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Study on the Impact of the MoU on Harmonisation of Chargers for Mobile Telephones and to Assess Possible Future Options

Final Report (Main Report)

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Executive Summary

Background to the Study

In the past, mobile telephones were only compatible with specific mobile telephone chargers. Apart from causing inconvenience to the consumer, this created unnecessary electronic waste. In response to this, the European Commission facilitated an agreement among major handset manufacturers to adopt a common charger for data-enabled mobile phones sold in the EU. In June 2009, a Memorandum of Understanding (MoU) was signed in which mobile phone manufacturers agreed to harmonise chargers for new models of data-enabled handsets coming onto the market as of 2011. The MoU expired at the end of 2012 but it has been effectively extended by a number of its signatories through two subsequent 'Letters of Intent' (LoI), signed in 2013 and 2014.

The objective of this study is to evaluate the impacts these initiatives have had on the harmonisation of chargers for mobile telephones and indirectly on the markets for other portable electronic devices, and to assess the potential for further harmonisation. The study comprises three parts:

- Part I: assessment of the impact of the MoU on the market for mobile phones and their chargers;
- Part II: evaluation of the possible indirect impacts that the MoU has had on the EU market for other small portable electronic devices; and
- Part III: ex-ante assessment of the potential impacts of different policy options for further harmonisation of charging of mobile phones and other portable rechargeable devices.

Summary of Market Data and Charging Requirements

In 2009, 227 million **mobile phones** were sold in the EU28, increasing to a high of 239 million in 2010 and then declining to 206 million in 2012. Sales for 2013 are estimated to have been around 213 million. During this time, the share of data-enabled mobile phones increased significantly, with estimates suggesting they represented 90% of the European market in 2013. The popularity of smartphones is expected to continue increasing and in 2020 they are projected to account for 98% of all handset sales in Western Europe and 80% in Eastern Europe.

This study has utilised three approaches to estimating the market share of MoU compliant handsets (i.e. those with a Micro-USB socket or for which adaptors have been made available for purchase). These include the consideration of the market shares of MoU signatories, information collected through consultation and a market model which utilises data on handsets launched in Europe since 2008. All three approaches indicate that compliance rates are very high, with results from the model presented in the table below.

Percentage share of MoU compliant mobile phones						
Phone type	2011		2012		2013	
	Sales	*Stock*	Sales	*Stock*	Sales	*Stock*
Data-enabled mobile phones	80%	*63%*	95%	*79%*	99%	*91%*
All mobile phones	66%	*49%*	81%	*65%*	93%	*80%*

Mobile phone chargers are either sold 'in the box' with new handsets or supplied on a 'standalone' basis, for example as replacement for lost or damaged chargers. No phones were sold without a charger in 2010 but over the past few years, three schemes have emerged that sell handsets without chargers. Currently, the UK network carrier O2 is selling a number of handsets without a mains charger, only including a USB/Micro-USB cable. Fairphone supplies its smartphones without a

charger or data transfer cable. Both of the above-mentioned companies, however, offer consumers the possibility to purchase a mains charger separately. Finally, in some markets, Motorola sells its Moto G smartphone without a charger but includes a USB/Micro-USB cable. This study has estimated that approximately 0.05% of mobile phones were sold without a charger in 2013. This is a slight increase from 0.02% in 2012. Annual sales of standalone chargers (2011-2013) range from 18 to 30 million units, which respectively accounts for 9% to 14% of all mobile chargers supplied in any given year. The MoU is estimated to have resulted in six to 21 million fewer standalone chargers over the period 2011 to 2013.

European sales of **tablets** in 2011 are estimated to have been in the region of 13 million units, increasing to 24 million units in 2012. It is estimated that Europe accounted for around 20% of global tablet sales in 2010; however market analysts are expecting this proportion to decrease as the European market becomes saturated. A model of the tablet market suggests that between 2008 and 2013, 69% of models were supplied with a proprietary charger but the Micro-USB charger has become more common place, rising from 17% of sales (9% of stock) in 2011 to 47% (and 21% of stock) in 2013. Global shipments of **e-readers** peaked in 2011 at 23.3 million units, dropping to 11 million units in 2013, with this trend expected to continue as tablets and phablets become more popular. Estimates published during the market peak in 2011 put Europe's share of sales at 20% in 2010 and 16% in 2014, although these are likely to be over estimates. The percentage of e-readers sold in Europe which use a Micro-USB charger has been estimated by the market model developed for this study at 60% in 2009, 77% in 2010 and 97% in 2011, remaining consistent in subsequent years. The stock of e-readers which use a Micro-USB charger is also high, ranging from 60% in 2009 to 91% in 2013.

Market analysts are expecting the global sales of **laptops** to decrease in the coming years. This trend is already apparent, with sales in Europe decreasing from 69 million units in 2011 to 67 million units in 2013. The power requirements of laptops can vary greatly depending on the size and internal components, with most charging in the range 40W to 90W, although this is can be as low as 15W and as high as 240W. Therefore, Micro-USB is not suitable for charging many laptops. One notable exception is the Chromebook 11, which charges via Micro-USB at around 15W. In 2011, Europe was one of the largest markets for **digital cameras**, with sales reaching 46 million units. As with many other devices covered by this study, sales are expected to drop as smartphones become more capable and widespread. The situation is mirrored for **camcorders**; in the first half of 2011, sales declined by 12% in Western Europe to approximately 3 million units. In terms of charging requirements, only a small number of models use Micro-USB, despite its suitability. In most cases the battery is removed from the device and charged separately in a proprietary charger or the battery is charged in the camera through a proprietary cable.

European sales of **portable media players** peaked at 44 million units in 2007, equating to €3.8 billion, since which time sales have decreased. Apple has been the dominant manufacturer and its range of devices use a proprietary charger. Worldwide sales of **sports and activity monitors** have been estimated at 44 million units in 2013 and are expected to increase to 56 million units in 2017, mostly a result of wearable fitness devices. The Americas, Europe, and Middle East regions account for over 80% of global sales. Only a handful of sports devices have been identified which use a Micro-USB charger. Sales of **personal navigation devices** (PNDs) in Europe peaked at 17 million units in 2008 and by 2012 fell to less than 10 million units. A review of PND models released onto the European market show that the first incidence of a Micro-USB charger was in 2010; however there is no evidence linking this to the MoU. The percentage of sales with a Micro-USB port for charging increased noticeably from 14% in 2010 to 70% in 2012 (as estimated by a market model). However, owing to a change by Garmin to Mini-USB, this dropped to 27% in 2013. Over this period, the stock of PNDs that are compliant with the MoU has ranged from 10% in 2010 to 31% in 2012/13.

Sales of **portable handheld games consoles** reached 46 million units in 2008, however this decreased to approximately 25 million units in 2012. There are around five models on the market and all bar one require a proprietary charger. Regarding **personal care products**, Europe is a significant market for electric shavers and epilators, estimated to be around 22 million units in 2007. The dominant manufacturers are Philips and Braun, accounting for as much as 75% of the global market.

Conclusions regarding the Impact of the MoU

In relation to **mobile phones**, the number of different charging connectors on the market has declined substantially over the period of the MoU and the vast majority of handset owners now have an MoU compliant phone, which enables many to charge their phones using chargers of friends, colleagues, etc. This represents a significant improvement in consumer convenience which has been achieved at the expense of only a modest increase in cost on a per handset basis. It is noted, however, that the vast majority of owners of handsets that comply with the MoU by virtue of Micro-USB/proprietary adaptors having been made available have not purchased an adaptor. Handset manufacturers may have benefited from improved image in terms of environmental sustainability and consumer friendliness and charger manufacturers have benefited from increased revenues and simplified production.

The chosen method of bringing about harmonisation (a voluntary agreement facilitated by the European Commission, together with the development of a technical standard) has thus proven to be highly effective in terms of increasing harmonisation of mobile phone charging in the EU and improving consumer convenience. Manufacturers of mobile phones which did not sign up to the MoU appear to have also adopted Micro-USB charging solutions, extending the positive outcomes arising from the MoU. The fact that the MoU only focussed on new models may have been a contributory factor in this and the ability to make use of an adaptor to effect compliance appears to have contributed to the uptake of MoU-compliant solutions.

However, anticipated savings in raw material consumption do not appear to have materialised due to very limited decoupling of mobile phones from their chargers, with only 0.02% of EU handset shipments from 2011 to 2013 being supplied without a mains charger. In this regard, the effectiveness of the MoU could have been enhanced by measures to encourage increased decoupling. Low decoupling rates have also prevented consumers from benefitting from not having to purchase a charger with their phones, meaning that overall costs have increased. There has, however, been a decline in the number of sales of standalone chargers. The associated reduction in the consumption of raw materials can be estimated to be around 400 to 1,300 tonnes (2011-2013).

Whilst it is possible that the MoU has indirectly influenced the markets in the four non-EU countries considered in this report (China, Japan, South Korea and the United States), it is likely to have been a very minor factor in these countries' markets shifting to Micro-USB. As regards the future of the MoU/LoI approach, several stakeholders have noted that the rapidly increasing power of modern smartphones means that it is in need of updating.

Regarding **other devices**, in general terms, it is clear that the market share of devices with Micro-USB charging solutions has increased over the period 2009-2013. The following devices all exhibit a higher share of Micro-USB charging solutions at the end of the period covered by the MoU than at the beginning: tablets, e-readers, personal navigation devices and portable handheld games consoles. For laptops, portable media players, sports and activity monitors, and personal care devices, however, virtually no (or very few) Micro-USB charging solutions appear to have been adopted and proprietary charging solutions are dominant.

The increasing prevalence of Micro-USB charging across devices with similar charging power requirements has meant that consumers have been able to increasingly use the charger supplied with one device to charge another, leading to an increase in consumer convenience. This may also have limited the need to purchase standalone chargers and consequently reduced the use of raw materials than might otherwise have been the case.

Impact Assessment (IA) of Policy Options for Further Harmonisation

Policy Options

For the purposes of this study, the following policy options have been considered for potential future harmonisation, applying to new models introduced to the EU market from 2017:

- **Option 0 (No Harmonisation Scenario):** Option 0 assumes no action would be taken by the European Commission and no further voluntary agreements would be signed by manufacturers.
- **Option 1 (Encouraging a Voluntary Agreement):** The European Commission would encourage discussions among manufacturers of the relevant devices, with the aim of facilitating a consensus on the use of a common charger.
- **Option 2 (EU Legislation):** The European Commission would propose legislation requiring that the relevant devices use a common charger.

Variants of Options 1 and 2 include a) not allowing or b) allowing that adaptors are used in conjunction with devices that do not have integrated connectors conforming to the prescribed solution. This study assumes that the technical solutions to be adopted under both Option 1 and 2 would be based on the Micro-USB connector, although laptops and tablets could also rely on the Standard-USB connector. For the purposes of the IA, the different devices within the scope of this study have been divided into three groups, each containing products with similar power requirements:

- mobile phones, e-readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care devices;
- tablets; and
- laptops.

The assessment in this report has been carried out in the absence of precise technical requirements (such as lower and upper power boundaries) having been defined and, as a result, this report can only provide a general overview of the types of impacts that would arise from harmonisation on the basis of the Micro-USB connector. In addition, the impact assessment assumes that technical issues associated with the use of a common charger for devices with similar but different power requirements (see Section 5.4.3 of this report) could be overcome in time for these options to come into force in 2017 but this is by no means certain. The pertinence of these issues is underscored by the expectation that the next generation of mobile phones is likely to charge at significantly higher charging rates. Last but not least, some stakeholders expect a period of intense innovation to occur in the medium term, with novel solutions such a USB Type-C and wireless charging gaining increased popularity; however, at this juncture, it is not possible to reliably assess their future potential.

Wearable sports and activity monitors and some personal care products (and in some cases their chargers) also need to be waterproof or water resistant, which, combined with size considerations in the case of wearable devices, means that Micro-USB may not be suitable for these product groups. In addition, a number of tablets and laptops charge at power levels exceeding the capabilities of the Micro-USB connector (and in some cases even the capabilities of the Standard USB connector) and information received through consultation for this study suggests that there are technical issues that would need to be overcome before charging in these sectors could be harmonised on the basis of

Micro-USB and Standard-USB connectors. It is therefore considered advisable to accommodate the specific requirements of these product groups in any potential voluntary agreement or legislation.

Assessment of Economic Impacts

All in all, available information suggests that neither Option 1 or Option 2 are likely to impose significant costs on manufacturers of portable electronic devices, if implemented in way that provides manufacturers with sufficient time to take them into account when developing new products, and if exemptions for waterproof/water resistant and high-powered products are established. Significant impacts on competition, competitiveness, trade and investment flows are also not expected. However, a number of manufacturers responding to consultation for this study have expressed concerns about the impact of further harmonisation in terms of slowing down innovation. Overall, impacts on costs for manufacturers of devices and innovation are expected to be more limited should the use of adaptors be allowed. As the current uptake of Micro-USB connectors differs depending on the product group, ranging from over 90% for mobile phones and e-readers to (virtually) non-existent in laptops and portable games consoles, the impacts of Options 1 and 2 are likely to vary by sector. In addition, these sectors can be characterised by different market dynamics, ranging from a rapidly expanding market for tablets to sectors in decline (e.g. personal navigation devices and e-readers), meaning that they have different capacities to cope with additional regulatory requirements.

As regards manufacturers of chargers and cables, these could potentially benefit from the use of more expensive components but also are likely to incur revenue losses due to increased decoupling. Assessment in this report shows that charger/cable manufacturers may suffer a net loss at decoupling rates above 7%, which is far in excess of the current decoupling rates in the mobile phone sector but below the maximum theoretical decoupling rate estimated by this study on the basis of charging requirements of an average European household. Please note that losses incurred by charger and cable manufacturers also represent gains to consumers.

Under Option 1, the use of adaptors is likely to increase the market coverage of the voluntary agreement, in particular in sectors where proprietary connectors are widespread. However, under Option 2, no such increase can be expected, but it is expected that costs for device manufacturers would be lower than under the 'no adaptors' sub-option, which is especially significant in product sectors where the current uptake of Micro-USB is limited.

Social Impacts

Consumer convenience is likely to be enhanced more under Option 2 than under Options 0 and 1 and the variants of Options 1 and 2 that do not allow the use of adaptors are also expected to be more effective in eliminating problems linked to incompatible chargers. The cost impacts for consumers associated with the provision of more expensive Micro-USB chargers have been assessed for different rates of decoupling; the net costs have been estimated at just over €200 million between 2017 and 2021 in the event of 0% decoupling of chargers from their device and around €170 million if 2% decoupling occurs. If significant decoupling did occur, savings could potentially be accrued by consumers. In the event of 50% decoupling across mobile phones, e-readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care devices, consumers would enjoy net benefits of around €530 million over 2017-2021. For devices such as mobile phones and e-readers, lower rates of decoupling (around 7% and 3% respectively) are required in order for consumers to benefit overall (after accounting for costs) than for the other devices (portable media devices, PNDs, games consoles, personal care products and digital cameras) which require decoupling rates of 30% and above for consumers to break even. It is noted that these rates are far in excess of decoupling rates seen to date for mobile phones under the MoU between manufacturers signed in 2009 and that high

decoupling rates may be difficult to achieve in highly innovative sectors as requirements may need to be frequently revised to keep pace with technological advances, and consumer may thus need to periodically upgrade to higher specification chargers. Please note that the above calculations are based on the production/wholesale costs of the different chargers, rather than retail prices paid by consumers.

Some stakeholders have expressed concerns that further harmonisation of chargers may have an unintended side effect in that it could increase the market for poor quality, and potentially dangerous, chargers; these problems are expected to increase in direct proportion to the extent of decoupling of device and charger sales. This suggests that in response to Option 2 in particular, public authorities may need to intensify market surveillance and product legislation enforcement activities.

It is of note that even groups of devices that charge at similar power are characterised by a diversity of charging voltages and currents, raising questions about the feasibility, speed and safety of charging where a charger and/or cable designed for a different device is used. For example, careful consideration should also be given to harmonisation of charging in product groups which are characterised by a range of charging voltages (personal care products charge at voltages ranging from 2V to 18V) and to compatibility between high-power chargers for laptops and low-powered feature phones. This suggests that if consumer disappointment and safety risk are to be avoided, consumers may need to be educated on the charging requirements of the different devices, and the risks involved in using chargers that are not suitable for the power requirements of the device in question.

Environmental Impacts

The extent of environmental benefits from further harmonisation would depend on the degree to which the sales of chargers decouple from the markets for new devices. For the purposes of this study, two theoretical scenarios modelling different degrees of decoupling have been assessed. These are: Scenario 1 (2% of devices will be sold without a charger) and Scenario 2 (50% of devices sold without a charger). Scenario 1 is based on an extrapolation of the current decoupling trend for mobile phones and Scenario 2 is seen as the highest possible rate based on the current levels of ownership of devices and expected charging behaviour of consumers. However, it appears that in product sectors which are characterised by a high innovation and short product lifecycles, the 50% rate may never be achieved. Using study team estimates of the market size and baseline prevalence of Micro-USB, the following estimates of raw material savings have been calculated for 2017 for mobile phones, e-readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care products: Scenario 1 (2% decoupling): 300 tonnes and Scenario 2 (50% decoupling): 7,600 tonnes. These are annual reductions when compared with the 0% decoupling scenario.

Definitions of Key Terms

Term	Definition
Action cameras	Action cameras are small, lightweight cameras that attach to the body allowing the user to record hands-free. They are typically used by those doing high-octane sports.
Basic phone	Basic mobile phones have limited functionality and few features. They are primarily used for calling and texting. These are typically at the low-end of the price spectrum.
Compact digital cameras	Compact digital cameras are point-and-shoot' cameras, which are small, pocket-sized cameras that do not have detachable lenses.
Digital camcorders	A lightweight, handheld video camera which records in digital form onto a storage device such as a DVD or hard disk.
Electric Shaver	Also known as a dry shaver, an electric shaver is an electrical device for shaving which uses oscillating or rotating blades behind a metal guard.
Epilator	Electrical device to remove hair by mechanically grasping multiple hairs simultaneously and pulling them out.
E-reader	E-readers, also called electronic readers or e-book readers, are devices for reading electronic written content, such as e-books, newspapers and other documents (Techtarget, nd).
Feature phone	Mobile phones referred to as feature phones have more advanced features, including web browsing. These are often in the low to mid-range price.
Full-size notebook/laptop	Laptops, other than netbooks, are referred to in this report as 'full-size" or "large" laptops.
Handheld Games Console	Portable electronic device with a built-in screen, game controls and speakers
MP3 Player/Portable Media Player	Rechargeable pocket-sized devices that play digital music and videos
Netbook	Netbooks can be defined as small, light, low-power notebooks with less processing power than a full-size laptop.
Notebook/Laptop	References to 'laptops' in this study are to be construed as covering both netbooks and full-size laptops.
Network carrier	A company which provides voice and data services for mobile phones. Some companies are present in several countries whilst others are unique to a particular country.
Personal Navigation Device	For the purposes of this report, a Personal Navigation Device (PND) is considered to be a portable rechargeable device that has been designed for use within automobiles or motorbikes for the purpose of assisting navigation. It does not include those devices that are physically integrated into vehicles and do not require charging.
Pocket camcorders	Pocket camcorders are small camcorders that offer basic recording functions and the possibility to upload to a computer.
Sales to end users	These figures represent the actual number of sales to consumers, and will often be lower than shipments.
Shipments	Refers to the number of units delivered to network carriers or retail chains for selling. These figures are commonly higher than sales to end users.
Smartphone	Smartphones are mobile phones which have advanced computing capability and connectivity. They can perform many functions of stand-alone computers. The price ranges from mid to high-end.
Smartwatch	Smart watches are multipurpose devices that are capable of performing similar functions to a smart phone. They can either be used as a standalone device or be paired with a smartphone

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1 Introduction

1.1 Background to the Study

1.1.1 Development of the MoU

In the past, mobile telephones were only compatible with specific mobile telephone chargers. Although some chargers may have been suitable for use with a few models of mobile telephone, in general they were not interchangeable amongst manufacturers or, even, amongst different models of a particular mobile telephone. Apart from causing inconvenience to the consumer this created unnecessary electronic waste.

By 2009, the average penetration rate of mobile phones in Europe was as high as 122 percent[1] and people were replacing their devices, on average, every two years. In addition, the diversity of the market for mobile phones had resulted in their being some 30 different chargers on the market[2].

To tackle the problems created due to the incompatibility of such a large number of mobile phone chargers, and also the increasingly large numbers of redundant chargers generated within the EU, the European Commission has been instrumental in bringing about an agreement amongst major mobile telephone manufacturers to adopt a common charger for data-enabled mobile phones[3] sold in the EU.

In March 2009, the European Commission gave mobile phone manufacturers an ultimatum – voluntarily adopt a common charger, for data-enabled hand held phones, or be subject to mandatory EU legislation[4]. The aim of this request was to improve consumer convenience by creating a common charger (for data-enabled hand held phones), thus making it easier and cheaper for consumers. The request for a common charging solution also aimed to have an environmental impact by improving (and ensuring) the energy efficiency of mobile phone chargers available on the EU market and reducing the overall number of chargers manufactured, thereby reducing the unnecessary use of valuable raw materials.

In June 2009 a Memorandum of Understanding ("MoU") was signed in which mobile phone manufacturers agreed to harmonise chargers for data-enabled mobile phones as of 2011. This was a result of collaborative efforts involving handset manufacturers, industry associations (e.g. Digital Europe) and the European Commission.

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1 Haeder et al (2012): Telephone Surveys in Europe: Research and Practice, available at http://books.google.co.uk/books?id=4XpeSHasBtcC&pg=PA109&lpg=PA109&dq=penetration+of+mobile+phones+in+Europe+2009&source=bl&ots=R5KY-VoF5V&sig=Dq4bwuulbTtPqhmHU8disonAXog&hl=en&sa=X&ei=1afOUtPVBILMhAfKkYCoDg&ved=0CEcQ6AEwAg#v=onepage&q=penetration%20of%20mobile%20phones%20in%20Europe%202009&f=false

2 See http://europa.eu/rapid/press-release_MEMO-11-75_en.htm

3 Most mobile phones (including smart phones) are 'data-enabled' as they can be plugged into a computer to exchange pictures, files, music, etc.

4 See http://europa.eu/rapid/press-release_MEMO-11-75_en.htm

1.1.2 Signatories of the MoU

The MoU was signed by companies which together represented over 90% of the mobile telephone market in the EU[5]. These companies are listed in Table 1-1.

Table 1-1: Signatories to the 2009 MoU	
Company	**Date of signature**
Motorola	Original Signatory
LGE	Original Signatory
Samsung	Original Signatory
RIM (BlackBerry)	Original Signatory
Nokia	Original Signatory
Sony Ericsson	Original Signatory
NEC	Original Signatory
Apple	Original Signatory
Qualcomm	Original Signatory
Texas Instruments	Original Signatory
Emblaze Mobile	30th June 2009
Huawei Technologies	28th July 2009
TCT Mobile	31st August 2009
Atmel	9th February 2010
Source: Annex I to MoU regarding Harmonisation of a Charging Capability for Mobile Phones, June 5th, 2009	

1.1.3 Development of the Standard

Upon signing the MoU, the signatories agreed to develop a common specification on the basis of the Micro-USB interface which would allow full charging compatibility between data-enabled mobile phones available on the market. For those phones that do not have a Micro-USB interface an adaptor is allowed under the terms of the MoU. It was anticipated that the common charger would be rolled out in 2011.

In addition, following the signing of the MoU, in December 2009 the European Commission, issued a mandate to the European standardisation bodies (CEN-CENELEC and ETSI) requesting the development of a European standard for a common charger. In December 2010, CEN-CENELEC and ETSI published a technical standard (EN 62684:2010) that sets out the detailed technical characteristics of a common mobile phone charger, based on the Micro-USB interface.

In addition, the European Commission has been involved in monitoring the progress under the MoU with manufacturers reporting to the European Commission at meetings of the Telecommunications Conformity Assessment and Market Surveillance (TCAM) Committee.

1.1.4 Letter of Intent (2013)

The MoU expired at the end of 2012. On 12th April 2013, eight mobile phone manufacturers signed a Letter of Intent (hereinafter LoI) in which they expressed their intention to "supply the EU market in

[5] DG Enterprise and Industry website, Radio and telecommunications terminal equipment; One charger for all – FAQ. Accessed at: http://ec.europa.eu/enterprise/sectors/rtte/chargers/questions/index_en.htm#1

2013 with chargers that meet the existing European standards for products within the scope of the MoU"[6].

The eight signatories of the LoI are listed below.

Table 1-2: Signatories to the 2013 LoI	
Company	**Date of signature**
Apple	Original Signatory
BlackBerry	Original Signatory
Huawei	Original Signatory
LGE	Original Signatory
NEC	Original Signatory
Nokia	Original Signatory
Samsung	Original Signatory
Sony	Original Signatory
Source: Digital Europe (2013): Letter of Intent	

1.1.5 Letter of Intent (2014)

On 10th March 2014, five handset manufacturers have signed another Letter of Intent, declaring their intention to continue supplying chargers to the EU market which conform to MoU[7]. This LoI is effective until the end of 2014.

The five signatories of the 2014 LoI are listed below.

Table 1-3: Signatories to the 2014 LoI	
Company	**Date of signature**
Apple	Original Signatory
BlackBerry	Original Signatory
Huawei	Original Signatory
Samsung	Original Signatory
Sony	Original Signatory
Source: Digital Europe (2014): Letter of Intent	

1.2 Study Objectives

Risk & Policy Analysts (RPA) has been invited by DG Enterprise and Industry to evaluate the *effectiveness, efficiency, utility and sustainability of the European Commission's initiative on harmonisation of chargers for mobile telephones and indirectly on other small portable electronic devices and their chargers*. As set out in the Terms of Reference, this study comprises three parts:

- Part I analyses the impact that the MoU had so far on the market for mobile telephones and their chargers;

[6] Digital Europe (2013): Letter of Intent - 2013, available at http://www.digitaleurope.org/DocumentDownload.aspx?Command=Core_Download&EntryId=558

[7] Digital Europe (2014): Letter of Intent – 2014

- Part II evaluates the possible indirect impact that the MoU had so far on the EU market for other small portable electronic devices requiring similar charging capacity, including tablets, e-readers, laptops (including netbooks), digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable handheld games consoles, and personal care products; and

- Part III provides an assessment of the expected impacts of different policy options for harmonisation of charging of small portable electronic devices up to and including laptops.

1.3 Structure of this Report

This report has been organised as follows:

- Section 2: overview of the methodology/approach for this study;

- Section 3: Part I – information collected on the market for mobile phones and the impacts of the MoU;

- Section 4: Part II – information on the markets for other portable rechargeable devices and the impacts of the MoU on these markets; and

- Section 5: Part III – impact assessment of policy options for further harmonisation of charging requirements for mobile phones and other portable rechargeable devices.

More detailed information on each device and the methodology underpinning quantitative modelling in this study can be found in the annexes to this report; these are presented in a separate document.

2 Methodology

2.1 Overview

This section outlines the approach to the study. The main sources of information presented in this report include desk research, stakeholder consultation and market models developed for mobile phones, tablets, e-readers and personal navigation devices.

2.2 Desk Research

Data were collected for mobile telephones and other portable rechargeable devices, including tablets, e-readers, laptops, digital cameras and camcorders, portable media players, sport and activity monitors, personal navigation devices, portable handheld games consoles and personal care products. These data were collated in a structured way following the same headings which include: summary of market data, main market trends, impacts on the market, impacts on consumers, impacts on manufacturers, impacts on environment, and any, other impacts, conclusions and summary of charging requirements in non-EU countries. Data collected from desk research are presented in this report and in its annexes.

The study aimed to collect data covering all EU Member States; however, as can be appreciated, a comprehensive analysis of the situation in all Member States for all the relevant devices was not feasible within the given time and budget. Therefore, it was decided to undertake a country case study analysis, covering five large countries (Germany, United Kingdom, Poland, Spain, Italy and France) and four small countries (Finland, Portugal, Netherlands and Slovakia). Information, where available on the case study countries is presented under each product group in the annexes to this report. It has been difficult to identify specific breakdowns of data by country in a lot of cases and some data are therefore presented at the global and European levels only. The annexes also contain information collected on key non-EU countries, including China, Japan, South Korea and the United States.

Where market data were not available, the study team have continued to search for additional information to inform the development of models to generate estimates of the size and share of the markets for the different devices with Micro-USB connectors in the EU (see below).

2.3 Models

There was an absence of hard data at the EU or Member State level regarding sales and market shares of MoU compliant mobile telephones and their chargers as well as other devices that use Micro-USB for charging. Therefore, the study team developed a number of models from the available data and information gathered during consultation with key actors to estimate these metrics.

Models have been developed for mobile telephones, e-readers, tablets and personal navigation devices, the results of which were shared with industry actors in order to confirm their validity.

In order to develop the models, a representative sample of devices was reviewed; 444 mobile phones (smartphones, feature phones and basic phones), 218 tablets, 126 e-readers and 98 PNDs. Efforts were made to ensure that the devices were available for sale within the EU from 2008 to 2013. For each device reviewed the following information was recorded: manufacturer, model,

release date and charging method. The model was supplemented with data gathered on the market share of manufacturers during the study period, as well as information on the length of the replacement cycle and the market lifetime.

For a detailed description of the methodology used to derive estimates of compliance with the MoU/market shares of devices with Micro-USB connectors, please refer to Annex 11.

All models outputs were sent to selected stakeholders, including manufacturers and consumer organisations. Any comments received were taken into account. It is of note that Digital Europe arranged a conference call with mobile phone manufacturers to discuss the draft model estimating MoU compliance in the mobile phonen sector.

Micro-USB is not widely used or even at all in some devices, therefore models have not been developed for laptops, portable media players, sports and activity monitors, portable handheld games and personal care products. Although Micro-USB is used within digital cameras and camcorders, a lack of information meant that a model could not be developed. In spite of this, a sample of over 90 cameras launched between 2010 and 2014 has been reviewed and the extent to which Micro-USB is used for charging has been assessed qualitatively.

2.4 Consultation

2.4.1 Questionnaire

Questionnaires were developed for the main stakeholder groups:

- mobile phone manufacturers;
- manufacturers of portable rechargeable electronic devices other than mobile phones;
- charger manufacturers;
- consumer associations; and
- other stakeholders.

These questionnaires requested information on the impacts of the MoU (proportion of devices with Micro-USB sockets), essential market characteristics (product lifetime) and desirability, feasibility and impacts of further harmonisation across a range of devices.

E-mail invitations to the relevant RPA webpage were widely disseminated; the numbers of stakeholders approached are given in Table 2-1. The number of manufacturers contacted for each product group reflected the market structure for that particular product group or the relative importance of that product group to the study. Furthermore, there is a degree of cross-over between market sectors as there are many companies that manufacture several of the devices covered by this study. For this reason, the number of manufacturers of each of devices contacted is greater than indicated.

Table 2-1: Stakeholders contacted to complete questionnaire

Sector	Manufacturers contacted
Cameras	6
Chargers	22
E-readers	17
Health & fitness	6
Industry associations	21

Table 2-1: Stakeholders contacted to complete questionnaire	
Sector	**Manufacturers contacted**
Laptops	8
Mobile phones	31
National contact points and market surveillance authorities	134
Personal care products	5
PNDs	4
Portable DVD players	5
Portable games consoles	1
Retailers	72
Smartwatches	2
Tablets	9
Total	**343**

Unfortunately, only a very limited set of questionnaire responses were received (see Table 2-2). Due to the low number of questionnaire responses received stakeholders were sent reminder e-mails offering them other means of contributing to the study, including conference calls and shortened questionnaires. Where possible, the study team tried to make contact via telephone.

Table 2-2: Completed questionnaires received	
Sector	**Number received**
Mobile phone manufacturers	5
Manufacturers of other devices	11
Other stakeholders	7
Consumer Associations	2[8]
Total	**25**

In addition, shorter written input (email reponses, etc.) was also received from other stakeholders.

2.4.2 Conference Calls

In total, 27 conference calls have been held with manufacturers of mobile phones, other devices and chargers, retailers, mobile telephone operators, charging technology platforms and a national authority, to gain greater insight to the issues surrounding charging technology and potential impacts of policy options for further harmonisation. A face to face meeting was also held with a manufacturer of mobile phones and other devices.

2.4.3 Workshop

In addition, a workshop was held with manufacturers of mobile telephones in Brussels in December 2013, hosted by Digital Europe. Seven companies participated in the workshop where issues around market structure and the penetration of Micro-USB charging on devices, charging requirements of different devices, innovation in charging and battery technology and potential impacts of further harmonisation were discussed.

[8] One of these was a joint response from ANEC/BEUC

3 Part I: Mobile Phone Market and Impacts of the MoU

3.1 Introduction and Definitions

This section of the report summarises the main information collected for this study on the markets for mobile phones and their chargers and the impacts of the MoU. A more comprehensive review of the markets for mobile phones and other devices is provided in the annexes to this report.

The main terms used in this section of the report are defined in Table 3-1. These include the three categories of mobile phones (smartphones, feature phones and basic phones) as well as data categories commonly used to report the size of the mobile phone market (shipments and sales).

Table 3-1: Definitions of Key Terms (Section 3)

Term	Definition
Mobile phone	In this study, the term 'mobile phone' comprises smartphones, feature phones and basic phones.
Smartphone	Smartphones are data-enabled mobile phones which have advanced computing capability. They can perform many functions of computers. The price ranges from mid to high-end.
Feature phone	Mobile phones referred to as feature phones have more advanced features, including web browsing. These are often in the low to mid-range price. Whilst in the past the term 'feature phone' may have been used to describe very basic phones that were not data enabled, recently released feature phone models resemble smartphones and tend to be data enabled.
Basic phone	Basic mobile phones have limited functionality and few features. They are primarily used for calling and texting. These are at the low-end of the price spectrum and are typically not data enabled.
Sales to end users	These figures represent the actual number of sales to consumers, and will often be lower than shipments.
Shipments	Refers to the number of units delivered to network carriers or retail chains for selling. These figures are commonly higher than sales to end users.

The significance of these terms for this report is that smartphones and feature phones tend to be data enabled and are thus within the scope of the MoU, while basic phones are generally not data enabled and therefore fall outside the MoU's scope. Market research companies typically publish data for all mobile phones and smartphones.

It should be noted that these terms are not definitive; there are varying levels of technological innovation within each category and, due to the pace of development, older smartphones may be considered a feature phone in comparison to those currently on the market. More generally, information provided by manufacturers of mobile phones indicates that the general trend is one of blurring differences between feature phones and smartphones, as well as between different types of devices, such as mobile phones and tablets.

Market research analysts typically report two figures in relation to the number of mobile phones supplied to a particular market ('sales to end users' and 'shipments'), with the difference between

these two data categories being merchandise shipped to retailers but not sold to end users (Whitney, 2011)[9].

3.2 Mobile Phone Market

3.2.1 Summary of Market Data

EU Market

Table 3-2 provides data on shipments of mobile phones to EU28 countries. In this table, signatories of the MoU are highlighted in yellow and signatories of the LoI, which de facto extended the MoU until the end of 2013, are indicated in orange.

Table 3-2: EU28 shipments of mobile phones by manufacturer (units in millions)

Manufacturer	Year				
	2009	2010	2011	2012	2013**
Apple	10	19	22	30	29
Blackberry	8	14	16	11	*
HTC	*	6	14	*	*
LG	22	16	*	*	13
Nokia	85	82	53	41	29
Samsung	65	65	67	87	95
Sony	26	20	11	10	17
Others***	11	17	32	27	31
Total	***227***	***239***	***216***	***206***	***213***
% change		3%	-17%	-2%	3%

*Notes: *included under 'others', **2013 shipments have been extrapolated based on Q1 and Q2 2013, *** some manufacturers in the 'other' category are signatories of the MoU/LoI*
Source: Estimated based on various IDC press releases, accessed at http://www.idc.com/about/press.jsp

Figures 3-1 and 3-2 depict the evolution of the market between 2009 and 2013, including the split between data-enabled and non-data enabled phones (Figure 3-1), as well as smartphones, feature phones and basic phones (Figure 3-2). These figures show that annual shipments rose slightly in 2010, but that was followed by a contraction in subsequent years, possibly due to the effects of the economic crisis. It is estimated that in 2012, shipments of mobile phones to the EU28 were almost 14% below their 2009 level. At the same time, the shares of data-enabled phones and smartphones in overall shipments increased significantly. Based on information provided by a handset manufacturer, it is estimated that in 2013, data-enabled phones accounted for 90% of the European mobile phone market.

[9] Whitney (2011): Apple vs. Samsung: Who's selling the most phones?, available at http://news.cnet.com/8301-13579_3-20123170-37/apple-vs-samsung-whos-selling-the-most-phones/

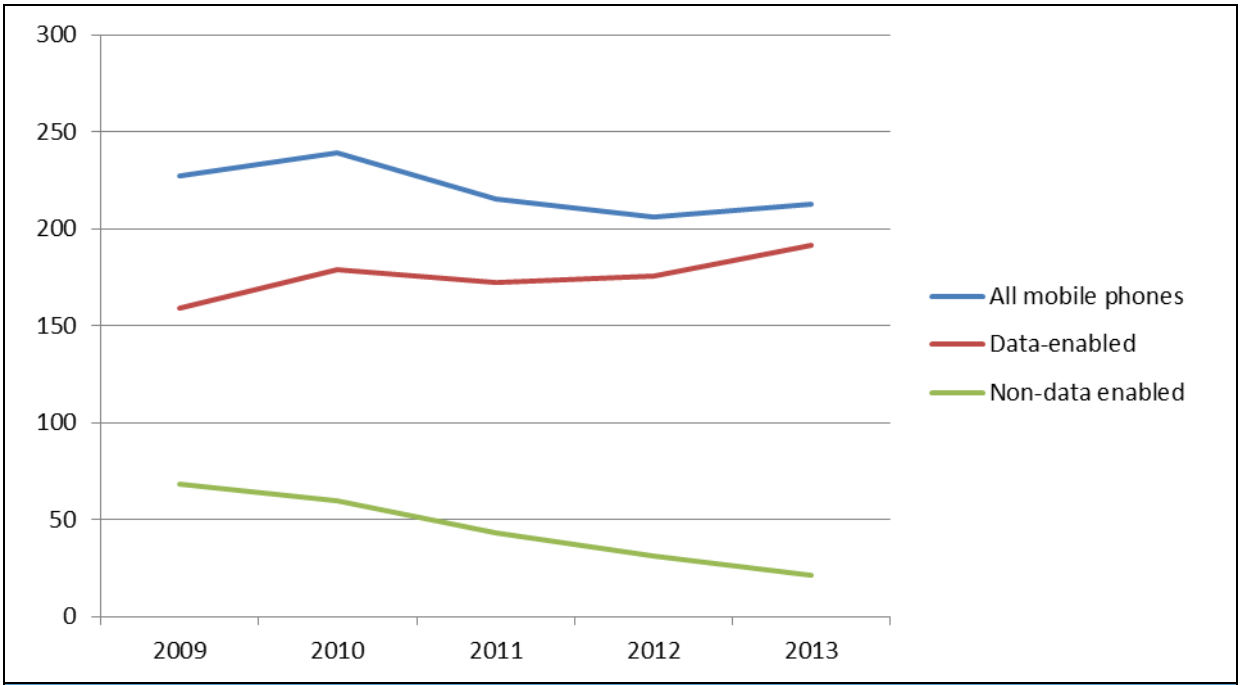

Figure 3-1: EU28 annual shipments of mobile phones (data enabled vs. non-data enabled) in million units (2009 to 2013)[10]

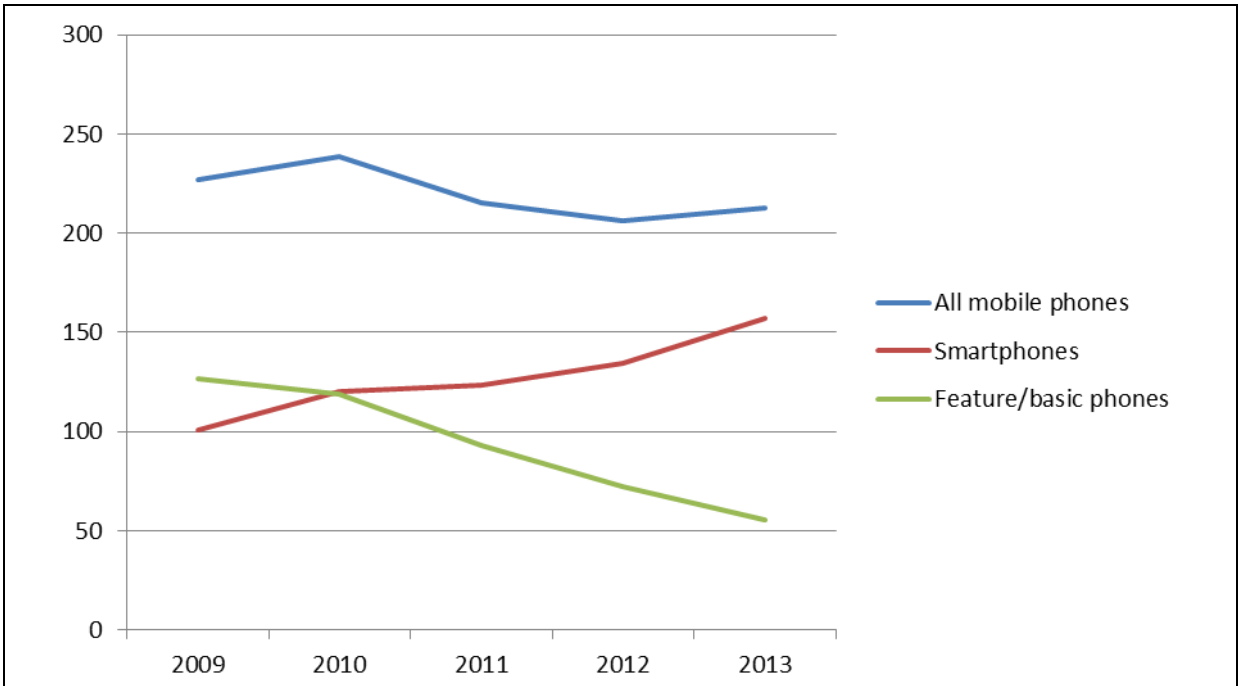

Figure 3-2: EU28 annual shipments of mobile phones (smartphones vs. feature/basic phones) in million units (2009 to 2013)[11]

[10] The split between data enabled and non-data enabled phones has been estimated based on information provided through consultation for certain years. Missing data have been extrapolated.

[11] Estimated based on data for Western Europe in various IDC press releases accessed at http://www.idc.com/about/press.jsp. Missing data have been extrapolated.

Table 3-3 below provides estimates of the value of the EU28 market for mobile phones between 2009 and 2013. These are based on shipments to the EU given in Table 3-2 and smartphone/feature phone market shares and estimates of the average selling price (ASP) for the different types of mobile phones provided in Table 3-4. The main market trends driving the total value of the handset market include decreasing ASPs of both smartphones and feature/basic phones and the increasing market share of smartphones, which command comparatively higher ASPs.

Table 3-3: Estimated value of EU28 handset shipments (€ billion)	
Year	**Handset shipments (€ billion)**
2009	46
2010	55
2011	47
2012	48
2013	51

Estimated European ASPs for smartphones and basic/feature phones are given in Table 3-4.

Table 3-4: European handset ASPs (€)					
Phone type	**Year**				
	2009	**2010**	**2011**	**2012**	**2013**
Smartphone (€)	402	419	357	341	316
Basic/feature phone (€)	42	40	35	32	28
Note: Estimated ASPs for smartphones between 2011 and 2013 are based on an average of global values published by IDC[12] and Strategy Analytics[13], adjusted to European prices based on IDC regional estimates[14]. Smartphone ASPs for 2009 and 2010 are based on estimates published by Asymco[15], converted using Eurostat historical exchange rates and adjusted to European prices. Basic/feature phone ASP has been estimated based on data for Nokia for 2009 & 2010[16], 2011[17], 2012[18] and 2013[19].					

[12] IDC website: IDC – Press Release, accessed at http://www.idc.com/getdoc.jsp?containerId=prUS24143513

[13] Asian new Network website: Business – Average smartphone now less than $300, accessed at http://www.asianewsnet.net/Average-smartphone-now-less-than-$300-48087.html

[14] MobiThiking (2013): Global Mobile Statistics 2013, available at http://mobithinking.com/mobile-marketing-tools/latest-mobile-stats/a#topsmartphonecountries

[15] Asymco (2010): The $85 Smartphone and the imminent extinction of non-smartphones, available at http://www.asymco.com/2010/12/27/the-85-smartphone/

[16] Average of quarterly ASP for feature/basic phones for 2009 and 2010 taken from Nokia's quarterly reports, avaiable at http://press.nokia.com/2010/04/22/nokia-q1-2010-net-sales-eur-9-5-billion-non-ifrs-eps-eur-0-14-reported-eps-eur-0-09/, http://press.nokia.com/2011/01/27/nokia-q4-2010-net-sales-eur-12-7-billion-non-ifrs-eps-eur-0-22-reported-eps-eur-0-20-nokia-2010-net-sales-eur-42-4-billion-non-ifrs-eps-eur-0-61-reported-eps-eur-0-50/, http://press.nokia.com/2010/01/28/nokia-q4-2009-net-sales-eur-12-0-billion-non-ifrs-eps-eur-0-25-reported-eps-eur-0-26/, http://press.nokia.com/2010/10/21/nokia-reports-q3-2010-net-sales-of-eur-10-3-billion-with-non-ifrs-eps-of-eur-0-14/, http://i.nokia.com/blob/view/-/165176/data/5/-/Request-Nokia-results2009Q3e-pdf.pdf

[17] Seeking Alpha (2013): Nokia's Feature Phone Sales, available at http://seekingalpha.com/article/1153531-nokias-feature-phone-sales-are-in-long-term-decline-can-it-cope or http://static.cdn-seekingalpha.com/uploads/2013/2/2/4497021-13598278888095703-Abu-Bakr-Hussain.jpg

[18] TechThoughts (2013): Nokia's Preliminary Q4 2012, available at http://www.tech-thoughts.net/2013/01/nokia-q4-2012-results-low-lumia-sales-positive-asp.html#.UyIiTWdOXWM

[19] TechThoughts (2013a): Nokia Q1 2013 Results, available at http://www.tech-thoughts.net/2013/04/nokia-q1-smartphone-feature-phone-shipments-region.html#.UyIe_2dOXWM

There are several reasons for the drop in the ASP of smartphones, with the main ones being:

- falling price of hardware components;
- increased demand for low-end smartphones; and
- rising competition among manufacturers[20].

Worldwide Market

Table 3-5 provides data on worldwide sales of mobile phones to end users, with the sales of MoU/LoI signatories highlighted in yellow/orange. Market analysts typically report the top five or ten manufacturers; therefore, if an individual company did not feature in every quarter, the figures reported for them will be lower than the actual values as some will be included in the 'others' category.

Table 3-5: Worldwide sales of all mobile phones by manufacturer (million units)

Manufacturer	Year					
	2008	2009	2010	2011	2012	2013
Apple	11.4	24.9	47.5	89.3	130.1	150.8
Blackberry	23.1	34.4	46.6	51.5	34.2	*
HTC	*	10.8	28.8	43.3	32.1	*
Huawei	*	13.5	23.8	40.7	47.3	53.3
Lenovo		*	*	*	*	45.3
LG	102.6	122.1	114.2	86.4	58.0	69.0
Motorola	106.6	58.5	38.6	40.3	33.9	*
Nokia	472.3	440.9	461.3	422.5	333.9	250.8
Samsung	199.2	235.8	281.1	313.9	384.6	444.4
Sony	93.4	54.9	41.8	32.6	*	37.6
TCL	*	*	*	*	37.2	49.5
Yulong		*	*	*	*	32.6
ZTE		*	24.7	56.9	67.3	59.9
Others	213.6	299.2	488.6	597.3	587.4	613.7
Total	***1,222***	***1,211***	***1,597***	***1,775***	***1,746***	***1,807***
% change		-1%	32%	11%	-2%	3%

** Included in Others*
Source: Various Gartner press releases, accessed at http://www.gartner.com/newsroom/archive/

Global sales of smartphones and feature/basic phones are depicted in Figure 3-3.

[20] Global Innovation Center website: Smartphone Pricing War, accessed at http://innovationcenter.deteconusa.com/article/smartphone-pricing-war/

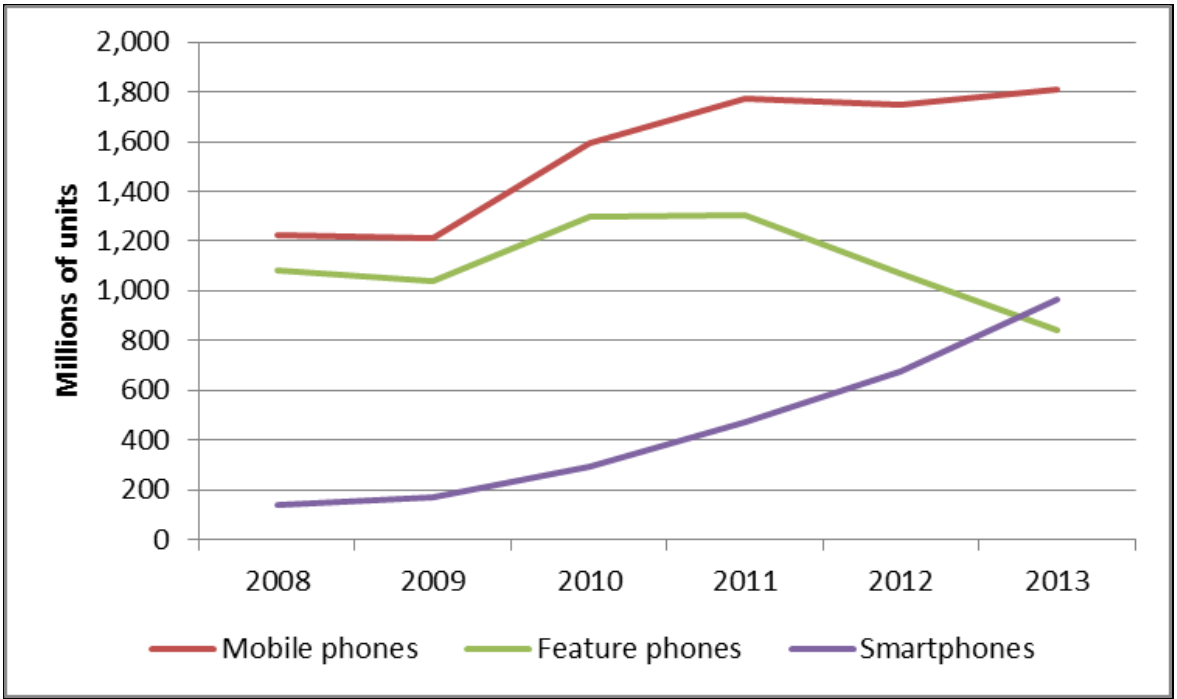

Figure 3-3: Worldwide mobile phone sales from 2008 to 2013

The global smartphone ASP is lower than that given for Europe in Table 3-4; in 2013, the price differential was approximately 25%[21]. The market research company IDC has reported that, in 2011, the worldwide ASP was €320. The global smartphone ASP dropped to €280 in 2013 and could reach €230 by 2017[22]. Alternative figures from Strategy Analytics are somewhat lower; €230 in Q1 2013, down from €255 and €250 in Q1 2011 and Q1 2012 respectively[23].

Table 3-6 below provides estimates of the value of the global market for mobile phones between 2011 and 2013. These estimates have been calculated on the basis of sales figures reported in Table 3-5 and average selling prices (ASP)[24]. Estimated values have been compared with published estimates from a range of sources (see far right column in Table 3-6). Although there are some differences, figures published by market research companies are of a similar order of magnitude; the differences in 2010 and 2011 mainly stem from different estimates of the number of handsets sold.

[21] MobiThiking (2013): Global Mobile Statistics 2013, available at http://mobithinking.com/mobile-marketing-tools/latest-mobile-stats/a#topsmartphonecountries

[22] IDC website: IDC – Press Release, accessed at http://www.idc.com/getdoc.jsp?containerId=prUS24143513

[23] Asian new Network website: Business – Average smartphone now less than $300, accessed at http://www.asianewsnet.net/Average-smartphone-now-less-than-$300-48087.html

[24] ASPs for smartphones are given in the preceding paragraph. For feature phones, ASPs in Table 3-4 have been used.

Table 3-6: Estimated value of the worldwide handset market (€ billion)		
Year	Estimated market value (€ billion)	Published market value (€ billion)
2009	99	94[25]
2010	151	129[26]
2011	182	108[27]
2012	218	210[28]
2013	255	n/a

Main Market Trends

As shown in Table 3-5, between 2009 and 2013, it is estimated that annual worldwide sales (to end users) of mobile phones increased by 45%. By contrast, estimated annual shipments to EU28 countries (given in Table 3-2) have deviated from the global trend, decreasing by 6% between 2009 and 2013. The trend is possibly a result of the economic situation or market saturation, with the mobile phone penetration rate being comparatively higher in Europe than elsewhere[29]. To some extent, this may also be the result of decreasing sales of feature phones, which have not been fully offset by increases in smartphone sales. For example, the start of 2013 witnessed a decrease in overall European market volume of 4.3%, as shipments of feature phones decreased by 31% while smartphone shipments increased only by 12%[30].

In fact, both European and global markets have undergone a significant structural change in that smartphones have become the dominant market segment at the expense of feature/basic phones. However, the magnitude of this shift has been greater in Europe than in some other parts of the world. In the worldwide market, smartphones narrowly outsold feature/basic phones for the first time between April and June 2013[31] but at the same time accounted for 75% of mobile phone shipments to Western Europe[32]. Moreover, the popularity of smartphones is expected to continue to increase. It is estimated that in 2020 smartphones will account for 98% of all mobile phone shipments in Western Europe and 80% in Eastern Europe[33].

Other key market developments of relevance to this study include the trend towards smartphones being used for functionalities other than making calls, including a range of audio and visual

[25] ITCandor (2010): Global handset market shares, available at http://www.itcandor.com/handset-shares-q110/

[26] PRWeb (2013): Mobile phone & Smartphone Market, available at http://www.prweb.com/releases/mobile-phone-market/smartphone-market/prweb11242089.htm

[27] BusinessWire (2013): Research and Markets: Mobile Phones Industry Guide, available at http://www.businesswire.com/news/home/20130130006071/en/Research-Markets-Mobile-Phones-Industry-Guide-2016#.UySSiWdOUdl

[28] MIT Technology Review (2013): Smartphones are eating the world, available at http://www.technologyreview.com/photoessay/511791/smartphones-are-eating-the-world/

[29] Active SIM card penetration rate has been used as a proxy. Source: GSMA (2013): The Mobile Economy 2013, available at http://www.gsmamobileeconomy.com/GSMA%20Mobile%20Economy%202013.pdf

[30] Various IDC press releases, accessed at http://www.idc.com/about/press.jsp

[31] Gartner website: Gartner Says Smartphone Sales Grew 46.5 Percent in Second Quarter of 2013 and Exceeded Feature Phone Sales for First Time, accessed at http://www.gartner.com/newsroom/id/2573415, GfK (2013): Demand for Mobile Phones at Record High, accessed at http://www.gfk.com/news-and-events/press-room/press-releases/pages/demand-for-mobile-phones-at-record-high.aspx

[32] IDC (2013): Press Release: Western European Mobile Phone Market Grows in 2Q13, accessed at http://www.idc.com/getdoc.jsp?containerId=prUK24312613

[33] Jeffries & Company predictions accessed at http://www.statista.com/

functions, implying increasing power requirements (as suggested by manufacturers of handsets). In addition, the diversity of charging requirements is increasing; information provided by handset manufacturers shows that the range of power levels for charging of the different models of mobile phones has increased over the years. This is also linked to the emergence of new crossover products that occupy the market space between mobile phones and tablets, so-called phablets.

Handset Replacement Cycle

The handset replacement cycle (the average period at the end of which consumers replace their mobile phones) is a key factor in determining the length of the transition towards Micro-USB chargers.

A study by Recon Analytics (2011)[34] suggests that in 2010, the handset replacement cycle in the four EU Member States examined ranged from 22 months in the UK to 75 months in Finland (in France, it was 31 months and in Germany, it was 46 months). However, other sources suggest shorter handset replacement cycles. Information provided by manufacturers of mobile phones also suggests that the average cycle may have become shorter since the Recon Analytics (2011) report was published. Institut National de la Consommation (2006) estimated that the handset replacement cycle in France was 20 months. Elen MacArthur Foundation (2012) suggests average usage time of less than 2.5 years[35]. Information collected through consultation for this study suggests that consumers replace their phones on average every two years. Similarly, GSMA (2006) estimated that, in developed countries, users purchase a new phone approximately every 18 months and a joint consultation response from ANEC and BEUC also suggests that the average replacement cycle may be around two years.

Based on the above information, for the purposes of this study, it is assumed that the average handset replacement cycle in Europe is two years.

Three factors were identified which impact the length of the handset replacement cycle: payment method (i.e. pre-pay or post-pay), the level of income and the availability of network carrier subsidies. The most influential is the presence and level of subsidisation, with the cycle being reduced by approximately nine months for every €80 subsidised (Recon Analytics, 2011).

Business Insider Australia (2013)[36] suggests that the replacement cycle is likely to lengthen in developed markets, such as the United Kingdom. Possible reasons include a lack of innovation, backwards compatible software updates and reduced or complete removal of network carrier subsidies.

[34] Recon Analytics (2011): International Comparisons – The Handset Replacement Cycle, accessed at http://mobilefuture.org/wp-content/uploads/2013/02/mobile-future.publications.handset-replacement-cycle.pdf

[35] Elen MacArthur Foundation (2012): In depth - Mobile Phones, available at http://www.ellenmacarthurfoundation.org/business/toolkit/in-depth-mobile-phones

[36] Business Insider Australia (2013): Consumers are taking longer to upgrade their phones, another sign the smartphone revolution is maturing, accessed at http://www.businessinsider.com.au/the-smartphone-upgrade-cycle-2013-9

3.2.2 Structure of the Sector and Trade

Manufacturing in the EU - Major Handset Makers

The bulk of handset production is concentrated in Asia, with 560 handset makers in China accounting for 80% of the world's supply in 2012[37]. Desk-research and consultation carried out for this study (which involved all major mobile phone manufacturers that collectively account for almost 90% of the EU28 market) show that EU-based manufacturing of mobile phones by major handset makers is limited, following substantial reductions over the past decade or so. However, there are indications that at least two major manufacturers produced mobile phones in the EU in the period considered in this study (2009-2013).

