energy to completely different devices in terms of voltage and powers.

Besides, a charging block able to meet power requirements of all tablets and laptops has to be bigger in size so that it can be used across these devices. This would then generate additional costs for consumers and manufacturers as well as negative impacts on the environments, i.e. more raw materials would be used up and more CO₂ would be released.

It is also unrealistic to believe that having a harmonised charging solution would automatically eliminate a consumer's need for more than one charging block and cable. In those instances when a consumer has to charge his or her tablet and smartphone at the same time, then two charging blocks, or at least two cables, would be needed.

It is also to be considered that laptops have a completely different timeframe as users hold on to their laptops (and possibly also tablets) from 5 to 7 years before they replace them with new ones. This means that transition to any new charging solutions would take a lot longer for laptops as opposed to smartphones. In other words, if a common charger were to be forced upon laptops, its adoption among all consumers might not be finished yet when a new charging interface for smartphones steps in.

All things considered, the potential consequences of mandating a common charger for other devices like tablets and laptops are likely to be negative for consumers and the environment as well as generate inefficiencies in terms of allocation of resources.

Annex 1 RAPEX Notifications related to mobile phone chargers

Table A1-1: RAPEX notifications related to mobile phone chargers			
Year	Number of notifications	Selected faults recorded	Risks
2019	23 (of 98 notifications) (to July 2019)	The cord contains short chain chlorinated paraffins (SCCPs) (measured value up to 1.6%). The placing on the market and use of articles containing SCCPs is banned.	SCCPs persist in the environment, are toxic to aquatic organisms at low concentrations and bioaccumulate in wildlife and humans, posing a risk to human health and the environment. The product does not comply with the Regulation on persistent organic pollutants (POP Regulation).
2018	25 (of 159 notifications)		
2017	20 (of 127 notifications)		
2016	24 (of 131 notifications)		
2015	12 (of 154 notifications)	The electrical insulation and the clearance /creepage distances between the primary and accessible secondary circuit are not sufficient.	The user could touch accessible live parts and receive an electric shock. The product does not comply with the requirements of the Low Voltage Directive and the relevant European standards EN 60950.
2014	18 (of 180 notifications)	The capacitor connected across the reinforced insulation is inadequate.	As a consequence, parts of the product can become live. The product does not comply with the requirements of the Low Voltage Directive and the relevant European Standard EN 60950.
		The electrical insulation is inadequate, and the housing is not sufficiently resistant to heat.	The product could overheat with live parts becoming accessible as a result. The product does not comply with the requirements of the Low Voltage Directive and the relevant European standard EN 60950.
		When the charger is removed from a wall socket, the live plug pins could detach and remain in the wall socket where they would be accessible to the user.	The product poses a risk of fire due to overheating of the contact areas.
		The amount of lead in the soldering of the USB cable is too high (measured value: 42 %).	The product does not comply with the requirements of the Low Voltage Directive.
			This may pose a risk to the environment in the disposal of the product. The product does not comply with the requirements of the Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS 2). This could lead to a short circuit and a fire if the insulation of the conductor is

Table A1-1: RAPEX notifications related to mobile phone chargers

Year	Number of notifications	Selected faults recorded	Risks
		<p>The internal wiring connections are not sufficient and rely upon solder to maintain their position.</p> <p>The pins on the charger are over-sized. Force is required to insert the charger into and remove from a socket.</p>	<p>damaged as a consequence. The product does not comply with the requirements of the Low Voltage Directive and the relevant European standard EN 60950.</p> <p>A loose wire could reduce creepage distances and clearances. The adaptor pins are inadequately sized which could cause damage to the socket and the adaptor resulting in live parts being exposed. The product does not comply with the requirements of the Low Voltage Directive and the relevant European standard EN 60950 and the relevant national standard.</p> <p>This could cause mechanical damage to the socket and charger that could result in live parts being exposed with the risk of electric shock. The product does not comply with the Low Voltage Directive and the relevant European standard EN 60950 and the relevant national standard.</p>



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