At least two (and possibly three) subcontractors working for RIM were, until recently, producing Blackberry phones in Hungary. These were all large multinational companies involved in electronics manufacturing (Elcoteq, Flextronics and Jabil Circuit). However, Hungary-based production of Blackberry phones appears to have been substantially scaled down in recent years. In 2012, Flextronics reportedly ceased producing Blackberry phones at its Zalaegerzeg plant, resulting in 600 redundancies[38]. In late 2013, Jabil Circuit announced that it would wind down the production of Blackberry phones at its plant in Tiszaujvaros, leading to 670 jobs being cut[39]. In the past, RIM also subcontracted the production of Blackberry phones to a plant owned by the Finnish electronics maker Elcoteq in Pécs, Hungary[40]. However, Elcoteq declared bankruptcy in 2011 and announced that it would close its Pécs facility[41].

Nokia has also had a production facility in Hungary (located in Komárom) since 2000. This is one of several production facilities that Nokia has had in Europe, with the others being the (now defunct) plants in Bochum (Germany), Romania (Cluj-Napoca) and Finland (Salo). In 2008, Nokia announced the closure of its plant in Bochum, resulting in at least 2,300 job losses[42], with the bulk of production reportedly relocating to Romania and some functions being moved to Hungary and Finland[43]. However, Nokia's plant in Cluj-Napoca (Romania) was closed in 2011 (resulting in 2,300 job losses) and production was moved to China and South Korea[44]. Nokia's last remaining (small-scale) mobile

[37] WeekInChina (2012): Yes, it's likely made in China, available at http://www.weekinchina.com/msingle/?mpage=15921

[38] Evertiq (2012): End of RIM orders behind job cuts at Flextronics, Hungary?, accessed at http://evertiq.com/news/22868

[39] Tampa Bay Times (2013): Jabil cuts 670 jobs in Hungary as it winds down BlackBerry business, available at http://www.tampabay.com/news/business/banking/jabil-cuts-670-jobs-in-hungary-as-it-winds-down-blackberry-business/2153591

[40] RIM (2006): Declaration of conformity, available at http://uk.blackberry.com/content/dam/blackBerry/pdf/legal/europeMiddleEastAfrica/documents/BlackBerry_8700_-_Declaration_of_Conformity_-_English_(Turkey).pdf

[41] Budapest Business Journal (2011): Elcoteq to close plant in S Hungary, available at http://www.bbj.hu/business/elcoteq-to-close-plant-in-s-hungary_60782

[42] M-GovWorld (2008): Decision to close factory results in anti-Nokia backlash in Germany, available at http://www.mgovworld.org/News/anti-nokia-backlash-grows-in-germany

[43] Bloomberg Business Week (2008): Germany Rages at Nokia Plant Closure, available at http://www.businessweek.com/stories/2008-01-17/germany-rages-at-nokia-plant-closurebusinessweek-business-news-stock-market-and-financial-advice

[44] BBC (2011): Romania's 'Nokia City' hopes dashed, available at http://www.bbc.co.uk/news/world-europe-16290078 and Romania-Insider (2011): Nokia closes down Romanian factory by end-2011 in restructuring move, available at http://www.romania-insider.com/nokia-closes-down-romanian-factory-until-end-2011-in-restructuring-move/35824/ and NY Times (2011): Nokia to Eliminate 3,500 More Jobs, available at http://www.nytimes.com/2011/09/30/technology/nokia-to-cut-3500-more-jobs.html?_r=0

phone production facility in Finland (located in Salo) closed in 2012, affecting around 1,000 staff[45] (already down from 2,500 in 2009[46]). However, it was reported that R&D activities would continue at the Salo plant[47]. In 2012, Nokia also announced the closure of its R&D facility in Ulm (Germany)[48]; in total, 730 German redundancies were announced by Nokia[49]. In 2012, Nokia announced that it was going to lay off 2,300 workers at its facility in Komárom (Hungary), i.e. two-thirds of its Komárom workforce[50]. However, in early 2014 it was reported that Nokia started mass production of the Nokia X in Komárom[51], suggesting that Nokia intended to continue manufacturing mobile phones in Hungary. However, following the takeover of Nokia's Devices and Services division by Microsoft, it was announced that there will be a "phased exit" from the Komárom plant (which currently employs 1,800 people) and Microsoft's handset production will be concentrated in Vietnam, with some production also in China[52]. It has also been reported that Microsoft could lay off 1,000 of the 4,700 strong Finnish workforce it took over from Nokia[53], although reports suggest that some research and development work will continue in Finland[54].

In the more distant past, other major handset manufacturers had production facilities in Europe. However, those that have been identified by the study team closed down prior to 2009. Please note that it is not the purpose of this report to review mobile phone production before 2009 and, for this reason, only a few examples are given here. BenQ and Motorola withdrew from Germany[55]. Mitsubishi Electric and Phillips had handset production facilities in France[56]. Sony Mobile was

[45] ZDNet (2012): Nokia's closure of one small factory is one big lesson about its past - and its future, available at http://www.zdnet.com/nokias-closure-of-one-small-factory-is-one-big-lesson-about-its-past-and-its-future-7000002034

[46] Nokia (2009): Nokia continues to increase cost-efficiency and adapt operations to market situation, http://press.nokia.com/2009/02/11/nokia-continues-to-increase-cost-efficiency-and-adapt-operations-to-market-situation

[47] NDTV Gadgets (2012): Nokia to cut 10,000 jobs, available at http://gadgets.ndtv.com/mobiles/news/nokia-to-cut-10-000-jobs-231278

[48] NY Times (2012): Nokia to Cut 10,000 Jobs and Close 3 Facilities, available at http://www.nytimes.com/2012/06/15/technology/nokia-to-cut-10000-jobs-and-close-3-facilities.html?pagewanted=all

[49] Frankfurter Rundschau (2012): Auf Bochum folgt Ulm, available at http://www.fr-online.de/wirtschaft/nokia-ulm-geschlossen-auf-bochum-folgt-ulm,1472780,16385510.html

[50] Budapest Telegraph (2013): 2012 was bad year for IT manufacturers in Hungary, available at http://www.budapesttelegraph.com/news/234/2012_was_bad_year_for_it_manufacturers_in_hungary

[51] NDTV Gadgets (2014): Nokia X now in mass production at company's Hungary plant: Report, available at http://gadgets.ndtv.com/mobiles/news/nokia-x-now-in-mass-production-at-companys-hungary-plant-report-486423

[52] Elop (2014): Stephen Elop's email to employees, available at http://www.microsoft.com/en-us/news/press/2014/jul14/07-17announcement2.aspx

[53] Tung (2014): One in five ex-Nokia workers in Finland could be axed as Microsoft prepares for layoffs, available at http://www.zdnet.com/one-in-five-ex-nokia-workers-in-finland-could-be-axed-as-microsoft-prepares-layoffs-7000031667

[54] Elop (2014): Stephen Elop's email to employees, available at http://www.microsoft.com/en-us/news/press/2014/jul14/07-17announcement2.aspx

[55] Bloomberg Business Week (2008): Germany Rages at Nokia Plant Closure, available at http://www.businessweek.com/stories/2008-01-17/germany-rages-at-nokia-plant-closurebusinessweek-business-news-stock-market-and-financial-advice

[56] L'Usine Nouvelle (2002): Mitsubishi Electric ferme son usine de téléphones mobiles d'Etrelles, available at http://www.usinenouvelle.com/article/mitsubishi-electric-ferme-son-usine-de-telephones-mobiles-d-etrelles.N1383; Ouest France (2008): La fin de l'aventure Philips au Mans, available at http://www.ouest-france.fr/la-fin-de-laventure-philips-au-mans-140296

producing handsets in Ribeauville in France[57]; although it is not clear when this site ceased producing mobile handsets, consultation for this study suggests that there was no handset production as of December 2013.

It is possible that some R&D and administrative activities are still undertaken in the EU; for example, (as noted above) Nokia/Microsoft's handset production in Europe is expected to wind down, R&D activities may continue to be carried out in Finland.

Manufacturing in the EU - Other Companies

Around 30 EU-based companies that sell own brand handsets have been identified (see Table 3-7). 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-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. In addition, network carriers Orange/EE sell own-brand mobile phones. Whilst these companies appear to be headquartered in Europe, most of them are unlikely to produce handsets in the EU. We have managed to determine the supply chains of seven companies, with six of them selling mobile phones produced in Asia and one hand assembling luxury phones in the UK[58].

Table 3-7 provides a list of European companies selling own brand handsets, together with the number of their employees. Companies that may be SMEs are highlighted in green. Please note that this table may underestimate the workforce involved in the manufacture of their products.

Table 3-7: European Companies Selling Own Brand Mobile Phones

Company	Country	Established[59]	No. employees[60]
Emporia	Austria	1991	11-50
Evolveo	Czech Republic	2006	-
Jablotron	Czech Republic	1990	51-200
VERZO	Czech Republic	2010	-
Prestigio	Cyprus	Unknown	11-50
Lumigon	Denmark	2009	11-50
Jolla (FI)	Finland	2011	51-200
Twig Com (ex-Benefon)	Finland	2011	11-50
Bull	France	1960s	9,300 in more than 50 countries
Mobiwire	France	2011	2,500
Orange/EE	France	-	166,000[61]
Thomson Téléphonie/Technicolor	France	1893, renamed in 2010	14,639 (2012)
Wiko Mobile	France[62]	2011	501-1000

[57] Sony (nd): Company history, available at http://presscentre.sony.eu/Content/detail.aspx?NewsAreaId=19&ReleaseID=4489; MSP Today (2007): ModeLabs Group Signs Pact with Sony's 'Centre de Technologie' in Alsace, available at http://www.msptoday.com/news/2007/10/09/3002602.htm

[58] See https://www.vertu.com/ti/see

[59] Linked In: *Individual profiles*, accessed at https://uk.linkedin.com/ (unless indicated otherwise)

[60] Ibid.

[61] See http://orange.com/en/press/press-releases/press-releases-2013/Third-quarter-2013-financial-information

Table 3-7: European Companies Selling Own Brand Mobile Phones			
Company	**Country**	**Established**[59]	**No. employees**[60]
GSMK Cryptophone	Germany	2003	11-50
ConCorde	Hungary	circa. 1993	100
Brondi	Italy	1935	11-50
Olivetti	Italy	1908	1,570 (2005)
Just5	Latvia	2007	-
Fairphone	Netherlands	2013	11-50
Yarvik[63]	Netherlands	1978	11-200
Overmax	Netherlands and Poland	PL - 2006	-
Allview	Romania	2002	51-200
BQ	Spain	2008	-
Geeks Phone	Spain	2009	50
Primux Tech	Spain	2007	-
Doro	Sweden	1974	-
Handheld	Sweden	1997	40
Fonerange[64]	United Kingdom	1994[65]	130[66]
MOJO Maker	United Kingdom	2011	11-50
TTfone (TTsims)	United Kingdom	Unknown	-
Vertu	United Kingdom	1998	1001-5000
Note: Companies that may be SMEs are highlighted in green. However, please note that this table may underestimate the workforce involved in the manufacture of their products.			

EU Production Data

In Eurostat's Prodcom database, mobile phones are included under the category "26302200 - Telephones for cellular networks or for other wireless networks". Information provided by Eurostat suggests that this code also covers components for this category, as well as items such as Voice over IP devices connecting through internet via WiFi and walkie-talkies, and so is not completely restricted to mobile phones. Consultation with Member State statistical agencies suggests that in at least one EU Member State (the UK), this product code also covers satellite phones. However, it does provide an indication of the limited production of mobile phones across the EU, especially in the latter part of the period under review.

Table 3-8 overleaf suggests that there has been relatively limited mobile phone related production in EU Member States from 2009 to 2012 (the last year for which Prodcom data are available). Overall, these data suggest that EU-based handset production has decreased over time and thus correlate with the overview of handset production facility closures given earlier in this section.

[62] Headquartered in France but majority owned by Chinese technology group Tinno. Source: Thomas (2014): Smartphone maker Wiko challenges big players, available at http://www.ft.com/cms/s/0/04eb8800-f480-11e3-a143-00144feabdc0.html#axzz36PdMlokx

[63] Brand name owned by Sweex Europe B.V. Information in this table is for Sweex Europe B.V.

[64] Brand name owned by Elite Mobile. Information in this table is for Elite Mobile.

[65] See http://www.elitemobile.com/news.html

[66] See http://www.elitemobile.com/news.html

Table 3-8: Prodcom data for production quantities and values in the EU for category "26302200 - Telephones for cellular networks or for other wireless networks"								
Member State	Production in the EU							
	2009		2010		2011		2012	
	Quantity/unit	Value/€	Quantity/unit	Value/€	Quantity/unit	Value/€	Quantity/unit	Value/€
Austria	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	0	0
Bulgaria	:	:	:	:	0	0	0	0
Croatia	0	0	0	0	0	0	0	0
Cyprus	0	0	0	0	0	0	0	0
Czech Republic	0	0	0	0	0	0	0	0
Denmark	65,000	50,291,000	80,000	33,791,000	83,000	5,544,000	60,000	3,828,000
Estonia	0	0	0	0	0	0	0	0
Finland	:	:	:	:	:	:	:	:
France	:	:	362,000	23,505,000	:	:	42,000	19,374,000
Germany	619,000	97,457,000	580,000	103,107,000	607,000	118,570,000	792,000	103,465,000
Greece	:	:	:	:	:	:	:	:
Hungary	58,565,000	3,791,178,000	56,311,000	5,161,559,000	45,377,000	4,156,207,000	28,689,000	2,264,439,000
Ireland	0	0	0	0	0	0	0	0
Italy	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0
Lithuania	0	0	0	0	5,000	278,000	0	31,000
Luxemburg	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0
Netherlands	0	0	0	0	0	0	0	0
Poland	:	:	:	:	:	:	:	:
Portugal	0	0	0	0	0	0	0	0
Romania	:	:	:	:	:	:	:	:
Slovakia	0	0	0	0	0	0	0	0
Slovenia	0	0	0	0	0	0	0	0
Spain	:	:	:	:	:	:	0	0
Sweden	:	:	:	:	:	:	:	:
United Kingdom	281,000	87,527,000	259,000	83,531,000	274,000	81,866,000	280,000	102,458,000
EU25 TOTALS	***79,619,000***	***8,000,000,000***	***82,504,000***	***8,000,000,000***	***55,820,000***	***5,600,000,000***	***34,000,000***	***3,000,000,000***
EU28 TOTALS	***115,619,000***	***7,854,009,000***	***112,504,000***	***9,009,600,000***	***73,820,000***	***6,697,288,000***	***34,000,000***	***3,000,000,000***
Note: Figures are rounded, : = no data available, Source: Eurostat								

Employment

Eurostat provides only limited breakdown of information regarding the number of enterprises and employees at NACE two digit code level and consequently it has not been possible to identify the numbers of people employed in the mobile phones sector in individual Member States, or the total for the whole EU. Table 3-9 provides data at the level of NACE Code C26 "Manufacture of computer, electronic and optical products" which will include all the products considered under this study, as well as numerous others. Clearly, the number of enterprises and people employed in the mobile phone sub-sector will be significantly less than indicated in this table, particularly when considering data in Table 3-8 which indicate that production related to mobile phones occurs only in a few Member States.

Table 3-9: Number of enterprises and employees in NACE Code C26 "Manufacture of computer, electronic and optical products"

Member State	Total Employees	No. of Enterprises
Austria	19,485	566
Belgium	15,735	517
Bulgaria	8,367	364
Croatia	:	758
Cyprus	:	:
Czech Republic	39,394	3,871
Denmark	16,180	549
Estonia	5,542	106
Finland	35,171	565
France	138,818	3,034
Germany	300,481	8,348
Hungary	59,142	1,658
Ireland	14,266	105
Italy	112,974	6,178
Latvia	1,240	104
Lithuania	3,580	137
Luxembourg	:	9
Netherlands	27,677	1,410
Poland	66,793	2,821
Portugal	9,151	341
Romania	25,049	964
Slovakia	20,454	792
Slovenia	5,760	307
Spain	33,652	2,668
Sweden	40,578	1,735
United Kingdom	132,858	6,387
European Union (27 countries)	***1,140,000***	***44,100***

Source: Eurostat

Imports and Exports

Figures for imports and exports have been accessed using Eurostat's Prodcom database for the product code 'Telephones for cellular networks or for other wireless networks'. Whilst this can contain other devices, such as Voice-over Internet Protocol (VoIP) phones and walkie-talkies, these comprise a small proportion. The product code also includes components but due to the absence of more detailed data, imports and exports from/to non-EU countries for this product code are presented in Table 3-10.

Imports of mobile phones (units) into the EU27 increased by 8% between 2008 and 2012; however there is a substantial variation between individual Member States (for country level data, please refer to Annex 1). Please note that these data appear to reflect trade, rather than imports for sale in the EU and production for export. For example, although in some years Luxembourg exported large quantities of telephones to countries outside the EU, there has been no production of these devices in this country between 2009 and 2012. Consultation for this study suggests that these have been devices that were imported to Luxembourg and subsequently re-exported.

Table 3-10: Imports and exports of telephones for cellular networks or for other wireless networks

Year	Imports	% change	Exports	% change
Units (in thousands)				
2008	214,374		90,296	
2009	205,468	-4%	64,764	-28%
2010	213,441	4%	71,109	10%
2011	202,081	-5%	75,314	6%
2012	231,368	14%	56,812	-25%
Overall		8%		-37%
Value (€ million)				
2008	15,254		9,382	
2009	14,171	-7%	6,197	-34%
2010	16,366	15%	8,329	34%
2011	19,784	21%	10,713	29%
2012	27,485	39%	9,745	-9%
Overall		80%		4%
Source: Eurostat				

3.3 Mobile Phone Charger Market

3.3.1 Summary of Market Data

There are two main markets for chargers: those supplied 'in the box' with new mobile phones or those purchased on a 'standalone' basis, for instance by consumers wishing to replace lost or damaged chargers or to own multiple chargers.

Table 3-11 and Figure 3-4 present the results of a model developed by the study team to estimate the size of the charger market in Europe. It draws on data/estimates collected through desk research and consultation. For actual sales of standalone chargers, the model provides two estimates (high and low). Actual sales are then compared with a scenario modelling the situation that would have arisen in the absence of the MoU.

Table 3-11: Estimates of EU28 mobile phone charger market (2011-2013) (million units unless indicated otherwise)					
Scenario		**Parameter**	**2011**	**2012**	**2013**
Actual		Sales of chargers in the box with new phones	216	206	213
		Sales of new mobile phones without chargers	0	0.033	0.101
		Sales of new mobile phones without chargers (% of total sales of mobile phones)	0%	0.02%	0.05%
Actual	High	Sales of standalone mobile phone chargers	34	32	30
		Sales of standalone mobile phone chargers (% of sales of chargers in the box with new phones)	16%	16%	14%
		Reduction in standalone charger sales due to the MoU	2	7	13
No MoU		Standalone charger sales (units)	35	39	43
Actual	Low	Sales of standalone mobile phone chargers	21	19	18
		Sales of standalone mobile phone chargers (% of sales of chargers in the box with new phones)	10%	9%	9%
		Reduction in standalone charger sales due to the MoU	1	2	3
No MoU		Standalone charger sales	22	21	21

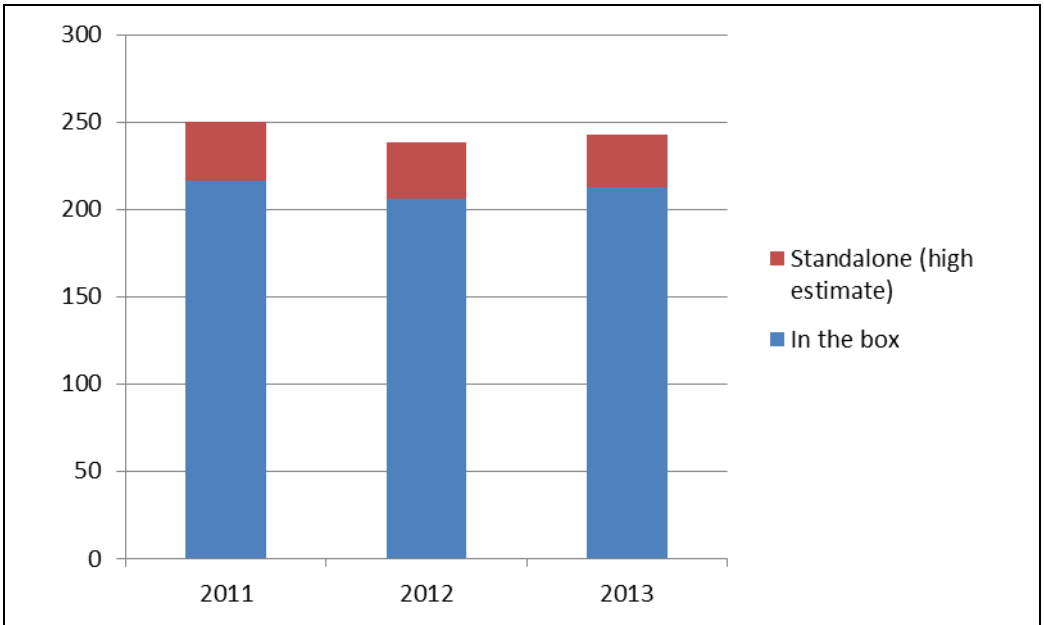

Figure 3-4: Estimates of EU28 mobile phone charger market (2011-2013) (million units)

The logic and key data/assumptions underpinning the model include:

- both the volume and composition of 'in the box' sales of chargers mirror the sales of mobile phones, with the exception of the three initiatives identified by the study team as not supplying chargers with new phones (O2, Fairphone and Motorola Moto G);
- two estimates for the volume of standalone have been derived. The low estimate is based on consultation for this study which suggested that the standalone market represents approximately 10% of the 'in the box market'. The high estimate reflects information published by Avenir (2011), suggesting that 7% of people in Western Europe purchase an

additional mobile phone charger each year (based on a 2010 survey by ABI Research). A leading electronics retailer in one of the large EU Member States responding to consultation for this study also agreed with the order of magnitude of these estimates. The composition of standalone sales is assumed to reflect the stock of mobile phones at the time, i.e. to include the legacy market;

- quantification of the impact of the MoU on the number of standalone chargers sold each year is based on information provided through consultation with a charger manufacturer, which suggests that there has been a 10-20% reduction in annual sales since the entry into force of the MoU[67]; and
- other sources of information suggest that the order of magnitude of the estimates in Table 3-11 is likely to be correct. Consultation with a charger manufacturer suggests an annual market for standalone mobile phone chargers in the EU of 30-40 million units. These estimates can also be compared to the market in Canada, which is a developed market that can be expected to be similar to the EU; extrapolating estimated annual sales in Canada to the EU suggests annual sales of mobile phone chargers in the EU28 of 33 million[68], which is similar to the high scenario in Table 3-11. Comparing global charger sales with the sales of mobile handsets also suggests that the logic underpinning our estimates is likely to be correct[69].

In order to quantify the proportion of new phones sold without chargers, the study team has carried out a review of websites of major network operators and retailers in a number of EU countries to determine whether handsets are supplied with or without chargers[70]. In addition, this issue was discussed with a number of consultees, including major mobile phone manufacturers, who have not identified any initiatives other than those mentioned below.

The UK network carrier O2 has trialled the 'Charger out of the Box' scheme, which currently covers four smartphones and one feature phone[71]. Phones are supplied without a mains charging unit, only with a USB/Micro-USB cable for charging and data transfer from a laptop or PC. Consumers are able to buy a mains charger for €4. The pilot of the scheme was heralded a success; 82% of customers which bought phones in the scheme didn't buy a separate charger and packaging volume was

[67] Please note that GfK (2014) has reported that February 2014 sales of standalone chargers in the UK increased by 30% when compared with February 2013. This includes the sales of wall chargers and power packs (i.e. a docking station for charging a battery outside the device) suitable for a range of devices (i.e. not only mobile phones). Source: GfK (2014): Power packs and wall chargers creating a highly valuable charging market, available at http://www.gfk.com/uk/news-and-events/news/pages/power-packs-and-wall-chargers-creating-a-highly-valuable-charging-market.aspx

[68] MarketNews.Ca (nd) provides data on unit sales of chargers for mobile phones in Canada showing that the average monthly sales of mobile phone chargers sold in Canada in 2008-2011 was about 192,000. Please note that data are available for selected months and do not include any in the Christmas period. This suggests annual sales in Canada 2.3 million. Extrapolating this figure to EU28 population (using GDP data) suggests annual sales of mobile phone chargers in the EU of 33.4 million.

[69] According to myFC (2011), two billion mobile phone chargers are sold each year globally and the travel charger segment is worth more than €11 billion. This can be compared with worldwide mobile phone sales in Table 3-5. Source: myFC (2011): Fuell Cell company myFC, available at http://fuelcellsworks.com/news/2011/07/05/fuel-cell-company-myfc-raises-usd-6-7-million-in-funding-to-launch-an-innovative-mobile-phone-charger/

[70] In some instances, desk-research was complemented by phone calls to determine whether specific handsets are sold with or without a charger.

[71] O2 website: Sony becomes third major manufacturer to join "Charger out of the Box" scheme, accessed at http://news.o2.co.uk/?press-release=sony-becomes-third-major-manufacturer-to-join-charger-out-of-the-box-scheme

reduced by 24%[72]. This was in spite of the fact that prior to the introduction of the scheme, research showed that only 47% of consumers "felt positively towards not receiving a charger"[73]. Similarly, and in contrast to the prevailing view among mobile phone manufacturers (as demonstrated by consultation for this study), the Institut National de la Consommation (2006) noted that 84% of consumers would be happy to buy a device without a charger as long as their old charger is compatible. O2 plans to sell all phones without a charger by 2015, as outlined in its environmental impact plans in 2012[74].

In addition, in November 2013, Motorola released the Moto G phone in Europe. This is a smartphone that is provided without a charger (although a USB/Micro-USB cable is still provided) and consumers are asked to pay extra for a charger (Virgin Mobile in the UK charge €6[75]) or purchase it separately[76]. A network operator responding to consultation estimated that 70% of the Motorola Moto G handsets supplied by them had been sold without a charger. The only other manufacturer found to provide smartphones without a charging unit is Fairphone, which is marketed as an environmentally friendly smartphone[77]. This is a smartphone that is supplied without a mains charger or data cable[78]. As of February 2014, Fairphone has sold 25,000 phones in Europe[79]. Information provided through consultation indicates that approximately 40% of Fairphone customers also bought a charger with the handset, with the other 60%-70% not doing so. A mains charger is offered as an accessory on Fairphone's website, currently for €9.99.[80]

3.3.2 Structure of the Sector and Trade

Desk-research and consultation indicate that chargers are typically manufactured outside the EU.

Although EU-based production of chargers appears to be limited, several European companies are involved in charger manufacturing by means of having production facilities outside Europe or subcontracting production to non-EU companies. For example, Salcomp (Finland), which in 2008 held a 24% share of the mobile phone charger market, made 90% of its Finnish workforce redundant in 1999 and outsourced its production to locations outside the EU[81]. Another large player, Friwo (Germany), which in 2008 held a 25% market share, may have production facilities in Germany and China[82]. Manufacturers of wired chargers headquartered in the EU are listed in Table 3-12;

[72] Edie website: O2 charging its way to sustainability, accessed at http://www.edie.net/library/view_article.asp?id=6405&title=O2+charging+its+way+to+sustainability+

[73] O2 (nd): Charger out of the box, accessed at http://www.o2sustainability.co.uk/2012/how_we_think_big/charger_out_of_the_box

[74] The Telegraph website: O2 to abandon mobile chargers, accessed at http://www.telegraph.co.uk/technology/mobile-phones/9808813/O2-to-abandon-mobile-chargers.html

[75] Virgin Media (2014): Motorola Moto G, accessed at http://store.virginmedia.com/virgin-media-mobile/pay-monthly-phones/motorola-moto-g-with-charger/motorola-moto-g-with-charger-tariffs.html

[76] Tesco Mobile (2014): Mototola Moto G, accessed at http://shop.tescomobile.com/mobile-phones/pay-as-you-go/motorola/moto+g+16gb?deal=12179

[77] Fairphone website: General specifications, accessed at http://buy-a-phone-start-a-movement.fairphone.com/en/specs/

[78] AndroidAndyUK (2014): Fairphone Unboxing and First Look, available at http://www.youtube.com/watch?v=81kwlLK66sE

[79] E15 (2014): Spravedliva revoluce, available at http://e-svet.e15.cz/it-byznys/spravedliva-revoluce-nizozemsky-fair-trade-telefon-prepisuje-pravidla-hry-1060022 and The Globe & Mail (2014): Meet Fairphone, available at http://www.theglobeandmail.com/technology/tech-news/meet-fairphone-a-phone-company-turning-protest-into-a-disruptive-product/article16901664/

[80] See http://shop.fairphone.com/accessories.html

[81] See http://evertiq.com/news/10155 and http://evertiq.com/news/20414

[82] See http://www.friwo-ag.de/unternehmen/geschichte/

information provided by a manufacturer of mobile phone chargers, however, suggests that "most" charger manufacturers with headquarters or design activities in Europe have production facilities in Asia or subcontract production to other companies in Asia. In addition, there are other companies offering wireless chargers but as these would not have been impacted by the MoU, they have not been included in Table 3-12.

Table 3-12: Manufacturers of Wired Chargers Headquartered in the EU		
Company	**Country**	**Details**
Ansmann	Germany	Large company that is present at several locations, including Germany and China[83]
Avenir Telecom	France	Very large company, mobile phone accessories are one of several business areas
Cellular Italia	Italy	Company produces in Italy, Europe and Asia, location of charger manufacturing not known
Friwo	Germany	Possibly produces in Germany and China
Mayamax	France	Planned to start production in France in 2014
Salcomp	Finland	Headquartered in Finland but produces outside the EU

Although a manufacturer of chargers has suggested to the consultants that there is production of mobile phone chargers in several new EU Member States, namely in the Czech Republic, Estonia, Poland and Romania, desk research has not identified any production facilities in these countries[84] and thus no companies from these countries could be included in Table 3-12.

Estimates of the size of EU-based charger production differ. Information provided by mobile phone manufacturers suggests that 98% of branded chargers are made in China. Consultation with a major manufacturer of chargers suggests that around 90% of chargers sold in Europe are manufactured in Asia (China and India) but also in Latin America, etc.[85] Around 10-15% of chargers sold in Europe are thus said to be produced in Europe. On the other hand, information provided by another charger manufacturer suggests that currently no companies produce chargers in the EU, with the exception of Mayamax's new factory that recently started production in France. Its expected output is 800,000 units in 2014, 2 million units in 2015 and 3 to 4 million units in 2016. Information provided prior to commencement of production suggests that Mayamax was expecting that its fully automated production process (except for the packaging line) will allow it compete with Chinese manufacturers, creating employment for 15 people (per shift) with 10 on the packaging line, compared with 300-400 in China.

3.4 Impacts of the MoU on the Market

The assessment of the extent to which the handset and charger markets and stock have shifted towards MoU-compliant charging is a crucial starting point for the evaluation of the MoU's impacts. This section provides estimates of the following:

- market share of MoU compliant mobile phones;

[83] See http://www.ansmann.de/de/unternehmen/ansmann-weltweit/

[84] Several companies that may offer chargers have been identified in the Czech Republic and Poland but these appear either not to produce them or produce chargers for applications other than consumer electronics.

[85] This assertion is also supported by a study a study completed by the ITU and GeSI which surveyed more than 300 power supplies (chargers) and found that 90% of chargers analysed were made in China. Source: ITU and GeSI (2012): An Energy-Ware Survey on ICT Device Power Supplies, accessed at http://www.itu.int/dms_pub/itu-t/oth/0B/11/T0B110000163301PDFE.pdf

- proportion of the stock of mobile phones that is compliant with the MoU; and
- market share of chargers for MoU compliant phones.

3.4.1 Market Share of MoU Compliant Mobile Phones

There are essentially three ways of measuring market share of MoU compliant phones. These include:

- assessment of the market shares of MoU/LoI signatories;
- presentation and evaluation of information on compliance rates reported through consultation with mobile phone manufacturers; and
- estimation of compliance rates on the basis of a model developed to assess a sample of mobile phone models released since 2008.

The above-mentioned approaches are used below to estimate the market share of MoU compliant handsets.

Market Share of MoU/LoI Signatories

Table 3-13 shows the market shares of leading manufacturers of mobile phones. In this table, signatories of the MoU are highlighted in yellow and signatories of the LoI, which de facto extended the MoU until the end of 2013, are indicated in orange. Although shipment data are not available for all signatories of the MoU/LoI (e.g. companies such as Huawei and TCL Mobile are included under the 'others' category), Table 3-13 still clearly shows that signatories of the MoU/LoI account for the vast majority of the handset market.

Due to the fact that market research companies do not break down market data between data-enabled and non-data enabled phones, Table 3-13 relates to all mobile phones. However, data reported for smartphones (all of which are data-enabled) provide a similar picture, with MoU signatories having been in the 'Top 5 smartphone manufacturers' since 2008, including Apple, Blackberry, HTC, Huawei, LG and ZTE. However, it is worth noting that the proportion of 'other' smartphone manufacturers (i.e. those for which individual sales data are not available) has increased from 19% in 2009 to 39% in 2013[86].

[86] Various IDC press releases, accessed at http://www.idc.com/about/press.jsp

Table 3-13: Market share by manufacturer of shipments of all mobile phones to EU28 (%)					
Manufacturer	Year				
	2009	2010	2011	2012	2013**
Apple	4%	8%	10%	15%	14%
Blackberry	4%	6%	7%	5%	*
HTC	*	3%	6%	*	*
LG	10%	7%	*	*	6%
Nokia	37%	34%	25%	20%	14%
Samsung	29%	27%	31%	42%	45%
Sony	11%	8%	5%	5%	8%
Others***	5%	7%	15%	13%	15%

*Notes: *included under 'others', **2013 shipments have been extrapolated based on Q1 and Q2 2013, *** some manufacturers in this category are signatories of the MoU/LoI*
Source: Estimated based on Various IDC Press Releases, accessed at http://www.idc.com/about/press.jsp

The combined market shares of MoU/LoI signatories for which individual shipments are known are shown in Figure 3-5. The fact that at least 80%-90% of the market is supplied by MoU/LoI signatories suggests that at least 80%-90% of data-enabled mobile phones released since 2011 have been compliant with the MoU.

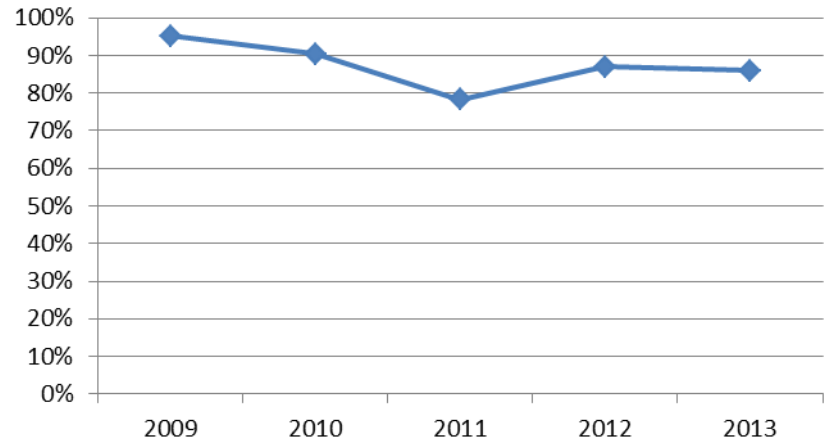

Figure 3-5: Minimum market coverage of MoU/LoI signatories (market for all mobile phones)
Note: Total % only includes market shares of companies for which individual shipments data are available.

The key weaknesses of this approach include:

- non-availability of data on market shares of some MoU/LoI signatories and the fact that many non-signatory manufacturers have also moved to Micro-USB charging. This suggests that the above data may underestimate the 'real' market share of MoU compliant phones;
- since only new phones released since 2011 have been subject to the MoU and handset manufacturers have been allowed to continue selling older non-compliant models, focus on signatories' market shares may overestimate the real market coverage of the MoU; and
- as data reported by market research companies do not distinguish between data-enabled and non-data enabled handsets, the assessment of the compliance rate in the data-enabled segment is not possible.

The fact that many non-signatory manufacturers have also moved to Micro-USB charging can be illustrated on the example of European handset manufacturers listed in Table 3-7 in Section 3.2. A review of the charging requirements of their phones in Table 3-14 shows that all smaller European manufacturers for which it has been possible to determine the charging method now offer at least part of their portfolio with Micro-USB charging capability.

Table 3-14: Charging methods used by European companies selling own brand handsets

Company	Country	Type of mobile phones manufactured	Charging method
Emporia	Austria	'Easy to use' mobile phones	Micro-USB
Prestigio	Cyprus	Smartphones	Micro-USB
Evolveo	Czech Republic	Easy to use mobile phones, smartphones, and 'rugged' feature and smartphones	Micro-USB
Jablotron	Czech Republic	'Easy to use' mobile phone that resembles a landline in appearance	Unknown
VERZO	Czech Republic	Smartphone	Micro-USB
Lumigon	Denmark	Smartphones	Micro-USB
Twig Com (ex-Benefon)	Finland	Locator phones	Proprietary
Jolla	Finland	Smartphone	Micro-USB
Bull	France	'Secure' mobile phone and smartphone	Unknown
Mobiwire	France	Feature phones and smartphones.	Micro-USB
Orange/EE	France	Feature phones and smartphones	Micro-USB
Thomson Téléphonie/ Technicolor	France	Range of feature phones, smartphones and 'easy to use' phones	Micro-USB (smartphones), proprietary and charging cradle (feature phones and 'easy to use' phones)
Wiko Mobile	France	Feature phones and smartphones	Micro-USB
GSMK Cryptophone	Germany	'Secure' mobile phones	Proprietary but can also charge via Micro-USB port
ConCorde	Hungary	Range of smartphones and rugged phones	Micro-USB (smartphones), some feature phones use proprietary chargers
Brondi	Italy	Make feature phones, smartphones and a range of 'easy to use' phones	Micro-USB (smartphones) and proprietary
Olivetti	Italy	Smartphones	Micro-USB
Just5	Latvia	'Easy to use' mobile phone	Micro-USB
Fairphone	Netherlands	Smartphone	Micro-USB
Overmax	Netherlands and Poland	Smartphones	Micro-USB
Yarvik	Netherlands	Smartphones	Micro-USB
Allview	Romania	Smartphones and feature phones	Micro-USB (most) and Mini-USB
Geeks Phone	Spain	Smartphones	Micro-USB

Table 3-14: Charging methods used by European companies selling own brand handsets			
Company	**Country**	**Type of mobile phones manufactured**	**Charging method**
Doro	Sweden	Range of mobile phones for senior people	Micro-USB or charging cradle*
Handheld	Sweden	'Rugged' smartphones	Micro-USB and proprietary
Fonerange	United Kingdom	'Rugged' feature and smartphones	Micro-USB
MOJO Maker	United Kingdom	Range of 'budget' mobile phones and smartphones	Micro-USB
TTfone (TTsims)	United Kingdom	Easy to use mobile phones	Charging dock* or Micro-USB
Vertu	United Kingdom	Smartphones	Micro-USB
Source: Various sources, primarily websites of manufacturers, unboxing videos and online tests *Note: For some manufacturers, 'charging method' information is based on a sample of handsets* **Micro-USB cables can be plugged directly into the charging cradle of these manufacturers*			

Information on Compliance Rates Collected Through Desk Research and Consultation

Several estimates of the market share of MoU compliant phones have been collected through desk research and stakeholder consultation (mainly from handset manufacturers). Consultation with handset manufacturers included communication with companies that collectively held between 80-90% of the EU market between 2009 and 2013; it can therefore be expected that information provided is representative of the EU handset market.

Information identified through consultation and desk research suggests that the MoU covers almost all data-enabled phones and the majority of mobile phones overall, with the market share of Micro-USB chargers having increased significantly since 2009, in particular in the feature phone segment. Key estimates and information are reproduced below.

In 2011, two years after the MoU was signed, all signatories either produced data-enabled phones which were supplied with a Micro-USB charger or made an adaptor available for purchase. The proportion of chargers compatible with the MoU, however, varied from about 15% to 100% of the total production of these companies, possibly also reflecting differences in the importance of feature phones in each manufacturer's overall production (consultation with handset manufacturers and Bolla et al, 2011[87]).

As regards non-data enabled phones, it was estimated that in 2009 feature phones typically did not have a data connector and as such they were not using Micro-USB for charging. However, information provided by a handset manufacturers in 2014 suggests that 90% of current feature phone releases use a Micro-USB charger, and using linear extrapolation, it was suggested that around 50% of feature phones released in 2011 had a Micro-USB socket. Overall, non-data enabled handsets are estimated to currently represent less than 10% of mobile phone sales in the EU; this is a drop from around 20% in 2011, when feature phones accounted for 30% of the market.

Information provided by mobile phone manufacturers and collected through desk research indicates that, in 2013, Micro-USB connectors were mainstream across mobile phones, even with manufacturers that did not sign up to the MoU (as can be seen in Table 3-14). Manufacturers

[87] See https://itunews.itu.int/en/1944-Environmental-benefits-of-a-universal-mobile-charger.note.aspx

indicated that almost 100% of data enabled phones sold in Europe in 2013 were compliant with the MoU/LoI, albeit some requiring an adaptor.

Information from handset manufacturers has been combined with published market data to estimate the market shares of MoU compliant phones between 2011 and 2013. These are given in Table 3-15 and Figure 3-6.

Table 3-15: Market share of MoU compliant mobile phones (%), estimates based on consultation			
Parameter	Year		
	2011	2012	2013
Market share of MoU compliant phones (% of data-enabled)	95%	95%	100%
Market share of MoU compliant phones (% of all handsets)	67%	80%	93%
Source: estimated on the basis of information collected through consultation with handset manufacturers			

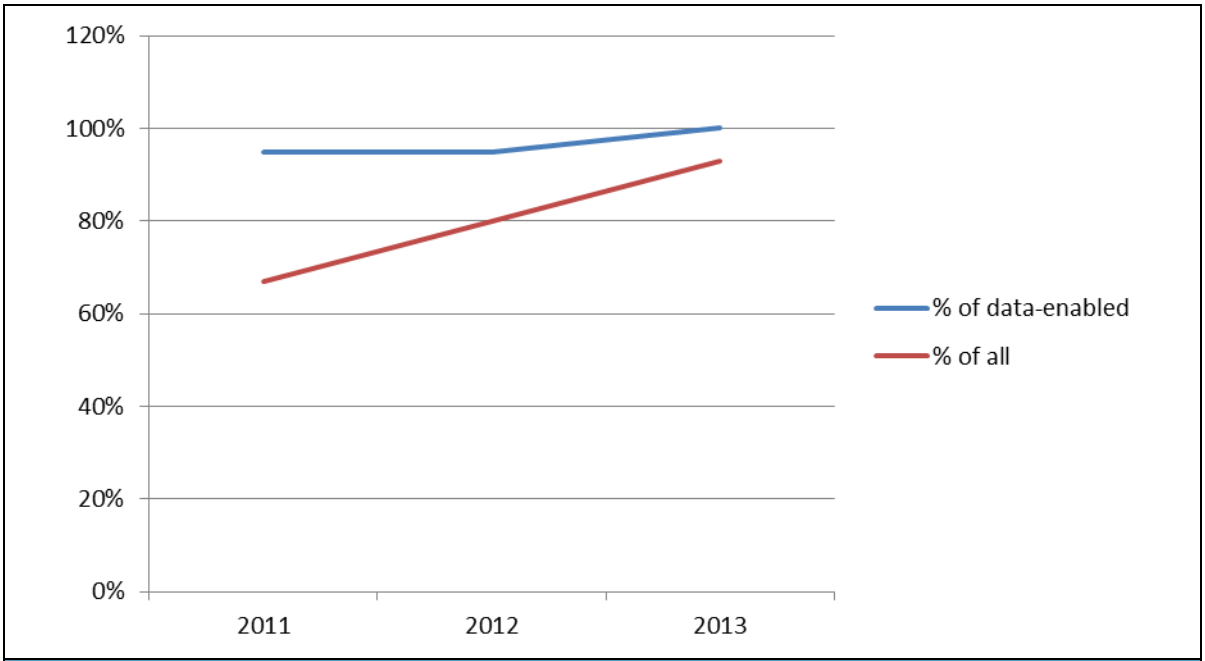

Figure 3-6: Market share of MoU compliant handsets, 2011-2013 (%),estimates based on consultation

In the feature phone segment, the move towards Micro-USB charging appears to be linked to the increased popularity of data-enabled phones. A major handset manufacturer noted that consumers have come to expect more of their feature phones and a data connector is a useful addition. A non-signatory manufacturer of mobile phones that moved towards Micro-USB charging prior to the MoU noted that the Micro-USB connector facilitates the upgrading of software on feature phones.

Model-based Assessment

A model has been developed for the purposes of this study that estimates the annual market share of MoU compliant mobile phones between 2011 and 2013 on the basis of on data collected through desk research and consultation and a range of assumptions about market and consumer behaviour. This includes a review of charging requirements of a sample of over 400 mobile phones released between 2008 and 2013 (around 160 smartphones and 260 feature/basic phones). For these phones, data were collected on whether they have a Micro-USB socket that can be used for

charging[88] or could be charged by a Micro-USB charger via an adaptor. Where such information was available, handsets not sold in Europe were excluded from the sample. The results of the model were discussed with a number of stakeholders, including mobile phone manufacturers and, where appropriate, their comments were taken into account.

Data on the charging requirements of the sample[89] have been used to calculate the proportion of MoU compliant models released by each manufacturer for each year while differentiating between smartphones, feature phones and basic phones. These were combined with data on the average market churn, manufacturers' market shares and market shares of the different types of mobile phones to derive estimates of the proportion of the 2009-2013 sales (number of units sold) that were compliant with the MoU. Data and assumptions underpinning the model are described in more detail in Annex 11. Estimates of the market shares of MoU compliant phones derived from the model are given in Table 3-16 and Figure 3-7.

Table 3-16: Market share of MoU compliant mobile phones (%), estimates based on market model

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: estimated on the basis of market model developed for this study			

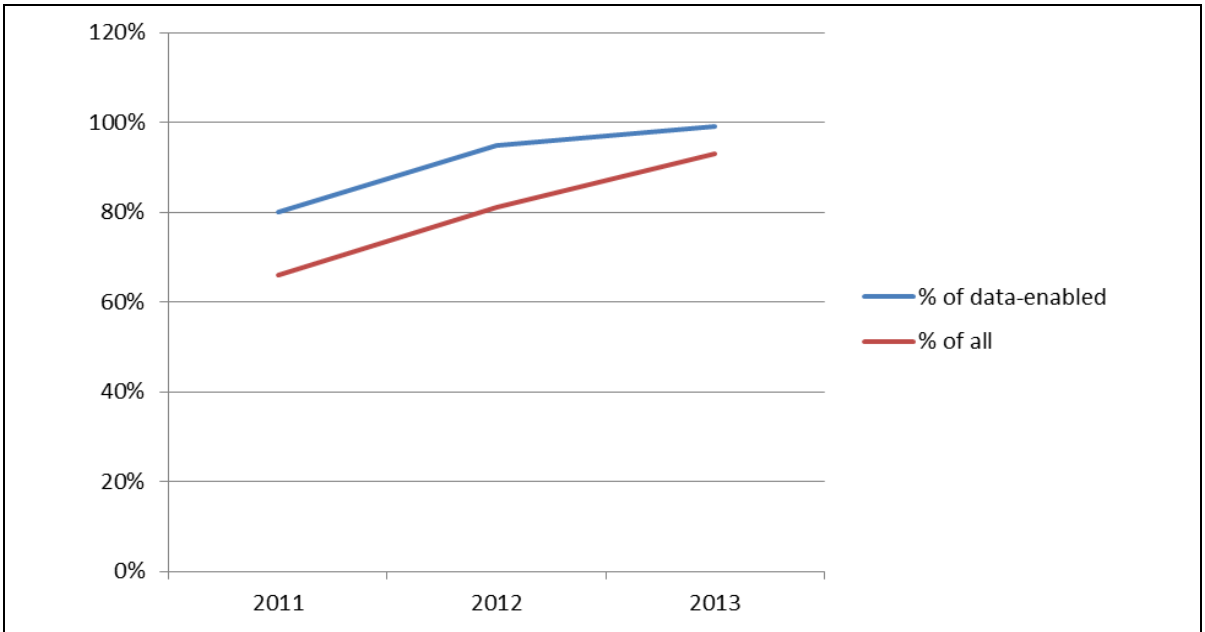

Figure 3-7: Market share of MoU compliant handsets, 2011-2013 (%),estimates based on market model

[88] Some mobile phones with a Micro-USB socket that have been sold in the EU between 2009-2013 have only used Micro-USB for data transfer and in spite of having a Micro-USB port, could not be charged with a Micro-USB charger. For example, the Nokia 3720 had both a Micro-USB socket for data transfer and a proprietary port for charging. Unlike later Nokia models (e.g. Asha 302) with Micro-USB and proprietary sockets, the Micro-USB port on Nokia 3720 could not be used for charging.

[89] For one handset manufacturer, the proportion of models using Micro-USB in the sample was for certain years and types of handsets substantially different to the proportion indicated by the manufacturer in the course of consultation for this study . For this manufacturer, estimates provided by its representative have been used where consultation and sample data differed.

Table 3-16 and Figure 3-7 show that the market share of MoU compliant data-enabled phones increased from about 80% in 2012 to almost 99% in 2013. When all handsets are considered, in 2013 MoU compliant phones accounted for 93% of the market, up from 66% in 2011 (please note that this market also includes phones that are not data enabled).

Please note that there is a very high degree of consistency between estimates derived from consultation data (see Table 3-15 and Figure 3-6) and the market model (Table 3-16 and Figure 3-7). In fact, for most years both methods result in almost identical estimates.

When expressed as the number of units shipped to EU28 countries, the market for MoU-compliant handsets is given in Table 3-17 and Figure 3-8.

Table 3-17: EU28 Shipments of MoU-compliant handsets (million units), estimates based on market model

Parameter	Year		
	2011	2012	2013
MoU-compliant handsets (million units)	142	167	198
Handsets not compliant with the MoU (million units)	73	39	15

Source: estimated on the basis of market model developed for this study and shipment data in Table 3-2

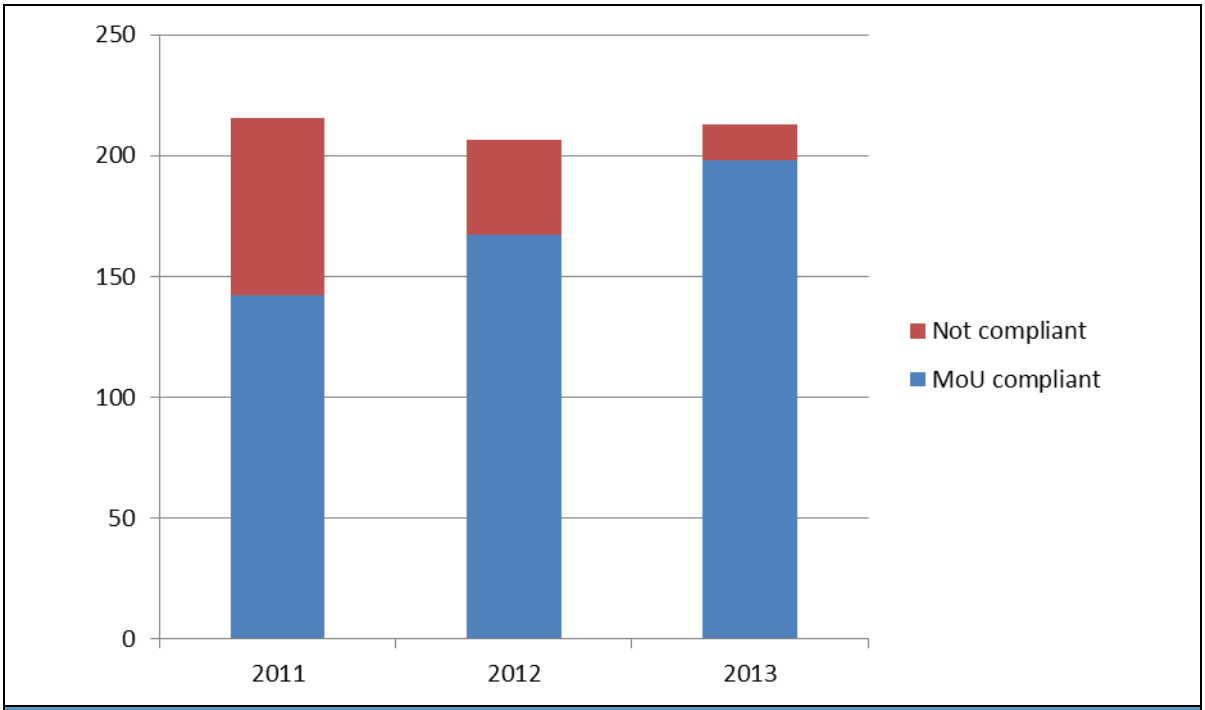

Figure 3-8: EU28 Shipments of MoU-compliant handsets (million units), estimated based on market model and shipment data given in Table 3-2

An alternative source of data on mobile phones (the PDAmaster database[90]) has also been identified which could be compared with the sample of mobile phones collated by the study team. An overview of the data in PDAmaster database is provided in Table 3-18.

[90] See http://pdadb.net/index.php?m=pdamaster

Table 3-18: Connectors on GSM-enabled devices in the PDAmaster database (number of models released by year)					
Connector	Year				
	2009	2010	2011	2012	2013
Proprietary excluding Apple	30	23	5	12	4
Apple connectors	5	6	8	32	40
Micro-USB	95	270	352	561	1,012
Total releases	***130***	***299***	***365***	***606***	***1,056***
% of total releases that are MoU compliant	***77%***	***92%***	***99%***	***98%***	***100%***
Source: PDAmaster database, available at http://pdadb.net/index.php?m=pdamaster					

Data in Table 3-18 broadly confirm the high level of compliance with the MoU indicated earlier in this section and the fact that the proportion of releases with Micro-USB increased over time. In fact, the proportion of releases with Micro-USB appears to be somewhat higher than in the sample used to derive figures in Table 3-16. This may reflect the very low number of non-data enabled models in the PDAmaster database. In addition, three important caveats need to be made when considering the data in Table 3-18. Firstly, there are no search criteria for determining the type of device and relevant devices have been screened on the basis of whether they support GSM900 or GSM1800. However, some tablets use mobile phone networks for data transfer but do not support traditional voice calls and may have been included in Table 3-18 even though they are clearly not mobile phones. Secondly, this database only allowed us to determine whether the relevant model has a Micro-USB connector but not whether this connector can be used for charging; the purpose of recording information on connectors in this database is linked to data transfer. Thirdly, the PDAmaster database does not specify whether the relevant handsets have been sold in Europe.

3.4.2 Stock of MoU Compliant Mobile Phones

Estimates of the market shares of MoU compliant mobile phones have been combined with information on the handset replacement cycle presented in Section 3.2 to estimate the proportion of compliant stock between 2009 and 2013. Please note that in this model, the term stock refers to mobile phones in use, i.e. mobile phones no longer in use but not yet disposed of are not included. Estimates of the proportion of MoU compliant phones in total stock are presented in Table 3-19 and Figure 3-9.

Table 3-19: MoU compliant mobile phones in total stock (%), estimated based on market model			
Parameter	Year		
	2011	2012	2013
MoU compliant phones in total stock (% of data-enabled)	63%	79%	91%
MoU compliant phones in total stock (% of all)	49%	65%	80%
Source: estimated on the basis of market model developed for this study			

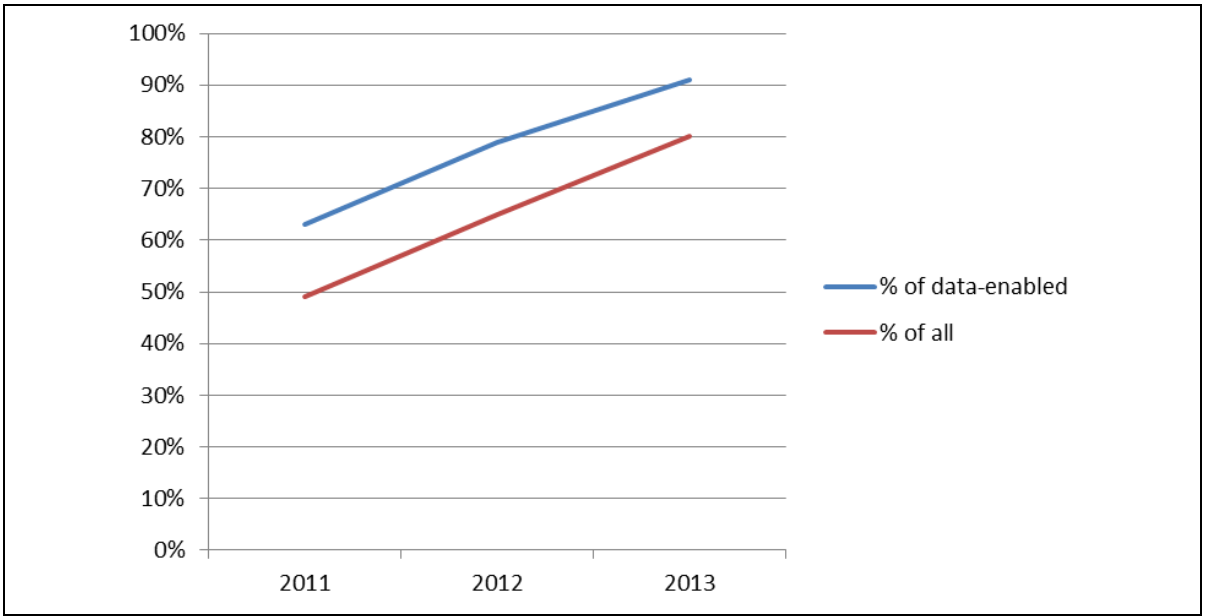

Figure 3-9: MoU compliant hansets in total stock (%, 2011-2013), estimated based on market model

Data in Table 3-19 and Figure 3-9 suggest that around 80% of EU consumers currently have an MoU compliant handset, up from less than 50% in 2011. It is important to bear in mind that the percentages in Table 3-19 include phones that can be charged using a Micro-USB charger together with an adaptor, with the proportion of handsets with a Micro-USB connector given in Table 3-21.

Estimates of the total number of MoU compliant handsets in use in the EU are provided in Table 3-20 and Figure 3-10. Please note that estimates of the total stock of mobile phones in the EU are based on GSMA's data on the number of active SIM connections; however, some users use dual SIM phones and the 'real' number of handsets in Europe may thus be lower.

Table 3-20: EU28 Stock MoU-compliant vs. non-compliant mobile phones (million units)

Parameter	Year		
	2011	2012	2013
MoU compliant phones (million units)	321	418	503
Non-compliant phones (million units)	335	225	126

Source: Proportion of MoU compliant phones have been estimated on the basis of market model developed for this study. Total EU28 mobile phone stock has been estimated based on GSMA (2011)[91] and GSMA (2013)[92].

[91] GSMA (2011): European Mobile Industry Observatory 2011, available at http://www.gsma.com/publicpolicy/wp-content/uploads/2012/04/emofullwebfinal.pdf

[92] GSMA (2013): The Mobile Economy 2013, available at http://www.gsmamobileeconomy.com/GSMA%20Mobile%20Economy%202013.pdf

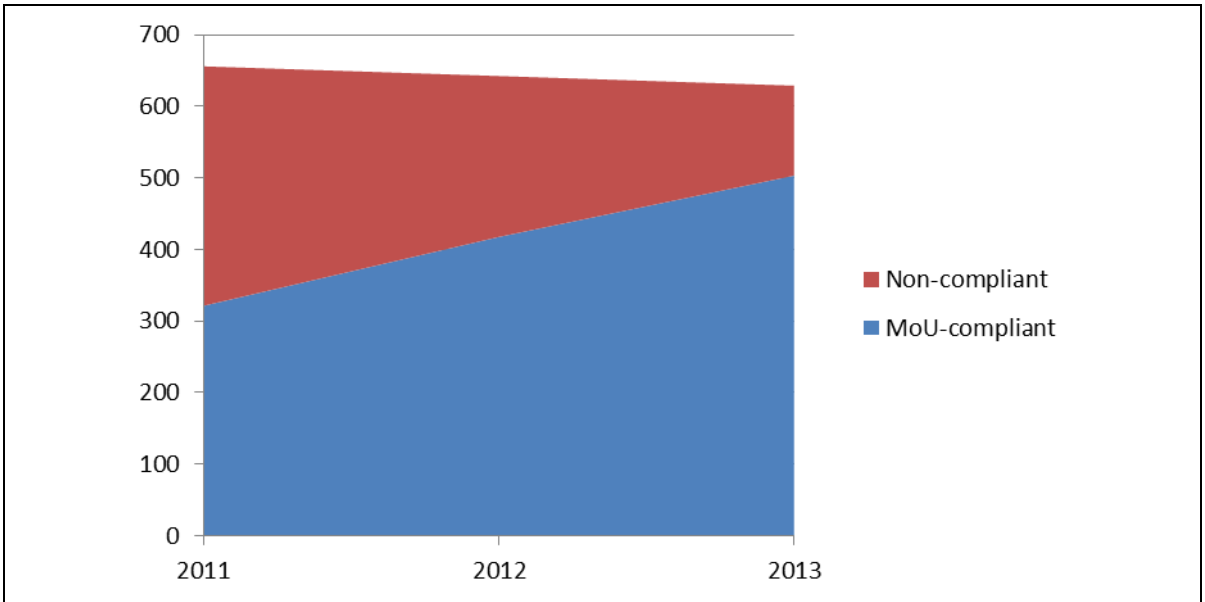

Figure 3-10: Stock of mobile phones in EU28 – MOU compliant vs. non-compliant handsets (million units, 2011-2013), estimated based on market model and data from GSMA (2011 and 2013)

The information presented in this section thus far relates to MoU-compliant mobile phones. This is, however, not the same as the proportion of mobile phones in use that have a Micro-USB connector, as MoU-compliant phones include those that can be charged with a Micro-USB charger via an adaptor (i.e. Apple handsets). Estimates of the stock of phones with a Micro-USB socket are given in Table 3-21 and Figure 3-11. These figures are broadly consistent with published estimates of the proportion of mobile phone users that have a Micro-USB charger, with information published by O2 and ITU and provided by a handset manufacturer suggesting that around 70% consumers already have a charger that can be used with a Micro-USB handset[93].

Table 3-21: EU28 Stock of mobile phones with/without a Micro-USB socket (million units)

Parameter	Year		
	2011	2012	2013
Phones with a Micro-USB connector (million units)	274	346	420
Phones without a Micro-USB connector (million units)	382	296	209

Source: As Table 3-20, without Apple handsets.

[93] O2 (nd): Charger out of the box, available at http://www.o2.co.uk/thinkbig/planet/sustainable-products-and-services/charger-out-of-the-box; ITU (2013): European decision supports move to universal mobile charger, available at http://www.itu.int/net/pressoffice/press_releases/2013/47.aspx

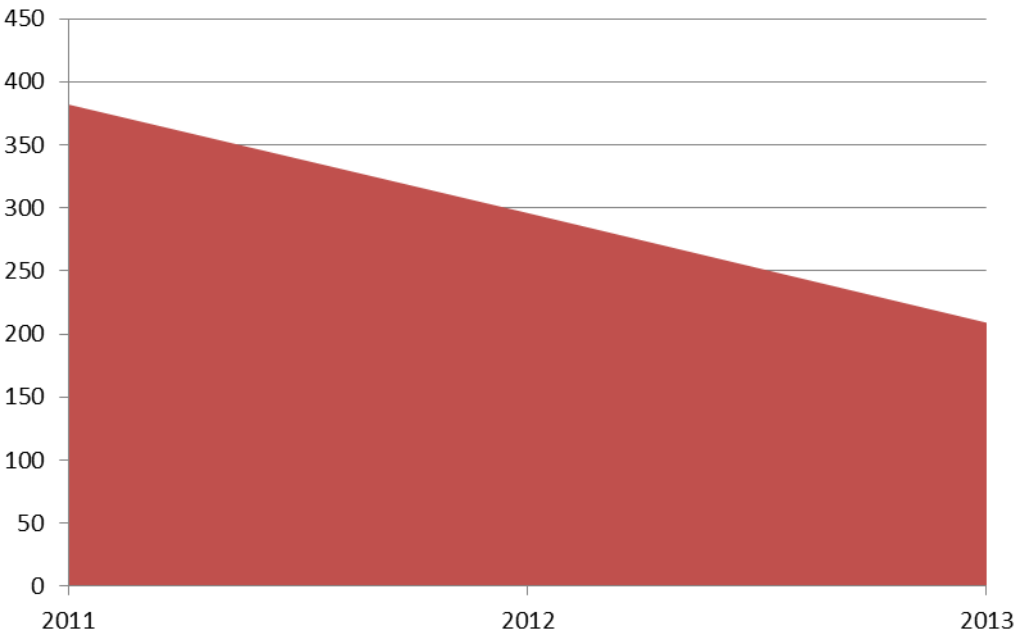

Figure 3-11: Stock of mobile phones in EU28 without a Micro-USB connector (million units, 2011-2013)

3.4.3 Market Share of MoU Compliant Chargers

For the purposes of this section of the report, the term 'MoU compliant charger' is taken to refer to any charger that can be used to charge an MoU compliant handset, i.e. Apple 30 pin and Lightning chargers are included among MoU compliant chargers.

Estimates of the market share of MoU compliant chargers have been derived on the basis of market data in Section 3.3 and estimates of the proportion of MoU compliant handset shipments and stock. The composition of 'in the box' sales mirrors the market for mobile phones, while standalone sales are expected to reflect the stock of mobile phones in use, i.e. to also reflect the legacy market. The evolution of the market share of MoU compliant chargers between 2011 and 2013 is presented in Table 3-22 and Figure 3-12.

Table 3-22: Market share of chargers for use with MoU compliant phones (%)

Year	Chargers for use with MoU compliant phones (% of market)
2011	64%
2012	80%
2013	92%

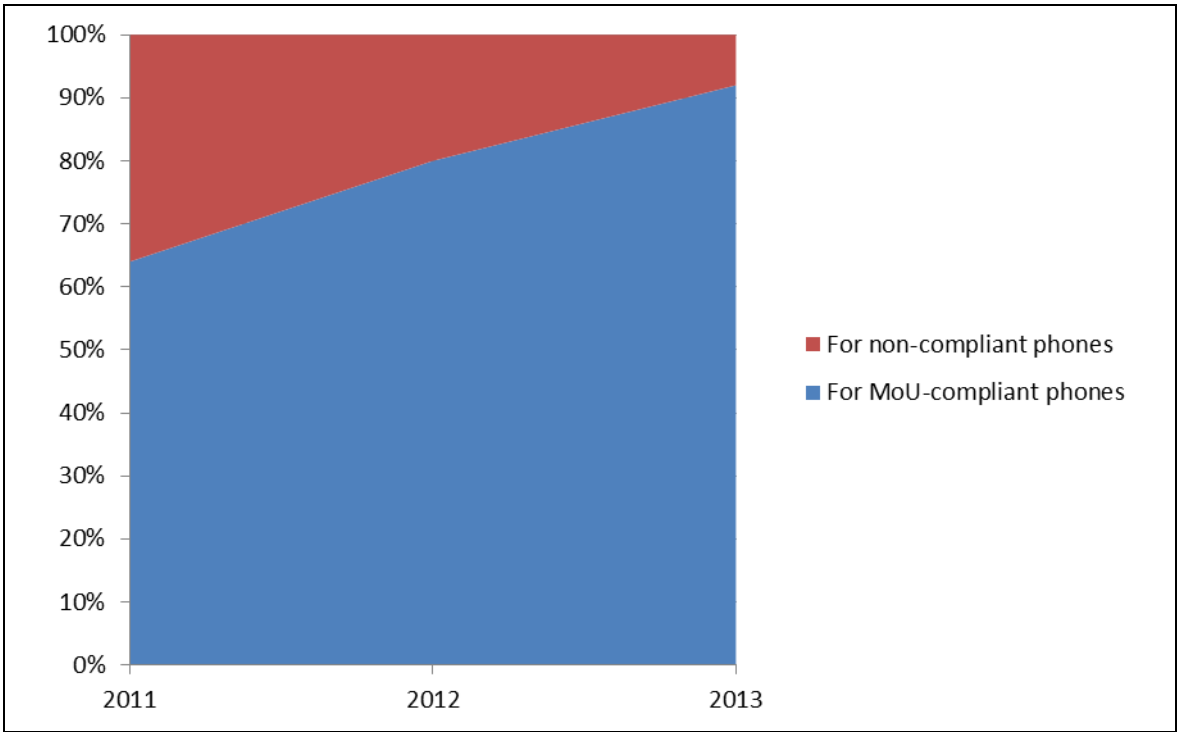

Figure 3-12: Market share of chargers for use with MoU compliant phones (%, 2011-2013)

The evolution of the market for chargers for MoU compliant phones, expressed as the number of units sold, is provided below. High and low estimates are given, reflecting the two scenarios in Table 3-11. This includes both chargers sold 'in the box' with new handsets, as well as those sold on a standalone basis.

Table 3-23: Market for chargers for use with MoU compliant phones (million units)

Scenario	Parameter	Year		
		2011	2012	2013
High	Chargers for MoU compliant phones (million units)	160	191	223
	Chargers for non-compliant phones (million units)	90	48	19
Low	Chargers for MoU compliant phones (million units)	151	180	212
	Chargers for non-compliant phones (million units)	85	45	18

Source: Estimated on the basis of Tables 3-11 and 3-22.

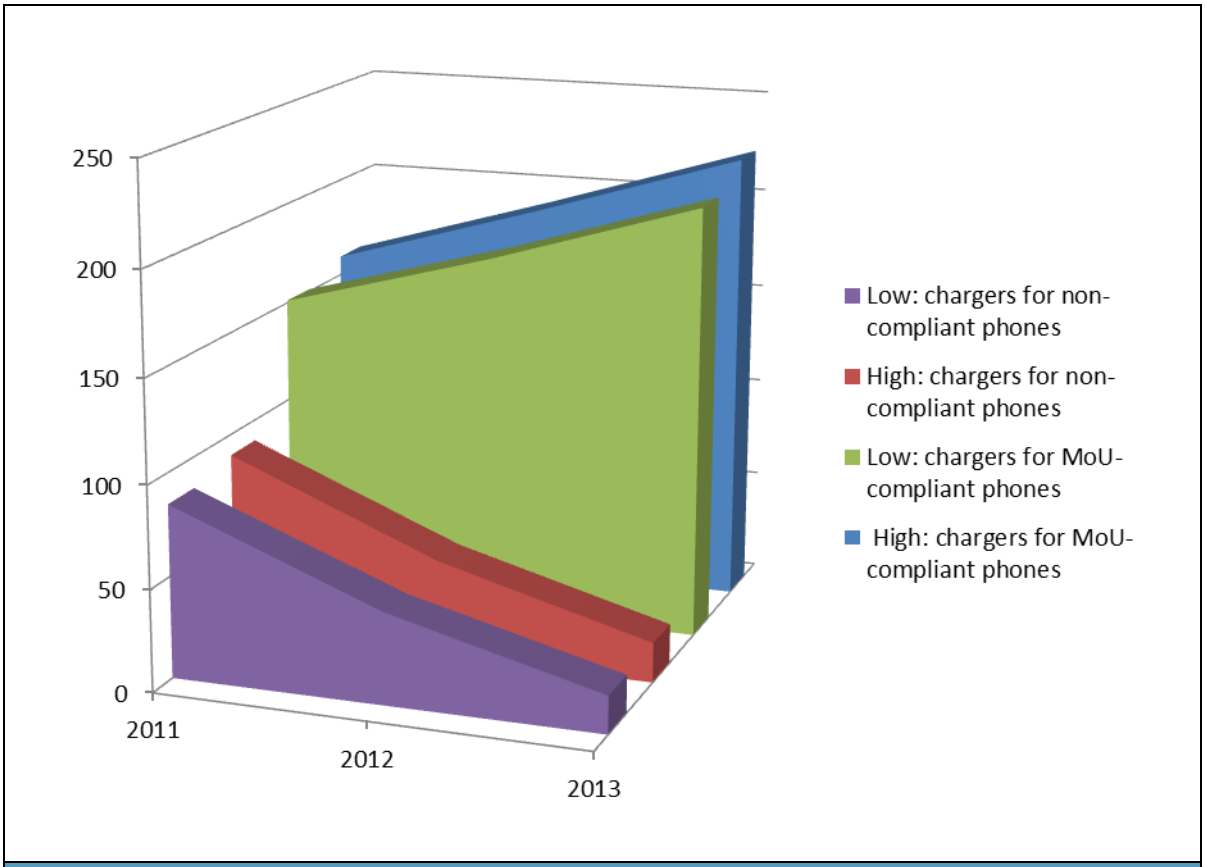

Figure 3-13: EU28 charger market, high and low estimates (million units, 2011-2013)

3.5 Impacts on Manufacturers

3.5.1 Impacts on Handset Manufacturers

All in all, consultation with handset producers suggests that they have experienced relatively limited impacts from the MoU. There appear to be two main reasons for this:

- **focus on new model releases only**: the MoU only applied to new model releases and did not necessitate the withdrawal of old non-compliant models from the market; and
- **a sufficiently long transition period**: the consultation response from Digital Europe notes that "as the MoU provided a feasible timeframe for the transition towards chargers with the common charging capability, it seems that there were no strong negative impacts on the sector of mobile manufacturers." The MoU was signed in 2009, IEC/CENELEC EN62684 was published in 2010 and its implementation started in 2011. In this respect, it is of note that, in the mobile phone sector, new models are released on a frequent basis and the design-to-production period for mobile phones is approximately 18 months to two years (as suggested by handset manufacturers).

However, this is not to say that there have been no impacts at all. There appears to be general agreement among manufacturers of mobile phones and chargers that the use of Micro-USB chargers is more expensive than the use of proprietary chargers, suggesting that the overall cost of chargers supplied with mobile phones may have increased. The cost increase has been estimated at about 20-30% per unit on the charger side and tens of euro-cents on the handset side. On the other hand,

there appears to be no such agreement among manufacturers as regards the cost difference between Micro-USB and Mini-USB chargers. The two opposing views are that a) Micro-USB is smaller, cheaper and lighter than Mini-USB (as suggested by handset manufacturers) and b) there is no cost difference between Mini-USB and Micro-USB chargers (as suggested by a charger manufacturer).

The wholesale price of a proprietary charger can be estimated at around €1[94]. The retail price of a typical charger is higher and can be estimated at around €5. Buckinghamshire Trading Standards (2008)[95] estimated the 2008 online price of a standalone charger at about €2, plus P&P, which when adjusted for inflation suggests a current unit price of around €2.50. O2 and Virgin Media in the UK (i.e. network carriers that give consumers the choice whether they wish to buy a handset without a charger or pay extra for it to be included with their phone) charge end users around €4 to €6 for a charger[96]. However, some chargers cost more. For example, the iPhone mains charger (with a UK plug and excluding a cable) is sold by Apple Store in the UK for around €19[97].

Disregarding Mini-USB phones and assuming that the market share of Micro-USB chargers would have remained at its 2010 level, the additional cost of supplying Micro-USB chargers has been estimated in Table 3-24. The unit cost used for calculation is €0.50, covering both the charger and the handset – this is an estimate based on the information given above.

Of course, modelling of a counterfactual scenario is inherently uncertain. For example, the shift to Micro-USB charging was to some extent driven by increasing popularity of data-enabled handsets, which required a dual charging and data transfer connector. This suggests that the overall market share of Micro-USB chargers would have increased in the absence of the MoU even if their market shares within the data-enabled and non-data enabled segments remained unchanged, simply because of increasing popularity of data-enabled handsets. Another shortcoming of the estimates in Table 3-24 is that they are based on estimated market shares of Micro-USB phones, thus modelling a scenario where handsets with a Micro-USB socket are supplied with Micro-USB chargers. However, as noted in Section 3.4.1, this has not always been the case. Considering the above reservations, Table 3-24 likely overestimates the actual costs, as the market was in the process of moving toward Micro-USB charging in any event. In addition, it is unclear to what extent these additional costs would have been borne by handset makers. Mobile phone manufacturers appear to disagree about whether any cost increases have been passed on to consumers.

[94] Estimates provided by consultees include: €1 for a proprietary charger; less than US$1 for a feature phone charger and US$1.2 for a Micro-USB charger; Buckinghamshire Trading Standards (2008) estimated that the wholesale price of a fully compliant charger purchased in Hong Kong was estimated to be €0.25. While no estimate of shipping costs was provided, Buckinghamshire Trading Standards (2008) – see next footnote - used the example of a similar product (small plastic toy) for which the costs of shipping, British customs duty, insurance and unloading into a warehouse were estimated to be €0.15 per unit, thus suggesting the overall wholesale price of around €0.40.

[95] Buckinghamshire Trading Standards (2008): What's in your socket?, available at www.buckscc.gov.uk/media/137366/60600_Booklet_proof.pdf

[96] Virgin Media (2014): Motorola Moto G, accessed at http://store.virginmedia.com/virgin-media-mobile/pay-monthly-phones/motorola-moto-g-with-charger/motorola-moto-g-with-charger-tariffs.html and O2 (2013): Sony becomes third major manufacturer to join "Charger out of the Box" scheme, available at http://news.o2.co.uk/?press-release=sony-becomes-third-major-manufacturer-to-join-charger-out-of-the-box-scheme

[97] See http://store.apple.com/uk/product/MD812B/C/apple-usb-power-adaptor?fnode=48

Table 3-24: Additional cost of supplying Micro-USB chargers incurred by handset makers (€ million)	
Year	€ million
2011	42
2012	70
2013	98

However, it is difficult to distinguish the impacts of the MoU from other (simultaneous) developments which have impacted the cost of chargers supplied with mobile phones. In recent years, mobile phone charging has experienced two somewhat contradictory developments. First, there has been an overarching trend towards manufacturing smaller chargers by manufacturers to reduce shipping costs – this (together with the requirements of legislation on energy efficiency) has spurred innovation in the field of charging, implying a reduction in raw material use. However, manufactures of mobile phones noted that this is more a development of charging technology than the fact that chargers have a common connector and standard. Second, it was also noted that the market trend towards increasingly powerful smartphones necessitates faster, higher-powered charging and larger charging blocks contain more materials. These developments have clear implications for the cost of chargers, as larger chargers are more costly both in respect of production and shipping.

On the other hand, manufacturers do not seem to have benefitted from significant cost savings either. When asked whether they accrued any cost savings from standardising the charging connector, a panel of representatives of handset producers noted that this had not been the case. This is because (as noted by handset manufacturers) individual chargers (of some manufacturers) still differ depending on the power requirements of each phone and therefore a different charger tends to be supplied with each phone; in other words, the connector is the same but electrically chargers supplied with different handset models are different.

In addition, having a proprietary charging connector can provide an additional revenue stream for mobile phone manufacturers through selling licencing agreements to manufacturers of chargers and other accessories; this is particularly so where the same connector can also be used for data transfer. In this respect, the reduction of the number of connectors described in more detail in Section 3.6 may theoretically have curtailed this source of revenue for some manufacturers; however, no indication of such losses has been provided by handset manufacturers consulted for this study. Most importantly, Apple continues to generate revenue from the sale of Apple-branded accessories and licensing deals. For example, the latest data from Apple suggests that in Q4 of 2013, its revenue from sales of hardware peripherals and Apple-branded and third-party accessories for iPhone, iPad, Mac and iPod was in excess of €1 billion[98]. Apple's Lightning connector includes an authentication chip and third party manufacturers have to pay a licensing fee to be included in the Made for iPhone licensing programme[99].

There are likely to be some marginal financial gains for manufacturers from not supplying a charger. These savings may have been accrued by Fairphone, Motorola and those manufacturers participating in O2's 'Charger out of the Box' scheme. These savings are linked to the cost of production, shipping and storage and can be estimated to be higher than the production cost of

[98] Apple (2014): Q4 2013 Unaudited Summary Data, available at http://images.apple.com/uk/pr/pdf/q4fy13datasum.pdf

[99] Apple (nd): MFi Program, available at https://developer.apple.com/programs/mfi/ and Golson (2013): Apple's Strict Requirements for Its Third-Party Lightning Accessory Program Detailed, available at http://www.macrumors.com/2013/02/14/apples-strict-requirements-for-its-third-party-lightning-accessory-program-detailed/

chargers but lower than retail prices paid for chargers by consumers. There may also be costs associated with the logistics of producing handsets without a charger, although this would be minimal given boxes are already tailored depending on the end destination. Assuming that cost savings accrued by handset manufacturers not supplying chargers equal at least the production cost of a Micro-USB charger (€1.25), the cost savings for the above mentioned manufacturers have been estimated in Table 3-25.

Table 3-25: Cost savings accrued by handset manufacturers not supplying chargers			
Parameter	Year		
	2011	2012	2013
Number of chargers avoided (units)	0	33,000	101,000
Chargers avoided as % of total in the box chargers	0%	0.02%	0.05%
Estimated cost saving (€)	0	40,000	130,000

Table 3-25 suggests that cost savings for handset manufacturers have been minimal (€170,000 since the entry into force of the MoU). The key shortcoming of these estimates is the non-inclusion of cost savings from reduced shipping and storage outlays (implying an underestimation of cost savings); however, even when the retail price is used as a basis for estimating the cost savings, these are only around €720,000. On the other hand, Table 3-25 does not take into account the fact that Motorola, as well as manufacturers partaking in the O2 scheme, still supply a data cable with their phones, which can be used for charging (implying that Table 3-25 may be overestimating the actual cost savings). Fairphone does not provide a data cable with its phones.

The key disadvantage of Micro-USB connectors is linked to the limitations of the USB 2.0 and Battery Charging specifications as regards charging and data transfer[100] rates (see Section 5.2.1 for an overview of maximum charging rates of the different USB standards). These are becoming more important with the emergence of more powerful smartphones and phablets. As smartphones continue to evolve and incorporate more functions, they will require more chips and more powerful processing cycles, which in turn require higher power levels. To overcome this issue, power supply manufacturers will need to use higher wattage power supplies[101]. However, with the advent of USB Power Delivery technology, which allows power delivery up to 60W for the Micro-USB connector[102], these potential limitations have been eliminated.

The use of a common charger, in this case Micro-USB, is likely to improve a company's image by showing they have taken consumer convenience into consideration. O2's scheme is linked to their sustainability aims, and any 'greening' will undoubtedly rub off on partner manufacturers.

3.5.2 Impacts on Manufacturers of Chargers

Considering that the MoU contributed to the market shift to Micro-USB chargers, it is fair to say that it has had an impact on companies that produce chargers for mobile phones.

[100] Technological progress can address both data and charging rates simultaneously. Improvements in USB standards are not only driven by increases in charging power but also by improving data transfer rates.

[101] Darnell Group Inc. (2011): External AC-DC Power Supplies: Economic Factors, Application Drivers, Architecture/Packaging Trends, Technology and Regulatory Developments (Tenth Edition), accessed at http://grouper.ieee.org/groups/msc/upamd/email/pdffXOUxetTqI.pdf

[102] Compatible with several USB connectors. For more information see http://www.usb.org/developers/powerdelivery/

The main impacts from the MoU can be summarised as follows:

- expansion of the stock of common chargers **depressed standalone charger sales** as some consumers that would have previously purchased an additional charger for their phone can now re-use their old charger;
- expansion of the stock of common chargers has enabled the three initiatives mentioned earlier in this section (Fairphone, Motorola and O2) to start supplying new handsets without a charger, **thus negatively impacting demand from the 'in the box' segment**; and
- on average, Micro-USB chargers contain more expensive components than proprietary chargers for feature phones; for this reason, **the value per charger has increased** (not taking into account other market developments, such as charger miniaturisation and the increasing charging power of smartphones).

The overall impact depends on the relative strength of the above effects (alongside other factors of importance to individual manufacturers). Two European manufacturers responding to consultation for this study have assessed the overall impact of the MoU on their sector as positive. One of them noted that the impact has been positive because the MoU has specified requirements on a higher level and more expensive components are now used. Charger manufacturers also noted that the MoU has been beneficial to them (and their sector) as it reduced the number of connectors on the market and thus helped them to streamline production.

However, the economies of scale that may have been expected from the MoU have not really been realised, as each mobile phone manufacturer still has a different charger – although the connector is the same, chargers differ in terms of design, size and also the internal components. For example, stakeholder consultation shows that charging power differs from charger to charger and some handset manufacturers require small and visually appealing chargers.

The three main impact categories outlined at the beginning of this section are considered in more detail below, although some of them are difficult to quantify reliably due to a lack of certainty about the counterfactual scenario which models the situation that would have arisen in the absence of the MoU. Quantifications of the effects of the MoU are thus inherently uncertain.

The reduction in annual sales of standalone chargers since the entry into force of the MoU has been estimated at 10-20% based on information provided by a charger manufacturer[103]. Table 3-11 in Section 3.3 provides estimates of this market reduction expressed as the number of units avoided between 2011 and 2013; this table shows that this reduction amounted to between six and 21 million units (reflecting the low and high scenario). If these had been proprietary chargers selling at wholesale unit price of €1, this amounts to a loss of between €6 million and €21 million.

The reduction in the number of chargers supplied with new phones was estimated in Table 3-25 in Section 3.5.1, together with the cost saving (benefits) for handset manufacturers, which also represents the loss of business for charger manufacturers (around 140,000 units, worth €170,000).

Information in Table 3-24 (Section 3.5.1) indicates that due to the need to supply Micro-USB chargers, handset manufacturers may have incurred additional costs amounting to around €210 million between 2011 and 2013, with approximately one half of this sum (around €105 million)

[103] However, please note that GfK (2014) reports that February 2014 sales of standalone chargers in the UK increased by 30% when compared with February 2013. This includes the sales of wall chargers and power packs (i.e. a docking station for charging a battery outside the device) suitable for a range of devices (i.e. not only mobile phones). Source: GfK (2014): Power packs and wall chargers creating a highly valuable charging market, available at http://www.gfk.com/uk/news-and-events/news/pages/power-packs-and-wall-chargers-creating-a-highly-valuable-charging-market.aspx

relating to the use of more expensive chargers. This sum represents gains for charger manufacturers.

Summing up the above three estimates suggests that charger manufacturers gained between €80 €100 million due to the MoU between 2011 and 2013, which may go some way towards explaining manufacturers' positive assessment of the MoU. However, it is necessary to reiterate the caveat noted above that models of counterfactual scenarios are inherently uncertain.

It is also of interest that a manufacturer of chargers noted that cost increases are typically passed down the supply chain. This is a consequence of very small profit margins per unit in the charger sector, where very large numbers of units have to be sold to generate sufficient profit.

No major impacts on the structure of the sector have been identified; two European charger manufacturers have suggested that the MoU has had little impact on their sector at large and that the impacts have been mainly distributional. For example, the market for multi-connector chargers has declined, affecting companies producing such products. As a result of the MoU, sales of a multi-connector charger pack produced by one such company dropped by 20-30% (from 50,000 units per year to 35,000) over a five year period. However, a charger manufacturer responding to consultation also suggested that the market for these chargers still exists and, in some cases, this is the only way to replace an old charger.

3.6 Impacts on Consumers

3.6.1 Consumer Convenience

One of the motivations behind the MoU was to minimise inconvenience for consumers and, in this respect, it has to a large extent succeeded.

The number of charging connectors on the market has declined substantially since the signing of the MoU and the vast majority of handset owners now have a charger for an MoU compliant phone. Therefore, many consumers are now able to charge their phones when away from home using the chargers of friends, family and colleagues. Prior to the MoU coming into force, the market comprised around 30 different chargers using 13 different connectors[104]. The diversity of chargers used by consumers has significantly reduced. For example, a European manufacturer of chargers noted that their current portfolio is based on only five connectors, including Micro-USB and in 2014, 80% of mobile phone owners possessed an MoU compliant phone (see Table 3-19).

However, the estimate that 80% of the mobile phone stock complies with the MoU does not mean that 80% consumers can easily charge 80% of the EU's stock of mobile phones. This is linked a) to the different ways in which handset manufacturers have chosen to comply with the MoU and b) the different power requirements of the different handsets.

The methods of compliance with the MoU include the following:

- Micro-USB socket on the phone and a Micro-USB charger;
- two sockets (Micro-USB and proprietary) and a proprietary charger;

[104] EU Business (2011): A common European mobile phone charger, available at http://www.eubusiness.com/topics/telecoms/mobile-charger/ and consultation with a charger manufacturer.

- proprietary socket on the phone and a proprietary connector on the charger, together with the option for the consumer to purchase an adaptor allowing the phone to be connected to a Micro-USB charger; and
- Micro-USB socket on phone, without a mains charger, and either together or without a data transfer cable.

An overview of compliance methods adopted by mobile phone manufacturers is given in Table 3-26 and Figure 3-14. Please note that this table and figure capture a scenario where chargers are provided with an integrated cable; where a detachable cable is provided, there is an additional USB interface between the charger and the cable.

Table 3-26: Methods of Compliance with the MoU

Method no.	Connector on charger/cable*	Socket on Phone	Mains charger provided?	Adaptor available?
1	Micro-USB	Micro-USB	Yes	No
2	Proprietary	Two sockets (Micro-USB and proprietary)	Yes	No
3	Proprietary	Proprietary	Yes	Yes
4	Micro-USB	Micro-USB	No (cable only)	No
5	Not provided	Micro-USB	No	No

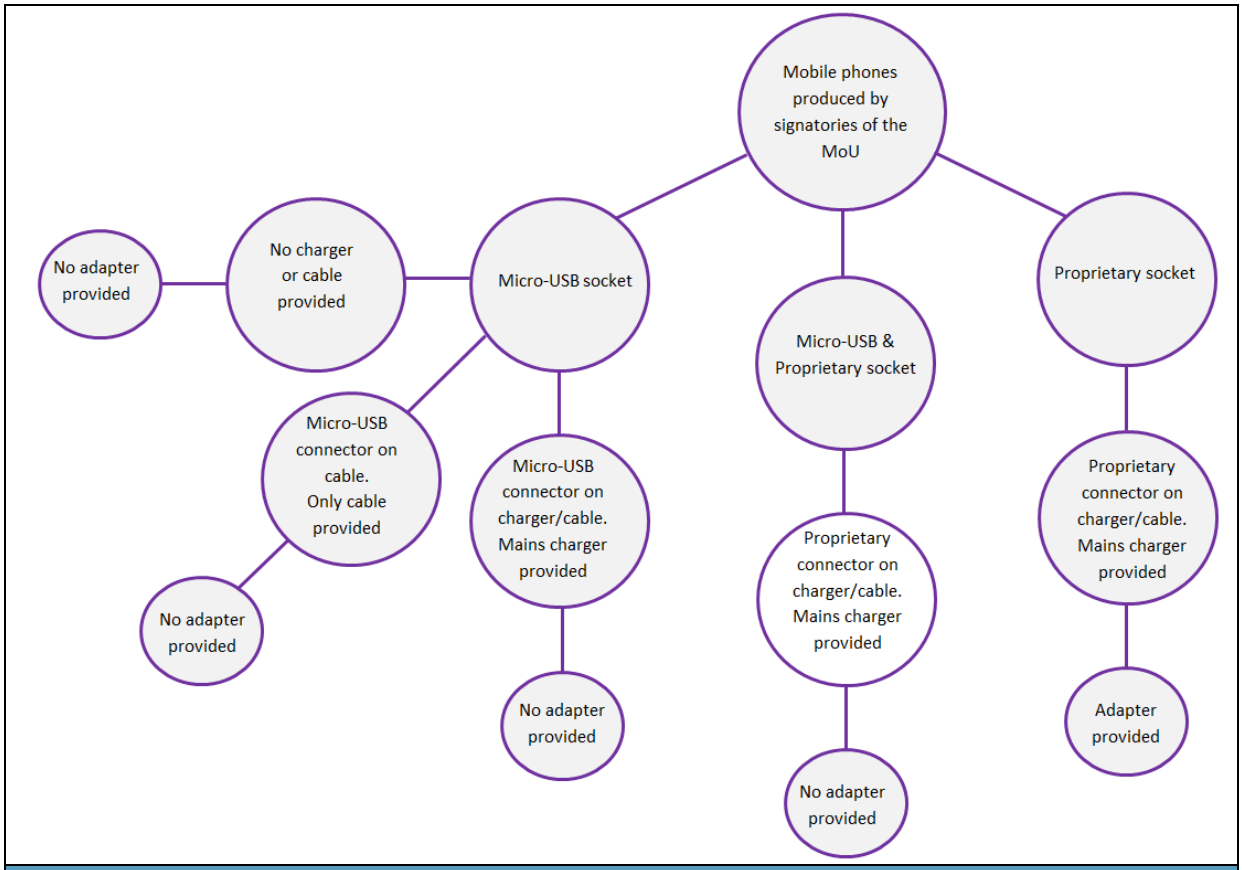

Figure 3-14: Methods of Compliance with the MoU

The diversity of the methods of complying with the MoU outlined in Table 3-26 and Figure 3-14 suggests that owners of an MoU compliant phone may not in all cases be able to charge their phone

using a charger belonging to another owner of an MoU compliant phone, either at all or not without the use of an adaptor.

In addition, although many chargers now have a Micro-USB connector, they are electrically different and different handsets also have a range of charging requirements, especially in terms of the current required. This means, for example, that low-current chargers with a Micro-USB connector may charge high-current handsets more slowly than the charger originally supplied with the handset or, in some circumstances such as during periods of heavy use, may not be able to charge a high-current phone at all. These issues are described in more detail in Section 5.4.3.

A number of 'away from home' scenarios facing users of MoU compliant phones prior to and following the MoU are set out below. Figure 3-15 provides a range of pre- and post-MoU scenarios for owners of handsets with a Micro-USB connector and Figure 3-16 provides the corresponding scenarios for owners of phones for which an adaptor has been made available following the entry into force of the MoU.

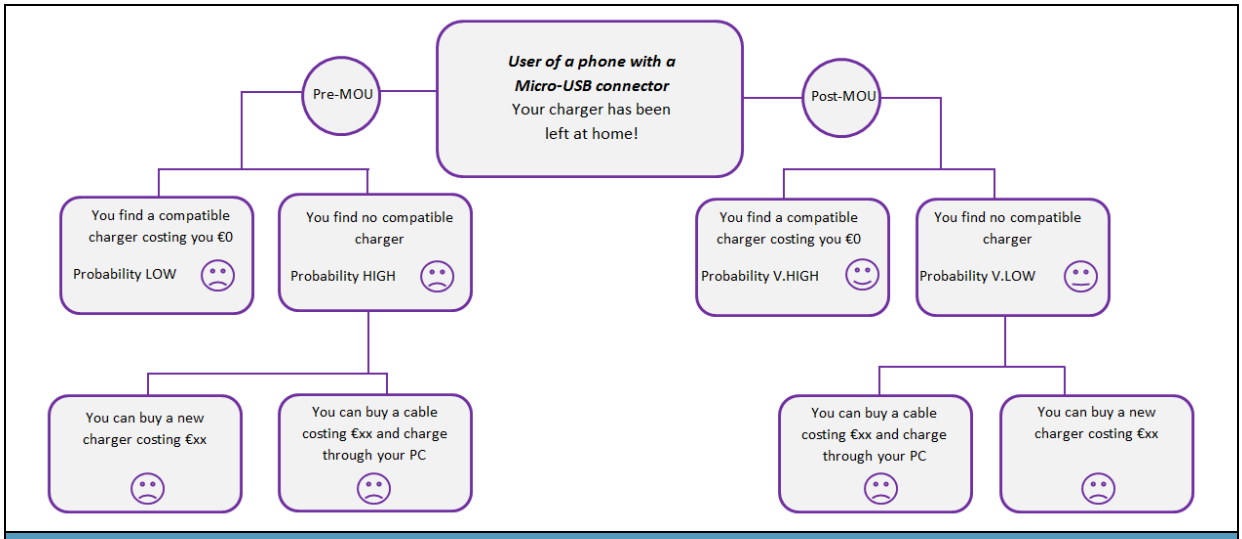

Figure 3-15: Pre- and Post-MoU charging scenarios for owners of Micro-USB handsets

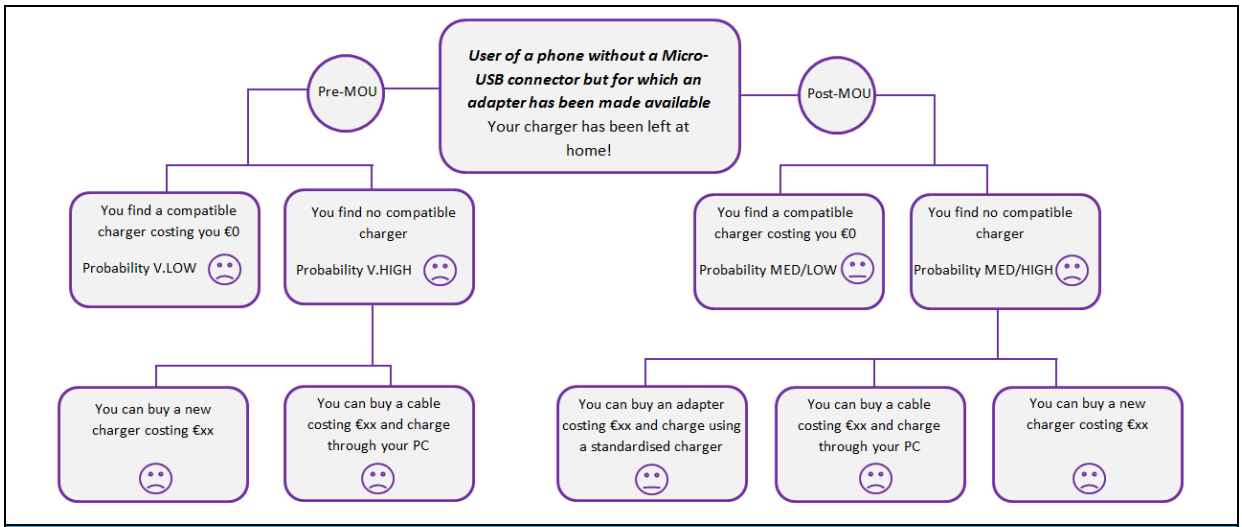

Figure 3-16: Pre- and Post-MoU charging scenarios for phones for which an adaptor has been made available

Figures 3-15 and 3-16 show that the MoU has improved overall consumer convenience but in some cases handset owners are still unable to find a suitable charger. These figures also show that the degree to which consumers have benefitted depends on the method of compliance with the MoU (these are summarised in Table 3-26 and Figure 3-14). Essentially, the main difference can be observed between consumers whose handsets comply by means of having a Micro-USB socket and those whose handsets comply by means of an adaptor being available for purchase.

Consumers whose handsets comply by virtue of having a Micro-USB connector (Figure 3-15) have benefitted from a large improvement. Available information (estimates derived through the market model and information from Fairphone, ITU and O2 presented elsewhere in this Section) suggests that most consumers now own handset with a Micro-USB connector and a Micro-USB charger. As shown in Figure 3-15, there is thus a high likelihood that these consumers are now able to charge their phones using a charger belonging to a friend or relative. It is estimated that the number of consumers able to charge away from home using somebody else's charger has approximately doubled when compared with the situation prior to the MoU. It can thus be concluded that for this group of consumers, the MoU has delivered substantial benefits.

Apple has chosen to comply with the MoU by means of making adaptors available for purchase and iPhones still have proprietary connectors. iPhone owners are thus unable to charge their phones using a Micro-USB charger, unless they purchase an adaptor, which in 2014 retailed at the Apple Store UK for €18 (Micro-USB/Lightning) or €9 (Micro-USB/30-pin adaptor)[105]. Considering that Apple's European market share between 2011 and 2013 was between 10-15% (see Table 3-13), it appears that around 10-15% of European handset owners require an adaptor to be able to charge their phone through a Micro-USB charger. As shown in Figure 3-16, when away from home, there is thus a low/medium chance that they will be able to borrow a charger belonging to another iPhone user and charge their phone; please also note that older iPhone models use the 30-pin connector and newer models use the Lightning connector. In most instances, iPhone owners would need to purchase an adaptor to charge using someone else's charger, as this is most likely going to be a Micro-USB charger. Therefore, benefits from the MoU have only been accrued by those consumers that have purchased an adaptor. However, information collected through consultation for this study shows that only a very small proportion of customers purchasing Apple handsets have in fact purchased an adaptor. Thus, only a very small proportion of iPhone users have benefitted from the MoU.

No other impacts on consumer convenience from the use of Micro-USB have been identified. The Micro-USB port is small and unlikely to impact the thinning and lightweighting of handsets, a feature highly regarded by consumers. However, handset manufacturers responding to consultation for this study felt that the Micro-USB connector is less resilient than some proprietary solutions.

3.6.2 Cost

As noted previously, the use of Micro-USB chargers appears to have had an impact on the overall cost of chargers. However, stakeholders disagree about whether such increases are likely to have been passed on to consumers. Moreover, the cost increase per handset has been limited; between 2011 and 2013, the estimated difference between a handset with and without a Micro-USB charger (€0.50) represented 0.15% of the European ASP of smartphones and 1.6% of the feature/basic phone ASP. Any cost impacts would thus have been very small when put in relation to each handset or charger sold.

[105] See http://store.apple.com/uk/product/MD820ZM/A/lightning-to-micro-usb-adaptor and http://store.apple.com/uk/product/MD099ZM/A/apple-iphone-micro-usb-adaptor

In fact, in spite of the upward price pressure exerted by a shift towards Micro-USB charging, Table 3-4 in Section 3.2.1 indicates that the average European ASP declined by €86 (smartphones) and €14 (feature/basic phones) between 2009 and 2013.

3.7 Impacts on the Environment

At the time of the adoption of the MoU, some sources expected that the standardisation of chargers may lead to the decoupling of the sales of handsets and chargers, thus resulting in a reduction in e-waste. Two sources quantified the anticipated reduction. IMS Research (cited in EPSMA, nd)[106] expected that the universal charging solution may encourage mobile phone manufacturers and network operators to stop providing chargers with new phones, resulting in a 6% decline in "the total shipments of all power adaptors and chargers in 2015, with shipments of chargers for mobile phones being much more severe." GSMA (2009) assumed that harmonisation of chargers for mobile phones was going to reduce charger waste by between 51,000 and 82,000 tonnes each year by negating the need for supplying chargers with new phones (GSMA, 2009)[107].

These benefits related to the expectation that handset manufacturers would cease to provide mains chargers together with new mobile phones. However, as previously noted in this report, research carried out for this study shows that only 0.02% of EU28 handset shipments between 2011 and 2013 (i.e. around 140,000 units) were actually supplied without mains chargers, with around 90% of these having been supplied with a USB/Micro-USB data cables (which lessens the reduction in e-waste).

In addition, as noted earlier in this report, the MoU/LoI may also have been responsible for a reduction in standalone charger sales which has been estimated by this study to amount to between six and 21 million units between 2011 and 2013 (reflecting the low and high scenario; see been Table 3-11 in Section 3.3). This is linked to the fact that consumers do not need to buy additional chargers as often as they used to because they can a) re-use their old chargers and b) charge their phones using other people's chargers.

These estimates can be combined with the average weight of mains chargers to estimate the reduction in the consumption of raw materials due to the MoU.

The average weight of mains chargers in published sources ranges[108] from around 60 grams (including cable) in Bolla et al (2011) to 270 grams (Sainsbury, 2010[109]). For the purposes of this study, a sample of mobile phone chargers has been weighed to determine the average charger weight. This sample included 25 chargers for mobile phones (both those with integrated and detachable cables) made by six manufacturers and purchased in six EU Member States between 2008 and 2014 (at least one charger was included for each year). This sample comprised eight Micro-USB chargers and 17 chargers with proprietary connectors (Apple's 30 pin and Lightning connectors, Nokia's 2mm and 4mm and proprietary connectors by Samsung, Sharp and LG). Given its geographical, temporal and brand diversity, this sample is deemed suitable for estimating the

[106] EPSMA (nd): Resources/Statistics, available at http://www.epsma.org/resources-statistics.php

[107] GSMA (2009): Mobile Industry Unites to Drive Universal Charging Solution, available at http://www.gsma.com/newsroom/mobile-industry-unites-to-drive-universal-charging-solution-for-mobile-phones/

[108] Examples of other estimates include and GSMA (2009) - 85 grams and Techweek (2013) - 187 grams (http://www.techweekeurope.co.uk/news/nokia-301-o2-charger-usb-123281).

[109] Sainsbury (2010): Sainsbury to Conquer the Mobile Phone Charger Mountain, available at http://www.j-sainsbury.co.uk/media/latest-stories/2010/20100801-sainsburys-to-conquer-the-mobile-phone-charger-mountain/

average charger weight for the purposes of this study. The average weight values for the chargers in this sample are given in Table 3-28.

Table 3-28: Sample of chargers – average weight	
Type of charger	**Average weight**
Detachable cable charger (charging block & cable)	68 grams
Detachable cable charger (cable only)	29 grams
Detachable cable charger (charging block only)	42 grams
Charger with an embedded cable	56 grams
Average across sample	***60 grams***

The values given in Table 3-28 broadly correspond with a study by Bolla et al (2011) which also relied on a sample of chargers (50) to measure environmentally-relevant charger characteristics. Bolla et al (2011) appears to suggest that chargers (including cable) weigh around 60 grams and chargers (excluding cable) weigh just over 40 grams.

Estimates of avoided chargers can be combined with data for average charger and cable weight in Table 3-29 to estimate the weight of avoided chargers (i.e. reduction in material use) resulting from the MoU/LoI.

Table 3-29: Reduction in consumption of raw materials due to the MoU/LoI (2011-2013)	
Source	**Reduction in raw material use (tonnes)**
'In the box' chargers*	7 tonnes
Standalone chargers**	390 tonnes (low scenario), 1,330 tonnes (high scenario)
Total raw materials reduction	Between 400 and 1,340 tonnes
*Note: *Over 80% still supplied with a data cable. ** Assumes one half would have been supplied with detachable cable, the other half with an integrated cable.*	

Of course, the reduction could have been much higher had decoupled handsets gained a larger market share. For the purposes of comparison, the potential reduction in raw material use can be estimated at around 25,000 tonnes, which corresponds to the total weight of chargers sold in the EU28 in the box with new handsets between 2011 and 2013[110]; this reflects the possibility that 30% of consumers that would otherwise be provided with a charger 'in the box with a new handset' would purchase it in the 'standalone' market.

There appear to be two main reasons for the vast majority of manufacturers still supplying chargers with new handsets. Firstly, manufacturers believe that consumers expect this. One manufacturer noted that this is a requirement of European network carriers and, in Japan, where phones are normally sold without a charger; this is driven by network carriers. On the basis of trials, a handset manufacturer found that consumers want to receive a charger with new devices unless there is a noticeable financial saving. However, such a reduction in price is not possible as the production cost of a Micro-USB charger has been estimated to be around €1.25. On high-end smartphones, stakeholder consultation suggests that any cost reduction from not including a charger would be miniscule. Secondly, some handset manufacturers pointed to safety concerns and noted they can only guarantee the safety of their own charger.

[110] Assumes a charging/data transfer cable would not be provided.

The evolution of the overall weight of chargers placed on the market in the EU between 2011 and 2013 can be estimated on the basis of sales data presented in Table 3-11, together with estimates of the weight of chargers in Table 3-28. This yields the following estimates: in 2011, the total weight of chargers sold in the EU (either together with handsets or as a standalone product) can be estimated at 15,000 tonnes (based on the high standalone sales scenario in Table 3-11). In 2012, this can be estimated at 14,300 tonnes and 14,600 tonnes in 2013.

As noted in Section 3.5.1, companies consulted for this study suggested mobile phone charging has experienced two somewhat contradictory developments in recent years. First, there has been an overarching trend towards manufacturing smaller chargers to reduce shipping costs, implying a reduction in raw material use. Second, it was also noted that the market trend toward increasingly powerful smartphones necessitates faster, higher-powered charging and larger charging blocks contain more materials. As regards the latter, it is of interest that whilst the general feeling among stakeholders responding to consultation for this study was that there is a positive correlation between power and charger size/weight, using a sample of 50 chargers Bolla et al (2011) found a positive but limited correlation between the weight of chargers and output power, also noting that the weight of chargers with the same output power differs widely. According to Bolla et al (2011), "this suggests that the mass of electronic and plastic parts of the charger do not change markedly with respect to the output power".

Although in the long run, the reduction in raw material consumption can be expected to translate into a reduction in e-waste, only a small proportion of chargers avoided due to the MoU would have entered the waste stream between 2011 and 2013. For example, mobile phone chargers can be estimated to be used on average for two years (i.e. the length of the handset replacement cycle) and it is clear that even after that not all end-of-life chargers are disposed of. For example, GSMA (2006)[111] also quotes a report that found that in the UK, people keep end-of-life mobile phones on average for 2.37 years before disposal. The same source also reproduces the results of a survey which found that approximately one half of people keep their old phone (even when it is functional) and 23% give it away to family, friends or someone else. Six percent have sold them, donated them to charity or traded them in for a replacement phone and five percent threw them away. Nine percent threw it away or lost it/had it stolen and four percent had it recycled. Four percent continued using their old phone even after purchasing a new one. The above percentages can conceivably be applied to chargers, too. Similarly, Sainsbury's (2010) estimated that the stock of unused mobile phone chargers in the UK was around 20 million units, which can be compared with estimates of 15 million mobile phones going out of use annually (GSMA, 2006). Extrapolating these data onto the population of the EU28 suggests that the stock of unused mobile phone chargers in the EU may be around 160 million units.

The above information suggest that over the period since the entry into force of the MoU, the reduction in waste has been significantly lower than the reduction in the use of raw materials, although these two metrics should be equal in the long run. The two year value for the average length of the handset replacement cycle, together with the assumption that people keep their old chargers together with their old mobile phones for another 2.37 years on average prior to disposal suggest that none of the chargers avoided due to the MoU between 2011 and 2013 would have become waste over the period of interest to this study (although the limitations of using average values are recognised). Assuming that 5% of people dispose of their old charger as soon as they replace their phone would suggest that a reduction in e-waste arisings of between around 3 to 5 tonnes. This corresponds to between 55,000 to 90,000 units of charger waste avoided.

[111] GSMA (2006): Mobile Phone Lifecycles, available at http://www.gsma.com/publicpolicy/wp-content/uploads/2012/03/environmobilelifecycles.pdf

3.8 Impacts on Safety

A number of stakeholders consulted for this study have expressed concerns about the sales of chargers that do not comply with the relevant safety requirements. Estimates derived from consultation suggest that as much as 30-60% of the standalone charger market may not comply with applicable technical standards, some of which relate to safety[112]. Voluntary organisations, charities and national authorities are also increasingly warning consumers about the dangers posed by some chargers, particularly some cheap non-OEM chargers purchased from on-line marketplaces.

3.8.1 RAPEX and ICSMS

Within the EU, authorities can report unsafe products to the RAPEX and ICSMS databases. To ascertain and identify trends relating to unsafe 'chargers' for all devices related to this study, data from the RAPEX and Information and Communication System for Market Surveillance (ICSMS) databases have been examined from 2008 to 2013 (up to September).

RAPEX

From 2008 through to 2013, a total of 108 chargers for products that are relevant for this study have been reported and listed on the RAPEX database (Table 3-30). Where possible, products have been categorised in the same way as has been listed on the RAPEX database. Thus all types of mobile phone chargers have been categorised as 'mobile phone charger' and all types of USB charger not designated for a specific use (e.g. AC adaptor with USB port) have been categorised as 'USB'.

There were a number of products listed as 'travel charger' on the database. While it is probable that a number of these are also mobile phone charges, these have been categorised separately in Table 3-30 (overleaf). In addition, many chargers were listed as suitable for iPads/iPhones/iPods. These have been listed as chargers for Apple products. However, where only one specific Apple product was noted, this was put into the appropriate category (e.g. iPod into personal music player category, iPhone into mobile phone). It must be stressed that although the chargers were for Apple products, they were not OEM Apple chargers.

Looking at the total number of products listed per product group in Table 3-30, it can be seen that mobile phone chargers account for around 62% of all notifications. The number of notifications each year has remained relatively consistent year on year, with the exception of 2012. This can be attributed to the high number of non-OEM chargers that were sold for Apple products, which are dispersed amongst categories which include chargers for Apple products, mobile phones (iPhones), laptop/tablets (iPads) and personal music player (iPods). Chargers for Apple products (non-OEM) were listed on the RAPEX database in 2011, 2012 and 2013. In 2011, two notifications were for iPhones and one was for iPods. This increased to ten notifications in 2012 (four iPod chargers, four for iPhone chargers and two chargers for iPhone/iPods). In 2013, the number of notifications for Apple products fell to four (one for an iPod, one for an iPhone and two for a charger for iPhone/iPad).

Following the death of a woman in China from an apparent electrocution from a third-party iPhone 5 charger, and to redress the sale of non-OEM chargers for Apple products, in August 2013 Apple launched a takeback programme' for counterfeit and third-party chargers. According to the Apple website, "some counterfeit and third party adaptors may not been designed properly and could

[112] As suggested by manufacturers of chargers and a market surveillance authority responding to consultation for this study.

result in safety issues"[113]. As a result of this, Apple offered customers the option to buy an official replacement charger at a 'special price' in return for the submission of a counterfeit or third-party charger. The programme ran from August to October 2013.

The view that non-OEM and counterfeit chargers/adaptors are more likely to be unsafe would appear to be supported by data contained within RAPEX, where it is frequently made note of the fact that the charger was a non-OEM charger. Finally, where the country of origin of the charger has been reported on the RAPEX database, it was listed as from China. This would support information received from a market surveillance authority, where it was suggested that around 90% of non-compliant chargers come from Asia and are non-OEM. With regard to the origin of the charger, this is not surprising as desk based research suggests that most chargers are manufactured and assembled in this region.

In total, 16 of those chargers notified in Table 3-30 (below) were USB chargers. Those seven which do not appear under the heading USB were categorised under a more specific heading (e.g. mobile phone, personal music player). Thus Table 3-31 provides a more detailed overview of all USB chargers within the scope of this study.

ICSMS

Table 3-32 (overleaf) shows those products that were listed on the ICSMS database from 2008 through to 2013 using the search term 'charger'. Products beyond the scope of this study have been excluded (e.g. chargers for rechargeable batteries). Although fewer products were notified, it can be seen that mobile phone chargers again represent around half of those products that were notified (49%). It should also be noted that it was not possible to discern the intended product for travel chargers. However, it is likely that many of these are in fact also intended for mobile phones. Finally, information on ICSMS suggests that most notified chargers were imported from Asia.

[113] Apple (2013): USB Power Adaptor Takeback Program, available from http://www.apple.com/support/usbadaptor-takeback/

Table 3-30: Charger Products listed on RAPEX database										
Year	Mobile phone	Remote control toy	Travel charger	Handheld console/ games controller	Laptop / tablet	USB	Personal music player	Apple product	Camera charger	Total number of products notified
2008	16	1	2	0	0	0	0	0	0	**19**
2009	10	1	1	1	0	0	0	0	0	**13**
2010	7	0	2	0	3	1	1	0	0	**14**
2011	9	0	0	1	0	3	1	0	0	**14**
2012	14	0	0	0	4	3	4	2	0	**27**
2013	11	0	2	0	2	2	1	2	1	**21**
Total	**67**	**2**	**7**	**2**	**9**	**9**	**7**	**4**	**1**	**108**

Table 3-31: USB Charger Products listed on RAPEX database							
Year	Mobile phone	Battery charger and USB adaptor	Travel charger / adaptor	Personal music player	USB charger	Games controller	Total number of products notified
2008	0	0	0	0	0	0	0
2009	1	0	0	0	0	0	1
2010	0	1	2	1	0	0	4
2011	0	0	2	0	1	1	4
2012	2	0	0	0	2	0	4
2013	1	0	0	0	2	0	3
Total	**4**	**1**	**4**	**1**	**5**	**1**	**16**

Table 3-32: Charger Products listed on ICSMS database										
Year	Mobile phone	Remote control toy	Travel charger	Handheld console/ games controller	Laptop / tablet	USB	Personal music player	Universal charger	Other	Total number of products notified
2008	6	1	1	0	2	0	0	1	0	**11**
2009	9	0	0	0	0	2	0	0	0	**11**
2010	4	0	4	1	0	1	1	1	0	**12**
2011	3	0	4	0	0	2	0	0	0	**9**
2012	8	0	1	0	0	3	1	1	0	**14**
2013	5	0	0	0	2	3	2	2	1	**15**
Total	**35**	**1**	**10**	**1**	**4**	**11**	**4**	**5**	**1**	**72**

Risk posed by non-compliant chargers

A description is provided alongside each product listed on the RAPEX database which outlines the risks posed by the product and the Directive and EN standard or national standard that it has not complied with. Chargers typically posed a serious risk to the consumer, either an electrical risk, risk of fire or both. Such risks arose as a consequence of chargers not complying with the Low Voltage Directive Electromagnetic and/or the Electromagnetic Compatibility Directive and relevant EN and/or national standard(s). It is noteworthy that most chargers were notified for failing to comply with EN 60950, a standard designed to reduce risks of fire, electric shock or injury for the operator and layman who may come into contact with the equipment[114].

Table 3-33: Non-conformity with Standards

Year	EN 55022	EN 55024	EN 50075	EN 60335	EN 60384	EN 60844	EN 60950	EN 61000	EN 61558	National Standard
2008	7	7	0	0	0	0	15	0	0	4
2009	0	2	1	3	1	0	6	2	0	3
2010	0	0	0	2	0	0	11	0	3	1
2011	0	0	0	0	0	2	5	0	3	6
2012	0	0	0	0	0	1	19	0	5	3
2013	1	0	0	0	0	0	10	0	9	3
Total	**8**	**9**	**1**	**5**	**1**	**3**	**66**	**2**	**20**	**20**

In addition to these risks, it has also been suggested by an industry association that counterfeit chargers may contain hazardous substances, as is often the case for counterfeit phones[115].

Non-OEM, counterfeit, unbranded chargers

According to a report by the European Commission on EU customs enforcement of intellectual property rights, in 2012, 1.1 million parts and technical accessories for mobile phones were seized by EU customs enforcement officials. These products are estimated to have a retail value (of the original goods) of €23.3 million. In comparison to seizures of counterfeit mobile phones, (46,609 articles seized with a value of €7.3 million) counterfeit mobile phone parts and accessories represent a significantly larger problem. A similar pattern is witnessed with audio/video apparatus including technical accessories and parts and with computer equipment including technical accessories and parts. As a result it would appear that the market for counterfeit accessories and parts is a significantly larger and potentially more lucrative market than that for counterfeit electronic devices. While a large market for these devices may exist within the on-line market place, these chargers hace also been found in local markets and shops. Indeed, Buckinghamshire Trading Standards seized over 3,600 unsafe chargers from such retail outlets in a six to eight week period[116].

[114] Techstreet Store, information technology equipment, safety, general requirements, accessed at: http://www.techstreet.com/products/1681378

[115] Source: Consultation with industry association

[116] Buckinghamshire Country Council, Buckinghamshire Trading standards, 2008, "What's in your socket?", accessed at: http://www.buckscc.gov.uk/media/137366/60600_Booklet_proof.pdf

Table 3-34: Seizures of Counterfeit Mobile Phones and Parts and Technical Accessories for mobile phones		
Product Sector	**Number of articles**	**Retail value of original goods**
Mobile phones	49,609	€7,349,673
Parts and technical accessories for mobile phones	1,122,188	€23,317,282
Source: EU (2013): Report on EU customs enforcement of intellectual property rights – results at the EU border 2012, available from http://ec.europa.eu/taxation_customs/resources/documents/customs/customs_controls/counterfeit_piracy/statistics/2013_ipr_statistics_en.pdf		

According to the UK Electrical Safety Council (ESC), counterfeit chargers are now one of the main fake electrical products entering the UK – some have given people electric shocks and started fires. Indeed, between April 2011 and March 2012, 125,249 counterfeit mobile phone accessories were seized in the UK[117]. Furthermore, in 2011 in France, more than 352,000 mobile phones and mobile phone accessories (batteries/chargers) were seized by customs officials, representing nearly 4% of all counterfeit goods in France[118].

The apparent increase in the sale, and thus confiscation of counterfeit chargers, may be attributed to an increase in the number of standalone chargers purchased from online marketplaces. It has been asserted that one problem with one particular online marketplace is that it is not effectively policed by its operator. Indeed, PlugSafe suggest that it has ignored reports of non-compliant products even when that report is from Trading Standards. Moreover, the practice of allowing a choice of suppliers to be listed under a single product listing undermines the customer review process that this online marketplace operates. In some instances, there may as many as 50 suppliers for a single listing. This makes it difficult for some consumers to be able to effectively ascertain which seller they are purchasing a product from and match a particular review with a specific supplier. Furthermore, the accessories that consumers are considering are likely to have a generic description and when multiple orders are placed against a number of different suppliers on the same listing, it is often the case that the products received are from different manufacturers. This clearly negates the review system operated by the online marketplace and may make it more difficult for a consumer to discern an authentic OEM charger from a counterfeit charger or a non-OEM charger that has multiple negative reviews. Interestingly, it has been noted that the practice of shipping products directly to consumers from China is a common way to circumvent UK custom controls[119].

In 2008, statistics gathered by a regional trading standards authority in the UK (Buckinghamshire Trading Standards) over a three month period suggested that 115,915 chargers were sold on one of the leading internet auction sites in the UK. As this website accounts for around 25% of total on-line sales, the annual number of charger on-line sales in the UK has been estimated to be in the region of 1.8 million[120]. Extrapolating this figure onto the EU28 and comparing it with estimates in Table 3-11, it can be estimated that around 30%-60% of chargers are sold online.

[117] Mobile News (2013): Counterfeit mobile goods a 'serious problem' in the UK**,** available from http://www.mobilenewscwp.co.uk/2013/04/08/counterfeit-mobile-goods-a-serious-problem-in-the-uk/

[118] UNIFAB (2012): L'Unifab lance aujourd'hui sa nouvelle champagne de sensibilisation pour informer le consommateur des risques induits par les contrefaçons, available from www.douane.gouv.fr/data/file/7668.pdf

[119] Public Bill Committee, Consumer Rights Bill, PBC (Bill 161) 2013 – 2014, accessed at: http://www.publications.parliament.uk/pa/cm201314/cmpublic/consumer/memo/consumerevidence.pdf

[120] Buckinghamshire Country Council, Buckinghamshire Trading standards, 2008, "What's in your socket?", accessed at: http://www.buckscc.gov.uk/media/137366/60600_Booklet_proof.pdf

Alongside effective regulation of online marketplaces, it may be the case that consumers need to be better educated about the risks associated with purchasing unsafe chargers. By way of example, Electrical Safety First reported in 2012 that a quarter of people would purchase counterfeit goods to give to a friend as a gift[121]. There is evidently a potential market for such devices, with PlugSafe having found hundreds of listings for Apple chargers for less than £3, commenting that these are all very likely to be counterfeit and/or unbranded and potentially unsafe[122]. The link between the price of the charger and its performance has also been observed by the ESC, who found that of the cheap chargers bought from online trading and auction sites, half had been wired using sub-standard components and none complied with relevant safety regulations[123]. With regard to unbranded chargers, tests undertaken by one UK Trading Standards authority found that all 19 of the unbranded chargers it tested were unsafe, in contrast to branded chargers, which were found to all be safe[124]. This would appear to be a common experience, with another UK Trading Standards finding that cheap unbranded chargers are more likely to have safety issues than branded equivalents[125]. Linked to this, experts have also raised concerns about non-OEM generic chargers that have been designed for multiple devices, urging consumers to only purchase branded chargers[126]. Evidently, these consumers are seduced by the price of the chargers. However, it is not reasonable for a consumer to assume that a product is unsafe simply because it is comparably cheaper than another product.

Accidents caused by chargers

The following paragraphs present information relating to the number of fires caused by electrical appliances/electrical faults in various Member States. Of course, this data has a number of limitations. In terms of the number of fires, it is important to note that it only reflects incidents that have been reported to national statistical research bureaus. However, these typically represent incidents where the fire service has attended the fire scene and it can be assumed that there are many occasions when they are not contacted. Indeed, it has been estimated that they are not contacted for around 78% of domestic fires in the UK. Moreover, even where the fire service has attended an incident, it may be the case that they do not report it to the national statistics bureau[127]. Despite these apparent shortfalls, the statistics presented below serve as an indicative guide as to the source of serious fires (these are most likely to be attended and reported by the fire service).

There are also limitations with regard to the cause of fires, with the most suitable category within the available statistics appearing to be fires caused by electrical systems/electrical faults. Clearly,

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[121] Switched On, Issue 28, Spring 2013, accessed at: http://www.electricalsafetyfirst.org.uk/mediafile/100015999/Switched-On-28.pdf

[122] Personal Communication, PlugSafe

[123] BBC news, how dangerous are phone chargers, (13 May 2014), accessed at: http://www.bbc.co.uk/news/uk-27390466

[124] Buckinghamshire Country Council, Buckinghamshire Trading standards, 2008, "What's in your socket?", accessed at: http://www.buckscc.gov.uk/media/137366/60600_Booklet_proof.pdf

[125] Suffolk County Council, Dangerous Electrical Chargers, accessed at: http://www.suffolk.gov.uk/assets/suffolk.gov.uk/Emergency%20and%20Safety/Community%20Safety/2011.12.08%20electrical%20charger.pdf

[126] BBC news, how dangerous are phone chargers, (13 May 2014), accessed at: http://www.bbc.co.uk/news/uk-27390466

[127] Consumer Council at the Austrian Standards Institute, Consumer Fire Safety: European statistics and potential fire safety measures, Austrian Ministry for Labour, Social Affairs and Consumer Protection, January 2009, accessed at: http://www.verbraucherrat.at/content/01-news/05-archiv-2009-2010/01-studie-brandschutz/firesafetyconsumer.pdf

this is a very broad category that will encompass many products from televisions to electric blankets and scenarios that may include a mains power supply fault or the failure of a fuse. This means that it is not possible to definitively ascertain how many of the fires were caused by chargers for electronic devices.

However, given the warnings from some UK fire services, numerous product recalls and anecdotal evidence in media reports (see below), it is assumed that a small proportion of electrical failures/faults can be attributed to chargers for electrical devices. This assumption is in part supported by previous research into unintentional domestic fires in London, which found that around 3% of fires were caused by a defect in an electrical apparatus. Similarly, it would appear that in the past, 4% of fatal domestic fires in Denmark were caused by technical faults, whereas in the UK, this percentage was as high as 8%[128]. More recently, in July 2014 UK firefighters again warned consumers about the risks of using chargers which are incompatible with their mobile phone phones after a fire was caused by a charger that was not an original supplied with the phone. It was stated that "It is important to ensure that all electrical items are safe to use and if you are in doubt of whether a device is the genuine article, don't buy it – it isn't worth the risk"[129].

Great Britain

The tables below outline the number of fires where 'faulty appliances and leads' were the main *cause* (defect act or omission leading to the ignition of the fire) of the fire in dwellings and the number of fires where 'electrical appliances' were the *source* of ignition (the source of the flame, spark or heat that started the fire). As would be expected, there is a close correlation between the number of fires where the source of the fire and cause of the fire are 'electrical appliances'. The number of non-fatal casualties and fatalities for each respective incident has also been incorporated into the tables[130]. While the number of incidents associated with electrical appliances has slightly declined in Great Britain in recent years, there are still a notable number of incidents reported each year. Of course, it must again be stressed that this does not reflect the number of fires caused by chargers of electronic devices. However, given the concern expressed by trading standards and charities/voluntary organisations in addition to recent reports in the media, it is possible that some of these incidents can be attributed to electrical chargers.

[128] Ibid

[129] Signa1 (2014): Phone charger causes Newcastle house fire, available at http://www.signal1.co.uk/news/local/phone-charger-causes-newcastle-house-fire/

[130] Fire statistics, Great Britain April 2012 to March 2013, accessed at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/313590/Fire_statistics_Great_Britain_2012-13__final_version_.pdf

Table 3-35: Fatal and non-fatal casualties from accidental fires in dwellings				
Year	**Non-fatal casualties**	**% of total non-fatal casualties**	**Fatal casualties**	**% of fatal casualties**
Cause - faulty appliances and leads				
2008/09	946	12%	23	9%
2009/10	-		-	
2010/11	983	12%	20	7%
2011/12	904	12%	21	8%
2012/13	831	11%	17	8%
Source of ignition - electrical appliances				
2008/09	818	10%	18	7%
2009/10	-	-	-	
2010/11	799	10%	21	8%
2011/12	803	10%	22	9%
2012/13	746	10%	14	6%
Source: Department for Communities and Local Government, 23 May 2014, Fire statistics Great Britain, accessed at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/313578/FSGB_2012-13_Time_Series_Tables_1a_-_16.xlsx				

Nordic States

Tables 3-36 and 3-37 show the number fires caused by electrical systems in buildings (private or public) and fatal fires (a fire that leads to one or more fire deaths, where at least one person dies in the fire or within 30 days due to injuries sustained in the fire, typically from burns or the toxic effects of smoke).

Table 3-36: Number of building fires caused by electrical systems in Nordic States						
Year	**Total fires in Denmark**	**% of fires caused by electrical systems**	**Total fires in Norway**	**% of fires caused by electrical systems**	**Total fires in Finland**	**% of fires caused by electrical systems**
2008/09	559	7%	360	10%	636	14
2009/10	413	6%	321	24%	587	9
2010/11	413	6%	311	21%	682	11
2011/12	497	8%	304	6%	677	11
2012/13	388	6%	230	6%	750	13
Source: Nordstat, Nordic statistics regarding incidents, accessed at http://nordstat.net/						

Table 3-37: Number of fatal fires caused by electrical systems in Nordic States										
Year	Denmark		Norway		Sweden		Finland		Iceland	
	Fires	Victims	Fires	Victims	Fires	Victims	Fires	Victims	Fires	Victims
2008/09	5	5	3	4	0	0	31	33	3	3
2009/10	3	3	4	5	0	0	8	9	0	0
2010/11	6	6	7	8	0	0	8	10	1	1
2011/12	5	5	2	2	0	0	8	9	0	0
2012/13	3	3	3	3	0	0	6	6	0	0
Source: Nordstat, Nordic statistics regarding incidents, Fatal fire, accessed at http://nordstat.net/										

With the exception of Finland, the number of incidents in the Nordic states would appear to be in decline. Of course, it is difficult to draw conclusions in relation to chargers, although some incidents may have been caused by these devices.

From the data available, it is evident that some serious incidents can be attributed to electrical appliances/systems. There is however a general decline in incidents. However, it must be again be reiterated that this data serves as a general indicator as it is not specifically relevant to only electrical chargers.

It is also likely that there are many incidents which go unreported by consumers and as such are not reflected in the data above. For example, if a charger were to 'spark' or cause minor damage to the socket, it is probable that the consumer would dispose of the charger and purchase a new one without notifying the relevant authorities. Unfortunately, it is not possible to estimate how frequently this is likely to occur, although Plugsafe have noted that negative reviews left on an online marketplace suggest that such incidents have occurred on multiple occasions.

PlugSafe have also observed that charger related incidents investigated by the relevant authorities are usually found to be caused by non-conforming products. As noted above, it would seem that a non-conforming charger is most likely to be a cheap non-OEM, counterfeit or unbranded charger. However, there may also be instances where an OEM charger will be unsafe and pose a risk to the consumer. Table 3-38 presents an overview of news reports of incidents identified for devices being considered in this study. It can be seen that most incidents reported relate to mobile phone chargers. While it was not possible to ascertain whether the charger was an OEM or non-OEM in all instances, there was an example of an OEM charger failing (iPhone 4S charger exploded while charging). This indicates that there is the potential for OEM chargers to also be unsafe and pose a risk to the consumer.

One aspect to consider when comparing reputable manufacturers of chargers (both OEM and non-OEM) with manufacturers of counterfeit, unbranded and unsafe chargers is the practice of voluntary recalls. A number of manufacturers have identified a potential safety issue and taken action to remove unsafe chargers from the market. For example, the Motorola Moto G smartphone is provided without a charger (although a USB/Micro-USB cable is still provided), leaving consumers who require a charger to pay extra at the point of purchase or source one elsewhere. Two retail chains in Germany (Saturn and Media Markt) decided to add a mains charger to Moto G handsets supplied by them but recently ceased supplying these and decided to recall these chargers due to

concerns over a potential fire hazard (Frontzeck, 2014; Giga, 2014)[131]. Apple has also recently recalled a European USB power adaptor[132]. These and similar cases are summarised in Table 3-38.

3.8.2 Conclusion

Data from RAPEX and ICSMS, consultation with a market surveillance authority, reports from national Trading Standards, voluntary organisations and charities, and various reports suggest that the volume of unsafe, counterfeit, and unbranded is increasing. However, this increase is not surprising given the significant increase in the number of portable electronic devices (including mobile phones) which have been purchased by consumers.

With regard to the type of charger, these sources suggest that **many counterfeit chargers on the market and some non-OEM chargers, often unbranded, do not comply with the applicable standards**. This is not to say that all chargers manufactured by non-OEM manufacturers pose a risk, as is evident by the very low number of incidents reported relative to charger sales. On the other hand, it would appear that **genuine OEM chargers are typically compliant with existing standards**, although there are also examples of isolated incidents involving OEM chargers.

It is not possible to identify the specific number of safety incidents (e.g. fires etc.) caused by chargers, although again, the numbers appear marginal relative to the overall numbers purchased with devices or as standalone products. On balance, when compared with other causes of serious injury in everyday life, the risk of serious injury to the consumer posed by chargers appears to be negligible, although it must be acknowledged that available information suggests that cheap, unbranded, non-OEM chargers present a greater risk to the consumer when compared to OEM chargers. However, it should also be noted that data on injuries and fatalities caused by chargers are currently not collected. While such devices may be purchased from a variety of sources, there would appear to be greater potential for purchasing an unsafe charger from an online marketplace due to the practice of operators.

[131] Frontzeck (2014): Rückruf-Aktion bei Media Markt & Saturn: Verkaufsstopp für Motorola Moto G, accessed at http://www.teltarif.de/moto-g-media-markt-saturn-rueckruf/news/55230.html, Giga (2014): Moto G: Verkaufsstopp bei Media Markt und Saturn, accessed at http://www.giga.de/smartphones/moto-g/news/moto-g-verkaufsstopp-bei-media-markt-und-saturn

[132] Apple, (2014) Apple 5W European USB Power Adaptor Exchange Program, accessed at http://www.apple.com/uk/support/usbadaptor-european

Table 3-38: Overview of selected incidents involving chargers across Europe[133]	
Year	**Description**
Mobile phones	
2009	Although no incidents or injuries were reported, Nokia recalled chargers that had been produced by the foreign manufacturing company BYD. Chargers were recalled because the plastic cover of the charger could loosen and expose the inside of the charger. There was thus the possibility that these chargers could potentially cause an 'electric shock'.
2011	A fire caused by a charger resulted in a house fire.
2013	An iPhone 4S charger exploded while being charged
2013	A consumer reported that his Apple charger exploded while charging the phone.
2013	A defective phone charger was cited as the source of a house fire.
2013	iPhone 5's battery charger exploded and caused a fire.
2013	A 13 year old boy was hospitalised following an incident involving an iPhone 5 charger.
2014	Chargers designed by the non-OEM for the Motorola Moto-G have been recalled because of purported belief that these chargers overheat and pose a fire risk.
2014	Suspected cause of a house fire was a faulty electrical phone charger.
2014	Apple 5W European USB Power Adaptor
Tablets	
2014	Nokia has halted the sale of the Nokia Lumia 2520 in Europe because the charger that accompanies the tablet poses a risk of electric shock.
Laptop	
2013	A laptop left to charge in a van was suspected as the source of a subsequent fire.

[133] Konsumo (2009): Rückruf: Stromschlag-Gefahr bei Nokia Handy-Ladegeräten [recall: electrocution hazard of Nokia phone chargers], accessed at: http://www.konsumo.de/news/101020-nokia-ladeger%C3%A4t-stromschlag-r%C3%BCckrufaktion; Motorola Moto G: Verkaufsstopp wegen Netzteil [Motorola Moto G: cessation of sales because of charger], accessed at: http://www.chip.de/news/Motorola-Moto-G-Verkaufsstopp-wegen-Netzteil_69160769.html; Giga (2014): Moto G: Verkaufsstopp bei Media Markt und Saturn [Moto G: cessation of sales at Media Markt and Saturn], accessed at: http://www.giga.de/smartphones/moto-g/news/moto-g-verkaufsstopp-bei-media-markt-und-saturn/; Telefoonabonnement (2014): Nokia stopt verkoop Lumia 2520 door gevaarlijke oplader [Nokia stops the sale of Lumia 2520 because of dangerous chargers], accessed at: http://www.telefoonabonnement.nl/nieuws/nokia-stopt-verkoop-lumia-2520-door-gevaarlijke-oplader/, Klacht (2013): Klacht: Oplader in de brand gevlogen tijdens het opladen en ontploft [Complaint: Charger started to burn during charging and then exploded], accessed at: http://www.klacht.nl/oplader-in-de-brand-gevlogen-tijdens-het-opladen-en-ontploft/ Nieuwsblad (2013): Zware woningbrand door defecte gsm-lader [serious house fire because of defective charger], accessed at: http://www.nieuwsblad.be/article/detail.aspx?articleid=DMF20131223_00901404; Lamia Report, (2013), I put the laptop to a service charge and a little burned car, accessed at: http://www.lamiareport.gr/index.php?option=com_content&view=article&id=80405:lamia-lampadiase-autokinhto-tou-ote-apo-fortisti-kinhtou-foto&catid=38:2010-04-22-20-27-04&Itemid=68; Digital news, (2013) The iPhone 5's battery charger exploded, accessed at: http://m.iltalehti.fi/digi/2013032016805849_du.shtml Ilta-Sanomat, (2013) iPhone charger flashed – to 13 – year old son to the hospital, accessed at: http://www.iltasanomat.fi/kotimaa/art-1288582526949.html; Vecernji list, (2011), Because of a short circuit in the mobile phone charges his house burnt down, accessed at: http://www.vecernji.hr/sjeverozapadna-hrvatska/zbog-kratkog-spoja-na-punjacu-mobitela-zapalila-mu-se-kuca-344931; Smartphonehrvatska, (2013) Another iPhone 4S explodes, this time in Zagreb, accessed at: http://www.smartphonehrvatska.com/2013/09/08/iphone-eksplozija-zagreb/; Apple (2014) Apple 5W European USB Power Adaptor Exchange Program, accessed at: http://www.apple.com/uk/support/usbadaptor-european/

3.9 Effectiveness, Efficiency, Utility and Sustainability of MoU/LoI

A summary assessment of the European Commmission's initiative on the harmonisation of chargers for mobile telephones is provided below, drawing on the information presented in Sections 3.1 to 3.8. The assessment covers the key evaluation areas of effectiveness, efficiency utility, and sustainability, and provides answers to evaluation questions set out in the Terms of Reference for this study.

3.9.1 Effectiveness

The European Commission's initiative on mobile phone chargers set in train a series of developments which include the signing of the MoU in 2009, the development of the relevant technical standard and two successive extensions of the MoU through Letters of Intent signed in 2013 and 2014. All in all, these developments can be seen as effective in terms of increasing the hadmonisation of handset charging in the EU. The key evaluation questions that relate to the effectiveness of the MoU/LoIs (reproduced from the Terms of Reference for this study) are considered below.

Evaluation Question 1: To what extent has the European Commission's initiative on harmonisation of chargers for mobile telephones contributed to delivering benefits for consumers, for industry (sustainability, innovation, image), and to reducing electronic waste?

The EU market for mobile phones has almost fully been harmonised with respect to charging. In 2013, around 93% of all handsets (and almost 100% of data enabled handsets) sold in the EU were compliant with the MoU, either by means of having a Micro-USB socket or by virtue of their manufacturer having made an adaptor available for purchase. This represents a substantial increase on 2011. As a result, the number of different charging connectors on the market has declined substantially and the vast majority of handset owners now have an MoU compliant phone. As a result, many consumers are now able to charge their phones when away from home using the chargers of friends, family and colleagues.

It can threrefore be concluded that the MoU/LoIs have resulted in a substantial increase in consumer convenience (in terms of charging away from home) but also contributed to a modest increase in costs for consumers, when the cost increase per handset sold is considered.

Handset manufacturers appear to have benefited from improved image in terms of environmental sustainability and consumer friendliness. Although the MoU and LoIs have locked the industry into using a specific solution, any negative impacts on innovation are likely to have been limited. This is because the MoU provides manufacturers with the flexibility of different methods of compliance (primarily, Micro-USB connector on the phone or making an adaptor available for purchase). As such, Apple was able to switch from the 30-pin connector to the Lightning connector after the MoU came into force. Charger manufacturers have benefitted from increased revenues and simplified production.

On the other hand, benefits in terms of reduced raw material consumption have not reached their full potential as of yet, primarily because the decoupling of the sales of mobile phones and chargers has only occurred to a very limited degree. Only 0.02% of EU28 handset shipments between 2011 and 2013 (i.e. around 140,000 units) were actually supplied without mains chargers, with around 90% of these having been supplied with a USB/Micro-USB data cables. Although significant impediments to decoupling remain, its extent has increased since 2011 and it is expected that this

trend may gather further momentum in the future. There has also been a decline in the number of sales of standalone chargers often used to replace a lost or damaged charger or to deal with situations where the owner has travelled without the device's charger. The associated reduction in the consumption of raw materials can be estimated to be around 400 to 1,300 tonnes (2011-2013). This was made possible by Micro-USB chargers becoming ubiquitous and people can now use the Micro-USB charger of their friends/colleagues or often already have one that had been supplied with another phone/device.

Although in the long run, the reduction in raw material consumption can be expected to translate into a reduction in e-waste, only a small proportion of chargers avoided due to the MoU/LoIs would have entered the waste stream between 2011 and 2013. Based on information in Section 3.7, it has been assumed that 5% of people dispose of their old charger as soon as they replace their phone; this suggests that the reduction in e-waste arisings achieved between 2011 and 2013 was around 3 to 5 tonnes.

By means of a summary, it can be concluded that the MoU has been effective in terms of contributing to the harmonisation of the market and delivering consumer benefits. Handset manufacturers may have benefited from improved image in terms of environmental sustainability and consumer friendliness and charger manufacturers have benefited from increased revenues and simplified production. On the other hand, the full potential of environmental benefits has not been realised, primarily due to the limited extent of decoupling of charger and handset sales.

Overall, the effect of the MoU has been reinforced by natural market developments, including the increasing market share of data-enabled mobile phones. The MoU and changing consumer preferences can thus be said to have been synergistic developments.

Evaluation Question 2: How effective was the initiative on harmonisation of chargers for mobile telephones as a mechanism and means to achieve each of the stated objectives i.e. to delivering benefits for consumers and for industry, and to reducing electronic waste? What, if anything, could have been done to render the initiative more effective as a means to achieve these objectives? What is the real added value of the Commission's initiative on harmonisation of chargers for mobile telephones for stakeholders?

The chosen method of bringing about harmonisation (a voluntary agreement facilitated by the European Commission, together with the development of a technical standard) has proven to be highly effective in terms of increasing harmonisation of mobile phone charging in the EU and improving consumer convenience. These benefits would not have occurred to the same degree in the absence of the European Commission's intervention.

Although the MoU has not been signed by all handset manufacturers, it covers the main producers that account for around 80-90% of the EU28 handset market, and the remaining manufacturers have taken their cue from MoU signatories and widely adopted Micro-USB charging (see Table 3-14 in Section 3.4.1). However, this initative has been less effective in terms of reducing electronic waste. The main reason for this is that most handset manufacturers have not ceased supplying mains chargers in the box with new handsets. In this regard, the effectiveness of the MoU/LoIs could have been enhanced through the inclusion of measures to encourage increased decoupling.

Evaluation Question 3: What are the barriers to effective harmonisation of chargers for mobile telephones, if any? How could any such barriers be overcome?

No significant barriers to effective harmonisation of chargers have been identified, although some potential future barriers are summarised in Section 5 (e.g. the potential to restrict charging to own certified chargers).

Evaluation Question 4: Are there any aspects/means/actors that render certain aspects of the harmonisation of chargers for mobile telephones more or less effective than others, and — if there are — what lessons can be drawn from this?

In terms of consumer convenience, the vast majority of owners of handsets that comply with the MoU by virtue of Micro-USB/proprietary adaptors having been made available have not purchased an adaptor. This means that they cannot use a Micro-USB charger with their phone. However, the inclusion of the 'adaptor provision' in the MoU can be seen as justified as its omission would have significantly reduced its market coverage.

3.9.2 Efficiency

Overall, the approach taken to harmonisation of mobile phone charging through the MoU can be seen as efficient. The effects and benefits outlined above have been achieved with relatively limited impacts on handset manufacturers and costs for consumers.

The evaluation questions relating to the efficiency of the MoU/LoIs set out in the Terms of Reference for this study are considered below.

Evaluation Question 5: What aspects of European Commission's initiative on harmonisation of chargers for mobile telephones are the most efficient or inefficient, especially in terms of resources that are mobilised by stakeholders during the different phases of the process? What does this represent in terms of administrative and reporting burdens on stakeholders and/or other actors?

As noted above, the approach taken to harmonisation of mobile phone charging through the MoU can be seen as efficient. The gains described in Section 3.9.1 have been achieved at little cost to handset manufacturers who have not reported any large negative impacts. Similarly, any cost impacts linked to the use of Micro-USB chargers have been limited. For example, the additional cost of supplying Micro-USB chargers (which are said to be more expensive than proprietary chargers) has been relatively limited (€0.50 per handset/charger), especially when the average selling price (ASP) of a European smartphone is considered (€340 between 2011 and 2013). This suggests that any cost impacts on consumers have also been limited (€0.50 corresponds to 0.15% of the European smartphone ASP). These have, however, been more significant when feature phones are considered (€0.50 corresponds to 1.6% of the European feature/basic phone ASP).

Adminsitrative and reporting burdens of this initiative do not appear to have been significant. In fact, the Commission's initiative has had an indirect benefit in that it contributed to the establishment of regular meetings between industry actors regarding mobile phone charging and a lot of information is now shared between stakeholders regarding charging requirements and standards.

Evaluation Question 6: Are there overlaps/complementarities between Commission's initiative on harmonisation of chargers for mobile telephones and any other Community, Member State or industry association action(s) in the relevant areas?

There have been complementarities between the role of the European Commission and the key industry association (Digital Europe) which has worked well. This is seen as a highly effient approach that is not only effective but also flexible in terms of identifying and taking into account new market developments, while ensuring continuity (it should be noted that the MoU has been extended through two successive Letters of Intent).

3.9.3 Utility

The key evaluation questions relating to the utility of the MoU/LoIs (as set out in the Terms of Reference for this study) are considered below.

Evaluation Question 7 (Part A): To what extent could measures be taken to improve the utility for consumers but also for industry of the harmonisation of chargers for mobile telephones, and what measures would it be?

No measures have been identified that could be taken at present to further enhance the utility from harmonisation for consumers and the industry.

Evaluation Question 7 (Part B): What lessons from the implementation to date of the harmonisation of chargers for mobile telephones are useful for the implementation of further options in view of achieving harmonising of the charging capabilities of different categories of products requiring similar charging requirements?

A number of lessons learned can be drawn from the experience of the MoU, including:

- a voluntary agreement signed by major manufacturers has the potential of harmonising not only products made by signatories to the agreement but also products made by non-signatories, thus effectively harmonising (almost) the whole of the market;
- a voluntary approach (i.e. one that has been developed by the industry) can be both highly effective but also efficient in terms of limiting costs for manufacturers;
- a sufficiently long transition period and an exclusive focus on new model releases can mitigate costs for manufacturers;
- expectations of increasing power requirements of the next generation of mobile phones suggest that a sustainable approach needs to incorporate a provision for the review of the agreement to accommodate technological advances; and
- natural market developments have reinforced the impacts of the MoU/LoI approach so far but future harmonisation also needs to consider the potential risks of natural market developments working against a further extension of the voluntary approach (see Section 3.9.4 for possible key future market developments).

As mentioned above, the fact that some devices require an adaptor for consumers to be able to use a Micro-USB charger detracts from the overall improvement in utility that was anticipated from the harmonisation initiative.

3.9.4 Sustainability

Evaluation Question 8: To what extent are any positive changes for consumers and/or manufacturers brought about by the hamonisation of chargers for mobile telephones likely to be sustained?

In relation to the current generation of mobile phones, the benefits for consumers from the harmonisation of charging for devices are not likely to be eroded quickly, although two handsets recently launched by Samsung (Galaxy Note 3 and the Galaxy S5) use Micro-USB 3.0 for charging (Dedezade, 2014[134]; The Verge, 2013)[135]. Given the ubiquitous nature of Micro-USB connectors and the investment that manufacturers have made in Micro-USB infrastructure along the supply chain, it is unlikely that there will be a reversion to proprietary connectors in the near future. In fact, on 10th March 2014, five major handset manufacturers effectively extended the MoU until the end of 2014 by means of a Letter of Intent, declaring their intention to continue supplying chargers to the EU market which conform to MoU.

However, in the long run, it is possible that developments in the mobile phone market may affect the degree of harmonisation, although handset manufacturers disagree about whether the diversity of charging solutions is likely to increase in the future. The key market developments that may impact on the level of harmonisation of charging include:

- increasing power requirements of smartphones, implying the need for more powerful chargers (there are different views on this but some expect 10W-12W); this also means that the range of power for mobile phone charging is likely to increase;
- the increasing market share of smartphones (at the expense of feature/basic phones), suggesting that the market share of non data-enabled handsets may further decrease in the future, resulting in further increases in the uptake of Micro-USB connectors;
- measures potentially taken by handset manufacturers to address issues arising from unsafe third-party chargers; and
- the potential for the USB Type-C to gain a significant market share.

In particular, a number of stakeholders responding to consultation for this study suggested that the increasing power requirements of smartphones mean that the MoU is becoming outdated and should be updated to increase the maximum charging power (please refer to Section 5 for more information on the power requirements of current and future mobile phones).

Given the fact that some expect market developments that may substantially alter the charging landscape, it is suggested that it may not be prudent to pursue further harmonisation by means of defining rigid charging requirements for the more distant future (e.g. five years) without establishing a procedure through which innovative products would be allowed to be introduced.

[134] Dedezade (2014): Samsung Galaxy S5 Hands-On Review, available at http://www.stuff.tv/samsung-galaxy-s5-hands-review/feature

[135] Whilst the Micro-USB 3.0 connector on the device is backwards compatible with Micro-USB 2.0 chargers, chargers with a Micro-USB 3.0 connector are not compatible with handsets that use Micro-USB 2.0.

3.10 Summary of the Situation in Non-EU Countries

3.10.1 Summary and Comparison with the EU

Available information suggests that key non-EU markets are characterised by very high market shares of handsets that could be charged via Micro-USB, either directly or through an adaptor (although comprehensive information is not available for all non-EU countries examined in this study). This is largely a result of efforts to standardise mobile phone chargers in these countries and there are indications from consultation that the rest of world has also been moving towards Micro-USB under a sort of cascade effect. Therefore, in this respect these markets are similar to the EU. However, there are some crucial differences that relate, for example, to the provision of chargers 'in the box' with new handsets.

In terms of the number of handsets sold, the **Chinese** handset market is approximately twice as large as the EU, with a comparable (or even higher) market share of smartphones, which however command lower ASPs. Available information suggests that harmonisation on the basis of requirements similar to those later espoused in the MoU was introduced in 2006, meaning that the Chinese market started harmonising several years before the EU.

The **Japanese** market is similar to the EU in respect of the recent rise in smarphone sales and the concomitant growth of the smartphone stock, with the proportion of smartphones in overall stock now appearing to be at a level that is broadly similar to the EU. There is a further similarity to the EU in that Japan appears to rely on Micro-USB. However, the crucial difference is that new handsets in Japan appear to be supplied without mains chargers, with this development being driven by network operators.

The handset market in **South Korea** can be characterised by a high market share of smartphones (at a level that is comparable or higher than the EU), and a remarkably high popularity of phablets. Efforts to standardise charging connectors in South Korea date back to the early 2000, with standardisation initially focussing on a 24-pin connector, which was replaced by a 20-pin connector in 2007. Production of handsets with a 20-pin connector for the domestic market and Micro-USB connectors for overseas market is reported to have been costly for South Korean handset makers, resulting in the Korean Telecommunications Technology Association (TTA) announcing that the standard was going to be changed to Micro-USB.

In many respects, the **US** market is similar to the EU. For example, the market shares of smartphones are broadly similar and they are expected to follow similar trajectories in the future. However, the market share of Apple (i.e. the Lightning connector) is almost three times as high in the US than it is in the EU. The US does not have any legislation mandating the use of specific connectors but CTIA (the main industry association of network operators) has endorsed Micro-USB. Using some strong assumptions, it has been estimated that almost 100% of the US smartphone stock is compatible with the MoU (i.e. either has Micro-USB or Apple Lightning/30-pin connectors).

Whilst it is possible that the MoU has indirectly influenced the markets in the four non-EU countries considered in this report, it is likely to have been a very minor factor in these countries' markets shifting to Micro-USB. The EU only accounts for around 10% of handsets sold globally and as such it is doubtful that the other markets would have switched to Micro-USB simply to take the cue from the EU. Moreover, efforts to harmonise handset charging in China and the US predate the publication of the MoU.

The situation in each of the key non-EU markets examined in this study (China, Japan, South Korea and the United States) is summarised below.

3.10.2 China

China accounted for the majority (27%) of global smartphone shipments in 2012 which is expected to decrease slightly in 2012 to 23%. In the second quarter of 2013, 90 million mobile phones were sold; using a crude calculation, sales for the whole year are likely to be excess of 360 million, 85% of which were smartphones[136]. This represents a 36% increase from the previous year. The top handset suppliers include Samsung, Lenovo, Yulong, ZTE and Huawei. Within China, price is a key factor for consumers, indeed demand is highest for Android devices that cost under €150 and the average selling price is expected to decrease further[137].

In December 2006, the Chinese Government set a single national standard for mobile phone chargers sold in the country[138]. This standard (coded YD/T 1591-2006[139]) stipulated the use of a standard USB Type A plug on the mains charger and USB interface that allows battery charging and data transmission on the handset. In addition, charger output voltage was set at 5V (with a 5% tolerance) and handset input current was limited to 1.8A, with the aim of ensuring that chargers can be used across all new handsets. This standard was to apply to all new mobile phones requesting approval in China from June 2007. The regulation was flexible, in that manufacturers can comply with it by means of providing an adaptor[140]. This was updated in 2009 and the most recent legislation is coded is coded YD/T 1591- 2009. This legislation defines chargers as comprising the following three parts: AC power adaptor, cable and handset. Of most relevance to this study are the requirements placed on the cable. The end of the cable connecting to the power adaptor is based on USB Type A, with the end being one of Micro-USB Type B, Mini-USB Type-B or a cylindrical connector. This means that the updated standard allows only three types of charging/data transfer cables[141].

3.10.3 Japan

In February 2012, 100 million people aged 13 and above used mobile devices in Japan (feature phone and smartphone devices). Sharp was the largest manufacturer of mobile devices within Japan, accounting for nearly 1 in every 4 devices produced with a market share of 24%. The next biggest manufacturer was Panasonic (14%), followed by Fujitsu (12%), NEC (10%) and Sony (8%).

[136] China Internet Watch website, accessed at http://www.chinainternetwatch.com/tag/smartphone/

[137] MobiThinking (2014): Global mobile statistics 2013 Part A: Mobile subscribers; handset market share; mobile operators, accessed at http://mobithinking.com/mobile-marketing-tools/latest-mobile-stats/a

[138] People (2006): China spells out national standard for cell phone chargers, accessed at http://english.people.com.cn/200612/19/eng20061219_334047.html

[139] The full text of the standard is available here: http://www.digikey.com/Web%20Export/Supplier%20Content/PI_596/PDF/PowerInt_ChinaUSB.pdf?redirected=1

[140] EE Times (2007): How to conform to China's new mobile phone interface standards, accessed at http://www.eetimes.com/document.asp?doc_id=1275077

[141] China Communication Standards Association (not dated): YD 1591-2009, available at http://www.ccsa.org.cn/article_new/show_article.php?categories_id=ccc49e22-587d-8397-4ff9-460c5ed9bf46&article_id=bzjs_2842bccf-7e49-0a74-8a92-4c58d44ef1d4

Apple was ranked as the eigth largest seller of mobile devices within Japan with a 7% market share[142].

Less than 20 million people owned smartphones in 2012, suggesting a market penetration of 19%[143]. However, more recent estimates from eMarketer (2014)[144] predict that smartphone penetration in Japan will reach 50% in 2014.

A thorough literature review has not revealed any particular details regarding the legislation on mobile phone chargers within Japan. Nevertheless, there is some information to suggest a shift towards the use of Micro-USB. For instance, Lee (2009)[145] states that the Communications and Information Network Association of Japan (CIAJ) started a discussion on a standard charger interface for mobile phones, with a preference for Micro-USB, in 2008. The standard was targeted for completion by 2009, however it is uncertain whether it has been implemented. Stakeholder consultation for this study indicates that Japan currently relies on Micro-USB and new handsets in this country are typically supplied without mains chargers.

3.10.4 South Korea

In the South Korean mobile phone market, smartphones accounted for 96% of the sales by value (€4.1 billion) and 85% of the sales by volume at the start of 2012[146]. In 2011, approximately 11 million smartphones were sold, an increase of 129% in value and 55% in volume. Phablets (smartphones with screens ranging from 5 to 6.9 inches) are particularly popular in South Korea, accounting for 41% of smart connected devices, compared to 7% globally. Korea is also home to the current market leader, Samsung, who has remained the dominant manufacturer. Interestingly, local companies, including Pantech and LG, accounted for 85% of the smartphone market on 2013, a phenomenon unseen elsewhere in the world[147].

From the late 1990s until 2000, mobile phones in South Korea used chargers that were designed specifically for each model. Furthermore, mobile phone chargers were not even unified across different models made by the same manufacturer (Rabinowitz & Seongmin, 2012)[148].

In 2000, the Korean Communications Commission (KCC) began working with a number of industry stakeholders, including the Korean Telecommunications Technology Association (TTA), to consider various options for charger harmonisation (Rabinowitz & Seongmin, 2012). By 2001, the KCC and TTA had introduced a 'Standard on I/O Connection Interface of Digital Cellular Phone', which required manufacturers to use a 24-pin connector/socket on mobile phones for charging, data

[142] Comscore (2012): In Japan, Smartphones Surpass Feature Phones among Newly Acquired Devices for First Time Ever, accessed at: http://www.comscore.com/Insights/Press-Releases/2012/4/1-in-5-Mobile-Phone-Users-in-Japan-Now-Owns-a-Smartphone

[143] Estimated from data provided

[144] eMarketer (2014): Worldwide Smartphone Usage to Grow 25% in 2014, available at http://www.emarketer.com/Article/Worldwide-Smartphone-Usage-Grow-25-2014/1010920

[145] Lee (2009): Presentation at Global Standards Collaboration (GSC) 14; Document no. GSC14-PLEN-046, Agenda Item 6.1

[146] ZDNet (2012): S. Korea smartphone market worth US$5.4B, accessed at http://www.zdnet.com/s-korea-smartphone-market-worth-us5-4b-2062304138/

[147] Ibid

[148] Rabinowitz & Seongmin (2012): Interoperability Case Study, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2146238

transfer and other signals[149]. The standard initially proved successful, as many companies were already moving towards the use of a 24-pin connector (Rabinowitz & Seongmin, 2012).

However, as technology progressed and newer phones came onto the market, the 24-pin charger became less favoured, especially for slimmer phones (Rabinowitz & Seongmin, 2012). The standard was revised in 2007 to a smaller and integrated 20-pin connector[150].

In spite of the efforts made by the TTA, the 20-pin standard was not as widely adopted as its predecessor. By 2010, many manufacturers were finding it costly to produce mobile phones with 20-pin outlets to adhere to Korean standards whilst simultaneously exporting phones overseas where Micro-USB was becoming popular (Rabinowitz & Seongmin, 2012). As a result, the TTA declared in 2011 that the Micro-USB type charger would become the new standard. However, work on this standard is still ongoing and it is expected to replace the current 20-pin standard sometime in 2014 (Rabinowitz & Seongmin, 2012).

3.10.5 United States

In 2010, 127 million mobile phones were sold in the United States, equating to €8.1 billion[151] and by 2011 this increased to 131 million units (€7.6 billion)[152]. The value of the US mobile phone market is expected to increase to €9.3 million in 2015[153] and €9 million in 2016[154]. Smartphones are encroaching into feature phone sales and in 2012 around 98 million smartphones were sold in the US. By 2017, sales of smartphones will reach 183 million and account for 97% of sales[155]. Apple was the market leader in the third quarter of 2013 with 40%, followed by Samsung (25%), Motorola (7%), HTC (8%) and LG (7%)[156].

With regards to the regulatory situation in the US, consultation for this study indicates that there is no legislation requiring the use of a common connector. However, CTIA, the main industry association for U.S. mobile operators, endorsed GSMA's Micro-USB Universal Charging System in 2009[157]. The association counts among its members some of the main U.S. manufacturers including

[149] TTA (2001): Standard on I/O Connection Interface of Digital Cellular Phone, accessed at www.tta.or.kr/include/Download.jsp?filename=stnfile/TTA-0044.pdf

[150] Telecompaper (2008): TTA certifies first 20-pin battery charger for mobiles, accessed at http://www.telecompaper.com/news/tta-certifies-first-20pin-battery-charger-for-mobiles--629128

[151] Reuters (2012): Research and Markets: Mobile Phones Industry in the United States Expected To Increase to a Value of $12.4 Billion by End of 2015, accessed at http://www.reuters.com/article/2012/01/06/idUS33079+06-Jan-2012+BW20120106

[152] Research and Markets (2014): Mobile Phones in the United States, accessed at http://www.researchandmarkets.com/research/0b3125/mobile_phones_in_t

[153] Reuters (2012): Research and Markets: Mobile Phones Industry in the United States Expected To Increase to a Value of $12.4 Billion by End of 2015, accessed at http://www.reuters.com/article/2012/01/06/idUS33079+06-Jan-2012+BW20120106

[154] Research and Markets (2014): Mobile Phones in the United States, accessed at http://www.researchandmarkets.com/research/0b3125/mobile_phones_in_t

[155] IDC (2013): U.S. Smartphone 2013–2017 Forecast and Analysis, accessed at http://www.idc.com/getdoc.jsp?containerId=240555

[156] comScore (2013): U.S. Smartphone Subscriber Market Share, accessed at http://www.comscore.com/Insights/Press_Releases/2013/12/comScore_Reports_October_2013_US_Smartphone_Subscriber_Market_Share

[157] Business Wire (2009): CTIA–The Wireless Association Announces One Universal Charger Solution to Celebrate Earth Day, accessed at http://www.businesswire.com/news/home/20090422005349/en/CTIA%E2%80%93The-Wireless-Association%C2%AE-Announces-Universal-Charger-Solution#.U6l0HkDj6M8

Motorola and Apple[158]. Information provided through consultation shows that as of July 2014, there was no open legislation regarding a universal charging standard being considered during the current session of Congress[159] nor was there any pending legislation.

Two sources suggest that Android[160] and Blackberry smartphones in the USA predominantly use Micro-USB whilst Windows smartphones use either Micro-USB or Mini-USB[161]. However, please note that it has not been possible to verify these assumptions from other sources. Apple smartphones use proprietary connectors[162]. However, it is unclear from the online literature whether all or some of the smartphones on the Symbian platform use Micro-USB. In April 2014, 168 million people in the U.S. owned a smartphone (70% of all subscribers)[163]. Of the manufacturers, Apple had the largest share (41% of smartphone subscribers[164]) followed by Samsung (28%), LG (7%), Motorola (6%) and HTC (5%)[165]. However, Android was the top smartphone platform, accounting for 53% of the stock. The iOS (Apple) platform accounted for 41% of the smartphone market followed by Blackberry (3%), Windows (3%) and Symbian (0.2%)[166].

Using the above information and some strong assumptions, it is possible to estimate the proportion of Micro-USB phones in the U.S. stock of smartphones. Firstly, using the information above it can be estimated that the total size of the mobile phone stock within the U.S. stands at 240 million subscribers[167]**.** This would mean that there are approximately 72 million feature phone subscribers. It should be noted that this could be an underestimation of the total number of phones in use, as the original data only takes into account primary phones. For instance, estimates from another source for 2013 suggest that there are 227 million smartphones and 111 million feature phones in use within the USA (Daniel Research Group, 2013). Next, it is assumed that all Symbian phones in the USA have a proprietary connection. It will also be assumed that an equal number of Windows phones use both Micro-USB and Mini-USB connectors.

Table 3-39 presents the estimations of the total number of Micro-USB enabled smatphones in the United States.

Table 3-39: Estimation of the stock of Micro-USB smartphones in the United States, 2014

Platform	Share (%) of smartphone subscribers	Total number of smartphone subscribers (calculated)	Micro-USB charger (assumed*)	Estimated number of Micro-USB compatible phones
Android	52.5%	88,147,500	Yes	88,147,500

[158] Member List, CTIA website, accessed at: http://www.ctia.org/about-us/current-members

[159] This session of Congress is scheduled to end in January 2015.

[160] Gizmodo (2011): Google needs to standardise the Micro-USB positioning on Android phones, accessed at: http://www.gizmodo.com.au/2011/03/google-needs-to-standardise-the-microusb-positioning-on-android-phones/

[161] Tap that tech (not dated): List of cell phones that use Micro-USB, accessed at http://tapthattech.com/2013/09/list-cell-phones-use-micro-usb-chargers/

[162] Mashable (2012): Why Doesn't Apply Use Micro-USB?, accessed at http://mashable.com/2012/10/29/apple-lightning-micro-usb/

[163] Comscore (2014): U.S. Smartphone subscriber share, accessed at https://www.comscore.com/Insights/Press-Releases/2014/6/comScore-Reports-April-2014-US-Smartphone-Subscriber-Market-Share

[164] Comscore data is derived from an intelligent online survey of a nationally representative sample of mobile subscribers age 13 and older. Data on mobile phone usage refers to a respondent's primary mobile phone and does not include data related to a respondent's secondary device.

[165] Ibid

[166] Ibid

[167] Based on smartphones accounting for 69.6% (167.9 million subscribers) of the total stock.

Table 3-39: Estimation of the stock of Micro-USB smartphones in the United States, 2014				
Platform	**Share (%) of smartphone subscribers**	**Total number of smartphone subscribers (calculated)**	**Micro-USB charger (assumed*)**	**Estimated number of Micro-USB compatible phones**
iOS (Apple)	41.4%	69,510,600	No (proprietary)	0
Windows	3.3%	5,540,700	Micro- and Mini-USB	2,770,350
Blackberry	2.5%	4,197,500	Yes	4,197,500
Symbian	0.2	335,800	No	0
Total	100%	167,900,000	N/A	95,115,350
*Source: comScore MobiLens, accessed at: https://www.comscore.com/Insights/Press-Releases/2014/6/comScore-Reports-April-2014-US-Smartphone-Subscriber-Market-Share; *assuming that all Android and Blackberry phones use Micro-USB and Windows phones use both Micro and Mini-USB as stated in: http://tapthattech.com/2013/09/list-cell-phones-use-micro-usb-chargers*				

From the above it is estimated that just over 95 million smartphones in the US have a Micro-USB connector. Applying this figure to the total number of phones in the US (240 million) gives a share of Micro-USB in total stock of mobile phones approximately 40%. When iPhones (which are compliant with the MoU by virtue of Apple having made adaptors available for purchase) are added, the proportion of US smartphone subscribers that own an MoU-compliant phone can be estimated at almost 100%.

4 Part II: Impacts of the MoU on the Markets for Other Portable Rechargeable Devices

4.1 Introduction

This section of the report evaluates the possible indirect impact that the MoU has had on the EU market for other small portable electronic devices requiring similar charging capacity. This includes an overview of the markets for these devices.

4.1.1 Overview of Product Groups Analysed in this Report

Product groups were considered to be within the scope of this study and subject to detailed examination if they comply with the following criteria:

- the device is portable and rechargeable and could potentially be charged using the same means as mobile phones;
- the product group has significant sales within Europe or is a burgeoning market; and/or
- there are significant potential gains to be made from harmonised charging between different types of device.

Taking into account the above criteria, the list of products assessed in Sections 4 and 5 of this report includes (in addition to mobile phones):

- tablets;
- e-readers;
- laptops (including netbooks);
- digital cameras and camcorders;
- portable media players;
- sports and activity monitors;
- personal navigation devices;
- portable handheld games consoles; and
- personal care products.

It is, however, important to bear in mind that the MoU may have had an impact on other market sectors not analysed in this report. In addition, unless the policy options assessed in Section 5 of this report are defined as applying to a specific list of products, even products not assessed in detail in this report would be affected. For this reason, Section 4.1.2 provides several examples of the product groups not analysed in detail in this report.

4.1.2 Summary of Information Regarding Product Groups Not Analysed in this Report

Palm-top Organisers

Not so long ago, palm-top organisers, otherwise known as personal digital assistants (PDAs), were commonplace. However, as of 2009, PDAs are no longer manufactured by any large manufacturer. The most recent PDA was the HP iPAQ Glisten which was launched in 2009 and could be charged via Micro-USB technology. Prior to this, most recent models were released in 2007 or before. The main reason for their decline is the increase in demand for smartphones as they can do much of the work a PDA could do, as can tablets.

Portable DVD Players and TVs

As the market for portable DVD players and TVs is small, data on their sales are unavailable, as any company's sales reports of such products are usually put under the collective headings of 'entertainment systems' or 'DVD players'.

Many of the portable DVD players and TVs on the market are from China, although their financial/market information is not released and as such the extent to which they dominate the market is unknown. A number of well-known brands, including Sony, Bush, Philips, Toshiba, manufacture portable DVD players, although not in great quantities.

Although no data can be found, it is reasonable to assume that, with the growing popularity of tablets (especially in Western Europe), portable DVD players and TVs are falling out of demand.

Push-to-talk radios

Compared with mobile phones, two-way radios are a niche market, and one that is focused on professional applications rather than private consumers[168]. Although at least one product line (Motorola MotoTRBO SL4000/4010) uses Micro-USB for charging, push-to-talk radios need higher voltages and currents than mobile phones to allow continuous operation during a work shift (as noted by a company providing information for this study). This requires larger batteries than mobile phones (e.g. Motorola provides batteries with capacity around 31W). In addition, many professional users require multi-unit chargers that allow simultaneous charging of a number of devices.

[168] Seybold (2012): Commercial Push-To-Talk: Missing the Mark?, available at http://andrewseybold.com/3088-commercial-push-to-talk-missing-the-mark

4.2 Tablets

4.2.1 Summary of Market Data

Worldwide

The total worldwide tablet shipments in 2013 reached 218.8 million units. Tablets are a relatively new product group and data on their worldwide shipments are available from 2011 to 2013 (see Table 4-1).

Table 4-1: Worldwide shipments by manufacturer for tablets (units in millions)			
Manufacturer	**Year**		
	2011	**2012**	**2013**
Acer	-	1.7	2.6
Amazon	3.9	9.0	7.6
Apple	40.5	67.1	74.2
Asus	2.1	6.5	12.1
Barnes & Noble	3.3	1.4	-
Lenovo	-	2.6	7.2
Microsoft	-	-	0.9
Samsung	6.1	16.5	41.1
Others	9.4	23.8	0
Total	**65.3**	**128.7**	**218.8**
Note: 2012 and 2013 figures have been derived from quarterly figures. *Source: Various IDC press releases, accessed at http://www.idc.com/about/press.jsp*			

In terms of sales to end users, Gartner has reported that 195.4 million tablets were sold globally in 2013; for further information please refer to Table A2-6 in Annex 2. In 2010, when tablets became popular as a consumer device, Western Europe accounted for 20% of sales. This has gradually decreased as the market matures, being compensated by increases in developing markets (see Figure A2-1, Annex 2).

Europe

Using the EU market share (see Section 4.2.3) and worldwide shipments figures, the shipments of tablets to the EU from 2010 to 2013 have been estimated and are presented in Table 4-2.

Table 4-2: Estimated EU Shipments of Tablets	
Year	**Units (millions)**
2011	8.9
2012	34.0
2013	82.9

Key non-EU countries

In the US, Apple is the dominant vendor in the tablet market; with the iPad accounting for around 80% of the sales[169].

The situation in China is quite different, with relatively low penetration of tablets compared to smartphones. There are a large number of manufacturers, with half of all sales going to manufacturers that have a market share below 1%. The global market leader, Apple, has a relatively low market share; however, this may be linked to trademark issues, as sales increased following resolution of the dispute[170]. The tablet market in China is forecast to grow further in the future[171].

In South Korea, the tablet market is small compared to the smartphone market and sales have decreased since 2011, mainly a result of the emergence of phablets, which are hugely popular[172]. The Korean tablet market is dominated by Samsung and Apple.

For further detail on national markets within and outside the EU, please refer to Annex 2.

4.2.2 Structure of the Sector and Trade

Main market players

As tablets are a relatively new consumer device, it has not been possible to identify market share figures prior to 2011. There are a wide range of tablets available on the market at present and historically, Table 4-3 shows the top manufacturers in terms of market share for 2011 to 2013.

Table 4-3: Market share by vendor of worldwide tablet shipments

Manufacturer	Year		
	2011	2012	2013
Acer	-	1%	1%
Amazon	6%	7%	4%
Apple	62%	52%	34%
Asus	3%	5%	6%
Barnes & Noble	5%	1%	-
Lenovo	-	2%	3%
Microsoft	-	-	0.4%
Samsung	9%	13%	19%
Others	14%	19%	33%

Note: 2012 and 2013 figures have been derived from quarterly figures.
Source: Various IDC press releases, accessed at http://www.idc.com/about/press.jsp

[169] Chitika Insights: First Quarter 2014 Tablet Update: Major Tablet Brands See Biggest Year-over-Year Gains, accessed at http://cdn2.hubspot.net/hub/239330/file-481676760-pdf/ChitikaInsights-2014-TabletUpdate.pdf

[170] Computerworld: Apple's iPad shipments for China nearly double, after trademark dispute, accessed at http://www.computerworld.com/s/article/9233743/Apple_39_s_iPad_shipments_for_China_nearly_double_after_trademark_dispute

[171] Research and Markets: China - Tablet PC Market Forecast & Opportunities, 2016, accessed at http://www.reuters.com/article/2012/01/25/idUS13318+25-Jan-2012+BW20120125

[172] Digitimes Research: Korea tablet market being impacted by phablet products, accessed at http://www.digitimes.com/news/a20131230PD208.html

At the beginning of the period under examination (2011-2013), tablet shipments were dominated by Apple. In 2011, Apple's market share was 62%, which dropped to 52% in 2012 and 34% in 2013. Conversely, the market share for Samsung has increased from 9% in 2011 to 19% in 2013. Whilst Acer, Amazon, Asus and Lenovo feature in the top 5 quarterly shipment figures, they hold a relatively small proportion of the market. Other manufacturers are accounting for an increasingly large proportion of the market (33% in 2013), demonstrating a high degree of competition. Barnes & Noble held 5% of the market in 2011; however, this dropped to 1% in 2012 and it does not appear in the 'Top 5' in 2013.

A brief overview of each of the leading tablet manufacturers can be found in Annex 2.

Manufacturing in the EU

A review of production facilities for each of leading tablet manufacturers and MoU signatories that also produce tablets (Acer[173], Apple[174], Asus[175], Huawei[176], Lenovo[177], Motorola[178], Samsung[179]) has not revealed any production of tablets in the EU.

4.2.3 Main Market Trends

Worldwide

Worldwide sales (to end users) of tablets have been increasing year on year since 2010; figures from Gartner show an increase of more than 1,000% from 17.6 million in 2010 to 195.4 million in 2013[180].

A similar trend is depicted in tablet shipments with an increase of 235% from 2011 to 2013 to 219 million units[181]. Beyond 2013, it is expected that shipments of tablets will continue to increase but the rate of growth will lessen. The growth rate of the tablet market has already begun to decrease and is expected to do so beyond 2013, with a predicted year-on-year increase of 22% in 2014 to 270.5 million units and by 2017, this will have dropped to less than 10% to 386.3 million units[182].

[173] The Economic Times website: Acer India launches five tablets under Iconia series, accessed at http://articles.economictimes.indiatimes.com/2011-05-04/news/29509109_1_tablets-capacitive-android-honeycomb

[174] The Verge website: Apple building new manufacturing facility in Arizona, expected to create over 2,000 jobs, accessed at http://www.theverge.com/2013/11/4/5066404/apple-building-new-manufacturing-facility-in-mesa-arizona

[175] The Times of India website: Asus eye 15% share of Indian tablet market in 2013, accessed at http://articles.timesofindia.indiatimes.com/2013-04-08/hardware/38372808_1_nexus-7-tablet-tablet-pc-market-share

[176] IT Next website: Huawei unveils new tablet; plans big investments, accessed at http://www.itnext.in/itnext/news/15747/huawei-unveils-tablet-plans-investments

[177] NDTV Gadgets website: Lenovo opens first manufacturing facility in US, accessed at http://gadgets.ndtv.com/laptops/news/lenovo-opens-first-manufacturing-facility-in-us-375997

[178] Phone Arean.com website, accessed at http://www.phonearena.com/news/Take-a-peek-inside-Motorolas-Moto-X-US-assembly-facility_id47347

[179] Unleash the Phones website: Samsung invests $70 Million in India's Noida Mobile Manufacturing Facility, accessed at http://unleashthephones.com/2011/09/15/samsung-invests-70-million-in-indias-noida-mobile-manufacturing-facility/

[180] Various Gartner press releases, see Table 4-2

[181] Various IDC press releases, accessed at http://www.idc.com/about/press.jsp

[182] IDC website: Worldwide Tablet Shipments Forecast to Slow to Single-Digit Growth Rates by 2017, According to IDC, accessed at http://www.idc.com/getdoc.jsp?containerId=prUS24461613

The slowdown in sales may represent the early signs of market maturation or a result of slowing product innovation. Please refer to Annex 2 for information on the declining growth rate of tablets.

Europe

In 2010, the US accounted for 53% of worldwide sales compared to 20% in Europe (see Figure A2-1, Annex 2)[183]. It is expected that these market shares will decrease as the market matures and emerging markets will account for a growing proportion of tablet sales. It is expected that in 2015 the market shares for the US and Europe will be 27% and 14% respectively[184].

Average selling price

Increased diversity in the tablet market and the popularity of cheaper smaller screened models has resulted in the ASP decreasing year on year; Gartner's predicted prices until 2015 are shown in Table 4-4. More detailed information of the ASP in individual Member States can be found in Annex 2.

Table 4-4: Average selling price of tablets[185]

Year	Price (€)
2010	411
2011	304
2012	268
2013(f)	227
2014(f)	211
2015(f)	199

Note: (f) forecast

4.2.4 Impacts on the Markets for Tablets and their Chargers

Current Charging Requirements

A sample of tablets available in the EU from 2008 to 2013 has been reviewed to determine the charging requirements and identify any prevailing trends. The majority of models (69%) were supplied with a proprietary charger, which includes barrel, 30 pin or USB/MHL[186]. A quarter were supplied with a Micro-USB charger and 4% were supplied with a Mini-USB charger (see Figure 4-1).

[183] Morgan Stanley (Mar 2012), accessed at http://www.statista.com/statistics/183427/forecasted-sales-of-tablet-pcs-by-region/

[184] Morgan Stanley (Mar 2012), accessed at http://www.statista.com/statistics/183427/forecasted-sales-of-tablet-pcs-by-region/

[185] Gartner (2011): IT spending forecast, 1Q11 update – Media tablets boost outlook, accessed at http://www.gartner.com/it/content/1577900/1577914/april_5_it_spending_forecast_1q11_update_rgordon.pdf

[186] Mobile High-Definition Link

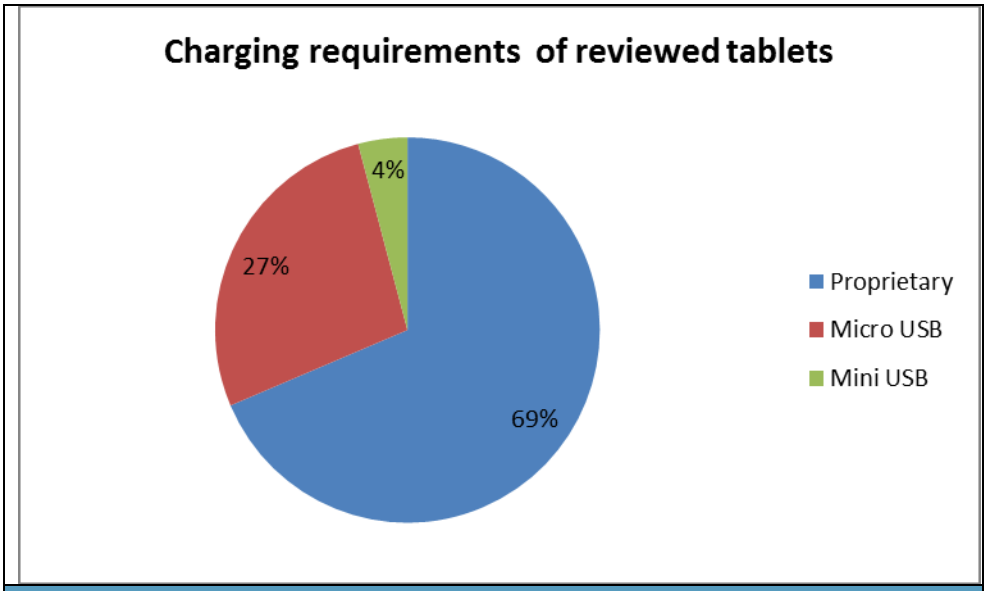

Figure 4-1: Charging requirements of reviewed tablets

A likely reason for the high proportion of proprietary chargers is the inherent charging limit of the USB 2.0 and Battery Charging specifications which are not sufficient for some tablets. Indeed, the sample revealed that a considerable range in terms of the charger outputs, the lowest being 4W and the highest being 65W (average 18W). The analysis revealed that in some cases the output and connector of the supplied charger can be linked to the screen size of the device, and thus to the size of the battery required to power the device. Micro-USB chargers are often supplied with smaller screened devices in the range of 7 - 8.9 inches and when used in larger devices, very slow charging rates have been reported[187]. Typically, larger tablets are supplied with a higher output proprietary charger. Those smaller screened tablets which use a proprietary charger are mostly older models (only 3 were released in 2013) and lesser known brands.

For manufacturers with a diverse portfolio, a different types of charger can be supplied. For instance, Samsung provides a Micro-USB with small to mid-sized tablets and a proprietary charger for larger or convertible tablets; this is also the case for Acer.

Since 2011 (the first year for which data are available), there has been a move towards Micro-USB chargers by several manufacturers, including Asus, Barnes & Noble, Lenovo, LG and Sony. Many of the MoU signatories use Micro-USB in some or all of their tablets; this includes Blackberry, LG, Motorola, Samsung, Sony and ZTE. Although it cannot be confirmed, it is possible that the apparent migration to Micro-USB chargers may have been an indirect result of the popularity of Micro-USB in the mobile phone sector. In order to maintain simplicity and harmonisation within the product portfolio, particularly across more than one type of device, manufacturers may seek to use a common charger where possible. Please refer to Table A2-8 in Annex 2 for more information on the charging solution used by the leading tablet manufacturers and MoU signatories.

Amazon is the only manufacturer identified which does not supply a mains charger with their tablets only a USB/Micro-USB data transfer cable is included. A range of adaptors are available for purchase

[187] Tech radar website: Sony Xperia Tablet Z review, accessed at www.techradar.com/reviews/pc-mac/tablets/sony-xperia-tablet-z-1133193/review; Ubergizmo website: Samsung Galaxy Tab 3 10.1 Review, accessed at http://www.ubergizmo.com/2013/08/samsung-galaxy-tab-3-10-1-review

which allow tablets which require a proprietary charger, including Apple, Samsung, and Sony to be charged using a Micro-USB charger (see Table A2-8 in Annex 2 for more information).

Market Share of Tablets that Use Micro-USB Charging

Using market share data and the charging requirements of tablets for 2011 to 2013, a model was developed to estimate the prevalence of Micro-USB chargers; the results are presented in Table 4-5. For more information on the methodology underpinning this model, please refer to Annex 11.

Table 4-5: Tablet model outcomes for 2011 to 2013

Parameter	Year		
	2011	2012	2013
Percentage of tablet sales that use Micro-USB charging	17%	17%	47%
Percentage of tablet stock that use Micro-USB charging	15%	16%	37%
Percentage of tablet chargers supplied (standalone and included with new devices) which are Micro-USB	17%	17%	47%

It is evident that the percentage of tablet sales that use Micro-USB chargers has increased from 2011 to 2013, with almost half of all tablets sold in 2013 using a Micro-USB port for charging. Indeed, when reviewing the charging methods of the sample, it appears that 2013 is the turning point, as the use of Micro-USB chargers noticeably increased and proprietary chargers decreased. From those tablets sampled, the use of Micro-USB charging is most common in those models with a screen size of up to 8.9 inches.

In 2010, 79% of the sample tablets used a proprietary charger, this dropped to 69% in 2011 and 2012 and in 2013 this proportion decreased more noticeably to 42%. Consequently, the proportion of the stock of tablets that use Micro-USB charging is low, ranging from 15% to 37% for 2011 to 2013. Please note that these percentages include iPads which use Apple's proprietary 30-pin/Lightning connectors.

The model assumes that the types of chargers supplied in any given year will reflect both the sales of new tablets as well as the existing stock of devices in use. The overall charger sales is thus also determined by the percentage of tablet owners which purchase a standalone charger in addition to the one which was supplied with the tablet. As previously explained, the model assumes that 2% of tablets owners buy a standalone charger each year. Therefore, the percentage of tablet chargers which use Micro-USB largely mirrors the tablet sales.

4.2.5 Impacts on Consumers

As there appears to be some (although admittedly limited) degree of standardisation of chargers for smartphones and tablets, particularly from those companies that manufacture both devices, consumers may be able to use a single charger for more than one device. Tablets produced by HTC have a Micro-USB/MHL[188] port which supports HD video and digital audio whilst simultaneously providing power to the device. This port serves both as a means of charging and data transfer and is compatible with Micro-USB 2.0, allowing consumers to share chargers between devices. It should be noted that whilst a manufacturer may supply a proprietary charger and recommend its use for optimal charging, the device may also support Micro-USB charging, albeit at a much slower rate, for example Panasonic's 'Toughpad'.

[188] Mobile High-Definition Link. For more information, see http://www.meetmhl.com/WhatIsMHL.aspx

4.2.6 Impacts on Manufacturers

Where possible, moving to a common charger may be beneficial to manufacturers, particularly those who produce more than one portable rechargeable device. Reducing the number of chargers which need to be produced or sourced, is likely to lead to cost savings through simplified production processes and/or economies of scale. Using a common charger will also require less research and development into charging solutions. It is also of note that Micro-USB has aspects which can be beneficial to product design. Its multi-functionality, i.e. charging and data transfer, negates the need to have separate power and data transfer ports, thereby saving space and allowing a less 'cluttered' design. The Micro-USB port is small, allowing thinning of devices.

Opting for Micro-USB chargers could conceivably demonstrate that the company considers the needs of consumers and this could improve the image of the company. However, as the charging requirement of a device is unlikely to be the main factor when consumers are choosing a tablet, any improvement will probably be minimal. The top 3 factors which are reported to be considered by consumers are the operating system, screen size and the processor[189].

4.2.7 Impacts on the Environment

As noted above, the MoU has potentially had an indirect impact on the type of charger supplied with tablets. However, as almost all tablets are supplied with a charger, there are no overall environmental benefits.

4.2.8 Other Impacts

As with mobile phones, it is feasible to believe that there is a market for cheap tablet chargers and that some of these may be counterfeit and indeed present a risk to the consumer[190]. This risk could be avoided provided consumers take steps to purchase replacement chargers from reputable retailers. However, there are no indications that this development is in any way linked to the MoU for mobile phones.

4.2.9 Conclusions

Although it is possible that the MoU has had an indirect impact on the tablet sector, a review of tablets sold during the period covered by this study suggests that many models still rely on proprietary chargers. In the past, the main barrier to a further shift towards Micro-USB was the fact that tablets require power beyond the capabilities of USB 2.0 and Battery Charging specifications. However, the USB Power Delivery specification announced in 2012 can transfer up to 100W of

[189] Tech Radar website: Tablet buying guide: 10 things to look for, accessed at http://www.techradar.com/news/mobile-computing/tablets/tablet-buying-guide-10-things-to-look-for-973184

[190] For example, a blog has compared a genuine iPad charger with a counterfeit iPad charger. Externally, differences are difficult to discern with only some of the small print on the casing indicating which charger is an official charger and which a counterfeit. Internally, there is a much bigger difference with the counterfeit containing fewer components while the Apple charger uses larger, higher-quality components. This is particularly noteworthy for the capacitors and transformer, which will impact on the power quality and safety of each respective charger. With regards to safety, it was also evident that the internal parts of the Apple charger had greater insulation and that the overall build quality was much higher. The circuitry of the iPad charger was also notably more complex. Source: Ken Shirriff's blog, iPad charger teardown: inside Apple's charger and a risky phony, accessed at: http://www.righto.com/2014/05/a-look-inside-ipad-chargers-pricey.html

power using the standard USB connnector, or 60W for the Micro-USB connector, which is sufficient to power almost all tablets.

4.2.10 Summary of Charging Requirements in Non-EU Countries

No information has been identified as regards requirements on the charging of tablets in countries outside of the EU.

4.3 E-readers

4.3.1 Summary of Market Data

Worldwide

Table 4-6 and Figure 4-2 show global e-reader shipments between 2010 and 2015.

Table 4-6: Worldwide E-reader Shipments (million units)			
Year	**IHS iSuppli Research**	**IDC**	**Research & Markets (2011)**
2010	10		
2011	23.3	27.7 (26.4*)	
2012	14.9	19.9 (18.2*)	
2013	11		
2014	8.7		50
2015	7.8		
Sources: Bensinger (2013); IDC(2013), Research & Markets (2011)			

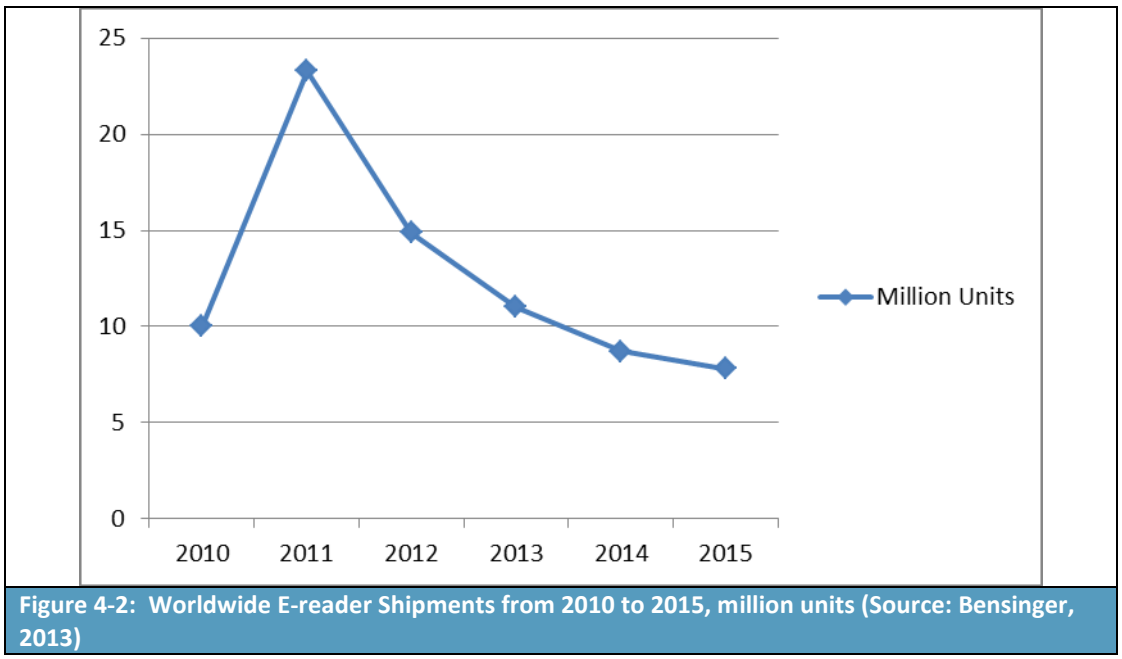

Figure 4-2: Worldwide E-reader Shipments from 2010 to 2015, million units (Source: Bensinger, 2013)

Currently, unsubsidised prices of e-readers range significantly from around €30 to around €480.

Key non-EU countries

The USA is the largest market for e-readers and in 2013 e-readers were the main means of reading e-books. However as tablets become more popular, this is likely to change[191]. Indeed, the falling

[191] Forbes: Kindle Most Popular Device For Ebooks, Beating Out iPad; Tablets On The Rise, accessed at http://www.forbes.com/sites/jeremygreenfield/2013/10/30/kindle-most-popular-device-for-ebooks-beating-out-ipad-tablets-on-the-rise/

sales of e-readers, despite more people reading e-books, signifies the switch to tablets. E-reader sales are forecasted to fall further in the future[192].

While e-reader sales were booming globally from 2010 to 2011, they have not gained huge popularity in China, with most consumers opting to use their smartphones to read e-books. The two biggest players of the Chinese e-reader market are Hanvon Technology and SNDA Bambook[193]. Kindle entered the market in 2013, but did not increase sales significantly. E-reader sales are expected to fall as smartphones and tablets become more popular[194].

E-books started to become popular in South Korea in 2011 and the country has the highest ratio of e-book to paper book sales[195]. E-readers, however, have never become popular in the country. The likely reason for this is that, while globally people started reading e-books on e-readers and migrated to other platforms (smartphones and tablets) later on, Korean consumers skipped the e-reader and went straight for smartphones and tablets[196].

For more information on national e-reader markets outside the EU as well as in selected EU Member States, please refer to Annex 3.

4.3.2 Structure of the Sector and Trade

At least 22 companies currently sell e-readers in the EU, with most companies offering more than one model. These are listed in Table 4-7, alongside companies which have recently withdrawn from the market. These companies range from large multinational firms to relatively small companies that purchase generic devices whioch they then sell under their own brand name. For more information on this, see Annex 3.

Approximately one half of these companies are headquartered in the EU.

Table 4-7: Companies selling own brand e-readers in the EU

Company	Country (HQ)	Currently active?	Active in the past? (Year Ceased Activity)
Aluratek	US	Yes	
Amazon	US	Yes	
Archos	FR	Yes	
Barnes & Noble	US	Yes	
Binatone	HK/UK	Yes	
Bookeen	FR	Yes	
BQ	ES	Yes	
DistriRead/ICARUS	NL	Yes	

[192] E-Reader Market Shrinks Faster Than Many Predicted, accessed at http://bits.blogs.nytimes.com/2012/12/20/e-book-reader-tablets-cannibalized/?_php=true&_type=blogs&_r=0

[193] China E-Reader Sales Down Thanks To Lack Of Content, accessed at http://paidcontent.org/2011/12/16/419-china-e-reader-sales-down-thanks-to-lack-of-content/

[194] E-books: Black, White and E-read All Over, accessed at http://knowledge.ckgsb.edu.cn/2014/01/29/technology/e-books-black-white-and-e-read-all-over/

[195] Melville House: South Korean bookseller sets new standard for rock-bottom ebook prices, accessed at http://www.mhpbooks.com/south-korean-bookseller-sets-new-standard-for-rock-bottom-ebook-prices/

[196] The Hankyoreh: E-book craze hits S.Korea, accessed at http://www.hani.co.kr/arti/english_edition/e_national/478936.html

Table 4-7: Companies selling own brand e-readers in the EU			
Company	**Country (HQ)**	**Currently active?**	**Active in the past? (Year Ceased Activity)**
ECTACO (JetBook)	US	Yes	
Eelo	UK	Yes	
Elonex	UK	Yes	
Energy Sistem	ES	Yes	
iRex	NL	No	Yes (2010 - iLiad)[197]
Iriver	KR	Yes	
Kobo	CA	Yes	
Kolporter Info SA	PL	Yes	
Mobiwire (Sagem)	FR	No	Yes (2011[198] – Binder)
Onyx	CN	Yes	
Pocketbook	CH	Yes	
Sony	JP	Yes	
Tianjin Jinke Electronics	CN	Yes	
TrekStor	DE	Yes	
Txtr	DE	Yes	
Wexler	US/RU	Yes	

4.3.3 Main Market Trends

The market for e-readers has undergone rapid growth over the past five or six years but the increasing competition from tablet computers is now eroding its market share. The reasons for this include the shrinking price and size of tablets (Bensinger, 2013). Looking at figure 4-2, it appears that the e-reader market peaked in 2011 and has been declining since then. It is expected to decline further over the medium term. For example, IDC (2013) expects to see modest growth in e-reader shipments in 2013 and 2014, before witnessing a "gradual and permanent decline" starting in 2015.

On the other hand, Research & Markets (2011) forecasted in 2011 that global e-reader sales would reach 50 million units by 2014, representing revenues of over €4.5 billion. It was further expected that the European share in the e-reader market would grow from 2% in 2010 to 16% in 2014, amounting to 8 million units/€700 million. It should be noted that these estimates were published in 2011 when e-reader sales were booming, thus encouraging optimistic forecasts.

However, as noted by Bensinger (2013), dedicated e-readers still enjoy some advantages over competing devices. On average, they are lighter than tablets and use display technologies that give them a longer battery life, meaning that consumers do not have to charge them as often as tablets. For example, Bensinger (2013) notes that the Nook Simple Touch can last up to two months between battery charges, compared with ten hours reading time with the Nook HD tablet. More information on the factors affecting e-reader sales is provided in Annex 3.

4.3.4 Impacts on the Markets for E-readers and their Chargers

An extensive sample of e-readers was created which included 125 models from 29 manufacturers and covered eReader models released onto the market from 2009 to 2014. For more information on

[197] Brafado (2010)
[198] Enders Analysis (2012)

this sample please refer to Annex 3. An analysis of the sample suggests that virtually all rechargeable e-readers use USB ports for charging (see Table 4-8).

Table 4-8: Charging Connectors – Sample of E-Reader Models 2009-2013			
Year	**Micro-USB**	**Mini-USB**	**Other**
2009	14%	57%	29%
2010	38%	54%	8%
2011	45%	55%	0%
2012	64%	31%	5%
2013	96%	4%	0%

Overall, e-readers tend to have a relatively long battery life which means that charging is infrequent, with many lasting up to eight weeks between charges (E-book Reader, nd). Manufacturers appear to be routinely supplying mains chargers or at least USB cables with their products.

Data on the charging requirements of the sample of e-readers has been combined with information on the market shares of major manufacturers and a model for estimating the sales of e-readers which utilise the Micro-USB connector for charging has been developed. The assumptions underpinning the model are set out in Annex 11. The outcome from the model is shown in Table 4-9 and Figure 4-3, as well as Table 4-10 and Figure 4-4.

Table 4-9: Sales of E-readers					
Parameter	**2009**	**2010**	**2011**	**2012**	**2013**
Devices with Micro-USB connector (million)	0.5	1.8	5.2	3.3	2.4
Devices with other connector (million)	0.4	0.5	0.2	0.2	0.1
% of all devices with Micro-USB connector	60%	77%	97%	95%	96%
% of all devices with other connector	40%	24%	3%	5%	4%

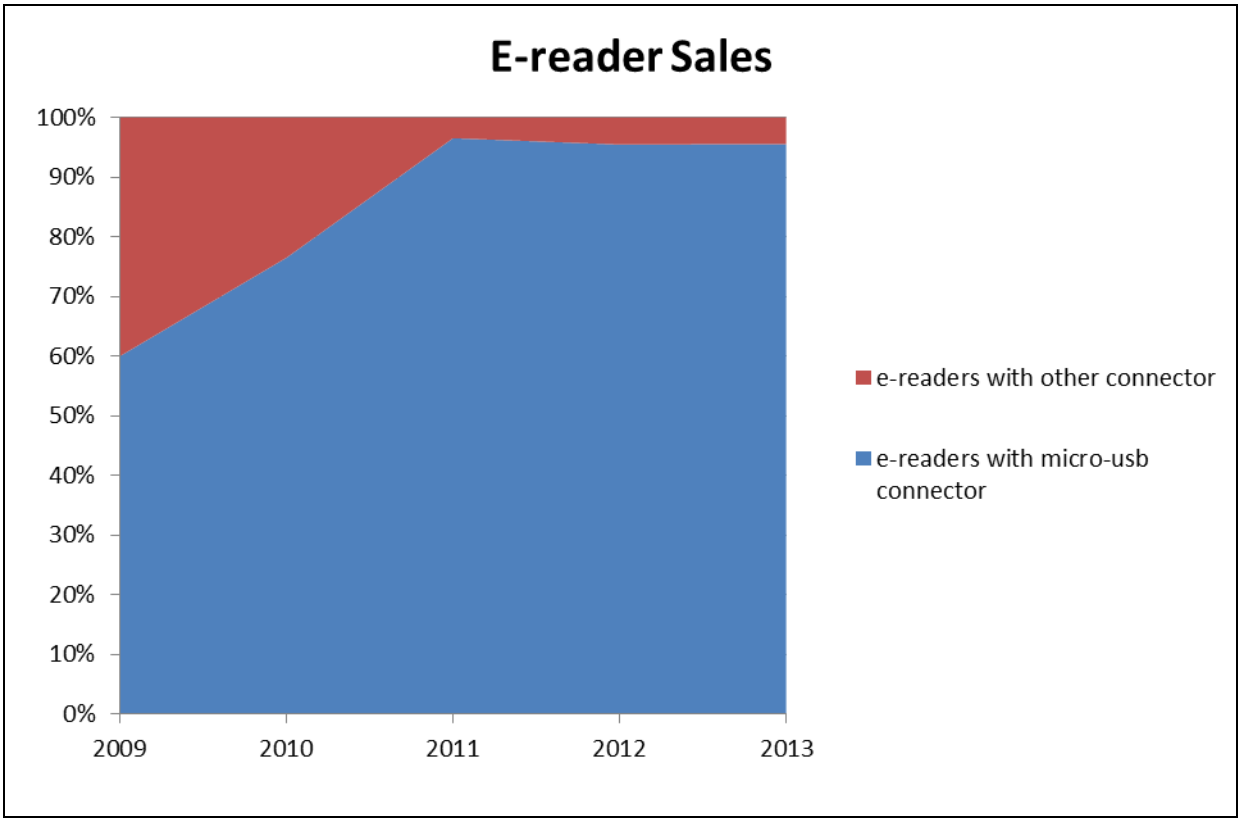

Figure 4-3: E-reader sales

The stock of e-readers within Europe which have a Micro-USB connector for charging has increased year on year through 2009 to 2013. The model suggests that Micro-USB is the charging method of choice for the majority of manufacturers, with 91% of the stock of e-readers utilising Micro-USB by 2013.

Table 4-10: Stock of E-readers

Parameter	2009	2010	2011	2012	2013
Devices with Micro-USB connector (million)	0.5	2.3	7.5	10.8	12.7
Devices with other connector (million)	0.4	0.9	1.1	1.2	1.0
% of all devices with Micro-USB connector	60%	72%	87%	90%	93%
% of all devices with other connector	40%	28%	13%	10%	7%

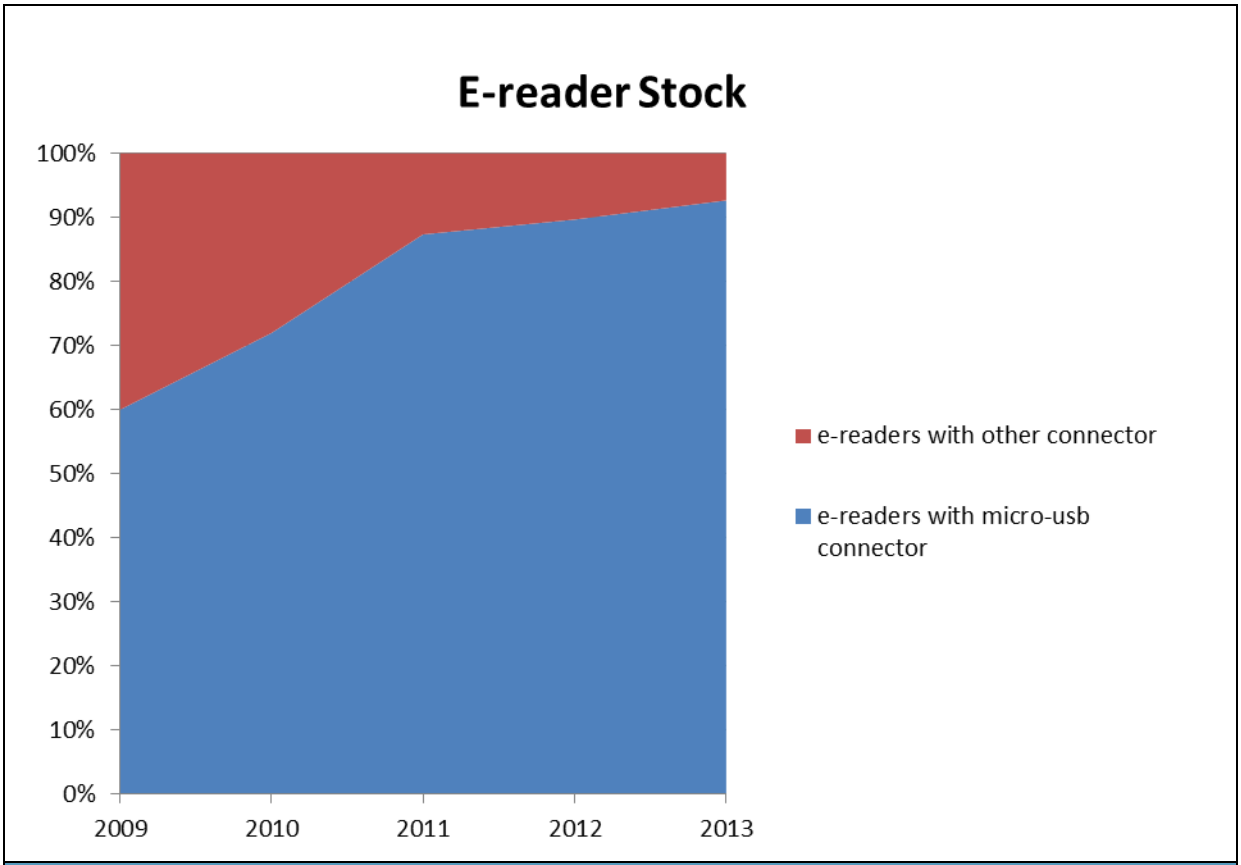

Figure 4-4: E-reader stock

As can be seen from the tables above, the most popular method of charging e-readers is via Micro-USB. However, it is difficult to determine whether this can, in any way, be attributed to the MoU. Companies active in this sector tend not to produce mobile phones which suggests that the shift to Micro-USB has not been driven by the desire to standardise approaches across multiple product groups. On the other hand, the increased uptake of Micro-USB appears to coincide with the MoU, with the greatest increase occurring between 2009 and 2011.

4.3.5 Impacts on Consumers

It can be assumed that a large proportion of consumers can use their mobile phone charger to charge their e-reader and vice versa. This is to a certain extent the result of the harmonisation of charging in the mobile phone sector and can thus be attributed to the MoU. In this respect, the impact of the MoU on e-readers have been positive.

4.3.6 Impacts on Manufacturers

22 companies that sell own brand e-readers in the EU have been identified and approximately 50% of them are headquartered in the EU. In addition, several companies have withdrawn from the market since 2008 but there is no indication that these withdrawals were in any way linked to the MoU. Overall, the impact of the MoU on manufacturers of e-readers has in all likelihood been limited. Most companies producing e-readers do not make mobile phones (although there are exceptions such as BQ and Sony) and some e-reader manufacturers continue to introduce models that charge via Mini-USB.

4.3.7 Impacts on the Environment

Manufacturers appear to continue supplying chargers or at least USB cables with new devices. This shows that the extent of decoupling of charger and device sales has been limited. It is possible, however, that consumer acceptance of models that are supplied with a charging cable has increased because many consumers that also own a mobile phone now have a USB mains charger at home.

4.3.8 Other Impacts

No impacts of the MoU on the safety of e-readers have been identified.

4.3.9 Conclusions

As noted above, the most common method of charging e-readers that are currently on the EU market is Micro-USB. Whilst it is difficult to determine whether this can in any way be attributed to the MoU, it is clear that harmonisation of charging in the mobile phone sector has enabled many users of e-readers to charge their devices using their mobile phone charger.

Some manufacturers continue to rely on Mini-USB charging, even on recent models, but the market share of these manufacturers is limited.

4.3.10 Summary of Charging Requirements in Non-EU Countries

No information has been identified as regards requirements on the charging of e-readers in countries outside of the EU.

4.4 Laptops (Including Netbooks)

4.4.1 Summary of Market Data

The scope of this study encompasses netbooks and large laptops. Whilst netbooks belong to the larger family of laptops, netbooks can be defined as "small, light, low-power[199] notebook computers that have less processing power than a full-size laptop" (Techtarget, nd). All other laptops are referred to as full-size or large laptops. In the absence of concrete definitions, it can be difficult to determine the thresholds which distinguish netbooks and other laptops. For example, given their smaller size, it would be reasonable to assume that the chargers of netbooks have a lower output. However, this is not necessarily the case; for example, a charger for the Advent 4211C netbook can charge at up to 65W[200] while a charger for a Samsung NP-R519 full-size laptop operates at 60W[201]. For this reason, the assessment in Section 4 and Section 5 of this study is carried out jointly for netbooks and large laptops. References to 'laptops' in this study are thus to be construed as covering both netbooks and full-size laptops[202].

Worldwide

In 2011, global laptop shipments were expected to reach 211 million units, with this being a 10% increase on 2010 (Smith, 2011b). Protalinski (2013b) provides data for global notebook sales, which reached 234 million units in 2012 and projected sales of 205.6 million units in 2013 and 171.9 million units in 2017. This appears to be supported by a sharp decline in laptop shipments in mid-2013, with shipments in Q2 of 2013 decreasing by almost 14% (Protalinski, 2013). Table 4-11 provides an overview of actual and expected global shipments of all laptops and netbooks on a global scale between 2008 and 2017.

Table 4-11: Global Shipments of Laptops and Netbooks

Year	Laptop shipments (million units)	Netbook shipments (units)
2010	189.9	36.0
2011	211.0	26.0
2012	234.0	36.0
2013 (f)	205.6	
2014 (f)	197.2	
2015 (f)	188.8	
2016 (f)	180.3	
2017 (f)	171.9	

Sources: Gothard (2013), Smith (2011b), Protalinski (2013b), projections based on Protalinski (2013b)
Note: (f) - forecast

[199] Netbooks used low-power Intel Atom processors (McAllister, 2012).

[200] Amazon, For advent 4213, 4214, 4211C Netbook charger AC adaptor, accessed, http://www.amazon.co.uk/ADVENT-4211C-NETBOOK-CHARGER-ADAPTOR/dp/B003T0ALEI/ref=tag_stp_s2_edpp_url

[201] Amazon, SAMSUNG NP-R519 AD-6019R LAPTOP CHARGER AC ADAPTOR 19V 3.15A 60W, accessed, http://www.amazon.co.uk/SAMSUNG-NP-R519-AD-6019R-CHARGER-INCLUDES/dp/B005Q9PSIO/ref=sr_1_1?s=computers&ie=UTF8&qid=1389353021&sr=1-1&keywords=samsung+laptop+charger

[202] Some sources use also terms such as "sub-notebooks" or "mini notebooks", which appear to be similar in their specifications to netbooks. A more recent type of laptop is the "Ultrabook" (based on Intel's brand name), which is a sub-notebook designed to be less bulky than a full-size laptop while still providing a high level of performance and battery life.

Laptop sales have begun to decline as a result of the increased popularity of tablets. European laptop sales have been decreasing gradually since 2011 and this trend is expected to continue. In Eastern Europe, sales have remained largely static, compared to Western Europe, where sales are expected to decrease by 5 million units between 2011 and 2014, as illustrated in the Table 4-12. Further information on the laptop market in individual Member States can be found in Annex 4.

Table 4-12: Notebook sales forecast for Europe from 2011 to 2014

Year	Western Europe	Eastern Europe
2011	40,512,000	28,720,000
2012	37,400,000	31,697,000
2013	36,928,000	29,800,000
2014	35,544,000	30,879,000

Sources: Statista (2013); Statista (2013b)

Key non-EU countries

As laptops have become more affordable, customers in the US have shown a preference towards portable PC solutions than desktops[203]. The market is expected to grow further but the main driver is now likely to be ultrabooks, some of which are smaller, lighter and have an extended battery capacity[204].

By 2012, China will have become the most important laptop market in the world, accounting for 22% of demand and contributing to over 90% of total production[205]. Currently the desktop/laptop ratio is around 50/50, but in China laptops are expected to become more popular in the future at the expense of desktop, similarly to the global trend[206].

The Korean laptop market is dominated by Samsung and LG and other domestic manufacturers. According to Euromonitor International (2012), Korean consumers will keep turning away from desktop in favour of laptops and tablets[207].

Further details on the laptop market in non-EU countries can be found in Annex 4.

Structure of the Market and Trade

The main manufacturers of laptops sold in Europe have remained largely unchanged from 2009 to 2013. These are HP, Acer, Asus, Dell, Lenovo and Apple (see Figure A4-1 in Annex 4).

[203] CM(2013): The Retail Market for Laptop Computers in the US - Industry Market Research Report, accessed at http://www.companiesandmarkets.com/Market/Retail/Market-Research/The-Retail-Market-for-Laptop-Computers-in-the-US-Industry-Market-Research-Report/RPT1133572?aCode=b665b089-afc2-4102-9abd-a47c38e3ae3c

[204] IBISWorld (2013): The Retail Market for Laptop Computers in the US, accessed at http://www.prweb.com/releases/2013/1/prweb10314317.htm

[205] IHS (2012): China's PC Market to Enjoy Healthy 13 Percent Growth in 2012, accessed at http://www.isuppli.com/China-Electronics-Supply-Chain/News/pages/Chinas-PC-Market-to-Enjoy-Healthy-13-Percent-Growth-in-2012.aspx

[206] BBC (2013): China becomes biggest PC market in 2012 - IHS report, accessed at http://www.bbc.co.uk/news/business-22346821

[207] Euromonitor International (2014): Computers and Peripherals in South Korea, accessed at http://www.euromonitor.com/computers-and-peripherals-in-south-korea/report

There is no dominant manufacturer in terms of market share in Europe; this is also the case at a global level, where the leading manufacturers are also HP, Lenovo, Dell, Acer and ASUS, as depicted in Figure 4-5.

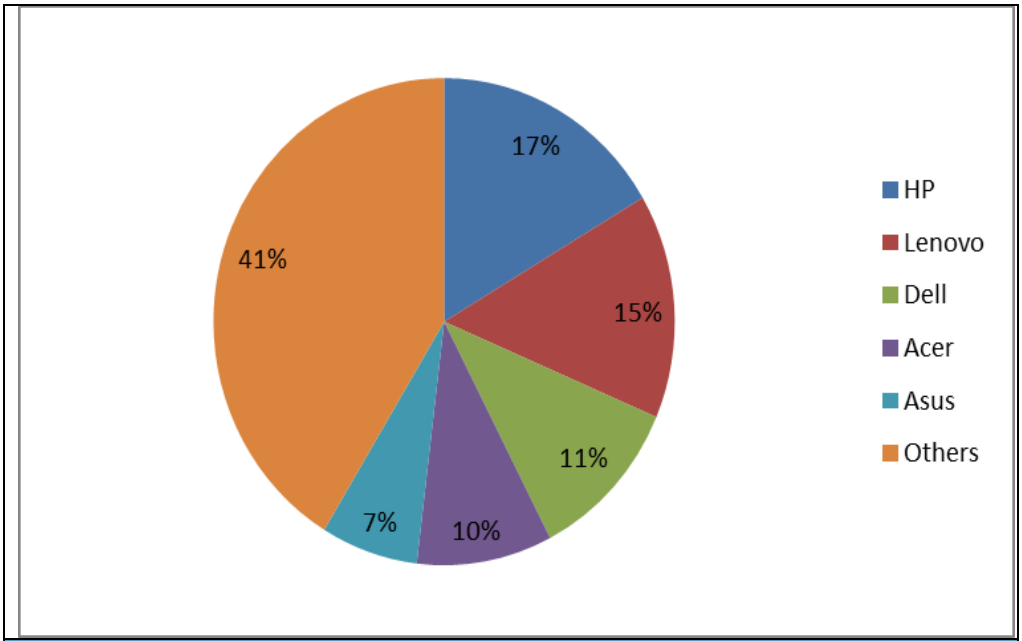

Figure 4-5: Market share of the main manufacturers of the global PC sector in 2012
Source: King (2013)

Prodcom code '26201100 – Laptops and palm-top organisers' covers the production of laptops but also covers "notebook computers; personal digital assistants and similar computers" and thus is also likely to include tablets. Table 4-13 overleaf shows production levels across Member States for the period 2009 to 2012. Limited production is carried out in the EU (a maximum of 11 Member States recorded production in any one year), with Germany recording the highest levels of production by far.

Table 4-13: Production of '226201100 - Laptop PCs and palm-top organisers' in the EU								
Member State	Production in the EU							
	2009		2010		2011		2012	
	Quantity/unit	Value/€	Quantity/unit	Value/€	Quantity/unit	Value/€	Quantity/unit	Value/€
Austria	:	:	:	:	:	:	:	:
Belgium	0	0	0	0	0	0	0	0
Bulgaria	:	:	:	:	0	0	:	:
Croatia	1,000	1,251,000	1,000	1,950,000	1,000	1,668,000	0	1,173,000
Cyprus	0	0	0	0	0	0	0	0
Czech Republic	:	:	:	:	:	:	:	:
Denmark	0	13,000	0	25,000	0	85,000	0	30,000
Estonia	:	:	6,000	2,624,000	7,000	2,853,000	4,000	1,418,000
Finland	11,000	4,483,000	0	1,000	7,000	1,004,000	7,000	1,223,000
France	:	:	7,000	4,192,000	5,000	3,971,000	6,000	:
Germany	6,070,000	2,145,076,000	:	:	:	1,933,214,000	5,572,000	1,938,532,000
Greece	:	:	:	:	:	:	:	:
Hungary	:	:	0	0	0	0	0	0
Ireland	:	:	0	0	0	0	0	0
Italy	137,000	52,219,000	129,000	48,466,000	96,000	56,301,000	86,000	53,196,000
Latvia	0	0	:	:	0	0	:	:
Lithuania	3,000	1,157,000	0	0	0	0	0	0
Luxemburg	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0
Netherlands	0	0	0	0	0	0	:	:
Poland	24,000	11,312,000	:	10,774,000	:	12,131,000	:	:
Portugal	672,000	133,548,000	677,000	122,071,000	2,024,000	229,222,000	1,394,000	161,268,000
Romania	0	0	0	0	0	0	0	0
Slovakia	0	0	0	0	0	0	0	0
Slovenia	:	:	:	:	:	:	0	0
Spain	40,000	16,710,000	48,000	12,225,000	231,000	23,143,000	15,000	3,717,000
Sweden	24,000	11,237,000	39,000	20,955,000	:	:	:	:
United Kingdom	77,000	37,390,000	:	:	:	44,196,000	105,000	54,935,000
EU27 TOTALS	12,000,000	5,000,000,000	10,000,000	4,000,000,000	5,000,000	2,338,610,000	7,800,000	2,280,000,000
Notes: Figures are rounded. : = no data available								
Source: Eurostat, data for 2009-12 for 26201100 - Laptop PCs and palm-top organisers								

4.4.2 Main Market Trends

Between 2008 and 2013, shipments and sales of laptops were decreasing year on year. An even sharper decline has been experienced by the netbook market. By the end of 2012, the manufacture of traditional netbooks in particular had been largely discontinued by the vast majority of manufacturers. Indeed, Acer and Asus were the only manufacturers which continued production, mostly for emerging markets in South America and South East Asia. However, both manufacturers did not expect to continue production beyond 2012. Additionally, HP, Samsung, Sony, Toshiba and Dell have all exited the netbook market. The market for such low-end and low-capability netbooks has been significantly eroded by tablets making it an unprofitable market segment for manufacturers. Additional information can be found in Annex 4.

4.4.3 Impacts on the Market for Laptops and their Chargers

Prior to the MoU for mobile phones, all laptops used a proprietary charger. Following a review of laptops on the EU market from 2008 to 2013, it is evident that over this period, all but one laptop have used a proprietary charger. Therefore the MoU has had no impact on the charging solution for laptops and netbooks. The Chromebook 11, released by Google and HP, charges via a USB 2.0 Micro-USB charger which is capable of delivering up to 15.75W (5.25V, 3A). It is not clear what the motivation was behind the decision to use this type of charger. Although USB 2.0 Micro-USB chargers for smartphones or tablets could in theory be used to charge the Chromebook, the rate of charging would be slow, as the chargers will not supply sufficient amperage.

4.4.4 Impacts on Consumers

The MoU has had no impact on the market for laptops and consequently no impact on consumers.

4.4.5 Impacts on Manufacturers

The MoU has had no impact on the market for laptops and there has been no impact on manufacturers.

4.4.6 Impacts on the Environment

The MoU has had no impact on the market for laptops and there has been no impact on the environment.

4.4.7 Other Impacts

No other impacts of the MoU have been identified. Given that there have been a number of faulty laptop chargers seized in recent years in the UK alone, it could be assumed that there is a market for cheap laptop chargers as there is for mobile phone chargers. It may also be the case that a number of these cheap laptop chargers may be counterfeit and some may also present a danger to the consumer. For this reason, consumers have been urged by to purchase replacement laptop chargers from reputable retailers[208]. However, this cannot be attributed in any way to the MoU for mobile phones.

[208] Wandsworth Council, Fire risk from cheap phone and laptop chargers, 19 December 2012, accessed at: http://www.wandsworth.gov.uk/news/article/11603/fire_risk_from_cheap_phone_and_laptop_chargers and BBC news, Brian Milligan, Internet shoppers warned about electrical goods, 27 November 2010,

4.4.8 Conclusions

The MoU has had no impact on the market for laptops.

It would appear that the main reason chargers for laptops have not moved to harmonisation (particularly Micro-USB) relates to the power output limitations of older USB specifications. To date, only one laptop charges via Micro-USB. It is possible that other manufacturers will follow suit and develop laptops which charge via Micro-USB. Charger harmonisation is more feasible given the release of USB Power Delivery which is capable of delivering up to 100W with the standard USB connector and up to 60W with the Micro-USB connector.

4.4.9 Summary of Charging Requirements in Non-EU Countries

No requirements on laptop charging in jurisdictions outside the EU have been identified.

accessed at: http://www.bbc.co.uk/news/business-11849914 and Newham Recorder, Melissa York, Fresh warning after a thousand 'dangerous' laptop leads found heading for Upton Park, 5 April 2013, accessed at: http://www.newhamrecorder.co.uk/news/court-crime/fresh_warning_after_a_thousand_dangerous_laptop_leads_found_heading_for_upton_park_1_2003474 and IWillKeepYouSafe, Dan Olewiler, Fire hazards: generic laptop power cords, 16 October 2012, accessed at: http://www.iwillkeepyousafe.com/2012/10/fire-hazards-generic-laptop-power-cords

4.5 Digital Cameras and Camcorders

4.5.1 Summary of Market Data

Europe

Europe is one of the largest markets for **digital cameras** globally. In terms of its size, it is very close to the USA and far exceeds the market sizes of both China and Japan. Overall, sales of digital cameras are decreasing as the market for compact digital cameras matures and the capabilities of other devices, such as the smartphone, increase. Japanese manufacturers account for 83% of the global market for digital cameras. Table 4-14 presents the total shipments by Japanese manufacturers of digital cameras to Europe between 2008 and 2012. For more information, see Table A5-1 in Annex 5.

Table 4-14: CIPA Production and Shipment Data 2008-2012

Year	Total Unit Shipments to Europe	Total shipments to Europe (€1,000)	Units Shipped to Europe (%)	Price Shipped to Europe (%)
2012	32,451,434	3,484,867	33.07	29.30
2011	35,613,406	4,184,537	30.83	28.81
2010	37,045,314	4,087,327	30.50	27.95
2009	32,086,090	3,949,640	30.31	30.85
2008	37,889,399	6,042,941	31.64	32.47
Source: CIPA (nd)				

The global market for digital cameras includes a large number of players, each of which is competing for a share of a shrinking market. From the data available, it would appear that globally, no one manufacturer dominates the market for digital cameras. The global market share of a number of manufacturers in 2009 and 2010, as well as in 2012, is presented in the table below.

Table 4-15: Market Share of Manufacturers of Digital Cameras in 2009, 2010 and 2013 (global)

Company	2009	2010	2012
Canon	19%	19%	23%
Nikon	11.1%	12.6%	21%
Sony	16.9%	17.9%	15%
Samsung	10.9%	11.1%	9%
Fujifilm	5.4%	4.9%	8%
Kodak	8.8%	7.4%	-
Panasonic	7.6%	7.6%	-
Olympus	6.2%	6.1%	-
Casio	4.7%	4%	-
Pentax	1.7%	1.5%	-
Vivitar	0.7%	1.2%	-
Other	7%	6.7%	24%
Source: Wakabayashi (2013); Sawa & Yasu (2011)			

For the digital camera market as a whole, Canon is the market leader, and although it has gained market share between 2010 and 2012, competition from Nikon (which has also gained market share during this time) is increasing. The growing market shares of Canon and Nikon appear to have been at the detriment of other players such as Sony and Samsung, with the exception of Fujifilm which

has increased its market share over this period. In 2012, Kodak announced it was to stop production of digital cameras, pocket digital camcorders and digital picture frames in an effort to cut costs (Techradar, 2012b).

In 2011, 16.6 million **camcorders** were produced globally, which represents a decrease of 2.6% compared with 2010 (Gartner, 2012). According to a study by GfK, in Western Europe, the camcorder market suffered a decline of 12% in the first half of 2011 compared with the previous year, with overall unit sales of 1.7 million. Pocket camcorders, and particularly 'action cameras', is one segment that is notably buoyant. In Europe specifically, sales of action cameras grew 83% in 2012 (Futuresource Consulting, 2013). The market for action cameras is expected to grow significantly, at a compound annual rate of 11% (Herman, 2013). For more information on the expected growth of action cameras, see Annex 5.

The main manufacturers of digital camcorders on a global scale are Sony, Panasonic, JVC and Canon. Some smaller companies may also be involved in the manufacture of camcorders; however, due to competition from big-name rivals as well as from smartphones, many have ceased production. Such was the case with Flip, which manufactured pocket camcorders but was dissolved by its owner Cisco in 2011.

Key non-EU markets

In 2011, the US was the biggest importer of digital cameras and camcorders and the fifth biggest exporter[209]. Sales have been decreasing in the past years due to the highly saturated market. Research and Markets still forecasts the US digital camera market to grow at a CAGR of 8.3% between 2013 and 2018, mainly due to the appearance of new technology (mirrorless interchangeable lens cameras) offering high-quality pictures taken by a low-weight device[210].

In 2011, China was the second biggest importer of digital cameras and camcorders and the biggest exporter globally[211]. KEN Research's study suggests that the Chinese market is projected to grow at a CAGR of 21.9% from 2012 to 2017. Similarly to the global trend, the driver behind the growth is the high demand for cameras with interchangeable lenses[212].

In South Korea, between 2012 and 2013, the sales value of digital cameras fell by 21.9% and the interchangeable lens camera market declined by 30.1%.[213] During the same period, the camcorder market declined by 30.4%. The main cause of this trend is the increasing popularity of smartphones and their ability to meet the needs of the average Korean consumer. Within the camcorder market,

[209] World Trade Daily: WIT Report for HS Code: 852580 Digital Cameras & Camcorders, accessed at http://worldtradedaily.com/2013/04/22/wit-report-for-hs-code-852580-digital-cameras-camcorders/

[210] KEN Research: Global Digital Camera Industry Outlook to 2017 – Emerging Markets, Next Big Destination for DSC Manufacturers, accessed at http://www.reportlinker.com/p01171795-summary/Global-Digital-Camera-Industry-Outlook-to-Emerging-Markets-Next-Big-Destination-for-DSC-Manufacturers.html

[211] World Trade Daily: WIT Report for HS Code: 852580 Digital Cameras & Camcorders, accessed at http://worldtradedaily.com/2013/04/22/wit-report-for-hs-code-852580-digital-cameras-camcorders/

[212] KEN Research: Global Digital Camera Industry Outlook to 2017 – Emerging Markets, Next Big Destination for DSC Manufacturers, accessed at http://www.reportlinker.com/p01171795-summary/Global-Digital-Camera-Industry-Outlook-to-Emerging-Markets-Next-Big-Destination-for-DSC-Manufacturers.html

[213] GfK Market Insight: South Korea An Overview and Key Highlights of the Consumer Technology Market, accessed at http://www.gfkrt.com/imperia/md/content/gfk_rt_asia/gmi_korea_february_2013_en.pdf

the rising demand for HD camcorders, in particular, is expected to lead to marginal positive growth[214].

For more information on key national markets within and outside the EU, please refer to Annex 5.

4.5.2 Structure of the Sector and Trade

Compact digital cameras

As regards compact digital camera market, there is a large number of players competing for a share of a shrinking market. However, in the market for other types of digital cameras, competition is significantly less intense with fewer companies dominating (e.g. Canon and Nikon dominate the market for digital SLR cameras).

Manufacturing in the EU

The EU is not a significant producer of compact digital cameras; indeed, the majority are currently imported from Japanese manufacturers. However, some companies such as Leica of Germany do conduct manufacturing in Europe, although it is not known how many compact digital cameras are manufactured in the EU by them.

As shown in Table 4-16, the EU produces a number of digital cameras annually, and importantly, in spite of the decrease in sales of digital cameras at the global level, the level of production in the EU has been increasing since 2009.

Table 4-16: EU Production of Digital Cameras (2008 to 2012)

Year	Production Quantity	Production Value (€)	Average Value (€)
2008	102,238	154,376,839	1,510
2009	161,152	152,000,000	943
2010	231,000	240,000,000	1,039
2011	257,160	315,541,688	1,227
2012	316,928	319,117,932	1,007

Source: Eurostat (note: data for Croatia were not available)

From Table 4-16, it can be seen that the average production value per unit produced in the EU was €1,006 in 2012. When compared to the value (per unit) of imported digital cameras, which is in the region of €100, it is clear that the units produced in the EU are of significantly greater value than those that are imported. Indeed, cameras manufactured in Europe appear to be 'high-end' and aimed primarily at the niche or professional markets, with no mass manufacturing taking place. For example, one company active in Europe, the German manufacturer Leica, produces high-value cameras and has plants in both Germany and Portugal. In addition, there are some other companies which continue to manufacture in the EU, for example:

- In Sweden, the company Hasselblad has manufacturing facilities. It specialises in the manufacture of professional camera equipment but has recently began (in collaboration with Sony) making compact cameras for the consumer market.
- Linhof (Germany) manufactures high-end professional camera equipment. It does not appear that it currently manufactures cameras for the consumer market.

[214] Euromonitor International: Imaging Devices in South Korea, accessed at http://www.euromonitor.com/imaging-devices-in-south-korea/report

- DHW Fototechnik (Germany) appears to manufacture Rolleiflex cameras in the country. These are specialist, high-end products. Compact Rollei cameras are also available but appear to be manufactured outside of the EU.
- Silvestri (Italy) produces digital cameras in Italy. Their products are mainly for the professional market.

It is not clear to what extent the components for cameras captured in EU production data are actually manufactured in the EU. Indeed, it would appear that some components are produced outside of the EU, with final assembly taking place in the EU. However, there are a number of component manufacturers located within the EU, e.g. Cooke Optics (UK) which manufactures lenses, Schneider Kreuznach of Germany which also manufactures lenses and filters, and Carl Zeiss, an international company which manufactures lenses, and which also has some manufacturing in Europe. Production figures from Table 4-16 are broken down by Member State in Table 4-17, which clearly shows the limited number of Member States involved in this sector.

Employment

The total level of employment in the manufacturing of cameras in the EU is not known. According to data from Eurostat, employment in the EU27 in the manufacture of optical instruments and photography was 44,500 (and 2,500 companies) in 2010 (Eurostat, 2013[215]). That said, the Leica camera group company has a number of employees in the EU. It was estimated that in 2008, there were 451 employees in Germany and 477 in Portugal. Hasselblad (Sweden) has 180 employees, and DHW Fototechnik employs approximately 50 people.

SMEs

It would appear that a number of the digital camera manufacturers active in Europe are SMEs. For example, Hasselblad (Sweden) has only 180 employees, and DHW Fototechnick has 50.

Charging methods

A sample of over 90 cameras launched between 2010 and 2014 by three biggest manufacturers and one smaller manufacturer has been reviewed to determine the extent to which Micro-USB is used for charging. This review indicates that Micro-USB is not used extensively. Rather, many cameras have removable or disposable batteries and those with a battery that is charged in the camera commonly use proprietary connectors. Cameras capable of in-device charging are offered with a mix of Mini-USB, Micro-USB, and proprietary chargers. In addition, it seems that there is no consistency between the connectors used and the brand, i.e. major manufacturers appear to go between proprietary and Micro-USB chargers with different digital camera models and release dates. One of the large manufacturers offered its devices exclusively with Mini-USB during this period, and another offered them exclusively with a proprietary charger. Another large manufacturer offered either a proprietary cable or Micro-USB for the models released throughout this period. During 2011 – 2012, a smaller manufacturer offered its devices exclusively with a proprietary charger; however, its newer models released in 2013 have a Micro-USB conector. Overall, it appears that the devices released by these manufacturers during 2010 – 2014 were predominantly offered with a proprietary charger, followed by Mini-USB. Micro-USB appears to have been the least popular option.

[215] Eurostat (2013): Manufacture of computer, electronic and optical products – statistics – NACE Rev.2, available from http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Manufacture_of_computer,_electronic_and_optical_products_statistics_-_NACE_Rev._2

Table 4-17: Production of '26701300 - Digital cameras' in the EU								
Member State	Production in the EU							
	2009		2010		2011		2012	
	Quantity/unit	Value/€	Quantity/unit	Value/€	Quantity/unit	Value/€	Quantity/unit	Value/€
Austria	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	0	0
Bulgaria	0	0	0	0	0	0	0	0
Croatia	0	0	0	0	0	0	0	0
Cyprus	0	0	0	0	0	0	0	0
Czech Republic	0	0	0	0	0	0	0	0
Denmark	2,000	15,868,000	3,000	23,625,000	3,000	26,160,000	1,000	7,236,000
Estonia	0	0	0	0	0	0	0	0
Finland	0	0	0	0	0	0	0	0
France	:	:	:	:	:	:	:	:
Germany	142,000	101,931,000	204,000	189,987,000	226,000	237,598,000	285,000	262,869,000
Greece	0	0	0	0	0	0	0	0
Hungary	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0
Italy	:	:	12,000	1,619,000	15,000	2,060,000	16,000	1,494,000
Latvia	0	0	0	0	0	0	0	0
Lithuania	0	0	0	0	0	0	0	0
Luxemburg	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0
Netherlands	:	:	:	:	:	:	:	:
Poland	:	:	0	0	0	0	0	0
Portugal	0	0	0	0	0	0	0	0
Romania	0	0	0	0	0	0	0	0
Slovakia	0	0	0	0	0	0	0	0
Slovenia	0	0	0	0	0	0	0	0
Spain	0	0	0	0	0	0	0	0
Sweden	0	0	0	0	:	:	:	:
United Kingdom	3,000	13,249,000	4,000	15,115,000	4,000	12,463,000	6,000	17,965,000
EU27 TOTALS	161,000	152,000,000	231,000	240,000,000	257,000	315,542,000	317,000	319,118,000
Note: Figures are rounded. : = no data available								
Source: Eurostat, data for 2009-12 for 26701300 - Digital cameras								

Trade

When comparing data on sales of digital cameras in the EU and level of imports of digital cameras to the EU, it is evident that the EU is heavily reliant on imports of such products with little domestic production. Imports, however, have fallen from 2008 to 2012, with approximately 48 million imported in 2008, compared to 32 million in 2012. This is largely explained by the decrease in sales of digital cameras on a global basis, and particularly by the decrease in sales of cheap compact digital cameras. Exports of digital cameras are significantly lower than imports and although they too have decreased, it has been at a significantly lower rate than imports: from 5.5 million in 2008 to 3.2 million in 2012. The change in imports and exports of digital cameras is illustrated in the figure below.

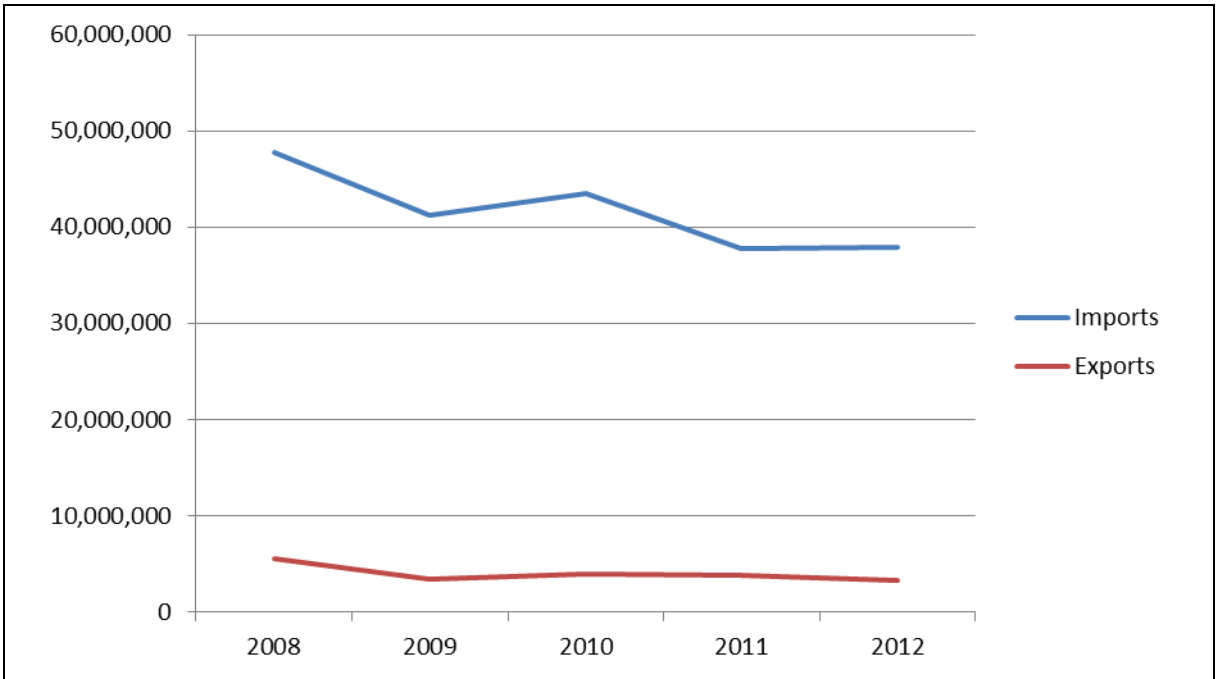

Figure 4-6: Imports and Exports of Digital Cameras to and from the EU from 2008 to 2012 (Source: Eurostat)

Digital Camcorders

As previously noted, the main manufacturers of digital camcorders on a global scale are Sony, Panasonic, JVC and Canon. It appears that smaller companies involved in the manufacture of camcorders may be facing stiff competition from big-name rivals and/or may have been wound up by parent companies, as in the case of Flip.

Sony is a European market leader in digital camcorders, and in 2012 accounted for 40% of the market by volume and 44% by value (Phillippon, 2013). The market leader in action cameras is the US company GoPro which dominates the market in every European country (Futuresource Consulting, 2013). Sales of GoPro action cameras have more than doubled every year since the sale of the first camera in 2004. In 2012, GoPro sold 2.3 million cameras worldwide and grossed €400 million (Mac, 2013). However, GoPro is facing increasing rivalry from manufacturers of conventional digital camcorders, including Sony and JVC. The manufacturer of GPS/Personal Navigation Devices, Garmin, has also released an action camera onto the market. Possibly as a result of increased

competition, Contour, a company which was second to GoPro for many years, ceased production and closed down in August 2013.

Manufacturing in the EU

Sony has a manufacturing presence in the EU. Previously, camcorders were manufactured in a plant in France, although this site now manufactures other Sony products. Sony high-end system cameras (video cameras for the professional market) are manufactured and serviced at a site in Wales, UK. The site at Pencoed, South Wales, employs some 513 people, and 135 focus on the manufacture of professional products (Sony, nd).

Camcorders are likely to be captured under the Prodcom code '26403300 – Video Camera Recorders'. Production figures for each EU Member State for this code over the period 2009 to 2012 are presented in Table 4-20.

Employment

Total employment in the manufacture of digital camcorders within the EU is not known. However, it would appear that very little (if any) manufacturing is currently conducted in the EU. Therefore, employment levels are not expected to exceed those reported by Sony in South Wales (although they focus on the manufacture of professional video cameras rather than digital video cameras which are more widely used by consumers).

SMEs

From the data available, it would appear that there are no SMEs involved in the manufacture of digital camcorders within the EU.

Video cameras

Data from Eurostat suggest that imports of video camera recorders have fallen from 54 million units in 2008 to 24 million units in 2012. When compared with other data regarding sales and production of digital camcorders, it would appear that that these data include more than digital camcorders. Exports of video cameras have also fallen slightly, from 2008 to 2012, although they have increased in value. Tables 4-18 and 4-19 present the imports and exports of video cameras to and from the EU from 2008 to 2012.

Table 4-18: Imports of Video Camera Recorders to the EU (2008 to 2012)

Year	Imports (quantity)	Exports (quantity)
2008	53,993,208	4,897,702
2009	46,359,344	7,164,973
2010	42,364,624	4,063,739
2011	37,167,876	3,784,973
2012	24,012,043	3,698,688
Source: Eurostat (note: data was not available for all countries)		

Table 4-19: Production of '26403300 - Video camera recorders' in the EU								
Member State	Production in the EU							
	2009		2010		2011		2012	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Austria	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	:	:	:	:
Bulgaria	0	0	0	0	:	:	:	:
Croatia	0	0	0	0	0	0	0	0
Cyprus	0	0	0	0	0	0	0	0
Czech Republic	:	:	:	:	:	:	:	:
Denmark	1,000	626,000	0	64,000	4,000	2,321,000	10,000	830,000
Estonia	0	0	0	0	0	0	0	0
Finland	0	0	0	0	0	0	0	0
France	:	:	1,000	4,729,000	:	:	0	0
Germany	27,000	:	28,000	:	22,000	:	:	:
Greece	0	0	0	0	0	0	0	0
Hungary	2,746,000	376,552,000	2,532,000	188,197,000	699,000	47,173,000	571,000	39,626,000
Ireland	0	0	0	0	0	0	0	0
Italy	8,000	5,945,000	10,000	7,250,000	9,000	6,399,000	10,000	7,042,000
Latvia	0	0	0	0	0	0	0	0
Lithuania	46,000	911,000	0	0	0	0	0	0
Luxemburg	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0
Netherlands	:	:	:	:	:	:	:	:
Poland	:	:	:	:	:	:	58,000	4,324,000
Portugal	111,000	13,248,000	126,000	20,129,000	109,000	21,893,000	77,000	14,567,000
Romania	0	0	0	0	0	0	0	0
Slovakia	0	0	0	0	0	0	0	0
Slovenia	0	0	0	0	0	0	:	:
Spain	0	0	:	:	:	:	:	:
Sweden	0	0	0	0	:	:	:	:
United Kingdom	20,000	39,328,000	19,000	42,284,000	33,000	57,594,000	28,000	55,628,000
EU27 TOTALS	6,600,000	729,159,000	6,978,000	589,477,000	4,651,000	433,960,000	3,524,000	345,511,000
Note: Figures are rounded. : = no data available								
Source: Eurostat, data for 2009-12 for "26403300 - Video camera recorders"								

4.5.3 Main Market Trends

Between 2008 and 2013, sales of digital cameras and camcorders decreased. Most notably affected were entry-level compact digital cameras as smartphones have taken interest and necessity away from basic 'point-and-shoot' cameras. As a result, manufacturers have begun to move production away from compact digital cameras and towards more high-end cameras. This, however, has not had any noticeable impact on charging.

4.5.4 Impacts on the Markets for Digital Cameras/Camcorders and their Chargers

It does not appear that the MoU has had any direct or indirect impact on the market for digital cameras and camcorders. With regard to charging digital cameras, more often than not the battery from the camera can be removed and charged separately in a proprietary charger, or the camera can be charged from a USB computer port. Although this is rarely done through Micro-USB, some manufacturers use the Micro-USB connector. Considering that the two companies whose portfolio includes digital cameras with a Micro-USB connector (although this may not in all instances be for charging), Casio and Sony, also manufacture mobile phones and/or tablets, it is possible that their decision to use Micro-USB may have been influenced by the MoU.

4.5.5 Impacts on Consumers

The MoU has not had any noticeable impact on consumers.

4.5.6 Impacts on Manufacturers

The MoU has not had any impact on manufacturers.

4.5.7 Impacts on the Environment

The MoU has not had any impact on the environment.

4.5.8 Other Impacts

No impacts of MoU on the safety of these devices have been identified. No evidence has been found of incidents involving these devices. The market for digital cameras is in decline, which makes the number of potential incidents potentially smaller compared with mobile phones.

4.5.9 Conclusions

It does not appear that the MoU has had a significant impact on the charging of digital cameras and camcorders, although some cameras are now equipped with a Micro-USB connector. However, more often than not, the battery is removed and charged separately in a proprietary charger, or charged using a proprietary cable. It is possible that more camera manufacturers may move to Micro-USB charging as they attempt to make cost savings and appeal to a larger number of consumers. However, as the MoU has not had any significant impact on the market for digital cameras and camcorders to date, the extent to which this will occur is unknown.

4.5.10 Summary of Charging Requirements in Non-EU Countries

No requirements on charging digital cameras and camcorders in non-EU countries have been identified.

4.6 Portable Media Players

4.6.1 Summary of Market Data

Worldwide and Europe

Sales of MP3 players in Europe appear to have peaked in 2007, when 43.5 million devices were sold at a value of €3.8 billion (EITO, 2010). Since 2007, interest in MP3 players has been declining largely due to the increasing capabilities of smartphones and the increasing popularity of multi-functional devices. For example, according to Mintel, in 2012 the UK sales of MP3 players fell by almost €136 million – or 22% – to €470 million, when compared to 2011 (Hall, 2012; Islam, 2012). Mintel predicts that, by 2017, UK sales will have halved and, under a worst-case scenario, sales may drop to just €31 million.

Apple has the largest market share within the MP3 player market. In 2011, the market share of the Apple iPod in the music player market was 78% (Macale, 2011) and remained at over 70% in 2012 (MacTech, 2012). The contraction of the portable media player market has also affected global iPod sales, which (as shown Figure A6-1 in Annex 6) have dropped significantly between 2006 and 2013.

Key non-EU countries

The portable media player market has been shrinking in USA, China and South Korea and is forecasted to decline further. As multi-functional smartphones have become more popular, the demand for portable media players has been constrained to areas such as running/training, where a cheaper and lighter device has considerable advantages.

For more information on key national markets within and outside the EU, please see Annex 6.

4.6.2 Structure of the Sector and Trade

As previously stated, Apple holds the majority of the market. In 2009, SanDisk was Apple's closest competitor, with a 7.2% market share, and in that year Microsoft held 1.1% (Topolsky, 2009).

Apple's current portable media player range includes the iPod Classic, the iPod Nano, the iPod shuffle, and the iPod Touch. SanDisk's current range include: the Sansa Fuze+, the Sansa Clip Zip, and the Sansa Clip+. A number of other manufacturers including Sony have a range of portable media players on the market.

Manufacturing in the EU

It does not appear that any portable media players are currently manufactured in the EU. As such, there is no associated employment and there do not appear to be any EU-based SME manufacturers.

Trade

No information regarding trade in portable media players to/from the EU has been found.

4.6.3 Main Market Trends

As noted above, the market for personal media players is decreasing due to the increasing capabilities of the smartphone and other devices (e.g. e-readers and tablets). This development can be observed in a number of national markets assessed in Annex 6.

4.6.4 Impacts on the Markets for Portable Audio Players and their Chargers

Apple is the dominant manufacturers of portable media players, with their devices using proprietary chargers rather than the Micro-USB technology. Therefore, the MoU has had no impact on the market for personal media players.

4.6.5 Impacts on Consumers

As a result of the MoU, Apple has made the Lighting/Micro-USB and 30pin/Micro-USB adaptors available for purchase by consumers and as such the MoU has had a positive impact on the ability of iPod users to charge their portable media players using a charger for a different device, e.g. a smartphone.

4.6.6 Impacts on Manufacturers

It does not appear that the MoU has had any noticeable impacts on manufacturers.

4.6.7 Impacts on the Environment

It does not appear that the MoU has had any noticeable impacts on the environment.

4.6.8 Other Impacts

It does not appear that the MoU has had any other impacts, including on the safety of charging portable media players.

4.6.9 Conclusions

Due to the fact that that Apple is the largest player in the market for personal media players, and thus the majority of devices continue to use proprietary charging capabilities, it can be concluded that the MoU has not had a significant impact on the sector. However, consumers now have the option of purchasing adaptors that allow them to charge their iPods through a Micro-USB charger. In this respect, the MoU has had a positive impact on consumer convenience in this sector.

4.6.10 Summary of Charging Requirements in Non-EU Countries

No requirements on the charging of portable media devices in non-EU countries have been identified.

4.7 Sports and Activity Monitors

4.7.1 Summary of Market Data

Worldwide

For the purposes of this report, a sports device is considered to be any portable and rechargeable device designed to enhance a leisure pursuit or sport. This includes devices which provide feedback on sporting performance (e.g. running or cycling devices which provide data on heart rate or speed), devices for golf that assist with shot selection or walking devices that assist with navigation when walking. Activity monitors are designed to be worn all day and in some instances, during the night. They are designed to help users maintain a healthy lifestyle.

IMS Research has estimated 2013 sales of sports and fitness devices at 43.8 million, increasing to 56.2 million in 2017[216]. Another reports has estimated that around 90 million wearable fitness devices will be shipped in 2017 (see Table A7-1 in Annex 7[217]). Almost half of sales in the coming years are expected to be wearable fitness devices, such as Nike's FuelBand. The Americas and Europe/Middle East regions account for over 80% of global sales[218].

Smartphones are capable of performing some functions of sports devices, such as pedometers and GPS tracking, and resultantly will affect the sales of dedicated devices. However, manufacturers of health and fitness devices sell standalone heart rate monitors which can be teamed with smartphones.

For more information on the worldwide market for these devices can be found in Annex 7.

Key non-EU countries

Wearable electronics are widely considered to be the 'next-big-thing' after smartphones and tablets. However, currently this is a niche market. Devices like activity monitors or smartwatches have their specialist customer-base, but the average customer shows little interest towards them at the moment, no matter whether they are from the USA, China or South Korea.

For more information on the Chinese and US markets, see Annex 7.

Main manufacturers

The main manufacturers are Polar and Garmin, although there are a number of smaller manufacturers, including Fitbit, Suunto and Pebble. Garmin may have as much as 90% of the global

[216] Mobihealth news, Report: 56 million sports fitness monitors to ship in 2017, May 16, 2013, accessed at: http://mobihealthnews.com/22447/report-56m-sports-fitness-monitors-to-ship-in-2017/

[217] GPS Business News, accessed at: http://www.gpsbusinessnews.com/GPS-Watches-Sales-Forecasts-Until-2015_a4210.html

[218] IHS Technology, shipments of sports and fitness monitors to total one-quarter billion from 2013 through 2017, 16/05/2013, accessed at: https://technology.ihs.com/434231/shipments-of-sports-and-fitness-monitors-to-total-one-quarter-billion-from-2013-through-2017

fitness market in 2011[219]. Other manufacturers are moving into the sector, perhaps highlighting the future growth in this sector, including TomTom, Adidas and Nike.

Average selling price

There is a wide range of devices in this sector, ranging from a simple pedometer to a sophisticated training computer; therefore it is difficult to discern an ASP and as such interpret any variation.

The market for sports devices has grown and the range of devices available has also expanded, resultantly the ASP across all manufacturers has dropped, with the most common devices being available for around €150. To remain competitive, Garmin has predicted that the price of their products could further decrease by 25% over the coming years[220].

4.7.2 Structure of the Sector and Trade

Production

Polar Electro (Polar) manufactures products in its own factories and keeps the main suppliers close to reduce transportation[221]. Since 1989, Polar has had partner projects in Hong Kong and Malaysia. An additional facility was opened in Guangdong (Southern China) in 2003[222].

It is likely that Garmin and TomTom outsource production to Taiwan, as is the case for PND they manufacture (see Section A4.8)

Associated employment

Polar Electro employs around 1,200 people worldwide and has 21 subsidiaries globally[223]. Research and development mostly takes place in Oulu, Finland.

Polar Electro has its European logistic centre located in Amsterdam, with products delivered from there straight to the logistics warehouse in Vanta, Finland. Around 1,000 consignments are dispatched from here to retailers across Finland[224].

4.7.3 Main Market Trends

Unit sales and the sales revenue of sports and activity monitors have been increasing and this trend looks set to continue. However, smart phone apps may also be used to perform the same function as sports devices and can now be paired with accessories such as heart rate monitors. This may negatively impact the sale of dedicated sports devices.

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[219] Satellite Sportlight, Fitness GPS market gets hotter with emergence of new players, devices and applications, 05/08/2011, accessed at: http://satellite.tmcnet.com/topics/satellite/articles/205066-fitness-gps-market-gets-hotter-with-emergence-new.htm

[220] Garmin runs from crowded GPS market to new fitness focus, 03.06.2011, accessed: http://www.zdnet.com/blog/btl/garmin-runs-from-crowded-gps-market-to-new-fitness-focus/49890

[221] Polar website, Accessed: http://www.polar.com/us-en/support/Made_by_Polar_in_China__Designed_in_Finland_

[222] FINNDUND, Polar starting to making heart rate monitors in China, 25/09/2003 Accessed: http://www.finnfund.fi/ajankohtaista/arkisto03/en_GB/polarchn/

[223] Polar website, accessed: http://www.polar.com/en/about_polar/who_we_are

[224] Postnord - logistics, Fast delivery and high-quality distribution, accessed: http://www.postnordlogistics.fi/en/solutions/retail/Pages/Polar-Electro.aspx

4.7.4 Impacts on the Markets for Sports and Activity Devices and their Chargers

In terms of sports devices, only a handful of devices have been identified that are charged via Micro-USB, namely, the Polar RC3, Motorola Motoactv, O-Synce Navi2Coach, Polar V650 and Timex Cycle Trainer 2.0 GPS.

Garmin appears to have adopted two approaches for charging its sports devices, a charging clip/cradle and Mini-USB, although it has also recently launched one device using Micro-USB. The former method of charging allows for data transfer and is waterproof while maintaining acceptable device size. This has led to the development of specific swim watches, multi-sport watches and mariner watches that can be worn when undertaking activities in water. Furthermore, the charging method of the charging clip/cradle – pins attaching to flat contacts on the device – does not require much space on the device itself. This means that devices can stay small and can be worn comfortably on the wrist of the user. More recently, Polar and Timex have developed watches that are charged using a charging proprietary charging clip. However, Polar have also released a running watch (Polar RC3) which is charged via Micro-USB. Evidently, when manufacturers are deciding which method of charging to adopt, they will need to weigh up whether they want to offer consumers the convenience of Micro-USB charging or a proprietary method of charging which is waterproof without compromising the size of the device.

The second method of charging used by Garmin is the Mini-USB, which is typically used on those devices that are not required to be worn on the user. For example, the Garmin Edge series of sports devices are affixed to the bicycle rather than the user. Similarly, the Garmin approach device for golfers, that has an integrated rechargeable battery, needs only be looked at prior to taking a shot and does not need to be worn on the wrist of the user. Users are likely to attach the device to the golf bag/buggy or simply carry it in their pocket.

Mirroring the trend of sports monitors, the sales of activity monitors are also increasing. For these devices there is a range of proprietary charging methods.

4.7.5 Impacts on Consumers

No impacts of the MoU on consumers have been identified.

4.7.6 Impacts on Manufacturers

No impacts of the MoU on manufacturers have been identified.

4.7.7 Impacts on the Environment

No impacts of the MoU on the environment have been identified.

4.7.8 Other Impacts

No impacts of the MoU have been identified. No evidence has been identified of incidents involving these devices.

4.7.9 Conclusions

Overall, it does not appear that the MoU has had any impacts on the charging of sports and activity monitors.

One of the main barriers to standardisation appears to be the need for waterproofing the device and keeping the device small enough so that it can comfortably be worn on the wrist. Garmin have developed a proprietary charging clip/cradle that is waterproof and allows the transfer of data. While the Mini and Micro-USB port can be sealed with sealing rings and/or magnetic locks, it would seem that this approach is may not be an ideal solution for triathletes, swimmers or mariners (waterproofing a Micro-USB port may make the device bigger, less comfortable to wear and less robust). Consequently, Micro-USB charging is not suitable for devices that need to be waterproof.

4.7.10 Summary of Charging Requirements in Non-EU Countries

No requirements on the charging of sports and activity monitors in non-EU countries have been identified.

4.8 Personal Navigation Devices

4.8.1 Summary of Market Data

Global sales of personal navigation devices (PNDs) have been decreasing in recent years, from a high of 41 million units in 2008 to 28 million in 2012. Mitac estimate that sales will continue to drop to 17 million units in 2017. The decreasing sales coincide with the widespread adoption of smartphones which are capable of navigation. Many new vehicles are equipped with an in-built navigation system, negating the need for a standalone device.

Global shipments are predicted to decline from 41 million units in 2008 down to 17 million units in 2017 (see Table A8-1 in Annex 8). In Europe the market has declined from around 17 million in 2008 to around 9.5 million in 2012 (Table A8-3). Smartphones have cannibalised the PND market, for example, in France, 90% of smartphones sold in 2009 had the ability to perform the function of a PND (see case study on France in Annex 8).

A survey by Flash Eurobarometer of the EU27 countries revealed that 29% of consumers use a PND for navigation purposes; this is compared to 18% which use a smartphone and 13% which use an integrated system. The Netherlands had the highest PND use at 45%, followed by Germany (40%) and Finland (30%).

Non-EU countries summary

The market for PNDs was booming from 2008 to 2010; however, in the future PNDs will face increased competition from built-in systems and smartphones. The US and Korea are mature car markets, personal navigation devices sales in these countries have peaked and are forecast to decline in the future[225]. China has a considerably less mature car market and PNDs are still not very widespread among car owners. As car sales are expected to increase, so too will the customer base for this device and resultantly the PND market is expected to grow further[226].

Main manufacturers

The global and European PND market is dominated by two manufacturers, Garmin and TomTom; in 2009 the market shares were 36% and 30% respectively. TomTom has a market share in Europe around 47% in 2013 (see Table A8-9 in Annex 8)

Other manufacturers include Navigon, and Mio/Mag/Navman.

[225] GSA: GNSS Market Report – Issue 2 (2012), accessed at http://egnos-portal.gsa.europa.eu/sites/default/files/content/Market_Report_GSA_2012.pdf, GfK Market Insight: South Korea An Overview and Key Highlights of the Consumer Technology Market, accessed at http://www.gfkrt.com/imperia/md/content/gfk_rt_asia/gmi_korea_february_2013_en.pdf, Euromonitor International: In-Car Entertainment in South Korea, accessed at: http://www.euromonitor.com/in-car-entertainment-in-south-korea/report

[226] GPSWorld: China Industry Report: "Amazing Growth" in Mobile Market, accessed at http://gpsworld.com/china-industry-report-amazing-growth-in-mobile-market/, Technolohy Tell: China to Emerge as One of the Largest Markets for Automotive Navigation and Telematics Services, accessed at http://www.technologytell.com/in-car-tech/2602/china-to-emerge-as-one-of-the-largest-markets-for-automotive-navigation-and-telematics-services/

Average selling price

Although no data has been identified concerning the ASP of PNDs, it is believed that this has declined due to inter and intra-market competition and market diversification.

4.8.2 Structure of the Sector and Trade

Production

GPS systems are comprised of satellite constellations, terrestrial control stations and receiver devices. Taiwanese companies have concentrated on the latter sector as the former sectors require high technological complexity and are prohibitively expensive.

In 2010, Taiwan was reported as the biggest PND producer in the world, with almost 90 % of the global market share of production. This amounted to an estimated value of €3.1 billion. Unsurprisingly, production for the three major PND companies (Garmin, Taiwan, Mio) takes place in Taiwan[227]. Altogether, GPS shipments by Taiwanese manufactures of GPS devices in 2009 amounted to more than 40 million units. It has ranked number one in the world for GPS hardware production value and volume from 2005 – 2010[228].

As a result of vertical integration, Garmin is firmly established within Taiwan with research and development, production and marketing all based there. Around 50,000 – 60,000 devices are manufactured each day. Half of the workforce is located there. However, as the US is Garmin's biggest market and aviation navigation equipment requires US certification, the US headquarters are in charge of research and development and manufacture of aviation products[229]. For TomTom, production is undertaken by two companies, Inventec Appliance Corp. and Quanta, with Inventec taking on most of the business[230]. Both of these are located within Taiwan. The headquarters of MiTAC and its factories are located within Taiwan, although assembly centres can be found in the US, UK, Germany, Belgium and Japan[231].

With regards to manufacturing in the EU, Prodcom code '26511180 - Instruments and appliances for navigation (including for marine or river navigation) (excluding for aeronautical or space navigation, compasses)' has been identified as being the most likely to incorporate production of PNDs and Table 4-20 provides figures from Eurostat for this category. As with other Eurostat data, it has not been possible to break the category down any further and the figures are likely to include other products as well as PNDs and components.

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[227] Tawain insights, Tawain strives to create international brand names, 19/07/2011, Accessed: http://www.taiwaninsights.com/tag/pnd/

[228] Accessed: *Outlook of Taiwan GIS/GPS Industry Market* (2011.03.15), Alberta Taiwan Office, Canada *http://www.albertacanada.com/taiwan/images/TaiwanIndustryOutlook.pdf*

[229] Invest in Taiwan, Stunning R&D capacity grabs the globe from the skies, Accessed: http://investtaiwan.nat.gov.tw/eng/show.jsp?ID=5185&MID=5

Electronics 360, TomTom One 3rd edition portable navigation device teardown, Accessed: http://electronics360.globalspec.com/article/2239/tomtom-one-3rd-edition-portable-navigation-device-teardown

[231] MiTac website: Company Profile. Accessed at http://www.mitac.com/InvestorRelations/CompanyProfile.html

Table 4-20 Production of '26511180 - Instruments and appliances for navigation (including for marine or river navigation) (excluding for aeronautical or space navigation, compasses)'								
Member State	Production in the EU							
	2009		2010		2011		2012	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Austria	:	:	0	0	0	0	0	0
Belgium	0	0	:	:	:	:	:	:
Bulgaria	:	:	2,000	264,000	:	:	2,000	271,000
Croatia	:	:	:	:	:	:	0	324,000
Cyprus	0	0	0	0	0	0	0	0
Czech Republic	:	1,626,000	:	2,176,000	:	2,385,000	:	3,289,000
Denmark	3,000	3,949,000	3,000	3,307,000	2,000	3,313,000	2,000	2,539,000
Estonia	0	2,000	0	1,000	0	0	0	0
Finland	1,000	1,236,000	1,000	6,256,000	1,000	6,691,000	1,000	7,846,000
France	26,000	:	:	:	41,000	:	39,000	:
Germany	22,000	65,633,000	17,000	51,733,000	23,000	51,440,000	18,000	55,123,000
Greece	0	0	0	0	0	0	0	0
Hungary	:	:	:	:	:	:	:	:
Ireland	:	:	:	:	:	:	:	:
Italy	20,000	27,813,000	21,000	33,981,000	17,000	28,427,000	11,000	20,043,000
Latvia	0	0	0	0	0	0	:	:
Lithuania	0	0	0	0	0	0	0	0
Luxemburg	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0
Netherlands	:	:	:	:	:	:	:	:
Poland	3,000	414,000	5,000	1,074,000	:	:	:	:
Portugal	0	0	0	0	0	0	0	0
Romania	0	0	0	0	0	0	0	0
Slovakia	0	0	0	0	0	0	0	0
Slovenia	:	:	:	:	:	:	0	0
Spain	9,000	8,962,000	1,000	3,426,000	:	:	:	:
Sweden	:	:	:	:	0	0	:	:
United Kingdom	:	73,234,000	:	75,539,000	:	84,013,000	75,000	45,164,000
EU27TOTALS	851,000	558,472,000	780,000	630,334,000	704,000	605,185,000	237,000	527,771,000
Note: Figures are rounded. : = no data available Source: Eurostat, data for 2009-12 for 26511180 - Instruments and appliances for navigation (including for marine or river navigation) (excluding for aeronautical or space navigation, compasses)								

Associated employment

TomTom currently employs around 3,500 people worldwide[232]. In 2010, around a third of these were working in its headquarters in the Netherlands.

The supply chain of TomTom[233] includes the following Tier 1 suppliers:

- the 20 top TomTom Tier 1 suppliers operate in 13 countries and employ 4,000 workers to produce TomTom branded products, including content and services; and
- these suppliers provide all of the PND and in-dash navigation systems, assembling previously manufactured materials and components in their factories. These workers account for around half of the workers in Tier 1 of the supply chain.

4.8.3 Main Market Trends

The PND market is dominated by two companies, Garmin and TomTom. Both globally and in Europe, the sale of PNDs have been declining. Increasingly, consumers are using smart phones as PNDs.

[232] TomTom, company profile, Accessed: http://corporate.tomtom.com/overview.cfm
[233] TomTom, Corporate social responsibility, Accessed: http://corporate.tomtom.com/ethics.cfm?csr=11943

Within Europe, the biggest sales of PNDs were in the EU 5 countries (DE, ES, FR, IT, UK). There would also appear to have been a decline in the ASP of PND devices.

Preliminary research suggests that the first Micro-USB compatible PND devices emerged on the market in 2010. Whilst this appears to coincide with the MoU, there is no evidence to suggest that this change occurred as a result of the MoU.

4.8.4 Impacts on the Markets for PNDs and their Chargers

A model has been developed to calculate the following in relation to personal navigation devices (PND) sold on the EU market between 2011 and 2013:

- percentage of PND sales that use Micro-USB charging;
- percentage of PND stock that use Micro-USB charging; and
- percentage of PND chargers (standalone and included with new devices) which are Micro-USB.

The term 'stock' refers to PNDs which are owned by consumers.

The outcomes from the model are shown in Table 4-21 for 2011 to 2013.

Table 4-21: PND model outcomes for 2011 to 2013

Parameter	Year			
	2010	2011	2012	2013
Percentage of PND sales that use Micro-USB charging	31%	56%	70%	27%
Percentage of PND stock that use Micro-USB charging	3%	7%	10%	14%
Percentage of PND chargers supplied (standalone and included with new devices) which are Micro-USB	31%	56%	69%	27%

It is interesting to note that the percentage of PND sales that used Micro-USB charging increased dramatically from 2010 to 2012, with the model suggesting that 70% of PND sold in 2012 charged via Micro-USB. In 2013, the number of sales using Micro-USB charging decreased dramatically. This significant drop can in part be attributed to a change in direction by Garmin, which switched from Micro-USB to Mini USB. However, it must also be noted that the sample products for TomTom for 2013 was limited to only two devices for this year, the TomTom Rider V4 and TomTomGo 6000/5000/600/500. The TomTom Rider is designed for use on a motorcycle and uses Mini-USB while the TomTom Go series is designed for use in automobiles and uses Micro-USB. To provide a snapshot of the market across the years of interest for the purpose of this study, it has been assumed that the sales of each series of device are equal. However, for 2013 this gives the impression that fewer devices were using Micro-USB as the number of automobile PND (TomTom GO series) is likely to have been significantly more than motorcycle PND (TomTom Rider).

The model demonstrates that the stock of PND which use Micro-USB charging gradually increases from 2010 to 2013, when it is 14%. The low prevalence of Micro-USB charging can be linked to the high prevalence of other charging solutions, mainly Mini-USB, in 2010 and 2013 and the 4-5 year replacement cycle.

The model assumes that the types of chargers supplied each year will reflect the stock and the sales of PND, with the percentage chargers being Micro-USB, somewhere between these figures in any given year. The overall compliance is determined by the percentage of PND owners which purchase

a standalone charger in addition to the one which was supplied with the PND. As previously explained, the model assumes that 2% of PND owners buy a standalone charger each year. Therefore, the percentage of chargers which are Micro-USB largely mirrors PND sales.

The impacts of the MoU on the PND market are likely to have been minimal. In terms of consumer waste, consumers are unlikely to frequently replace their PNDs and be left with multiple chargers/charging cables. Furthermore, the PND and charger are likely to be stored together when not in use or, alternatively, the charger will be left in the car. Consequently, whenever the PND needs charging, the charger is likely to be at hand. Consumers are therefore unlikely to purchase replacement chargers as may be the case for other devices (hence the 2% estimate mentioned above).

4.8.5 Other Impacts

No evidence has been identified of incidents involving these devices. The market for PNDs is in decline, which makes the number of potential incidents potentially smaller compared with mobile phones.

4.8.6 Conclusions

Whilst there is no evidence that the MoU has impacted the market for PNDs (manufacturers of PNDs are not signatories of the MoU), in recent years some manufacturers have introduced products that are charged via Micro-USB connector. Interestingly, the market share of PNDs with Micro-USB chargers dropped significantly in 2013, i.e. following the expiration of the MoU.

4.8.7 Summary of Charging Requirements in Non-EU Countries

No requirements on the charging of PNDs in non-EU countries have been identified.

4.9 Portable Handheld Games Consoles

4.9.1 Summary of Market Data

In 2012, handheld gaming consoles/handhelds had 9.8% of the global games market. This is expected to decrease to 5.8% in 2016 (see Figure A9-3 in Annex 9). The market for portable handheld games consoles is dominated by Nintendo and Sony. Figure 4-7 presents the sales of Nintendo's DS range and Sony's PSP from 2008 to 2013, which appear to have declined over the past few years.

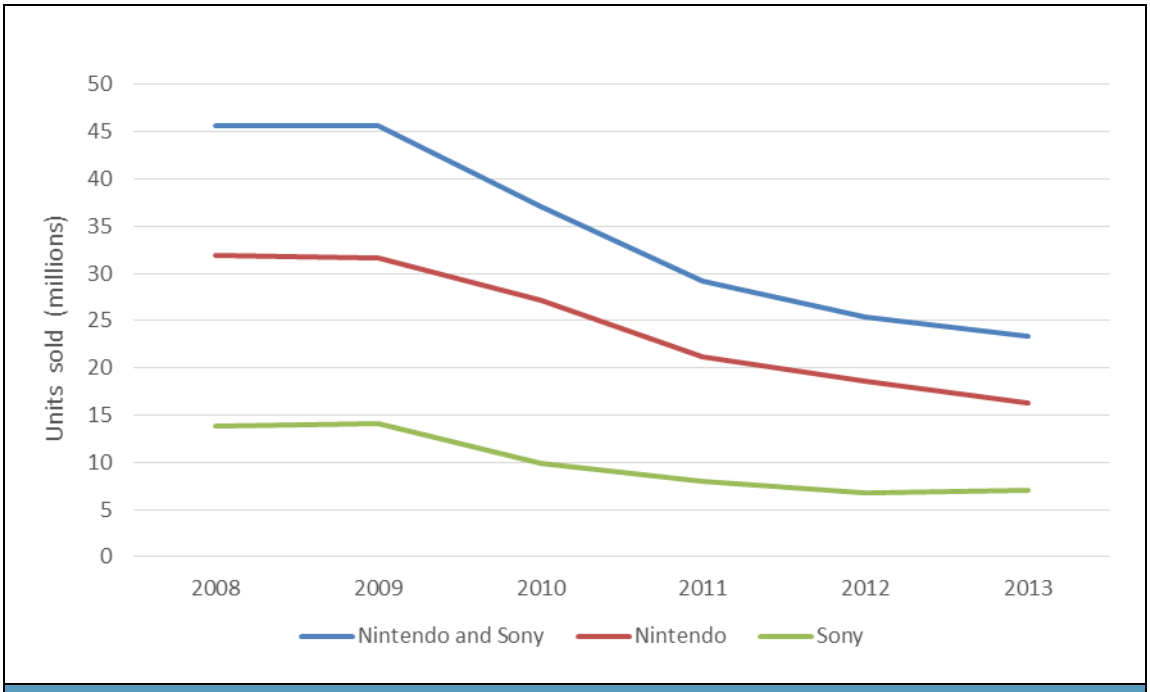

Figure 4-7: Unit sales for handheld games consoles for Nintendo and Sony.

Non-EU country summary

In the US and Korea portable gaming is migrating from dedicated Portable Handheld Game Consoles to other platforms, mainly smartphones and tablets. China's case is special as consoles were banned until January 2014. Whether this makes a considerable difference or not is questionable. Some are of the opinion that, as a black market for such products has always existed, lifting the ban is not going to have considerable effect[234]. Others suggest that lifting the ban enables advertising, promotions, marketing, and the legal distribution of games, which can promote market growth to a considerable extent[235].

[234] Nintendo stock surging after China lifts ban on consoles, accessed at http://www.gamasutra.com/view/news/208234/Nintendo_stock_surging_after_China_lifts_ban_on_consoles.php

[235] With console ban lifted, analysts predicted $13.1 billion game market in China for 2013, accessed at http://venturebeat.com/2013/09/30/analysts-predict-13-1-billion-china-game-market-for-2013/

4.9.2 Structure of the Sector and Trade

As has been previously stated, Sony and Nintendo dominate the market for handheld games consoles. Since 2010, Nintendo has held the larger market share, mainly due to the popularity of its latest consoles; the 3DS and 3DS XL. Figure 4-8 below shows the market shares for the main devices until 2015, when Nintendo is expected to remain the largest manufacturer[236].

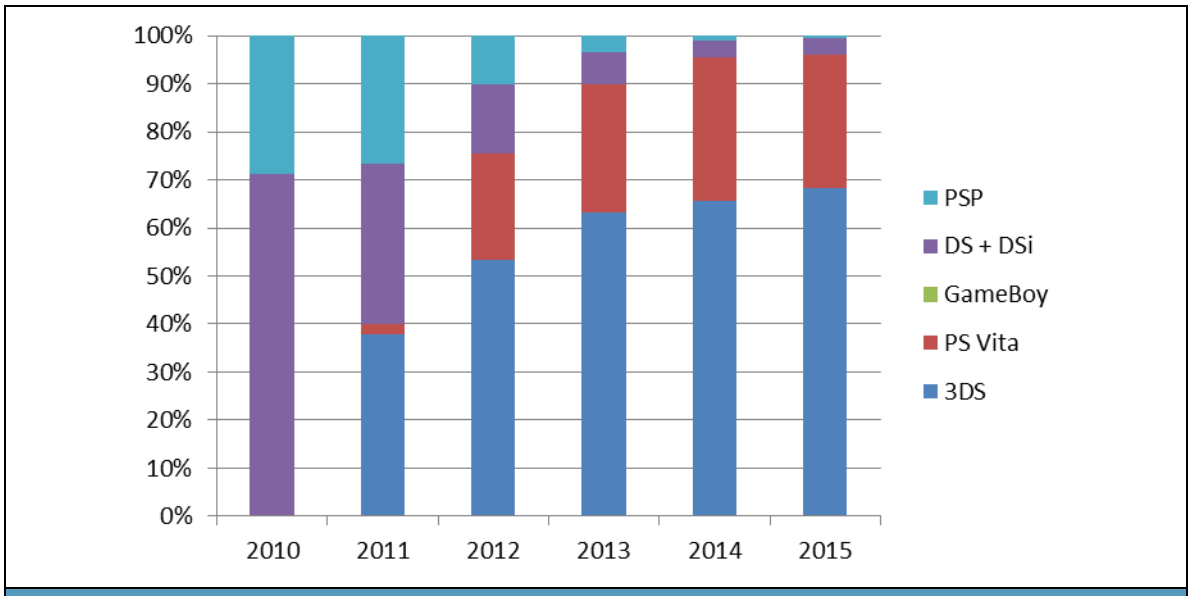

Figure 4-8: Handheld gaming hardware units shipments by OEM model[237]

Manufacturing in the EU

There does not appear to currently be any manufacturing of handheld games consoles in the EU.

Employment

As there is currently no manufacturing of handheld games consoles in the EU, there is consequently no employment in this sector.

SMEs

There does not appear to be any SMEs involved in the manufacture of handheld games consoles in the EU.

Trade

No information regarding trade has been identified.

[236] 3DS, GameBoy, DS, and DSi, are manufactured by Nintendo, and PS Vita and PSP are manufactured by Sony

[237] iSuppli website: Sony, Nintendo and Microsoft Change Strategies in Fragmented Handheld Gaming Market, accessed at http://www.isuppli.com/Home-and-Consumer-Electronics/MarketWatch/Pages/Sony-Nintendo-and-Microsoft-Change-Strategies-in-Fragmented-Handheld-Gaming-Market.aspx

4.9.3 Main Market Trends

In 2008, sales of handheld games consoles reached around 46 million units. However, since 2009 sales have decreased dramatically; in 2012, approximately 25 million units were sold and this is expected to drop further in 2013. This trend results from the increased popularity of smartphones and tablets which offer a gaming experience with the added benefits of convenience and cost.

There are two main manufacturers of handheld games consoles: Nintendo and Sony. During this period Nintendo has held the largest market share, although this has fluctuated, and is expected to remain dominant in 2015. Archos also produces a games console; however this is a hybrid tablet/games device rather than a dedicated games device and is therefore considered a tablet for the purposes of this study.

4.9.4 Impacts on the Markets for Portable Handheld Games Consoles and their Chargers

Of the games consoles on the market, only the newest one, the Sony PlayStation PSP Vita 2000, is equipped with Micro-USB charging. It is not possible to conclude whether this is a result of the MoU. The other consoles all use proprietary charging systems.

4.9.5 Impacts on Consumers

As there is only one device that chargers via Micro-USB, the MoU has had either limited or no impacts on consumer convenience in this product sector. However, customers purchasing the Sony PlayStation PSP Vita 2000 will now be able to charge their console with their mobile phone charger (as well as any other compatible device).

4.9.6 Impacts on Manufacturers

Cost savings due to simplified production processes are likely to be minimal until there are more products on the market from each manufacturer that utilise the Micro-USB technology.

4.9.7 Impacts on the Environment

No environmental benefits have been identified.

4.9.8 Other Impacts

No evidence has been found of incidents involving these devices. With regard to portable handheld games consoles, it may be the case that the low replacement cycle of chargers has helped to reduce the number of potential incidents.

4.9.9 Conclusions

A recently released console (Sony PlayStation PSP Vita 2000) uses Micro-USB and considering that Sony also manufactures mobile phones, it is possible that this move may be to some extent attributed to the MoU. However, whether this is an early indication of a future trend, with further releases of portable games consoles and wireless controllers, remains to be seen.

4.9.10 Summary of Charging Requirements in Non-EU Countries

No requirements on the charging of portable games consoles in non-EU countries have been identified.

4.10 Personal Care Products

4.10.1 Summary of Market Data

The global market value for male electric shaving is worth approximately €2.5 billion, with a market volume of approximately 40 million units (Zammit, 2007). Electric shavers are widely available for both men and women and Europe is the largest market for electric shavers worldwide, followed by the USA (Digital Journal, 2013). Within Europe, the largest markets for electric shaving are the UK, Germany and France (Hollensen, 2008).

Assuming the EU accounts for 30% of the market, the market volume would be in the region of 12 million units. Additionally, considering the female personal care products sector, the following assumptions have been made;

- the global female market will be half the size of the male; 20 million units; and
- the EU market accounts for 30% of the female global market; 10 million units.

Consequently, it is estimated that the EU market for personal care markets will be in the region of 22 million units.

Non-EU country summary

There is a relative lack of data on products within this category; however, the consumers' attitude towards personal care may give an important insight. The US is a mature, stable market. Sales of personal care products have decreased during the economic downturn but as the economy recovers and household income increases, sales are expected to grow as well[238]. In China sales are expected to increase as consumers have additional levels of disposable income[239]. Personal care is considered to be very important by the South Korean society; accordingly spending on personal care is among the highest globally[240].

4.10.2 Structure of the Sector and Trade

On a global scale, the large international companies Philips and Braun (which is part of the Procter & Gamble group) dominate the market for both electric shavers (male and female) and epilators. One source estimates that Philips and Braun combined may have as much as 75% of the global market for electric shavers (Hollensen, 2007, cited in AbouElgheit, 2012).

Other manufacturers of personal care products active in Europe include Remington (part of Spectrum Brands), Calor (a French brand which is part of Groupe SEB), Panasonic, Emjoi, Wahl, Veet and Babyliss, however their market shares are significantly smaller than that of Philips or Braun. Some retailers also produce their 'own brand' products, for example, in the UK the retailers Boots and Tesco have their own brand epilators and electric shavers. In the UK, the market for electric shavers amongst women is comparatively smaller than the male electric shaver market (see Table A10-2 in Annex 10).

[238] IBISWorld: Electric Shaver Manufacturing in the US: Market Research Report (2014), accessed at http://www.ibisworld.com/industry/electric-shaver-manufacturing.html

[239] Daxue: Market research: Skin care in China, accessed at http://daxueconsulting.com/skin-care-market-in-china/

[240] Haute Off the Press: South Korea Embraces the Power of Men's Cosmetics, accessed at http://www.makeup.com/south-korean-men-embrace-the-power-of-makeup/

Philips

Philips is an international company which is based in the Netherlands. In 2012, global sales reached €24 billion and the company had some 118,000 employees (Philips, 2013). Philips business is split into three divisions: healthcare, lighting and consumer lifestyle.

The consumer lifestyle sector of Philips business comprises: personal care, health and wellness, lifestyle entertainment and domestic appliances. In 2012, consumer lifestyle generated sales of almost €6 billion; of which personal care products (including male grooming) accounted for 25% of total sales (Philips, 2012). The consumer lifestyle division also has approximately 18,900 employees (Philips, 2012). The total sales by business of each are listed in the table below.

Table 4-22: Consumer Lifestyle – Total sales by business 2012	
Business	**Percentage**
Personal Care (male grooming, skincare, beauty)	**25%**
Health & Wellness (mother and childcare, oral healthcare)	15%
Lifestyle Entertainment (audio and visual entertainment, communications, headphones and accessories)	27%
Domestic Appliances (coffee, floor care, garment care, kitchen appliances, water and air, beverage appliances)	33%
Source: Philips (2012)	

In 2011, Philips was the market leader in electric shaving with a market share of more than 50% (Philips, 2011).

Braun

Braun is a wholly owned subsidiary of the international company Procter and Gamble. In 2010 and 2011, P&G (through the Braun brand) held 30% of the global market for male shavers and 50% of the female epilator market (Procter & Gamble (2010), Procter & Gamble (2011)). In 2012, P&G's global market share for male shavers remained the same (30%) whilst their share of the female epilator market fell to 40% (Procter & Gamble, 2012). By 2013, their share in male electronic shaver market dropped to 20% whilst their share of the female epilator market remained at 40% (Procter & Gamble, 2013b).

In 2012, 10% (16% of net earnings) of P&G's net sales were through grooming products, including blades and razors, electronic hair removal devices, hair care appliances, and pre- and post-shave products (Procter & Gamble, 2012b). 19% of their €62 billion net sales were in Western Europe and 14% in CEEMA (Central & Eastern Europe, Middle East, and Africa) (Procter & Gamble, 2012b).

Manufacturing in the EU

According to Eurostat, EU-based production of personal care products with self-contained electric motors remained near constant between 2008 and 2011 at circa 30 million units. However, in 2012 production dropped by almost 50% (see figure A10-1 in Annex 10). Imports into the EU of personal care products with self-contained motors have steadily increased since 2009 (Figure A10-2 in Annex 10).

Data from Eurostat suggests that manufacturing of personal care products occurs in Germany and Hungary, amongst others. Braun has five manufacturing sites in three countries, Ireland, China and Germany. It would appear that the Ireland plant focuses production on power refills, ethanol

cartridges and Oral-B toothbrushes (Deegan, 2012), with electric shavers and epilators predominantly manufactured in China and Germany. Philips has traditionally had two centres of manufacturing for electric shavers – one in Drachten in the Netherlands and another in Zhuhai, China. It would appear that the plant in Drachten produced shavers in the 1990s but this was outsourced to China, with the Drachten plant continuing to produce shaver heads. In 2012, Philips announced that it would bring back production of its high-end shavers to the EU (Drachten) as costs of production in China had increased and also staff turnover was extremely high (Bloomberg, 2012). The French company Calor (part of Groupe SEB), employs approximately 1,600 people in France. The company has manufacturing facilities in Pont-Evêque and Saint Jean de Bournay in Isère. From the data available, it would appear that manufacturing of personal care products takes place in the Calor factory at Pont-Evêque (Confortique Magazine, 2008). Wahl has manufacturing facilities in Europe, particularly in Germany, Hungary and the UK. Conair (the owner of Babyliss) has manufacturing facilities in Germany and Italy as well as a R&D facility in Belgium and a logistics centre in France.

Employment

The total level of employment in the manufacture of personal care devices in the EU is not known. However, the Philips plant at Drachten employs 2,000 people, although this will include the manufacture of a variety of products, not just personal care devices. Likewise, the Calor plant at Pont-Evêque employs 750 people and the factory at Saint-Jean de Bournay, 220 (Le Dauphine, 2012), although this involves the manufacture of a range of products.

SMEs

From the data available, it would not appear that any SMEs are active in the manufacturing of personal care products in the EU.

Trade

Imports into the EU of personal care products with self-contained electric motors, have been slowly rising. However, exports from the EU remained largely constant between 2009 and 2012.

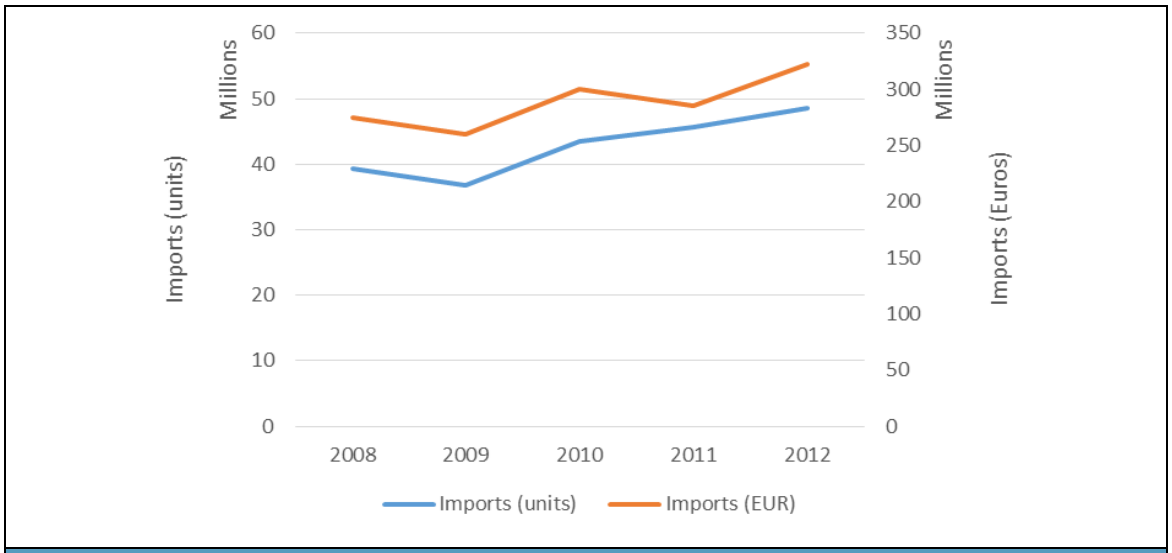

Figure 4-9: Imports of Personal Care Products with Self-Contained Electric Motor (units and Euros) 2008 to 2012 (Source: Eurostat)

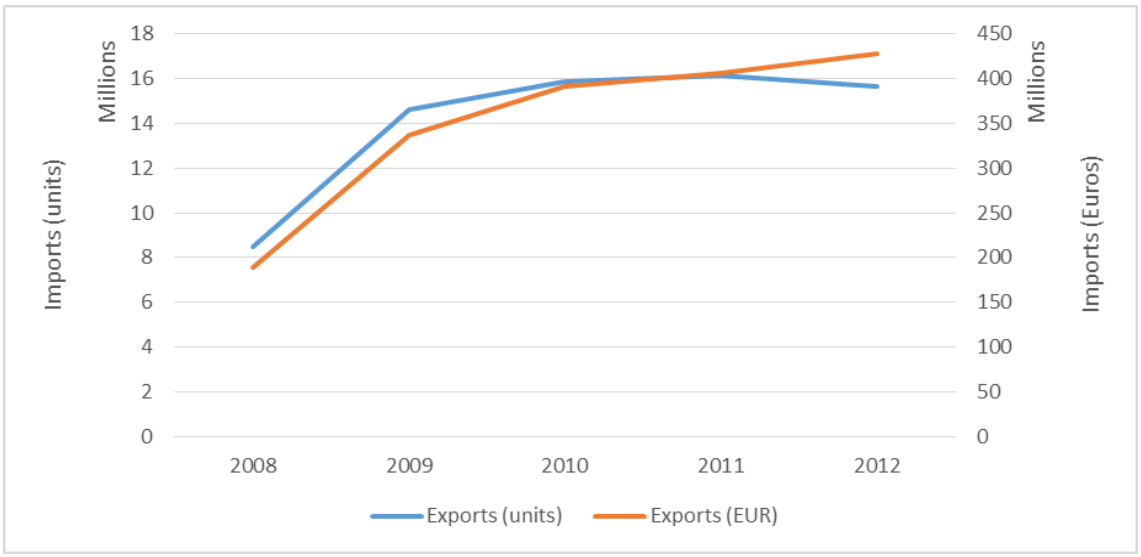

Figure 4-10: Exports of Personal Care Products with Self-Contained Electric Motor (units and Euros) 2008 to 2012 (Source: Eurostat)

4.10.3 Main Market Trends

The main trend identified thus far relates to EU-based production of personal care products with a self-contained motor. This trend is depicted in the figure below and shows that EU production of personal care products declined sharply in 2011 and 2012 to approximately 50% of its pre-2011 level (both in terms of the number of units produced and production value).

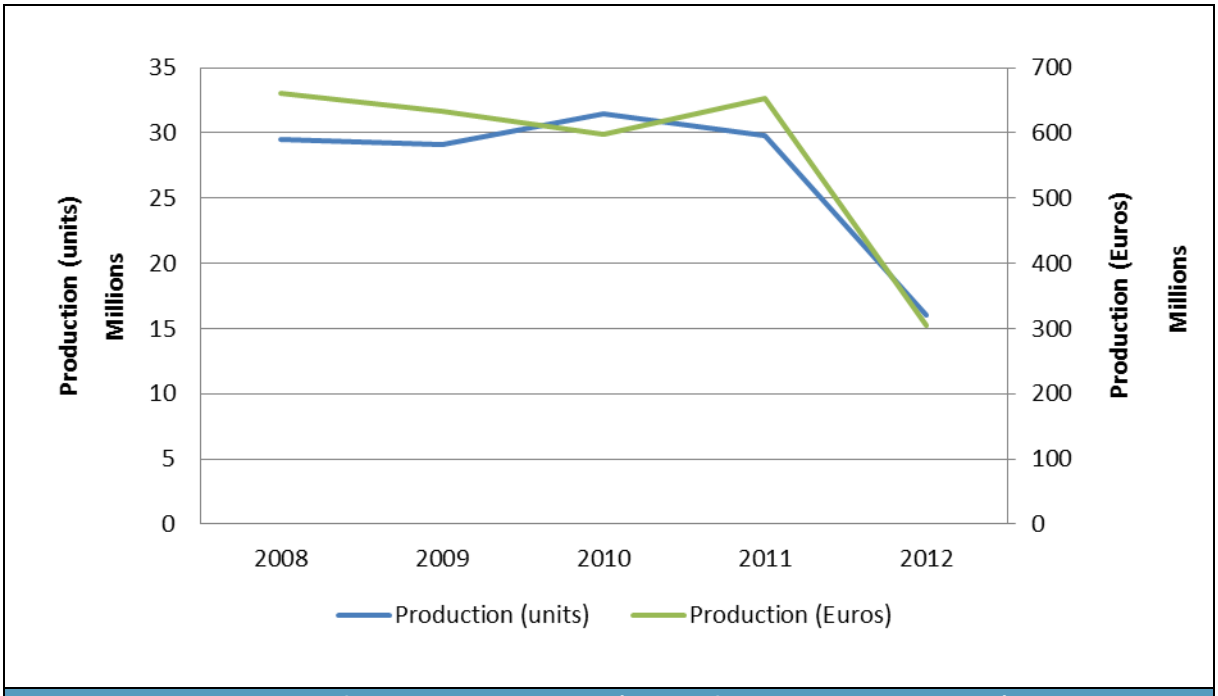

Figure 4-11: EU Production of Personal Care Products (with self-contained electric motor) in Europe (Volume and Value) from 2008 to 2012 (Source: Eurostat)

4.10.4 Impacts on the Markets for Personal Care Products and their Chargers

It does not appear that the MoU has had any impacts on the market and no shift towards Micro-USB charging has been identified.

4.10.5 Impacts on Consumers

The MoU does not appear to have had any impact on consumers.

4.10.6 Impacts on Manufacturers

The MoU has not had any impact on manufacturers as they have not changed their chargers or charging methods since the MoU.

4.10.7 Impacts on the Environment

The MoU has not had any impact on the environment.

4.10.8 Other Impacts

It does not appear that the MoU has had any impacts on the safety of personal care products. No evidence has been found of incidents involving these devices. It may be the case that the low replacement cycle of chargers for this product group has helped to reduce the number of potential incidents.

4.10.9 Conclusions

Generally, products in this sector use proprietary systems (either one pin or two pin connectors). Micro-USB charging is rare in the market for personal care products with only one Philips model identified which offers this. There are a number of cheaper and more basic models which offer charging via USB; however, these are models which are aimed at the travel market and are not aimed at daily use.

Therefore, it does not appear that the MoU has had any impact on the sector.

4.10.10 Summary of Charging Requirements in Non-EU Countries

No requirements on the charging of personal care products in non-EU countries have been identified.

4.11 Conclusions on the Impact of the MoU for Mobile Phones on Other Devices

4.11.1 Charging Solutions

Section 4 has reviewed a number of small portable electronic devices in relation to the charging solutions adopted and how these have changed over time (where information is available) and has provided details on overall market developments over the period covered by the MoU on mobile phone chargers.

In general terms, it is clear that the market share of devices with Micro-USB charging solutions has increased over the period 2009-2013. The following devices all exhibit a higher share of Micro-USB charging solutions at the end of the period covered by the MoU than at the beginning:

- tablets;
- e-readers;
- personal navigation devices; and
- portable handheld games consoles[241].

For laptops, portable media players, sports and activity monitors, and personal care devices, virtually no (or very few) Micro-USB charging solutions appear to have been adopted and proprietary charging solutions are dominant, suggesting there has been no impact from the MoU on the charging of these devices. The high power charging requirements for laptops appear to be the most significant drawback when considering Micro-USB solutions, whereas the need for waterproof charging appears to have been a significant restriction for a number of sports and activity monitors, as does the need for the charging solution to maintain a very small footprint due to the small size of the overall device. Restricting factors for personal care products include their use in wet environments and the associated need for both the charger and the device to be waterproof.

For other devices such as digital cameras, the situation is less clear. The MoU for mobile phones and the consequent shift to Micro-USB charging solutions may have been a consideration for those manufacturers of digital cameras and camcorders that are also manufacturers of mobile phones and tablets since some of these manufacturers have adopted Micro-USB charging solutions for some of their products released in recent years. This is in contrast to the majority of manufacturers who have stuck with proprietary solutions or issued products equipped with a Mini-USB charging solution.

Based on the models developed for selected devices, Figure 4-12 below illustrates the percentage of the overall sales of the different devices which are manufactured with Micro-USB charging capability. For all devices modelled, there has clearly been a significant increase in the level of compatibility of Micro-USB chargers over the life of the MoU. The share of sales of tablets which use Micro-USB has increased from 17% in 2011 to 47% in 2013 and the comparable figure for e-readers rose from 60% in 2009 to 95% of sales in 2013 (there appears to have been a levelling out in the last couple of years but at a very high level).

PNDs have also shown an increase in the proportion of sales that use Micro-USB, although there was a marked decrease in 2012/13 which, as explained in Section 4.8, is primarily due to the fact that

[241] It is noted that this has not been modelled due to lack of data, but the conclusion is based on the fact that the number of devices identified during literature reviews that have Micro-Usb charging solutions appears to have increased

there are only two major manufacturers selling these devices in the EU and one of them, after launching a number of devices with Micro-USB connectors between 2009 and 2012 reverted to Mini-USB in 2012/13.

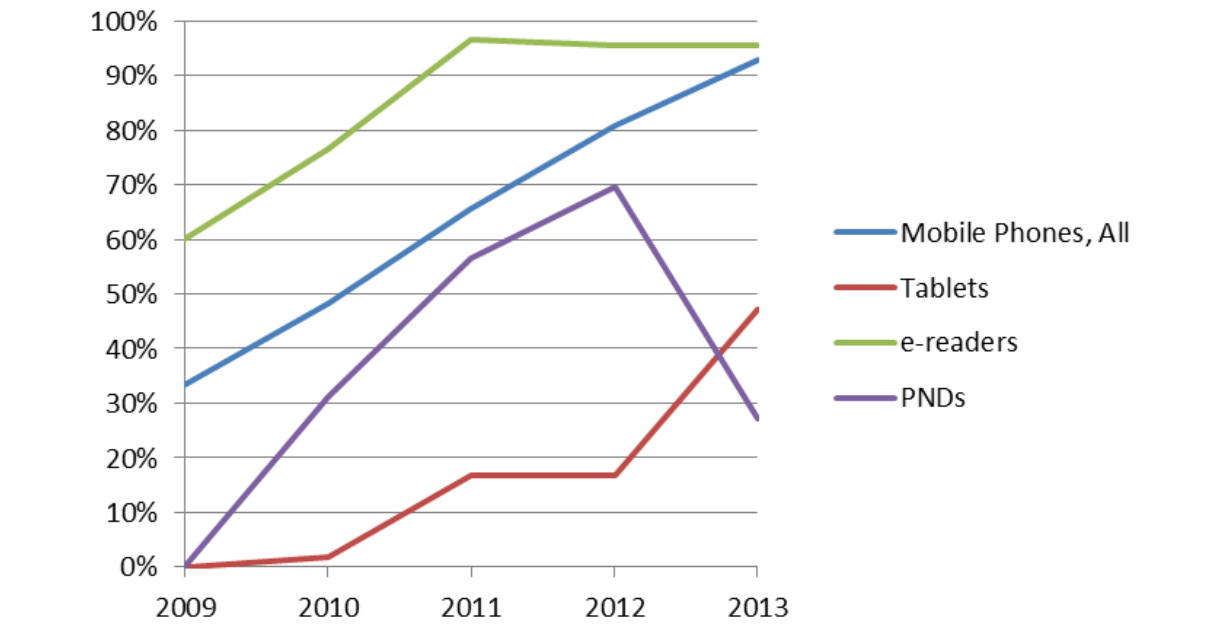

Figure 4-12: Percentage of Sales Which Use Micro-USB

Overall, there has clearly been an increase in the prevalence of the Micro-USB charging solution across a number of devices. The MoU itself does not apply to devices other than mobile phones but at the very least, it appears likely that the MoU may have consolidated the move towards the Micro-USB charging solution, given the high volumes of mobile phones sold during this period and the consequent high volumes of chargers supplied. The greatly increasing demand for Micro-USB components over the 2009 to 2013 period will likely have led to economies of scale in the production of the common charger, a potential increase in the attractiveness of this particular charging solution from the manufacturer's point of view (at least across those devices where there are no significant barriers to its use, e.g. need to be waterproof, power requirements, etc.), although consultation suggests that this incentive effect will have been limited due to the small costs involved relative to the cost of the overall device.

4.11.2 Impacts on Consumer Convenience and the Environment

It is noted that there has been a substantial consolidation of functions between devices over the period under consideration, with devices such as mobile phones and tablets incorporating the functions of e-readers, portable media players and some digital camera and camcorder functions. This has led to declining demand in some of these other sectors which suggests that the issue of incompatible chargers may be becoming less problematic in absolute terms.

The increasing prevalence of Micro-USB charging across devices with similar charging power requirements has meant that consumers have been able to increasingly use the charger supplied with one device to charge another. In terms of consumer convenience, this has resulted in a number of benefits to consumers. For example, the supply of similar chargers across devices increases the

likelihood that consumers will have access to a charger even when they travel away from home and leave their own device's charger behind.

From an environmental perspective, the standalone charger market is a sizeable one in the EU (see Section 3.3 for estimates of the standalone market for mobile phone chargers) and many of the chargers purchased will have been as replacements not just for a lost or damaged mobile phone charger, but also for chargers for other devices. Whereas previously, consumers would have had to purchase another charger, with the demonstrable harmonisation of charging that has taken place within the period covered by the MoU, consumers will have been increasingly able to rely on fewer chargers to charge multiple devices. However, with the exception of some e-readers, the majority of devices are still sold with a charger (i.e. there has not been any significant decoupling of devices and their chargers), thereby minimising any environmental benefit that the adoption of a common charging solution might have brought.

For e-readers themselves, it is unlikely that the MoU itself has led to significant numbers of them being sold without a charger. This way of selling e-readers began right at the start and even prior to the MoU for mobile phones and was linked very much to the fact that the functionality of the device relied heavily on downloading books and other readable materials from computers, which also provided the ability to charge. Add to this the fact that charging compatibility appears to be less of a factor for e-readers due to the long periods that charged devices can go without needing to be recharged, and the overall conclusion is that the MoU will not have played a significant role in manufacturers' decisions to sell their devices without a charger.

It is also important to note that it is unlikely that consumers would be able/willing to rely on a single charger for all compatible devices. Households, with a number of occupants who own multiple devices will each clearly require a minimum number of chargers in order to cater for simultaneous charging needs. Therefore, whilst it may be expected that closer harmonisation across devices may have had some effect on the sales of standalone chargers as replacements for lost/damaged/forgotten chargers (new devices are still sold with a charger as a rule, although some models of popular e-readers such as the Kindle are sold with a cable only, as is the case on occasion for some other devices), the effect will be limited by the extent to which consumers need/wish to charge their devices simultaneously.

4.11.3 Lessons Learned from the Harmonisation of Chargers for Mobile Phones that are of Relevance to the Harmonisation of Charging of Other Product Groups

The very high percentage of mobile phones now sold which are compatible with the MoU is, in large part, down to the fact that the major manufacturers (in terms of the volume of sales) signed up to participate and have extended the life of the original MoU through two subsequent Letters of Intent. Whilst a number of other manufacturers have not signed up to the agreement, they have manufactured products which either use the Micro-USB charging solution anyway, or sell their products in such small volumes that the overall level of compliance is unaffected to any significant extent. In order for any similar initiative to be successful for other portable electronic devices, the participation of the major manufacturers would therefore seem to be essential.

Another key factor in the success of the initiative to harmonise chargers for mobile phones which should be taken into account for other devices is the fact that the selection of the Micro-USB charging solution was one that all the major manufacturers (with the possible exception of Apple who selected making available an adaptor in order to comply with the MoU) were in agreement with at the time. Involvement of the manufacturers of groups of other devices would be an important element in ensuring wide participation in any voluntary agreement and ensuring that the selected

charging solution met the needs and delivered the functionality required across the range of their products.

Consultation with manufacturers of mobile phones as well as with the Commission services has identified that flexibility in terms of potential new products with new functionalities within existing device groups would also be something important to accommodate within any initiative that sought the further harmonisation of charging solutions for other devices. As technology develops, charging requirements may change over time (in terms of the level of power required and how it is delivered) and an inflexible approach to harmonisation may result in the prention of placing some devices on the market. An approach to harmonisation which incorporates regular review and communication between consumers, manufacturers and regulators would appear to be an essential element for other devices.

Whilst there may appear to have been some spillover from the MoU for mobile phones to other devices, with the proportion of some devices utilising Micro-USB charging solutions increasing over the same period as the MoU, this effect appears to be at a much lower level than for mobile phones (with the possible exception of e-readers). This would suggest that specific harmonisation initiatives for other groups of devices will be more effective than relying on spillover to occur. That being said, where manufacturers are involved in producing multiple devices, there does appear to be some indication of the use of the same charging solution across devices (e.g. Apple and Sony regularly use the same charging solution for both mobile phones and tablets) and where adaptors are permitted, a single adaptor can be used for multiple devices (e.g. an Apple adaptor can be used for the iPhone, iPad and iPod, although it is noted that there are two different adaptors for different models of iPhones and iPads).

5 Part III: Further Harmonisation of Chargers

5.1 Introduction

This section assesses a number of policy options for further harmonisation of charging of mobile phones and other portable rechargeable devices. It is divided in the following parts:

- Section 5.2 summarises possible technical options for harmonisation and sets out the policy options for the impact assessment;
- Section 5.3 assesses the main impacts that these options are expected to have across all portable rechargeable devices;
- Section 5.4 assesses the most significant impacts of using a common charger for mobile phones, e-readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care devices;
- Section 5.5 assesses the most significant impacts of harmonising chargers for tablets; and
- Section 5.6 sets out the main impacts from harmonisation of laptop charging.

5.2 Definition of Policy Options for the IA

Defining policy options for further harmonisation of charging of portable electronic devices requires consideration of the following:

- **technical options:** which technical solution should be used as a basis for the common charger?
- **method of implementation:** what method of implementation should be used (e.g. voluntary or mandatory)?
- **scope of these requirements:** which product groups should be included?
- **detailed definition of the requirements:** can adaptors be used? How often should these requirements be revised?

These aspects are considered in more detail below. A summary of policy options undergoing impact assessment is provided in Section 5.4.1 for for mobile phones, e-readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care devices and in Section 5.5.1 for tablets and 5.6.1 for laptops.

5.2.1 Technical Options

There are a number of technical solutions used for charging. The main ones include:

- proprietary wired charging solutions;
- USB charging (includes several USB specifications and connectors);
- other wired charging standards (e.g. Thunderbolt);
- wireless charging; and
- other charging solutions (primarily those not relying on mains electricity).

A short overview of each of the above methods of charging is provided below.

Proprietary Wired Charging Solutions

Proprietary charging refers to solutions which are unique to particular brand or product. There is typically no interoperability between devices made by different manufacturers or even devices made by individual manufacturers. This method of charging is still common in many market sectors, with a large variety of charging solutions catering for a wide range of power requirements. In some sectors, e.g. laptops, proprietary charging is the predominant charging method.

The key advantage of proprietary charging connectors is that they can be tailored to particular products (depending on their power requirements and cost considerations) and use enviroments (for example, use in wet enviroments).

USB Charging

USB is by far the most popular I/O standard in the world, combining data transfer and power delivery. A range of standards (USB 2.0, USB 3.1, USB Battery Charging, USB Power Delivery) and USB connector shapes (e.g. Original and Hi-Speed USB (USB 2.0) Standard-A/B, Mini-A/B, Micro-A/B, SuperSpeed USB (USB 3.1) Standard-A/B, Micro-USB-A/B,) are in existence.

USB was originally developed to make it easy for consumers to add peripherals (e.g. keyboards, hard drives, printers, cameras, printing devices etc.) to their personal computers providing both data transfer and power capabilities. The USB Promoter Group has released four USB core specification packages; USB 1.1, USB 2.0 and USB 3.0/3.1, with the data transfer rate and maximum power output gradually increasing with each iteration. Each specification package provides the technical details to implement the requirements and design. Released in January 1996, the USB 1.0 specification was the first to be implemented on a large scale and was superseded in April 2000 by the USB 2.0 specification (which includes Low, Full and Hi-Speed USB). A further specification was released in November 2008, USB 3.0 (SuperSpeed USB), and in January 2013, USB 3.1 (SuperSpeed USB 10 Gbps).

In addition, a number of subsequent specifications have been issued which work in conjunction with the USB 2.0 and USB 3.1 specifications. These include the USB Battery Charging v1.2 (released in 2010) and USB Power Delivery v1.0 (released in 2012) specification, which provide standards for higher power charging using the existing USB Standard-A/B, Mini-USB-A/B and Micro-USB-A/B and SuperSpeed USB Standard-A/B and Micro-USB-A/B connectors. These are described below.

History and Current Use of Micro-USB Connectors

In response to the limitations of the Mini-USB connector and the future needs of mobile phones and other portable devices, the Micro-USB Cables and Connectors specification was developed which initially operated in conjunction with USB 2.0. The Micro-USB connector is both smaller and more rugged than the Mini-USB connector, with durability of 10,000 insertions compared to 5,000[242]. There are two types of Micro-USB connectors, A and B, with the latter being commonly used as the data/charging interface on portable devices, including mobile phones. Mini-USB has been "deprecated" by the USB Implementers Forum, however it is still used on many portable devices.

The USB 3.0 specification defined a new Micro-USB-A/B connector, with the receptacle being backwards compatible with the USB 2.0 Micro-USB B plug (i.e. a USB 2.0 Micro-USB B plug will work

[242] USB Implementers Forum (2007): Universal Serial Bus Micro-USB Cables and Connectors Specifications (Revision 1.01), accessed at http://read.pudn.com/downloads114/doc/comm/476505/usb_20_040908/usb_20/Micro-USB_final/Micro-USB_1_01.pdf

with a USB 3.0 Micro-USB-B receptacle); however, the rate of charging (and data transfer) will be limited to the USB 2.0 and/or USB 2.0 with USB Battery Charging v1.2 specification. However, a USB 3.0 Micro-USB connector cannot be plugged into a USB 2.0 Micro-USB socket.

In December 2013, the USB 3.0 Promoter Group announced that it was developing a new USB connector specification, referred to as the USB Type-C connector. The USB Type-C connector will be similar in size to the current USB 2.0 Micro-USB connector, reversible (meaning it doesn't matter how the consumer plugs it in). It will also have bi-directional cables (meaning it doesn't matter which end is plugged into the device) and support scalable power charging and scalable data performance beyond 20Gbps data rates. The connector will not be compatible with existing Micro-USB plugs and receptacles. However the USB Type-C specification will define passive new-to-existing cables and adaptors to allow users to continue using their existing products. The new connector specification is expected to be finalised mid-2014 and be implemented into power sources and devices in late 2014/early 2015 (USB-IF, 2013)[243].

USB Battery Charging

The USB 2.0 specification was intended to provide power to small connected peripherals rather than charge the batteries of powerful portable and larger devices and for this reason there was a need for a standard capable of delivering higher power. The USB Battery Charging specification provides the technical requirements for a dedicated power source with a Standard-USB or Micro-USB plug to deliver up to 1.5A (i.e. power of up to 7.5W); this is an improvement on USB 2.0 where a standard downstream ports are limited to 500mA and USB 3.0 where they are limited to 900mA[244], although dedicated charging ports on USB 2.0 power sources (and integrated power sources) were already capable of delivering 1.5A (i.e. 7.5W). There are three types of charging ports: standard USB downstream ports (which, as noted above, are limited to 500 mA in the case of USB 2.0), dedicated charging ports (e.g. on mains chargers), which only provide power (but can provide higher power) and charging downstream ports (computers, laptops, hubs, anything that has data signalling) which support both power delivery and data transfer[245].

It is of interest that some manufacturers exceed the 1.5A limit of the USB Battery Charging specification, for example Apple's iPad provides 2.1A at 5V, Amazon's Kindle Fire Charger supplies 1.8A and some USB power sources in cars can provide up to 2.1A[246]. It is worth noting that older devices may not charge via USB ports that meet the requirements of the USB Battery Charging specification, instead requiring a standard downstream port.

[243] USB-IF (2013): Next Generation USB Connection Definition Underway, available at http://www.usb.org/press/USB-IF_Press_Releases/Type-C_PR_20131203_Final.pdf

[244] Lunn (2012): New USB Spec Improves Charging in Portable Devices, accessed at http://electronicdesign.com/power/new-usb-spec-improves-charging-portable-devices

[245] Seal Level (2012): What is the difference between a battery charging USB port and a standard USB port?, accessed at http://www.sealevel.com/support/article/AA-00535/0/13.-What-is-the-difference-between-a-battery-charging-USB-port-and-a-standard-USB-port.html

[246] Anthony (2012): How USB charging works, or how to avoid blowing up your smartphone, accessed at http://www.extremetech.com/computing/115251-how-usb-charging-works-or-how-to-avoid-blowing-up-your-smartphone

USB Power Delivery

Released in July 2012, the USB Power Delivery (PD) specification enables more flexible power delivery. USB PD is intended as an extension to the USB 2.0, USB 3.1 and BC v1.2 specifications, addressing only those elements that are required to implement enhanced power delivery[247].

Compatibility between Different Standards

Generally speaking, compatibility between the different USB standards can be described as 'if the connectors fit, it will charge'. However, power sources and cables which meet older USB specifications and deliver a low current may not be able to charge newer (higher current) devices at these devices' maximum charging rates, and conversely, new power sources/cables may not be able to utilise its maximum power delivery when plugged into older devices. In addition, although power will typically be delivered from the power source to the device, in some instances, the battery may not charge; this issue is assessed in more detail in Section 5.4.3. Table 5-1 provides a comparison of the specifications detailed above in terms of power output and compatibility.

Table 5-1: Cable Charging Standards - Charging Capacity

Specification	Release date	Compatibility	Current	Voltage	Power
USB 2.0 (Low, Full & Hi-speed USB)	Apr 2000	All compatible, as long as connector fits, although maximum power may be limited to an older standard	500mA	5V	2.5W
USB 3.0 (SuperSpeed USB)	Nov 2008		900mA	5V	4.5W
USB 3.1 (SuperSpeed USB 10 Gbps)	January 2013		900mA	5V	4.5W
USB Battery Charging (BC) v1.2	Dec 2010		0.5 – 1.5A	5V	2.5 - 7.5W
USB Power Delivery (PD)	Jul 2012		2A 3A 3A 5A	5V 12V 20V 20V	10W 36W 60W 100W*
*Note: * Standard USB connector only*					

The compatibility is further clarified in terms of power output from a host port in Table 5-2. The host port can be on a personal computer, laptop, wall socket or charging block (mains or car).

[247] USB Implementers Forum (2013): Universal Serial Bus Power Delivery Specification, accessed at http://www.usb.org/developers/docs/documents_archive/

Table 5-2: Compatibility of Micro-USB Connectors and Host Port Specifications (Maximum Power Output)		
Host port	Connector on device	
	USB 2.0	USB 3.0 and USB 3.1
	Standard-A/B, Micro-A/B	Standard-A/B Micro-A/B
USB 2.0	2.5W	2.5W
USB 3.0	2.5W	4.5W
USB 3.1	2.5W	4.5W
USB BC*	7.5W	7.5W
USB PD "aware"	60W limit for Micro A/B 100W limit for Standard-A/B	60 W limit for Micro-A/B 100W limit for Standard-A/B
** Dedicated charging port or charging downstream port*		

The tables above show that USB has undergone a development of increasing charging capacity. Currently, most smartphones use the USB 2.0 Micro-USB connector for charging. However, two handsets currently use USB 3.0 Micro-USB. The first handset to use the USB 3.0 Micro-USB connector (Samsung Galaxy Note 3) was introduced to the market in late 2013, followed by the Samsung Galaxy S5 in early 2014 (Dedezade, 2014[248]; The Verge, 2013). The main USB charging standards are summarised in Figure 5-1[249].

[248] Dedezade (2014): Samsung Galaxy S5 Hands-On Review, available at http://www.stuff.tv/samsung-galaxy-s5-hands-review/feature

[249] All images sourced from WikiMedia Commons from the following links: http://commons.wikimedia.org/wiki/File:MP3-Player_Sansa.jpg?uselang=en-gb, http://commons.wikimedia.org/wiki/File:World%E2%80%99s_first_dual-core_smartphone_comes_to_europe.jpg?uselang=en-gb, http://commons.wikimedia.org/wiki/File:Canon_IXUS_430.jpg, http://commons.wikimedia.org/wiki/File:Sony_Tablet_S.jpg?uselang=en-gb, http://commons.wikimedia.org/wiki/File:AllWinner_A13_Tablet.jpg?uselang=en-gb, http://commons.wikimedia.org/wiki/File:Sony_Cybershot_DSC_W210.jpg?uselang=en-gb, http://commons.wikimedia.org/wiki/File:Smartphone_bdBuzz.png?uselang=en-gb

Figure 5-1: USB Cable Standards – Charging and Capacity

Other Wired Charging Standards

Other wired charging standards include Intel's Thunderbolt which, like USB, is a single solution for both data transfer and power delivery. Thunderbolt was introduced in 2011 and has been mainly used in laptops for data transfer and providing power to external devices rather than charging the battery of the laptop itself. It is capable of delivering power up to 10W which exceeds the capabilities of older USB specification but lags behind the USB Power Delivery standard.

In early 2014, the IEC published the IEC 62700 standard (DC Power supply for notebook computers), which appears to be the first step towards standardisation of laptop charging. However, consultation suggests that standardisation of laptop charging may require further development. For example, it was suggested that the IEC62700 standard does not define the charging connector.

Wireless Charging

Three different consortia have developed standards for wireless charging. The Wireless Power Consortium (WPC) developed the Qi standard, the Power Matters alliance (PMA) the Powermat and the Alliance for Wireless Power (A4WP) the Rezence standard. Whereas the Qi standard is based on resonance technology, the other two standards use induction charging. The different consortia have adopted different approaches to rolling out their technology. Qi had its method of charging incorporated into devices (e.g. Google Nexus and Nokia Lumia) while Powermat has sought to have its charging pads installed in public places such as coffee shops and airports, coupled with apps and cloud based services to locate public wireless charging stations[250]. Generally speaking, on the device side that wireless charging can be either a) integrated into the phone or b) the consumer has to buy an add on sleeve.

[250] Techweekeurope, Michael Moore, Wireless Charging Groups A4WP And PMA Team Up Against Qi, (12/02/2014), accessed at: http://www.techweekeurope.co.uk/news/a4wp-and-pma-sign-wireless-charging-partnership-agreement-138881

To some extent, the competition to become the dominant wireless charging standard was reduced in February 2014 following a partnership between the PMA and A4WP. PMA will adopt A4WP for magnetic resonance charging hardware, while the inductive kit of PMA will be added to A4WP resonance systems. They will also collaborate to develop PMA's cloud services. It is therefore an alliance that has served to remove one of the barriers to a global wireless standard. Indeed, in the press release announcing the partnership, it was noted that the agreement that has been signed seeks to establish the 'global interoperability' of these two standards[251].

At the time of writing, it is not possible to ascertain whether this alliance or the Qi will become the dominant standard for wireless charging. It is of interest that the Consumer Electronics for Automotive (CE4A), a group of German automotive manufacturers comprising Audi, BMW, Daimler, Porsche and Volkswagen, has recently adopted the Qi standard for in-car wireless charging[252]. However, it is also interesting to note that Nokia recently switched from the Qi standard to PMA for the Nokia Lumia 1520[253].

Advantages of wireless charging

As smartphones have become more powerful with greater capabilities, for some consumers, one charge is insufficient to ensure the phone is powered throughout the day. Indeed, one study found that 70% of consumers charge their phone at least once a day, with 30% charging their device more than once[254]. This necessity to constantly 'top-up' the battery helps to explain why more than 80% of consumers want wireless charging in public areas[255]. Pioneers of wireless charging are therefore likely to use this as one of the features to differentiate their product within a very competitive marketplace.

With regard to charging in public places, there have been trials using wireless charging ports within coffee shops and other public spaces (e.g. Madison Square gardens in New York, major airport terminals)[256]. Wireless charging in such places offers the consumer a convenient means to recharge their device (they do not need to carry a charger around with them) while they are drinking their coffee or waiting to catch a flight. Wireless charging also offers consumers the opportunity to charge multiple devices on one charging pad, which may also benefit some consumers.

Another advantage of wireless charging is that it may be a more suitable charging solution, compared to Micro-USB, for devices that may be exposed to wet environments as the device can be

[251] Power Matters Alliance, Alliance for wireless power and power matters alliance join forces, (11/02/2014), accessed at: http://www.powermatters.org/menuless/314-alliance-for-wireless-power-and-power-matters-alliance-join-forces

[252] PR Newswire, Influential automotive working group, CE4A, recommends its members use Qi in current and future vehicle models, (05/09/2013), accessed at: http://www.prnewswire.com/news-releases/influential-automobile-working-group-ce4a-recommends-its-members-use-qi-in-current-and-future-vehicle-models-222518341.html

[253] WP Central, Rich Edmonds, AT&T removed Qi wireless charging in the Lumia 1520 to make room for PMA, (25/10/2013), accessed at: http://www.wpcentral.com/att-removed-qi-lumia-1520-make-room-pma

[254] IHS Technology, Ryan Sanderson, Wireless charging coming to all US Starbucks – but incompatible with most enabled devices, (12/06/2014), accessed at: https://technology.ihs.com/503159/wireless-charging-coming-to-all-us-starbucks-but-incompatible-with-most-enabled-devices

[255] Computer world, Lucas Mearian, Starbucks' new wireless charging won't work for most devices, (12/06/2014), accessed at: http://www.broadbandnews.net/articles/share/316707/

[256] Cnet, Roger Cheng, Wireless charging blazes path toward mainstream, (16/11/2012) accessed at: http://www.cnet.com/uk/news/wireless-charging-blazes-path-toward-mainstream/

sealed[257]. Indeed, wireless charging is now well established for electric toothbrushes for this very reason. Looking to the future, other manufacturers have for some time acknowledged the potential benefits in terms of waterproofing. For example, Toshiba showcased a concept waterproof tablet wirelessly charging in a fish tank in 2012[258]. Furthermore, wireless charging is evidently more durable than conventional wired charging as there is no connector or port to damage following multiple insertions.

Disadvantages of wireless charging

There are however a number of obstacles that have prevented the wider adoption of wireless charging. These include[259]:

- **efficiency:** perhaps most importantly, wireless chargers need to demonstrate that the time taken to charge a device is of a comparable rate to that achieved by conventional wired charging. However, it would appear this obstacle has been sufficiently overcome with a number of mobile phones already offering wireless charging. Other companies are also working to overcome this issue, perhaps with wireless charging for other devices in mind (e.g. Toshiba has developed two new efficiency receivers that improve the 5W output efficiency of the receiving module from 87% to 95%[260]). A stakeholder active in the wireless charging sector responding to consultation for this study noted that losses during power transfer are limited to 20-30% of the charge;
- **safety and electromagnetic interference/electromagnetic compatibility:** companies developing wireless technology will need to ensure that wireless chargers comply with all relevant and applicable safety standards. Evidently, this problem is not significant with regard to mobile phones given that a number of wireless chargers for mobile phones are already on the market; and
- **cost:** wired chargers are still supplied with mobile phones or where they are not, consumers are likely to already own a suitable charger. Consumers may therefore be reluctant to make the necessary financial investment required to switch to wireless charging. An overview of some of the wireless chargers available on the market and their cost can be found in Table 5-3, although it should be noted that some of the chargers are currently unavailable for purchase. It appears that the retail prices of chargers in Table 5-3 generally exceed those of most wired chargers. This has been confirmed by a manufacturer of chargers that responded to consultation for this study and which suggested that supplying a wireless charger would represent a 70-80% increase on the cost of supplying a wired charger. On the other hand, information provided by consultation suggests that the production cost of magnetic connectors for wireless charging are less than €2, suggesting that the cost differential between wired and wireless chargers may also relate to their positioning in the market and as such the prices of wireless chargers may decline in the future.

[257] Qualcomm, Francesco Carobolante and Geoff Gordon, Application Segment Overview – Wireless Power Transfer, accessed at: http://www.qualcomm.com/media/documents/files/psma-roadmap-wireless-power-transfer.pdf

[258] GottaBeMobile, Adam Mills, Toshiba's waterproof tablet can even charge wirelessly underwater, (01/10/2010), accessed at: http://www.gottabemobile.com/2012/01/10/toshibas-waterproof-tablet-can-even-charge-wirelessly-underwater/

[259] Qualcomm, Francesco Carobolante and Geoff Gordon, Application Segment Overview – Wireless Power Transfer, accessed at: http://www.qualcomm.com/media/documents/files/psma-roadmap-wireless-power-transfer.pdf

[260] Toshiba, Toshiba Electronics Europe, Leading the charge for wireless charging, accessed at: http://www.toshiba-components.com/wireless/6444A_White%20Paper.pdf

Table 5-3: Wireless chargers		
Manufacturer/Brand	**Description**	**Price**
Sony	Wireless Charging Plate WCH10 and the Wireless Charging Cover WCR12	Charging plate - €57 Charging Cover - €73
Google	Nexus Wireless Charger – works with Nexus 7, 5 and 4	€44
Bitmore	Qi Airpulse™ Wireless Samsung Galaxy S3 Charging Ki	€34
Powermat	Duracell Powermat	€30
Nokia	Recharge pillow (compatible charging cover may be required)	Pillow - €100 Charging cover - €35
Oregon scientific	Time & Wireless Charging Station	€114
Incipio	Wireless charging cover for Galaxy S4 (works with Powermat charger)	€22
LG Electronics	WCP 300	€37
Wireless Qi power charger pad	For Nokia Lumia 920 , Lumia 820 and Google Nexus 4 Nexus 5 Samsung Galaxy S3 i9300 S4 i9500 Note II N7100 Note3 N9000 N9005 HTC 8X , Droid DNA, LG DIL, LTE2 BC252L	€25
Expower(R)	Google Nexus 5 and Goole Nexus 7 II FHD Tablet and Goole Nexus 4 and Samsung galaxy S5 note3 S4 S3 note2 and NOKIA Lumia 920 and 820 and Iphone5s Iphone5	€15
CHOE Qi	Galaxy S5	€58
KoolPuck Qi	Includes: Nexus 5, Samsung Phones with Receivers & iPhone with iQi Mobile	€50
DigiYes Qi	LG google Nexus 4, Optimus Vu II, Nokia Lumina 920	€16

Sources: Clove technology, Sony Wireless charging plate and cover, accessed at: http://www.clove.co.uk/sony-wch10-wireless-charging-plate & http://www.clove.co.uk/sony-xperia-z2-wcr12-wireless-charging-cover-black; Google play, Google Nexus wireless charger, accessed at: https://play.google.com/store/devices/details?id=nexus_wireless_charger; Bitmore, accessed at: http://www.bitmore.co.uk/products/samsung-galaxy-s3-charging-kit; Powermat, accessed at: http://www.duracellpowermat.com/; Amazon, Nokia rechargeable pillow and cover, accessed at: http://www.amazon.co.uk/dp/B00A7QZ3L8/?m=A3P5ROKL5A1OLE&tag=nouk-21 & http://www.amazon.co.uk/s/ref=nb_sb_noss?url=search-alias%3Delectronics&field-keywords=nokia+charging+cover&rh=n%3A560798%2Ck%3Anokia+charging+cover; Oregon scientific, accessed at: http://uk.oregonscientific.com/cat-Time-sub-Designer-Clocks-prod-Time-and-Wireless-Charging-Station.html#.U6A0dSh1yUk ; Incipio, cover for Galaxy S4, accessed at: http://www.incipio.com/cases/samsung-smartphone-cases-accessories/samsung-galaxy-s4-cases/wireless-charging-cover-for-samsung-galaxy-s4.html; LG Electronics, accessed at: http://www.lg.com/us/cell-phone-accessories/lg-WCP-300-wireless-charging-pad; Amazon, wireless QI power charger pad, accessed at: http://www.amazon.co.uk/Wireless-Charger-Google-Samsung-BC252L/dp/B00FEAGZ6E/ref=sr_1_2?ie=UTF8&qid=1403009146&sr=8-2&keywords=wireless+chargers; Amazon, Expower(R) QI standard wireless Charger, accessed at: http://www.amazon.co.uk/Expower-standard-Wireless-Charger-Iphone5s/dp/B00F8VA3XU/ref=sr_1_3?ie=UTF8&qid=1403009146&sr=8-3&keywords=wireless+chargers ; Amazon, CHOE charger, accessed at: http://www.amazon.co.uk/Wireless-Charger-Including-Charging-Receiver/dp/B00DDTZN4S/ref=sr_1_5?ie=UTF8&qid=1403009146&sr=8-5&keywords=wireless+chargers; Amazon, KoolPuck QI, accessed at: http://www.amazon.co.uk/KoolPuck-Wireless-Compatible-Including-Receivers/dp/B00GY5UNPM/ref=sr_1_10?ie=UTF8&qid=1403009146&sr=8-10&keywords=wireless+chargers; Amazon, DigiYes charger, accessed at: http://www.amazon.co.uk/DigiYes%C2%AE-Wireless-Charger-Google-Optimus/dp/B00DY50GIE/ref=sr_1_65?ie=UTF8&qid=1403010049&sr=8-65&keywords=wireless+chargers

Wireless charger market

Information provided by a manufacturer of wireless chargers responding to consultation for this study suggests that as of June 2014 there were more than 500 electronic devices in the market with Qi capabilities built-in, including 65 mobile phones. In terms of global shipments, one report has estimated that around 20 million consumer devices were shipped with wireless charging capabilities in 2013 and that most of these were compatible with the Qi standard[261]. By January 2014, around 40 million phones had been sold that were compliant with the Qi standard[262].

Looking to the future, the global wireless chargers market is projected to grow in the upcoming years. The increase in unit sales and revenue of wireless chargers will not solely be accounted for by mobile phones, but other sectors such as consumer electronics, electrical vehicles, industrial applications and some military applications[263]. With this in mind, it is interesting to note that A4WP has recently updated its Rezence standard to support laptops, tablets and devices up to 50W. Given that A4WP members include industry leaders in the laptop market such as Qualcomm, Intel, Apple and Dell, it may be the case that wireless charging also comes to laptops in the future[264]. Consultation carried out for this study also suggests that in late 2013, the Wireless power Consortium were working on extending the charging capacity of the Qi standard to to 15W.

Although it is difficult to accurately ascertain the rate at which the market will grow, the potential for rapid global growth across all sectors (mobile phones, consumer electronics, electrical vehicles, industrial applications and some military applications) would appear to exist. IHS has predicted that by 2018, there will be around 900 million devices enabled for wireless charging, while the market for wireless power receivers is expected to grow to 1.7 billion shipments in 2023[265]. In terms of revenue, this is expected increase from €160 million in 2013, to €584 million in 2014 and then expand to €6.3 billion in 2018[266].

With regard to the geographic expansion of wireless chargers, it would seem that the Korean market has flourished. This can be attributed to mobile phone manufacturers and carriers incorporating wireless chargers with mobile phones at no additional cost to the consumer. Wireless charging is also gaining a foothold in the US. Although there is evidence of a wireless charger market for mobile phones in Europe, the uptake has been slower. One reason for the slow uptake in Europe could be the lack of a pioneering company championing wireless charging to consumers. However, there are now a number of mobile phones that can be wirelessly charged and these may raise the profile of wireless charging. Raising consumer awareness appears to be a key factor in ensuring the uptake of

[261] IHS Technology, Ryan Sanderson, Wireless charging coming to all US Starbucks – but incompatible with most enabled devices, (12/06/2014), accessed at: https://technology.ihs.com/503159/wireless-charging-coming-to-all-us-starbucks-but-incompatible-with-most-enabled-devices

[262] Techradar, Mary Branscombe, Cutting the Cord: why wireless charging will finally power up in 2014, (01/2014), accessed at http://www.techradar.com/news/phone-and-communications/mobile-phones/cutting-the-cord-wireless-charging-will-finally-power-up-in-2014-1216320

[263] Wireless efficiency, Wireless Power Industry Forecast 2014 – 2020, (22/11/2013), accessed at: http://www.wirelessefficiency.com/?p=2671

[264] TechnoBuffalo, Jacob Kleinman, Wireless charging coming to laptops, tablets and more, (14 June 2014), accessed at: http://www.technobuffalo.com/2014/06/14/wireless-charging-coming-to-laptops-tablets-and-more/

[265] Consumer Electronics Association, I3, Wireless charging, (05/06/2014), accessed at: http://www.ce.org/i3/Innovate/2014/May-June/Wireless-Charging.aspx

[266] HIS Pressroom, Global Market Revenue for Wireless charging to rise by nearly a factor of 40 by 2018, accessed at: http://press.ihs.com/press-release/design-supply-chain/global-market-revenue-wireless-charging-rise-nearly-factor-40-2018

wireless charging[267]. Of course, perhaps the biggest contributor to the slow uptake of wireless chargers may be the cost of these chargers to consumers.

Other Solutions

Other technologies include a range of solutions that do not rely on mains electricity. For example, in-car charging is often carried out using the so called 'cigarette-lighter' plug. However, consultation for this study suggests that the automotive industry now routinely includes USB sockets in their cars. Similarly, products that are not provided with a charger are typically provided with a Micro-USB/USB cable which serves for both data transfer and charging from a larger device or a USB wall socket.

Recent technological progress has seen the development of fuel cell chargers for mobile phones[268] but this technology is yet to reach mass market appeal. In addition, solar power chargers have been on the market for a number of years but appear to remain a product that complements mains chargers rather than replaces them[269].

In addition, products have now emerged on the market that can be charged and serve as chargers themselves for another product. These serve as an 'emergency back-up' in those instances where a mains power terminal or USB port (e.g. laptop) is not accessible. These products appeal to a wide market, including outdoor enthusiasts, professionals and the everyday consumer who need to ensure that their mobile phone has enough power to make an 'emergency' phone call. For example, the Proporta is slim and has been designed to be carried around in a wallet or pocket[270].

Summary of Technical Solutions

Whilst the use of the USB 2.0 Micro-USB specification is adequate for most current generation mobile phones, the power delivered under this specification is not sufficient to charge much larger devices, such as tablets and laptops. However, the advent of the USB Power Delivery specification will enable the increase in power that can be delivered through the USB 2.0 Standard/Micro connectors from 10W to 100W (USB Standard-A/B connectors) or 60W (Micro-USB A/B connectors) which will be sufficient to charge most portable electronic devices within the scope of this study, although it appears that many laptops may be charging at power rates above 60W. In fact, the average charger output in a sample of laptops examined for this study was around 70W and there are a number of laptops, particularly those aimed at gaming and multimedia tasks which require chargers in excess of 100W).

Table 5-4 and Figure 5-2 summarise the currently used connectors and propose possible technical options for harmonising chargers in each product group.

[267] Smithers Apex, Discussion: What's next for wireless power in Europe?, (29/01/2014), accessed at: https://www.smithersapex.com/market-reports/discussion-whats-next-for-wireless-power-in-europe.aspx

[268] See, for example, http://powertrekk.com and http://news.cnet.com/8301-1035_3-57611967-94/intelligent-energy-offers-upp-a-$200-phone-charging-fuel-cell/

[269] See, for example, http://www.techradar.com/news/portable-devices/are-solar-powered-chargers-worth-it-635326

[270] See http://www.proporta.co.uk

Table 5-4: Possible solutions for a common connector		
Device	**Current charging requirements**	**Possible common solution**
Mobile phones	5W to 7.5W (current) or up to 10W-12W (next generation)	Micro-USB
E-readers	4.25W to 10.4W	
Digital cameras and camcorders	Camera: 3.8W to 8.5W Camcorder: 7.9W to 19.7W	
Digital cameras and camcorders	Camera: 3.8W to 8.5W Camcorder: 7.9W to 19.7W	
Portable media players	2.5W to 5W	
Personal navigation devices	5W to 10W	
Portable handheld games consoles	2.3W to 10W	
Sports and activity monitors	2.5W to 5W	Micro-USB, unless waterproof/wearable
Personal care products	2W to 6.5W	
Laptops	10W to 240W	Micro-USB/Standard USB
Tablets	*4W to 65W*	
Source: Compiled from a large number of sources		

It is also possible to consider harmonisation across different groups of devices with similar power requirements rather than for all devices within the scope of the study. Figure 5-3 illustrates possible groupings of devices under different power specifications.

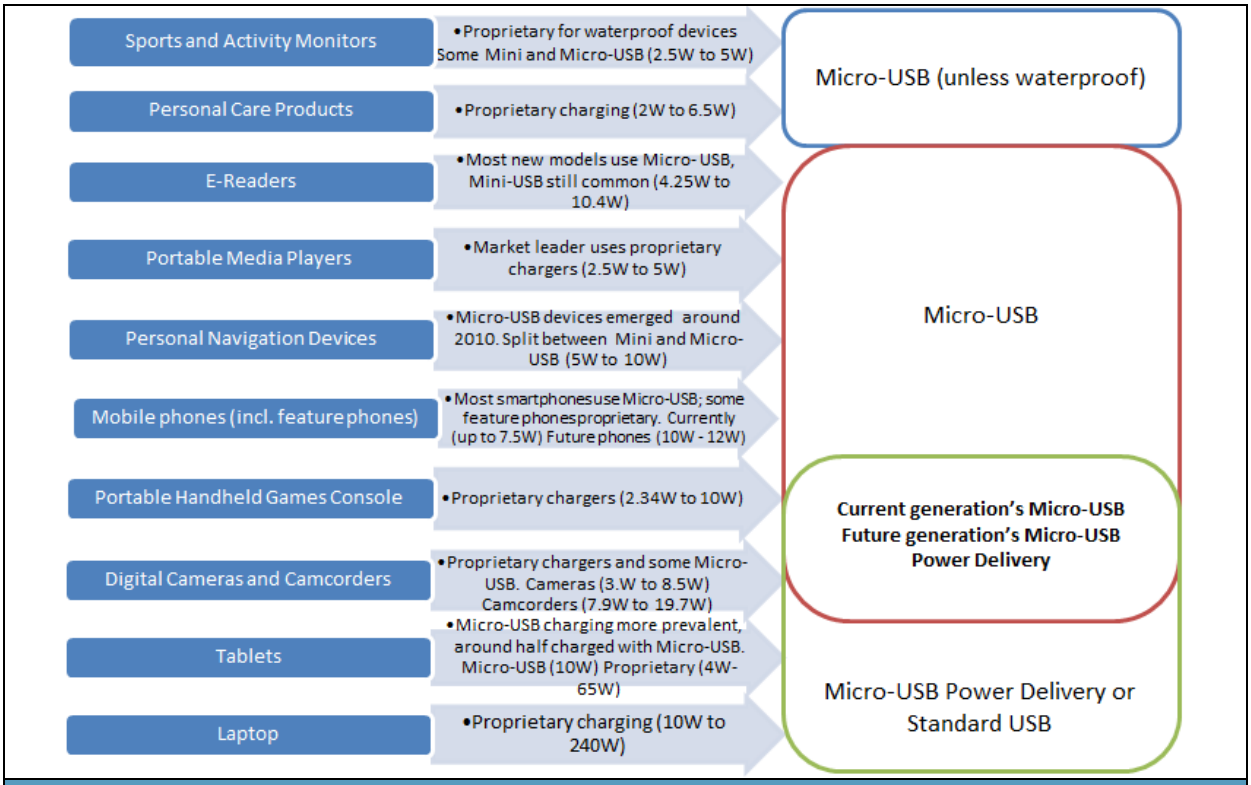

Figure 5-3: Possible solutions for a common connector

5.2.2 Method of Implementation

A common charging solution could be implemented in several different ways. The impact assessment in the following section considers the following implementation options:

- **Encouraging a Voluntary Agreement:** The European Commission would facilitate discussions among manufacturers of portable rechargeable devices with the aim to reach a consensus on the use of a common charger. The involvement of the Commission in this process would appear to be necessary as some of the relevant market sectors are not organised in associations. In addition, where competing technical solutions are being developed, the involvement of an external actor may be required to facilitate a consensus. This may possibly involve the Commission issuing standardisation mandates, if required.

- **EU Legislation:** The European Commission would propose legislation requiring that certain rechargeable devices use certain chargers. This Option may involve the Commission issuing standardisation mandates.

5.2.3 Scope of New Requirements

The scope in terms of the products considered in this study comprises mobile phones and other portable rechargeable devices, including tablets, e-readers, laptops, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care products, tablets and laptops. The process of determining the scope of the study is described in Section 4.

Harmonisation could be enacted on a per device basis (e.g. different requirements for mobile phones and e-readers, etc.) or for all portable rechargeable devices within the scope of this study. Due to the large diversity of charging power used by the devices considered in this report, the introduction of separate policy options for groups of devices that charge at similar power levels is considered more feasible. For this reason, the different devices have been divided into three groups depending on the power at which they charge:

- mobile phones, e-readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care devices;
- tablets; and
- laptops.

Please note that this report assess the potential impacts from the introduction of a common charger for the devices listed above, as opposed to the introduction of a common charger for all portable electronic devices. As such, the impacts of the use of a common charger for other product groups (e.g. two-way radios) are not considered in this report.

5.2.4 Definition of Detailed Requirements

Generally speaking, any requirements on the charging of portable rechargeable devices can focus either on:

- harmonisation of the connector;
- harmonisation of charging characteristics; and
- harmonisation of the connector and charging characteristics.

This study focuses on the harmonisation of connectors and it is expected that any requirements on power characteristics (such as minimum/maximum voltage/current, etc.) would be defined through standardisation. However, technical issues relevant to the standardisation across a range of devices

that charge at similar but not identical power (and different currents & voltages) are also considered in this report (primarily in Section 5.4.3).

In addition, two variants of each policy option are assessed in this report: a) not allowing or b) allowing that adaptors are used in conjunction with chargers that do not have integrated connectors conforming to the common solution.

5.2.5 Definition of Policy Options

The impact assessment in the following section considers the following policy options:

- **Option 0 (No Harmonisation Scenario):** Option 0 assumes no action would be taken by the European Commission and no further voluntary agreements would be signed by manufacturers.

- **Option 1 (Encouraging a Voluntary Agreement):** The European Commission would facilitate discussions among manufacturers of portable rechargeable devices with the aim to reach a consensus on the use of a common charger.

- **Option 2 (EU Legislation):** The European Commission would propose legislation requiring that certain rechargeable devices use certain chargers.

It is expected that the common charger would be based on the Micro-USB connector, although it is recognised that this connector is not able to deliver sufficient power for the charging of some tablet/laptop models; as a result, Section 5.6 also considers the impacts of using standard USB connectors for the charging of laptops. Two variants of Options 1 and 2 are assessed: a) not allowing or b) allowing that adaptors are used in conjunction with chargers that do not have integrated connectors conforming to the common solution.

A summary of the policy options is provided in Section 5.4.1 for mobile phones, e-readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care devices, Section 5.5.1 for tablets and Section 5.6.1 for laptops.

5.3 Determination of Most Significant Impacts

5.3.1 Introduction

This Section of the report assesses the main impacts that these policy options are expected to have on mobile phones and other portable rechargeable devices. The approach to the impact assessment elaborated for this study closely follows the European Commission's *Impact Assessment Guidelines*[271].

The Impact Assessment (IA) Guidelines specify that the initial two steps of the impact assessment involve defining the problem, the objectives of legislative or non-legislative intervention and setting out the associated policy options.

The key steps, therefore, in carrying out the assessment are:

[271] European Commission (2009): **Impact Assessment Guidelines**, dated 15 January 2009 SEC(2009) 92

- IA Step 1: Identification of existing problems and objectives of policy intervention;
- IA Step 2: Defining the policy options;
- IA Step 3: Identification of impacts that are relevant and key stakeholders that might be affected;
- IA Step 4: Initial assessment of the importance of these impacts based on their expected magnitude and on the likelihood of them occurring;
- IA Step 5: In-depth analysis of the most significant impacts;
- IA Step 6: Comparison of the policy options; and
- IA Step 7: Identification of the preferred policy option.

5.3.2 Steps 1-4 of the IA Process

As regards Step 1, the main problem to be addressed by the policy options is consumer inconvenience and unnecessary e-waste associated with the diversity of charging solutions. This issue is assessed in detail in Sections 3 and 4 of this report, which describes the types of chargers used for each device. A summary of the current situation is also provided in Table 5-4 in Section 5.2. Policy options to be assessed (Step 2) are developed in Sections 5.2 of this report and summarised in Section 5.4.1, 5.5.1 and 5.6.1. This section therefore focuses on Steps 3 to 7. Steps 3 and 4 are dealt with below for all portable rechargeable devices and Steps 5 and 6 are carried out in the remainder of this section for each device. Step 7 is not within the scope of the study.

The aim of IA Step 3 is to compile a list of impacts and stakeholders that are relevant to the policy options under consideration. This is achieved by reviewing the comprehensive checklist of potential economic, environmental and social impacts set out in Tables 1 to 3 in the Commission's Impact Assessment Guidelines and identifying any additional impacts.

The outcome (presented in Table 5-5) is a list of impacts that may arise should Option 1 or 2 be implemented. These could potentially affect the following stakeholders:

- **device manufacturers**, primarily in relation to operating costs, SMEs, innovation and research;
- **manufacturers of chargers**, primarily in relation to competition and revenue generated, as well as conduct of business;
- **other companies (network carriers, retailers, etc.)**, in relation to revenue generated and logistics;
- **national authorities**, primarily in relation to marklet surveillance and enforcement of product safety legislation; and
- **consumers**, in terms of convenience and prices paid for the relevant products but also as beneficiaries of potential environmental improvements.

Table 5-5: Initial screening of the relevance of impacts listed in the Commission's IA Guidelines

Impact type	Relevant?
Economic Impacts	
Functioning of the internal market and competition	**Potentially relevant**
Competitiveness, trade and investment flows	**Potentially relevant**
Operating costs and conduct of business/SMEs	**Potentially relevant**
Administrative burdens on businesses	Not relevant
Public authorities	**Potentially relevant**
Property rights	**Potentially relevant**
Innovation and research	**Potentially relevant**

Table 5-5: Initial screening of the relevance of impacts listed in the Commission's IA Guidelines	
Impact type	**Relevant?**
Consumers and households	**Potentially relevant**
Specific regions and sectors	Not relevant
Third countries and international relations	**Potentially relevant**
Macroeconomic environment	Not relevant
Social Impacts	
Employment and labour markets	**Potentially relevant**
Standards and rights related to job quality	Not relevant
Social inclusion and protection of particular groups	Not relevant
Gender equality, equality treatment and opportunities, non-discrimination	Not relevant
Individuals, private and family life, personal data	Not relevant
Governance, participation, good administration, access to justice, media and ethics	Not relevant
Public health and safety	**Potentially relevant**
Crime, terrorism and security	Not relevant
Access to and effects on social protection, health and educational systems	Not relevant
Culture	Not relevant
Social impacts in third countries	Not relevant
Environmental Impacts	
The climate	Not relevant
Transport and the use of energy	Not relevant
Air quality	Not relevant
Biodiversity, flora, fauna and landscapes	Not relevant
Water quality and resources	Not relevant
Soil quality or resources	Not relevant
Land use	Not relevant
Renewable or non-renewable resources	**Potentially relevant**
The environmental consequences of firms and consumers	Not relevant
Waste production/generation/recycling	**Potentially relevant**
The likelihood or scale of environmental risks	Not relevant
Animal welfare	Not relevant
International environmental impacts	**Potentially relevant**

However, not all questions listed under the relevant impact categories in the Commission's IA Guidelines are relevant to the policy options under consideration. The key questions that are considered in this impact assessment are given in Table 5-6.

Table 5-6: Key questions for the IA	
Impact type	**Key Questions**
Economic Impacts	
Operating costs and conduct of business/SMEs	• Will it impose additional adjustment, compliance or transaction costs? • Does it impact on the investment cycle? • Will it entail the withdrawal of cert ain products from the market? Is the marketing of products limited or prohibited? • Will it lead to new or the closing down of businesses? • Are some products or businesses treated differently from others in a comparable situation?

Table 5-6: Key questions for the IA	
Impact type	**Key Questions**
Research and innovation	• Does the option stimulate or hinder research and development? • Does it affect intellectual property rights (patents, trademarks, copyright, other know-how rights)? • Does it promote greater productivity/resource efficiency?
Consumers	• Does the option affect the prices consumers pay? • Does it have an impact on the quality and availability of the goods/services they buy, on consumer choice and confidence?
Competition	• Will it lead to a reduction in consumer choice, higher prices due to less competition, the creation of barriers for new suppliers and service providers, the facilitation of anti-competitive behaviour or emergence of monopolies, market segmentation, etc.?
Competitiveness, trade and investment flows	• What would be the impacts on the market for this product? • What impact does the option have on the global competitive position of EU firms? Does it impact on productivity? • What impact does the option have on trade barriers? • Does it provoke cross-border investment flows (including relocation of economic activity)?
Public authorities	• Does it bring additional governmental burden?
Third countries and international relation	• How does the option affect trade or investment flows between the EU and third countries? • Does the option concern an area in which international standards, common regulatory approaches or international regulatory dialogues exist?
Social Impacts	
Consumer convenience	• Does this option affect consumers in any way?
Health and safety	• Does the option affect the health and safety of individuals/populations?
Employment	• Does the option facilitate new job creation? • Does it lead directly or indirectly to a loss of jobs?
Environmental Impacts	
Waste generation/ recycling	• Does the option affect waste production or how waste is treated, disposed of or recycled?
Renewable and non-renewable resources	• Does this option impact on energy use, renewable/non-renewable materials, CO_2 emissions?
International environmental impacts	• Does the option have an impact on the environment in third countries that would be relevant for overarching EU policies, such as development policy?

The assessment of the most significant impacts and comparative analysis of the policy options (IA Steps 5 and 6) are dealt with below for each of the portable rechargeable devices within the scope of this study.

5.4 Mobile Phones and Devices Charging at Similar Power – Assessment of the Most Significant Impacts

5.4.1 Summary of Policy Options

For the purposes of this study, the following policy options are being considered for mobile phones, e-readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care devices:

- **Option 0 (No Harmonisation Scenario):** Option 0 assumes no action would be taken by the European Commission and no further voluntary agreements would be signed by manufacturers. Manufacturers of these devices would thus be free to use to any socket/connecter for charging (as regards handset manufacturers, this would be the case after the expiration of the LoI at the end of 2014).

- **Option 1 (Encouraging a Voluntary Agreement):** The European Commission would encourage discussions among manufacturers of the relevant devices, with the aim of facilitating a consensus on the use of a common charger. Two variants of this option are considered in this report; these are: a) not allowing or b) allowing that adaptors are used in conjunction with chargers that do not have integrated connectors conforming to the common solution.

- **Option 2 (EU Legislation):** The European Commission would propose legislation requiring that the relevant devices use chargers with a Micro-USB connector. This Option may involve the Commission issuing a standardisation mandate, thus facilitating the definition of detailed technical requirements of the common charger. Variants of Option 3 include a) not allowing or b) allowing that adaptors can be used in conjunction with chargers that do not have Micro-USB connectors.

For the purposes of this impact assessment, it is assumed that the technical solution to be adopted under both Option 1 and 2 would be based on the USB 2.0 Micro-USB connector but these policy options do not specify the precise requirements to be applied (e.g. power limitations or the use of specific USB standards) and it is expected that these would be defined through the development of standards. However, the power requirements of these product groups indicate that some of these devices (or their future generations) may need to rely on the Micro-USB Power Delivery standard, which is capable of delivering up to 60W (3A, 20V) through a USB 2.0 Micro-USB connector.

For the purposes of the impact assessment, it is expected that these requirements would come into force from 2017 and may be valid for a period of up to three, five or ten years. Options 1 and 2 may involve establishing a procedure for adapting these requirements to technical progress sooner (if required) and/or granting exemptions to innovative products. Any requirements would only apply to new models introduced to the market from 2017. Any models already on the market in 2017 would be exempt from these requirements and could continue to be marketed with their existing charging methods.

As indicated above, it is assumed that the technical solution to be adopted under Option 1 would be based on the Micro-USB connector. This is, however, by no means certain. A number of technical options would be reviewed by manufacturers; for most products these would most likely be European or international standards. Given the suitability and ubiquitous nature of the Micro-USB (B) connector, it is possible that this would be the preferred technical option for most product groups. Indeed, for some of the product groups it would appear to be the most suitable option, in

terms of current sales and the required levels of functionality and safety. In this regard, another key advantage of Micro-USB is that it is not a proprietary solution and as such there are no obstacles in terms of copyright/patents to all market players converging on this standard. Therefore, it appears to be a good basis for a common solution as manufacturers would not incur additional outlays for the development of a new common connector which may be an advantage in shrinking market segments such as portable media players. However, some manufacturers responding to consultation have expressed concerns about the suitability of Micro-USB connectors for personal care products and sports and activity monitors that need to be waterproof or that are used in wet environments (e.g. in the bathroom).

This raises the question whether some devices may see harmonisation on the basis of connectors other than Micro-USB, for example in the sports and activity monitors segment, where a manufacturer responding to consultation for this study suggested it would be open to developing a charging clip standard in collaboration with other companies. However, without information from any other manufacturers on this issue, it is not possible to determine whether this is a feasible technical option as those companies that have pioneered the charging clip may be unwilling to share their know-how with their competitors.

Option 1 would also give manufacturers the chance to exclude certain types of products from the scope of the voluntary agreement. For example, "wet/dry" personal care products could be exempted from inclusion under the voluntary agreement due to concerns about the suitability of Micro-USB for products used in wet environments such as showers. Such exemptions could also be established under Option 2, and where appropriate, the need for exemptions is discussed later in this section. Under Option 1, it is likely that should the voluntary agreement encompass all major manufacturers, it is more likely to permit the use of adaptors. In fact, for many of the product groups considered in this study, it can be expected that the variant of this option that allows the use of adaptors is likely to increase the market coverage of the voluntary agreement.

As regards Option 1, this impact assessment assumes that a voluntary agreement would be reached. However, the likelihood of such agreement being signed and its market coverage can be expected to differ by product group. There are essentially two key factors impacting the success of a potential voluntary agreement. The first factor is the structure of the sector (the number of companies) and the willingness of the major players to sign such an agreement. Although this differs somewhat by sector, in general the product sectors considered in this study are relatively concentrated and several key players can be easily identified. The second factor relates to the willingnees of these companies to sing up to an agreement. This is difficult to assess but, generally speaking, it can be expected that these companies would be more willing to participate in a voluntary agreement under the 'adaptors allowed' suboption, especially in sectors where proprietary connectors are used by the highest selling companies, such as tablets, portable media players, digital cameras and camcorders, sports and activity monitors, etc.

Please note that the assessment in this section is only a general overview of the impacts of using the USB 2.0 Micro-USB connector for charging of the relevant portable electronic devices. This assessment is carried out in absence of the precise technical requirements having been defined and as a result it only provides a very general overview of the impacts that would arise from Options 1 and 2. For example, it has not been specified whether minimum/maximum power limitations would be placed on the common charger or electronic devices. This report thus assumes that the power ouput of each charger would be tailored to the needs of the device it is supplied with. However, if minimum ouput requirements were specified to ensure that all chargers can charge more powerful devices, this could have cost implications that have not been taken into account in the assessment presented in this report. In addition, it is not clear whether the requirement to use Micro-USB would apply to all devices belonging to the relevant product groups or just those with certain power

requirements; for example, manufacturers may be asked to comply for their devices for which the technical restrictions of the harmonised charger are compatible, but then develop other solutions for other devices for which there are e.g. higher power requirements (e.g. current generation handsets vs. next generation handsets). Similarly, it is not clear whether there would be any exemptions, e.g. for wearable and waterproof products. The assessment presented in this section assumes that reasonable exemptions would be provided to manufacturers and as such wearable and waterproof devices would be exempted from the requirements. Of course, should this not be the case, the impacts would differ from those presented in this section. In addition, this impact assessment assumes that technical issues set out in Section 5.4.3 could be overcome in time for these options to come into force in 2017; however, this cannot be predicted with any degree of certainty.

This section of the report is structured as follows:

- Section 5.4.2 summarises the current and future charging requirements under Option 0;
- Section 5.4.3 sets out the main technical issues associated with the use of a common charger across a range of devices; and
- Sections 5.4.4, 5.4.5 and 5.4.6 assess the most relevant economic, social and environmental impacts of harmonising chargers for mobile phones and devices with similar power requirements.

5.4.2 Summary of Current and Future Charging Requirements Under Option 0

This section summarises the current situation as regards connectors and charging capacity for the relevant devices and considers how this may change in the future.

Mobile Phones

As noted in Section 3 of this report, in 2013, 93% of all handsets (and almost 100% of data enabled handsets) sold in the EU were compliant with the MoU. In terms of the connector on the device itself, 79% of all handsets and 85% of data-enabled handsets had a Micro-USB connector. This reflects the 14% market share of Apple, whose phones comply with the MoU by means of having made an adaptor available for purchase.

Given the ubiquitous nature of Micro-USB connectors and the investment that manufacturers have made in Micro-USB infrastructure along the supply chain, it was unlikely that there would be a reversion to proprietary connectors immediately upon expiration of the MoU at the end of 2012. In fact, handset manufacturers have extended this approach through two consecutive Letters of Intent (LoI), with the current LoI effectively extending the MoU until the end of 2014. Although sales data are not available for 2014, the current level of compliance is expected to be high as the five signatories of the 2014 LoI (Table 5-7) appear to account for the majority of the market. Although 2013 sales data are not available for two of these companies, the combined market share of the signatories of the 2014 LoI clearly exceeded 67% in 2013.

Table 5-7: Signatories of the 2014 LoI	
Company	**2013 Market Share (All Mobile Phones)**
Apple	14%
BlackBerry	n/a*
Huawei	n/a*
Samsung	45%
Sony	8%
*Note: *Individual sales data for Blackberry and Huawei are not available for 2013* *Source: Digital Europe (2014): Letter of Intent; market shares are estimates based on data in various IDC press releases accessed at http://www.idc.com/about/press.jpg*	

Handset manufacturers responding to consultation for this study have not provided any information suggesting the level of harmonisation of charging is likely to be significantly eroded in the very near future. Perhaps the only factor that could erode the current level of harmonisation in the very near future is the fact that two handsets launched recently by Samsung (Galaxy Note 3 and the Galaxy S5) use Micro-USB 3.0 for charging (Dedezade, 2014[272]; The Verge, 2013). Whilst the Micro-USB 3.0 connector on the device is backwards compatible with Micro-USB 2.0 chargers, chargers with a Micro-USB 3.0 connector are not compatible with handsets that use Micro-USB 2.0. However, there is disagreement about whether this is going to change in the long term with some consultees expecting the diversity of charging requirements/methods to increase (although it is less clear whether this increasing diversity is likely to affect the choice of connectors used for charging).

As noted in Section 3 of this report, the key future trends include increasingly **higher charge rates** of smartphones. This, however, does not necessarily mean that the market will revert back to a situation where multiple connectors are used but rather that one market segment will shift towards higher power charging. Consultation responses note that the range of power levels for charging of the different models of mobile phones has already increased in recent years and it is expected that this trend may continue into the future, with more powerful handsets requiring charge rates higher than those that can be delivered by the 5V/1.5A USB chargers defined by MoU. This development will not depend just on evolving functionalities of mobile phones but also on battery technology and the power that handset charging may increase to is difficult to predict at this stage. However, information provided by the USB Implementers Forum suggests that the charging power of smartphones is unlikely to exceed 10W over the next ten years. A manufacturer of chargers responding to consultation noted that the trend is towards 12W chargers (5V, 2.4A) for both smarpthones and tablets; in addition, Apple now also sells a 12W iPad charger (also compatible with the iPhone and the iPod).[273] In this respect, it is of interest that there are now several handsets that have a battery capacity around 5,000 mAh and a range of handsets with battery capacity in excess of 4,000 mAh are available on the global market (Smith 2014a[274]; Smith, 2014b[275]; Yugatech, 2014[276]), although as can be seen from Table 5-8, most handsets still rely on batteries with a capacity of less than 2,000 mAh.

[272] Dedezade (2014): Samsung Galaxy S5 Hands-On Review, available at http://www.stuff.tv/samsung-galaxy-s5-hands-review/feature

[273] See http://store.apple.com/uk/product/MD836B/B/apple-12w-usb-power-adaptor

[274] Smith (2014a): This monster smartphone should fix all your Android battery life woes, available at http://bgr.com/2014/04/17/5300mah-smartphone-battery-philips-w6618/

[275] Smith (2014b): Meet the beastly Android phone with a 5,000 mAh battery, available at http://bgr.com/2014/06/19/meet-the-beastly-android-phone-with-a-5000-mah-battery/

[276] Yugatech (2014): 7 smartphones with at least 4,000mAh batteries, available at http://www.yugatech.com/mobile/7-smartphones-with-at-least-4000mah-batteries/

Table 5-8: Battery Capacity of Handsets Available in 2014	
Battery capacity (mAh)	**% of handsets with this battery capacity**
<1,000 mAh	30%
1,100 mAh - 2,000 mAh	50%
2,100 mAh -3,000 mAh	10%
>3,100 mAh	10%
Note: This table relates to handsets available globally. *Source: Database of over 3,000 handsets available at http://www.gsmarena.com*	

These developments may also be driven by the emergence of so-called phablets, i.e. cross-over devices that combine features of mobile phones and tablets and typically require higher power than mobile phones. A handset manufacturer further noted that this might result in new battery and charger technologies but the winning technology is difficult to predict (please note that this statement does not necessarily refer to developments as regards the connector). This also implies a growing diversity of charging requirements to cater for an increasingly diverse range of mobile phones, as basic phones' power requirements are unlikely to change significantly.

It is not clear over what timeframe these developments may take place but in 2014 Micro-USB 2 is likely to remain the dominant connector. One consultee noted that they do not foresee major changes in the charging interface over the coming years, also because the current uptake of Micro-USB is so high and changes are thus unlikely to dramatically change the level of compliance. Another consultee expects that this will change completely by 2018, expecting increased diversity of charging solutions as new battery and charger technologies compete for dominance until the sector matures and stabilises.

Other key market developments that may impact on the harmonisation of mobile phone charging include:

- **the increasing market share of smartphones** (at the expense of feature/basic phones), suggesting that the market share of non data-enabled handsets may further decrease in the future, resulting in further increases in the uptake of Micro-USB connectors;
- measures potentially taken by handset manufacturers to address issues arising from **unsafe third-party chargers**; and
- the introduction of **USB Type-C**.

Other market developments that may substantially alter the charging landscape in the future include the introduction of variable power charging and very high current (multiple-C) charging rates.

The current market share of phones that are not data enabled is very low and is expected to continue decreasing. Based on information provided by a handset manufacturer, it is estimated that in 2013, non-data enabled handsets accounted for only 10% of all phones sold in Europe. Moreover, the popularity of smartphones (all of which are data enabled) in Europe is expected to continue increasing. It is estimated that in 2020 smartphones will account for 98% of all mobile phone shipments in Western Europe and 80% in Eastern Europe (please note that the Eastern Europe region includes several countries that are not members of the EU, such as Russia and Ukraine)[277]. According to IMS (2013)[278], the global market for smartphone chargers is expected to grow by 40 percent between 2012 and 2014 but longer-term projections expect lower rates of growth.

[277] Jeffries & Company predictions accessed at http://www.statista.com/

[278] IMS (2013): External Power Adaptor and Charger Market to Rise 19 Percent by 2014, available at http://www.imsresearch.com/news-events/press-template.php?pr_id=3611

Increased demand for smartphones is expected to come largely at the expense of non-smart phones, whose chargers are expected to see sales decline by 25%.

Measures taken by manufacturers in response to concerns about the safety of third party chargers may result in interoperability problems, although it is too early to say whether and how significant these problems could be. It has recently been reported that Samsung was exploring the possibility of using ID chips that would only enable their phones to be charged by licensed chargers only – this could potentially mean that Micro-USB chargers for phones manufactured by other companies may not be accepted by Samsung phones. A similar measure has been applied by Apple for some time. Until recently, iPhone users plugging in an unlicensed charger were confronted with a warning message and since the release of iOS 7 some non-licensed cables have been prevented from charging (Idnes, 2013; Bookwalter, 2013; Brownlee, 2013).[279] If this approach were to be adopted en masse[280], this could potentially erode the gains achieved by the MoU/LoI, unless this is done in a co-ordinated manner that ensures interoperability of chargers for different handsets.

In December 2013, the USB Implementers Forum announced that it was developing a new connector, the so-called USB Type C. It is expected that work on the new standard may be completed in mid-2014 (USB-IF, 2013) and first devices using this new standard are expected to be released at the end of 2014 (ITPro, 2014).[281] The first image of the new connector became available in April 2014; this will be a new smaller connector similar in size to the current Micro-USB 2.0 B (ITPro, 2014). USB Type-C is expected to offer a number of advantages compared with Micro-USB 2.0, including higher charging rates (up to 100W), reversibility, bi-directional power flow, etc. (USB - IF, 2013; ITPro, 2014). The standard has not been published yet and no products using it have been released yet. In addition, no information is yet available on the pricing of Type C connectors. As such, it is impossible at this stage to reliably assess the potential for USB Type C to replace the Micro-USB 2.0 connector. However, should the USB Type-C connector live up to industry analysts' expectations, and should it be competitively priced, its advantages over the Micro USB 2.0 connector could make it a popular choice among handset manufacturers, potentially even resulting in the market shifting to this new type of connector.

E-readers

The majority of e-reader models currently available on the EU market are charged via a Micro-USB charger. As indicated by the data in Section 4.3.4, the proportion of e-readers with a Micro-USB connector increased between 2009 and 2011, after which sales of e-readers with a Micro-USB connector have remained at around 95% of all sales. The remaining 5% rely on Mini-USB and standard USB.

Consultation with industry stakeholders does not suggest any significant change in this trend for the foreseeable future and as a result, under the baseline scenario, manufacturers would continue to select their own preferred charging options for e-readers and the convergence to the Micro-USB

[279] See http://www.techradar.com/news/phone-and-communications/mobile-phones/samsung-may-kill-off-unlicensed-third-party-accessories-with-id-chip-1192988 and http://www.cultofmac.com/246236/ios-7-killed-off-unlicensed-lightning-cables-but-heres-a-fix-that-might-work-for-you/ and http://mobil.idnes.cz/samsung-neoriginalni-prislusenstvi-dv8-/mob_samsung.aspx?c=A131024_142517_mob_samsung_lhr

[280] Currently, this does not appear to represent a major problem. It is expected that in cases where iPhone users are using an MoU compliant charger together with an adaptor produced by a licensed manufacturer, charging will take place.

[281] ITPro (2014): USB Type-C cable with reversible design breaks cover, available at http://www.itpro.co.uk/desktop-hardware/21984/usb-type-c-cable-with-reversible-design-breaks-cover#ixzz32WSaQmuq

solution already observed might be expected to continue. Without intervention from the European Commission to standardise chargers, it is possible that a combination of charging solutions would persist, although the market share of e-readers relying on connectors other than Micro-USB is low and the proportion of the stock of e-readers with connectors other than Micro-USB is clearly declining.

Given that the charging and data requirements of e-readers are limited in terms of the power and technology required (they are often marketed on the basis of their simplicity, light weight and long battery life), it appears unlikely that there will be major technological changes in the near future requiring additional power and consequently major changes to the charging technology required. Therefore, under the baseline scenario, manufacturers would be expected to continue to produce devices with similar charging abilities, and given that they have elected in the main to adopt the Micro-USB solution, this is what would be expected for these devices.

New devices are currently supplied with a charger (captive or detachable) or a data transfer cable, and whilst this may continue for the foreseeable future, the prevalence of Micro-USB chargers in other sectors could see consumers increasingly opting for e-reader models which are sold without a charger.

Digital Cameras and Camcorders

Currently, compact digital cameras and camcorders are powered using either disposable batteries or a rechargeable battery which is charged using a charging cable or external charging station. While some use the Micro-USB connector both to charge and transfer data, most use proprietary connectors and charge the battery externally. If no action is taken by the European Commission, manufacturers of digital cameras and camcorders will continue to choose the charging solution which best supports the characteristics of the particular model. There is some indication that some camcorders may use Micro-USB but overall, there is no strong indication that the market will shift away from proprietary charging. A manufacturer responding to consultation noted that digital cameras and camcorders are characterized by the vast differences in battery size and type between each model, with each battery type ensures an optimum performance of the respective device and from a technical view point, it is very hard to envisage a common solution for all type of batteries, which are used to cater for a range of consumer needs.

Portable Media Players

Currently, in the market for portable media players, the most common charging connectors are the Apple proprietary connectors, followed by the different USB connectors. If no action is taken by the European Commission, manufacturers of portable media players will continue to use the charging solution which best suits the needs of the particular product. Desk research suggests that the market share of Micro-USB portable media players is currently low but a consultation response from a manufacturer of such devices suggests that this is likely to increase in the future. The fact that the market is in decline and is expected to decline further would raise questions regarding the rate of new market launches by 2017.

Sports and Activity Monitors

As noted in Section 4, only a handful of sports and activity monitors have been identified that are charged via Micro-USB (some cycling and running devices are being charged via Micro-USB, e.g. Timex Cycle Trainer 2.0 and Polar V650). Under the 'do nothing' scenario manufacturers would likely continue to use the most suitable charging solution depending on the device.

The key considerations behind the choice of the charging method include the degree of water resistance and the size of the device. Sports devices are intended for active individuals that use the device in wet environments (e.g. swimming, running/cycling in the rain), so a charging solution which ensures the device is adequately waterproof is an important consideration. The size of the device is also an important factor that manufacturers consider when designing devices that must be worn on the wrist (running/triathlon/golf watches). It would seem that proprietary charging clips have an advantage over Micro-USB and Mini-USB for sports devices in that some devices with this charging method can be worn while swimming (e.g. Garmin Forerunner 910 XT). However, it should be noted that not all Garmin devices that have a charging clip can be worn while swimming (e.g. Garmin Forerunner 210). Rather, devices that must not be worn while swimming typically comply with IPX7 waterproof standard. Whilst Garmin cycling devices can achieve adequate waterproof resistance from moisture when cycling using a Mini-USB port (IPX 7 waterproof standard) and it would seem that Garmin have recently switched to Micro-USB for their newest cycling device (Garmin 1000), it cannot be expected that this sector will significantly move towards Micro-USB in the future.

The proprietary charging clip may also allow the device to be smaller. Comparing the size of Garmin watches to Garmin's cycling devices which are charged via Micro-USB, there is a notable difference in the size of the device and the power of the battery - the cycling device being larger in size and possessing a more powerful battery. This may explain why all of Garmin's watches have a charging clip. Interestingly, Timex have also recently developed a charging clip for the Timex Run Trainer. However, one of the more recent running watches (although it may also be used as a cycling device) released by Polar, the Polar RC3, uses Micro-USB as the means to charge and transfer data and is also of comparable size to the Garmin watches. In summary, it could be suggested that sports devices for triathletes and dedicated swimming watches are likely to contain either a non-rechargeable battery or will be charged by a proprietary charging clip. It is very unlikely that these devices will move to Micro-USB as the watches ability to resist water will be undermined and the device may need to be bigger.

Information provided by a manufacturer of sports and activity monitors stressed that Micro-USB is not always an optimal solution. Skin, dust and other matter can invade the port on the device, causing corrosion. This undermines the 'survivability' and long term viability of the device. Although it is technically possible to make waterproof devices with a Micro-USB socket (for example, Sony and Samsung produce waterproof handsets which have Micro-USB sockets covered with a flap[282]), this increases the size of the device. Micro-USB charging is also said to be less robust than the proprietary charging clip but will of course offer the consumer a more convenient charging solution All of these factors will be taken into consideration when a manufacturer is selecting the charging method for their sports watch during the design phase.

Under Option 0, it is highly likely that manufacturers will continue to develop proprietary solutions for devices that are worn on the wrist or need to be waterproof for another reason, such as devices used for swimming. In fact, on the whole, it would seem that manufacturers are gravitating towards

[282] See for example Wolpin (2014): Sony Xperia Z1S Waterproof Smartphone Is a Near Miss,available at http://mashable.com/2014/03/11/sony-xperia-z1s-review/

proprietary charging clips for sports devices worn on the wrist. It should be noted that some manufacturers already omit the mains charger from the device when it is sold.

Personal Navigation Devices

A review of models available on the EU market for the period covered by this study has revealed that devices commonly use Micro and Mini-USB charging. There is evidence to suggest that manufacturers may migrate to Micro-USB and have in some cases, voluntarily reduced their impact on the environment by not supplying a mains charger. For PND sold for use in cars, this trend may continue. However, PNDs intended for use on motorbikes will either charge directly from the battery of the motorbike or the user will charge the device prior to use. Although these devices are also migrating to Micro-USB, manufacturers of devices for motorbikes are likely to continue to supply a mains charger.

The PND market is currently dominated by Garmin and TomTom, which accounted for 66% of the market in 2009 and a decision made by a single manufacturer may sway the market significantly towards a specific connector and this should be borne in mind when considering the likely development of the market.

Portable Handheld Games Consoles

Currently, proprietary chargers would appear to dominate the, market although this trend may be changing as most recent version of Playstation Vita is equipped with a Micro-USB charging port. Mini-USB was available on older devices for data transfer.

If no action is taken by the European Commission, manufacturers of portable games consoles will continue to use the charging solution which best supports the characteristics of the particular device. Importantly, one manufacturer of portable games consoles responding to consultation for this study stated that in the future there may launch more powerful devices which would require chargers that can deliver more power than those using the current Micro-USB connector (please note that this statement likely does not take into account the possibility to use the USB Power Delivery standard). This company further highlighted the manufacturers themselves should have the freedom to determine how their products are charged and be given full flexibility in designing chargers, taking into account aspects such as safety, reliability, environmental impact, user friendliness and cost. Indeed, this manufacturer emphasises that it should be the responsibility of the manufacturer to decide if and when to adopt the Micro-USB connector as they are in the best position to know what chargers are required to meet the needs of the particular device.

Personal Care Products

Personal care products predominantly consist of three groups of electrical products; men's grooming, women's grooming and dental care. Dental products are typically completely sealed to make them 100% waterproof and safe to use in a damp or wet environments. Charging often occurs via inductive charging; the product is placed on a dock and power is transferred by induction through the plastic coating. For this reason, dental products have been excluded from our description of personal care products, as Micro-USB charging would not offer a suitable alternative charging option. Men's grooming largely consists of electrical shavers and trimmers.[283] Women's

[283] These products are usually based upon a set of oscillating or rotating blades powered by an internal motor. Typically shavers are covered by a fixed protective screen to prevent cuts, trimmers are often exposed comb shaped blades accompanied by removable plastic guards.

grooming consists of shavers, trimmers, epilators and more niche beauty products.[284] The niche products (e.g. facial and body exfoliators and Intense Pulsed Light (ILP) hair removal) were excluded from this study due to them being a relatively small sector[285] within women's grooming and no data were available on current EU sales and manufacturing.

Currently, personal care products predominantly use proprietary charging connectors. Some models which have Micro-USB charging capabilities (e.g. Philips electric shaver YS502/16) have been introduced to the market. However, Micro-USB charging appears not to be widely incorporated into most personal care products due to issues with waterproofing or the possibility of using the charger/mains cable in wet environments.

There are two main charging possibilities when it comes to rechargeable personal care appliances such as epilators and electric shavers: a) mains and rechargeable - which can be used when plugged into the mains and when unplugged and charged; and b) rechargeable only - can only be used when fully charged and removed from the mains.

Due to the introduction of wet/dry products (i.e. those that can be used in the bath or shower) and the environment personal care products are used in (usually bathrooms), the cordless rechargeable option has become a more popular choice with manufacturers as it reduces the possibility of accidents and injuries.

On a global scale, the large international companies Philips and Braun (which is part of the Procter & Gamble group) dominate the market for both electric shavers (male and female) and epilators. One source estimates that Philips and Braun combined may have as much as 75% of the global market for electric shavers (Hollensen, 2007, cited in AbouElgheit, 2012). Other manufacturers of personal care products active in Europe include Remington (part of Spectrum Brands), Calor (a French brand which is part of Groupe SEB), Panasonic, Emjoi, Wahl, Veet and Babyliss, however there market share is significantly smaller than that of Philips or Braun.

Currently, it would appear that there are many personal care products such as electric shavers and epilators that are rechargeable, allowing them to be used on the move and when a power source is not available (Argos, 2013). Those devices that are rechargeable are typically charged via a charging cable or docking station. There does not appear to be consistency within or between brands regarding the particular charging connector used. Additionally, some products are supplied with chargers that have an incorporated Safety Extra Low Voltage power supply protecting against electric shock. This means that even chargers with the correct connector from another product should not be used. The particular product characteristics ultimately dictate what charging solution is used in each product. For example, basic models may use mains only, while more advanced models will be fully rechargeable and operate cordlessly. A number of personal care products can now be used either 'wet or dry' meaning the charging connector used must be waterproof for safe use in the bath or shower. If no action is taken by the European Commission, manufacturers of personal care products will continue to design their products and choose the charging solution which best supports the characteristics of the particular model.

[284] Women's shavers and trimmers have similar design features to men's grooming products (use of oscillating or rotating blades), whereas epilators remove hair through the use of multiple rotating tweezers.

[285] Assumption made upon the percentage of niche products in comparison to shavers, trimmers and epilators available on leading retail sites.

Summary of Current and Future Use of Micro-USB Connectors

Table 5-9 summarises the extent of current use of Micro-USB connectors and assess the potential for this to change in the future. Please note that Table 5-9 does not take into account the potential for new connectors that have superior functional and cost characteristics to replace Micro-USB.

Table 5-9: Current and Future Use of Micro-USB Connectors						
Product group	Current situation			Potential future development of Micro-USB		
	Sales	Stock	Charger supplied?	Sales	Stock	Charger supplied?
Mobile phones	93% of all handsets sold in EU are MoU compliant. 79% of all and 85% data-enabled have Micro-USB	91% of data-enabled phones (80% of all) comply with the MoU, 76% of data enabled (65% of all) have Micro-USB	Over 99.9% phones are currently supplied with a charger, and of those that are not, most are still supplied with a data cable	No change in the immediate future, unknown changes in the long term	Stock of all handsets with Micro-USB or adaptors likely to increase, trends suggest up to 95% in 2017	Recent trends suggest 2% of sales in 2017 will be without a mains charger
E-readers	96% use Micro-USB	91% use Micro-USB	Typically supplied with charger or data transfer cable	Likely to remain similar	Likely to increase, potentially to 96% in 2017	No indication of change, potentially decrease
Digital cameras and camcorders	Mainly proprietary, then Mini-USB, Micro-USB least popular	Limited	Assumed provided with chargers	Micro-USB may increase but there is no indication of any significant overall shift from proprietary		
Portable media players	Dominated by Apple proprietary charger, USB and Mini-USB, limited Micro-USB	Limited	Typically supplied with a data transfer/charging cable	It is possible Micro-USB may increase but proprietary likely to remain dominant	It is possible Micro-USB may increase	No indication of any significant change
Sports and activity monitors	Primarily proprietary, Mini-USB and a handful use Micro-USB	Limited	Typically supplied with a data transfer/charging cable, some supplied with a mains charger	Manufacturers gravitating towards proprietary charging clips, this trend is expected to continue	Likely to decrease	% supplied without charger is likely to increase
Personal navigation devices	27% use Micro-USB	31% use Micro-USB	Market divided, some products supplied with mains chargers, others with cable	Further migration to Micro-USB possible	Likely to increase	No indication of change

Table 5-9: Current and Future Use of Micro-USB Connectors						
Product group	Current situation			Potential future development of Micro-USB		
	Sales	Stock	Charger supplied?	Sales	Stock	Charger supplied?
Portable handheld games consoles	Proprietary dominant	None (2013), Limited (2014)	No information	Likely to increase	Likely to increase	No indication of change
Personal care products	Proprietary dominant, some Micro-USB	Limited	Yes	There is no indication of any significant change		

5.4.3 Technical Issues Associated with Harmonisation Across Product Groups

Overview of Charging Requirements

This section of the report summarises the main technical issues associated with the use of a common charger for a range of devices that are characterised by similar but different power requirements. More specifically, this section deals with the possibility of introducing a common Micro-USB charger for mobile phones, e-readers, digital cameras and video camcorders, portable games consoles, personal media players, personal navigation devices, sports and activity monitors and personal care products[286]. The vast majority of these devices appear to charge at power levels between 2.5W and 7.5W which can be delivered by Micro-USB chargers complying with the USB Battery Charging specification. Similarly, in terms of voltage, most chargers have an output of around 5V with current supplied typically in the region of 1.0A. Mobile phones typically charge at power levels[287] between 2W and 7.5W (current between 0.3A and 1.2A[288] and voltage around 5V). There are however many products which fall outside of these parameters. For example,the PSP 1000 and 2000 models charge at 10W[289] as does a Sony e-reader[290]. In terms of differences in voltage supplied by a charger, the greatest diversity is found in the personal care products sector, where voltage delivered varies between 2V and 18V.. Consultation with a manufacturer of these devices also noted that charging requirements are frequently altered, which may also make harmonisation difficult. The greatest diversity of charging requirements can be found in the personal care products sector, where charging requires between 2V and 18V and between 0.1A and 1.5A. Consultation with a manufacturer of these devices also noted that charging requirements are frequently altered, which may also make hamronisation difficult.

It is also of note that the future generation of mobile phones is expected to charge at higher power, possibly up to 10W-12W. According to some stakeholders responding to consultation for this study, there are already mobile phones on the market that charge at 2A (considering that te typical voltage for mobile phone charging is a maximum of 5V, this suggests up to 10W of power), rather than the typical maximum of 1.5A. For example, the study team has identified a charger for Samsung Galaxy

[286] Tablets and laptops are considered separately in Sections 5.5 and 5.6.

[287] Power (watts) = Voltage (volts) x Current (amps)

[288] However, some higher amperage chargers have been identified: http://ericscorner.blogspot.co.uk/2009/08/not-all-nokia-battery-chargers-built.html

[289] eHow, Grahame Turner, PSP Power Adaptor Specs, accessed at: http://www.ehow.com/list_7484728_psp-power-adaptor-specs.html

[290] Pow (not dated): What DC Charger Will Work for a Sony Reader?, accessed at http://techchannel.radioshack.com/dc-charger-work-sony-reader-2297.html

S4 which is capable of delivering 2.1A[291]. According to a manufacturer of chargers, 1A chargers currently account for 90% of the mobile phone charger market but 2A chargers will become dominant in the future as from this it is possible to charge both a tablet and a smartphone.

An overview of the charging requirements of the different devices is provided in Table 5-10, showing that the voltage used by these devices for charging ranges from 2V to 18V and the current ranges from 0.1A to around 2A.

Table 5-10: Range of Charging Requirements of a Sample of Products Reviewed for this Study

Device	Current		Voltage*		Power	
	Lowest	Highest	Lowest	Highest	Lowest	Highest
Mobile phones	0.35A	1.5A	Around 5V		1.8W	7.5W
E-readers	0.85A	2A			4.25W	10.4W
Portable media players	0.5A	1A			2.5W	5W
Sports and activity monitors	0.5A	1A			2.5W	5W
Personal navigation devices	1A	2A (in car charger)			5W	10W
Portable handheld games consoles	0.45A	2A			2.34W	10W
Digital cameras and camcorders	1A	1.89A	3.7V	8.4V	3.8W	19.7W
Personal care products	0.1A	1.5A	2V	18V	2W	6.5W

*Note: * Quoted voltages on chargers will always be higher (by, say, 10-20%) than the quoted voltage of the batteries they are intended to charge. As such, the voltages in this table are indicative.*
Source: Compiled from a large number of sources detailing charging requirements of individual products or product descriptions of chargers sold on a standalone basis.

As examples of the diversity of charging requirements within individual product groups, an overview of charging requirements of e-readers, digital cameras and epilators is provided below.

E-readers

The sample below would suggest that it is likely that most Micro-USB chargers for e-readers have an output of 5V. Interestingly, the sample below shows that there is a degree of variation between the current outputted, as each of the manufacturers devices has different power requirements.

Table 5-11: Charger output of Micro-USB chargers for E-readers

Manufacturer	Model	Charger output		
		Volts	Amps	Watts
Amazon	Kindle (generation 2/3/4/5/paperwhite)	5	1.8	9
Sony	PRS-T3	5	1	5
Barnes and Noble	Nook SimpleTouch	5	0.85	4.25
Kobo	Touch, Glo	5	0.5	2.5
Onyx Boox	M92 Pearl Edition	5	1	5
Archos	7od e-reader	5	2	10
Bookeen	Cybook Odessey Frontlight, Cybook Ocean, Cybook Odessey 2013 Edition, Cybook Odessey Frontlight HD	5	0.7	3.5

[291] See http://www.mobilefun.co.uk/high-power-samsung-galaxy-s4-charger-mains-p46530.htm

Table 5-11: Charger output of Micro-USB chargers for E-readers				
Manufacturer	Model	Charger output		
		Volts	Amps	Watts
PocketBook	Pro 602, Basic Touch, Aqua, Touch Lux 2	5	1	5
Sources: *Amazon website, accessed at: http://www.amazon.co.uk/ref=gno_logo; Sony, Gecko covers website, accessed at: http://www.geckocovers.com/gecko-e-reader-usb-charger-5507.html; Barnes and Noble website, accessed at: http://www.barnesandnoble.com;Kobo website, accessed at: http://store.kobobooks.com/en-gb/; Oynx Boox webiste, accessed at: https://onyx-boox.com/; Archos website, accessed at: http://www.archos.com/; Bookeen website, accessed at: http://www.bookeen.com/en/; Pocketbook, accessed at: http://www.pocketbook-int.com/us/accessories/universal-charger*				

Epilators

Table 5-11 below provides an overview of the technical specifications associated with charging Phillips Epilators. It should be noted that Phillips also sell epilators that are mains powered and hair removers (as opposed to epilators) that are typically powered by AA batteries. These have not been incorporated in Table 5-11. The technical information provided reflects that which is available on the manufacturer's website.

Table 5-11: Technical specifications of Phillips rechargeable epilators		
Year	Model	Technical charging information
2013	Satinperfect HP6582	13V, 400mA
2012	Satin perfect HP6581/00	13V, 400mA
2012	Satin perfect HP6579/00	13V, 400mA
2012	Satin perfect HP6577/00	13V, 400mA
2012	SatinPerfect HP6575/00	13V, 400mA
2012	Satinsoft HP6522/01	3.6V
2012	Satinsoft HP6520/01	3.6V
2012	Satinelle HP6422/00	13V, 400mA
2010	Satin perfect HP6576	16 Watts
2010	SatinPerfect HP6574/11	16 Watts
Source: Philips, accessed at: http://www.philips.co.uk/c-m-pe/hair-removal/epilators/latest#layout=96.subcategory.p-grid		

It is evident from the table that most of Phillips rechargeable epilators require 13V, with two requiring 3.6V. For those devices listed in 2010, only the wattage was provided. A search for replacement chargers for other manufacturers of personal care products (Braun, Remington and Panasonic) suggests that their chargers range from 5V to 12V and 0.3A and 2A. Consultation confirmed that there is indeed a wide range in the voltage of personal care products. Although many rechargeable products are found with lower voltage, certain devices will require higher voltage to fulfil needs of the consumer.

Cameras

Table 5-12 shows the voltage requirements for digital cameras. From the sample below, it can be seen that most batteries have a voltage requirement of 3.7V. This would explain why most Micro-USB camera chargers have an output of around 5V. However, it should be noted that compact

system cameras and digital single lens cameras have been found with batteries requiring 8.4V. The existence of cameras with larger batteries was supported by information received as part of consultation, where it was noted that some chargers output up 8.4V (although it was not confirmed whether these cameras were charged via Micro-USB).

Table 5-12: Technical specifications of camera batteries charged via Micro-USB

Brand	Camera Model	Battery model	Charger output		
			Volts	Milliampere – hour	Watt hour
Casio	Exilim EX-100, Exilim EX-10, Exilim EX-ZR800, Exilim EX-ZR700, Exilim EX-ZR400, Exilim EX-ZR 1000	Rechargeable lithium ion battery (NP-130/ NP-130A)	3.7	1,800	6.7
Casio (cont.)	Exilim EX-ZS20, Exilim EX-ZS12, Exilim EX-ZS 15	Rechargeable lithium ion battery (NP-120)	3.7	600	2.3
	Exilim EX-ZS 150, Exilim EX-ZS6,Exilim EX-ZS 5	Rechargeable lithium ion battery (NP-80)	3.7	700	2.6
Nikon	Coolpix S02, Coolpix S3500, Coolpix S01, Coolpix s6400, Coolpix S4300, Coolpix S100	EN-EL 19 Lithium-ion rechargeable battery	3.7	700	2.6
	Coolpix P510	Rechargeable Li-ion Battery EN-EL10	3.7	740	-
	Coolpix S6200, Coolpix s9100, Coolpix Pix P300	Rechargeable Li-ion Battery EN-EL12	3.7	1,050	-
Sony	Cybershot DSC RX10	Rechargeable Battery Pack NP-FW50	7.2	1,080	7.7
	Cybershot DSC-TF1, Cybershot DSC W730, Cybershot DSC-TX30, Cybershot DSC-W690, Cybershot DSC-WX30, Cybershot DSC-TX55, Cybershot DSC-T110, Cybershot DSC-W560	Lithium - Rechargeable Battery Pack (NP-BN1)	3.6	-	2.3
	Cybershot DSC-WX10, Cybershot DSC-HX7V, Cybershot DSC-HX10V, Cybershot DSC-H90	Lithium N - Rechargeable Battery Pack(NP-BG1)	3.6	-	2.3
	EZCBA45	Lithium-Ion NP-FW50	7.2	1020	7.3

Sources: Sony website, accessed at: http://www.sony.co.uk/, Nikon website, accessed at: http://www.nikon.com/, Casio website, accessed at: http://www.casio.co.uk/

Key Issues Relating to Charging

The implication of the diversity of charging requirements is that even where different devices use the same charging socket, it may not be possible to use their chargers interchangeably, as charging may be slow or may not take place at all.

In many cases, a device will charge at or above its preferred charging rate even when a charger supplied with another device is used. For example, it appears that high-current chargers can often be used to charge low-current devices, in particular where they both rely on USB standards (Anthony, 2012[292]; Segev, 2013[293]). It was suggested by an organisation responding to consultation for this study that the device will dictate how much power to consumer. In some instances high-current chargers may not be able to utilise their maximum power delivery when plugged into a low-current device but in other cases, this is said to result in faster charging than would be the case when using the charger originally supplied with the device. For example, in 2012 Apple released a new 12W USB power adaptor compatible with every iPad, iPhone and some iPods. Apple devices are thus capable of drawing the most appropriate wattage, voltage and amperage for charging from high power Apple chargers. This means that the third and fourth generation iPad devices charge at a faster 2.5A speed rather than the 2.1A achieved by the older 10W charger (Guy, 2012[294]).

Similarly, in some instances, it may be possible to use high-voltage chargers to charge lower-voltage devices. For example, mobile phone chargers typically provide 5V and can thus be used to charge other mobile phones as most handsets fully charge to around 4.2V (Segev, 2013). However, in some cases this may not be possible and the use of high-voltage chargers may damage the device (as noted later in this section). For example, ITU and GeSI (2012)[295] note that, using a high voltage charger to charge a low-voltage device can damage the device and present a risk to the user.

In some cases, when the current and voltage supplied by the charger differ from those required by the device, charging may be slow, not take place at all or the charger may damage the device. This includes the following scenarios:

- **slow charging** - a low-current charger may not be able to charge a high-current device at its maximum charging rate. For example, some mobile phones requiring a high current may be charged using a low-current charger but the charging rate will be limited to that provided by the charger. In addition, Segev (2013), using the example of a 0.5A charger and a 0.7A mobile phone, notes that using a low-current charger in conjunction with a high current handset may not only result in very slow charging but also cause "overheating and complete failure" (of the charger which has to operate at maximum output). Slow charging may mean that a low-current charger may in practice not be usable for a high-power device.

- **failure to charge to full battery capacity** - where a charger only supports charging at a voltage below the level required to fully charge the device but at a level that is sufficient for charging to take place, clearly the battery will be not charged to its full capacity. For

[292] Anthony (2012): How USB charging works, or how to avoid blowing up your smartphone, available at http://www.extremetech.com/computing/115251-how-usb-charging-works-or-how-to-avoid-blowing-up-your-smartphone

[293] Segev (2013): How your charger could be killing your phone, available at http://mg.co.za/article/2013-03-12-how-your-charger-could-be-killing-your-phone

[294] Guy (2012) Apple 12W USB power adaptor, available at http://www.ilounge.com/index.php/reviews/entry/apple-12w-usb-power-adaptor/

[295] ITU and GeSI (2012): An Energy-Ware Survey on ICT Device Power Supplies, accessed at http://www.itu.int/dms_pub/itu-t/oth/0B/11/T0B110000163301PDFE.pdf

example, a 5V mobile phone charger will not fully charge the battery of a digital SLR camera which typically requires 7.4V to 7.6V.

- **failure to charge** - in the following situations, charging may not occur at all:

    - *insufficient current and heavy system use*: information provided by a handset manufacturer indicates that where the charger is only capable of delivering a low current and the device is in use while being charged, all power drawn from the charger may be diverted to support the heavy system load. For example, BlackBerry (not dated)[296] notes that "chargers supplying less than 750mA may not provide enough power to sustain a charge on the BlackBerry 10 during heavy use" and recommends that chargers capable of supplying more than 750mA are used with this handset. Interestingly, this implies that even the use of a charger supplied with another smartphone made by the same handset manufacturer does not necessarily guarantee consistent charging during periods of heavy use (Halevy, 2013).[297]

    - *repeated failed attempts to draw power from a low current charger*: information provided by a handset manufacturer indicates that where a device attempts to draw more power than the charger can provide, the charger voltage drops and the charger disconnects. Disconnection results in the charger voltage recovering to a level where the device registers a new charger insertion, initiating another failed attempt to start charging. In this scenario, repeated failed attempts to commence charging mean that no charging takes place.

    - *insufficient voltage*: where a charger can only support charging at a voltage significantly below the level required to charge the battery, charging will not occur. For example, a charger designed for a compact digital camera (typically 3.6V or 3.7V) is unlikely to charge a digital SLR camera (which tend to have 7.2V or 7.4V batteries).

    - *high current chargers used to charge a low-capacity battery*: as noted in the MoU, a charger supplying a current of around 1.5A to a handset with a 0.4Ah battery may cause this handset to cease charging, charge more slowly than the preferred charging rate[298] or not charge (for example to avoid overheating of the phone or battery). Please see Table 5-8 in Section 5.4.2 for an overview of current battery capacities of mobile phones.

- **device failure** - use of a charger with a significantly higher voltage than the device being charged may overload the device and damage it (Klosowski, 2013)[299]. In this respect, it is of

[296] BlackBerry (not dated): BlackBerry 10 device may lose charge when connected to a non BlackBerry 10 charger, available at http://btsc.webapps.blackberry.com/btsc/viewdocument.do?externalId=KB33672&sliceId=2&cmd=displayKC&docType=kc&noCount=true&ViewedDocsListHelper=com.kanisa.apps.common.BaseViewedDocsListHelperImpl

[297] Halevy (2013): PSA: Don't Charge Your BlackBerry 10 Device With Old Chargers (Amperage), available at http://www.berryreview.com/2013/02/18/psa-dont-charge-your-blackberry-10-device-with-old-chargers-amperage/

[298] In the MoU, the term "Preferred Charging Rate" is defined as charging a battery from 10% capacity to 90% capacity within a maximum of six hours.

[299] Klosowski (2013): Does It Matter Which Charger I Use?, accessed at http://lifehacker.com/does-it-matter-which-charger-i-use-922783980

note that while most devices listed in Table 5-8 charge at around 5V, digital cameras and personal care products rely on a range of voltages (2V to 18V).

Of course, any incompatibilities between devices may be overcome with the use of a smart charger and similarly smart battery, which is ubiquitous among Li-Ion systems. A smart charger is capable of monitoring the temperature, time under charge and voltage of the battery to ascertain the optimum current at which to charge the battery and when to terminate charging[300]. It must be noted that if a smart charger is not used to charge a Li-Ion battery, it is possible that too much lithium may be released from the cathode, which could lead to thermal instability of the remaining cathode material. Moreover, if it is exposed to high temperatures from overcharging the battery due to excessive voltage, there may be an exothermal reaction in the battery centre, which could cause the battery to ignite or cause an explosion[301].

It is of interest that Li-Ion batteries appear to be the most popular choice among handset manufacturers, although Li-Polymer batteries (sometimes called Li-Ion Polymer) are also used[302]. The Battery University (not dated)[303] notes that cost reduction, gradual increases in energy capacity, a relatively flat voltage curve and the absence of toxic materials have made Li-Ion the most popular battery technology for consumer products. The characteristics of Li-Ion batteries differ somewhat depending on the cathode material used (e.g. cobalt, manganese, phosphate, nickel-manganese-cobalt) but in general their voltage ranges from around 3.3V to 3.8V, with charging limit being 3.6V or 4.2V.

Please note that whilst the above discussion primarily relates to mains chargers, some of these issues may also arise when charging is carried out from a personal computer or laptop. For example, USB 2.0 and 3.0 standard downstream ports can only provide 0.5A or 0.9A respectively and may thus not be sufficient to charge some mobile phones (please refer to Section 5.2 for a definition of a standard downstream port and a more detailed discussion of the different USB standards).

It is also of interest that all USB standards (with the exception of the rarely used USB PD and USB 3.1) supply 5V and as such, most USB ports/Micro-USB chargers currently in use would be unsuitable for many digital cameras and personal care products (even if these were to switch to Micro-USB sockets following the adoption of Policy Options 1 or 2). In addition, Anthony (2012) notes that some older devices may not support more recent USB standards (e.g. USB BC) and may not charge from more modern USB ports.

Other issues for devices associated with charging cables

It may be the case that not only the charger used but also the particular Micro-USB cable coupled with the charger will influence the charging rate of a device. This issue has been discussed at length on the xdadevelopers forum[304] in relation to the Samsung Galaxy S4 (this is not to suggest that these issues only arise in relation to this handset but rather this handset has been used as an example). Here it has been suggested that the Samsung S4 will only charge at the full current when the charger

[300] Tarantola (2013): Can I use the same charger for multiple devices?, accessed at: http://gizmodo.com/can-i-use-the-same-charger-for-multiple-devices-510829339

[301] Egston, accessed at http://www.egston.com/en/power_supplies/facts/chargers.php#2.2

[302] Based on handsets listed in the PhoneArena.com database. See http://www.phonearena.com

[303] Battery University (not dated): Lithium-based Batteries, available at http://batteryuniversity.com/learn/article/lithium_based_batteries

[304] Xdadevelopers, accessed at http://forum.xda-developers.com/showthread.php?t=2274321

supplied with the device is used (or one capable of supplying a comparable or higher current rating, depending on the circuitry of the charger) alongside the supplied Micro-USB cable[305].

The charger used will also influence the current that is supplied to the device. In trying to ascertain why there was a drop in current when charging with some other chargers, it was noted that two of the data pins within the Samsung charger had been shorted and resistors added so as to deliver a particular signalling voltage to the Samsung S4. Indeed, it would seem that the Samsung charger sends an initial signal of 1.2V to 1.3V across the D+ / D- pins in the same way that Apple sends 2.0V or 2.8V across pins for USB chargers it supplies[306] (it has also been suggested that this may also be the case for some editions of the Nexus 7[307]). Thus the voltage of 1.2V to 1.3V indicates to the Samsung S4 that an OEM Samsung charger is being used and that the full charging current can be drawn. If this voltage is not detected, a lower current will be drawn by the device which results in slower charging. This can be seen in the figure below, which compares the charging time for the Samsung S4, one time for the standard BC1.2 charger and one for the Samsung S4 charger.

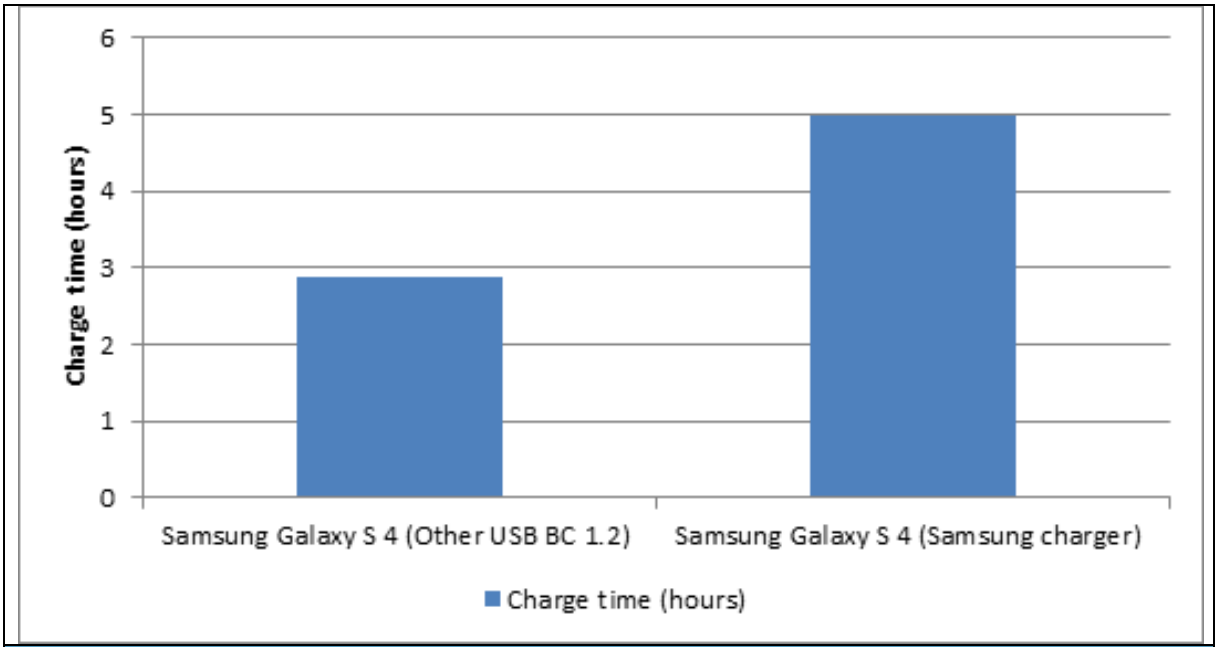

Figure 5-3: Samsung charger vs other USB BC 1.2 charger

It is evident that the Samsung S4 charges at a quicker rate when the supplied OEM Samsung charger is used[308]. Other devices (e.g. HTC phones) would also appear to adopt a similar practice, which means that the phone will only charge at its optimal charging rate when the OEM charger is used[309].

[305] Other Micro-USB cables would appear to work only if the 'shielding' (metal outer surface of the connectors) is connected at both ends of the cable. If this shielding is not present, then the charging current to the device drops, irrespective of the charger used. On the other hand, it has been discussed in a counter argument that shielding is not the cause of current drop and that this is instead explained by the difference in the wire gauge of the Micro-USB cable. For example, there are two options for Micro-USB cables, 28 gauge cables and 24/28 cables (normal size data wires (28) and large size power wires (24)). It is possible that the comparably thinner 28 gauge cables (in this instance, the 28/28 size is smaller than 24 size) drop voltage at higher currents and as noted above, this drop in voltage may signify to the device to draw current at a lower rate.

[306] AnandTech, accessed at http://www.anandtech.com/show/6914/samsung-galaxy-s-4-review/2

[307] Xdadevelopers, accessed at http://forum.xda-developers.com/showthread.php?t=1984838

[308] AnandTech, accessed at http://www.anandtech.com/show/6914/samsung-galaxy-s-4-review/2

The charging rate may also be influenced by the Micro-USB cable that is used. Examples of the charging current achieved using different chargers and Micro-USB cables presented at the xdadevelopers website are given in Table 5-13. The results seem to underline the importance of ensuring that the original charger is coupled with a suitable Micro-USB cable to ensure the device is charged effectively. Interestingly, limitations associated with the use of certain cables mean that in Table 5-13 the high-power Apple charger provides a charging performance that is comparable to that of the Samsung charger.

Table 5-13: Current output using different chargers and Micro-USB cables when charging

Charger	Stated rating (A)	Micro-USB Cable	Current (A)
HTC (1A)	1	Non-OEM (unshielded)	0.5
HTC (1A)	1	Samsung S4	1.0
Apple (1A)	1	Non-OEM (unshielded)	0.5
Apple (1A)	1	Samsung S4	1.0
Apple (2.4A)	2.4	Non-OEM (unshielded)	0.6
Apple (2.4A)	2.4	Samsung S4	1.3
Samsung S4 (2A)	2	Non-OEM (unshielded)	0.8
Samsung S4 (2A)	2	Samsung S4	1.3

Source: Xdadevelopers, accessed at http://forum.xda-developers.com/showthread.php?t=2274321

Similar results were also obtained by another user of the xdadevelopers forum who tested and compared a range of chargers with the stock Samsung S4 cable and another non-OEM charging cable; the results of these tests are presented in Table 5-14. Although there are some discrepancies between the results above (e.g. Samsung charging current when using official S4 charger and cable reported as 1.3A in the table above against 1.9A in the table below), the conclusion that the fastest charging rate for the Samsung S4 is achieved by using the official stock cable when the official Samsung charger is used is supported. However, it would seem that the Samsung S4 official cable can be paired with other chargers and the device will receive sufficient Amps for a quick charge. On the other hand, there are examples of power sources within the table that appears not to provide enough Amps to charge the Samsung S4.

Table 5-14: Current output using different chargers and Micro-USB cables when charging

Charger	Stated rating (A)	Samsung S4 Micro-USB cable	Non-OEM Micro-USB cable
Samsung S4	2	1.9	0.4
Samsung T2	2	1.9	0.3
Other charger 1 (dual)	2.1	1.9 (bottom) 1.9 (top)	n/a
Other charger 2	0.9	0.9	n/a
Other charger 3 (dual)	0.5 – 1	0.5 (bottom) 1.9 (side)	n/a
Other charger 4	1	0.5	n/a
Other charger 5	1	0.3	n/a
Other charger 6	1	1.9	0.3
Other charger 7	0.5 -1	1.9 (bottom) 1.9 (top)	n/a
Other charger 8 (dual)	0.5 (out 2) 1 (out 1)	1.9 (out 2) 1.9 (out 1)	n/a
Laptop USB port	0.5	0.5	n/a

Note: Figures have been rounded.
Source: Xdadevelopers, accessed at http://forum.xda-developers.com/showthread.php?t=2274321

[309] Xdadevelopers, accessed at http://forum.xda-developers.com/showthread.php?t=844284

Another user compared the charging output of various Samsung chargers using four branded Micro-USB cables. Looking at the results presented in Table 5-15, it can be seen that the Samsung S4 charger will provide sufficient charge to the device via three of these cables. Indeed, the only cable not to provide the full current is the Samsung S1 cable, which provides an output of 0.8A. There would be a noticeable difference between the length of time it would take to charge a Samsung S4 using the Samsung S4 charger and this cable compared to the three other cables.

The results achieved for the Nexus 7 (N7) charger are far more sporadic, with the third party and Samsung S4 cable only providing around 80% of the current that is supplied when the N7 charger is used. Again, the current drawn though the Samsung S1 cable (0.8A) would significantly impact the charging time of the Samsung S4. Finally, the S1 charger only provides 0.8A irrespective of the cable used, although this is to be expected given that it was designed to output 0.7A.

Table 5-15: Current output using different chargers and Micro-USB cables

Charger	Stated rating (A)	Cable	Current (A)
Samsung S4	2	Samsung S4	1.9
Samsung S4	2	N7	1.9
Samsung S4	2	Another manufacturer	1.9
Samsung S4	2	Samsung S1	0.8
Nexus 7	2	Samsung S4	1.5
Nexus 7	2	N7	1.9
Nexus 7	2	Another manufacturer	1.5
Nexus 7	2	Samsung S1	0.7
Samsung S1	0.7	Any	0.8

Note: Figures have been rounded
Source: Xdadevelopers, accessed at http://forum.xda-developers.com/showthread.php?t=2274321&page=7

Further test results were also posted by another user comparing the charging output for charging the Samsung S4 using different Samsung chargers and Samsung cables and the BlackBerry thin and thick USB cables. The information presented in Table 5-16 suggests that the Samsung S3 cable will not effectively charge the Samsung S4, even when used with the Samsung S4 charger.

Table 5-16: Current output using different chargers and Micro-USB cables

Charger	Stated rating (A)	Cable	Current (A)
Samsung S4	2	Samsung S4	1.9
Samsung S4	2	Samsung S3	0.5
Samsung S4	2	BlackBerry thick USB	1.9
Samsung S4	2	BlackBerry thin USB	1.6
Samsung S3	1	Samsung S4	1.2
Samsung S3	1	Samsung S3	0.3
Samsung S3	1	BlackBerry thick USB	1.2
Samsung S3	1	BlackBerry thin USB	1.2
Computer USB	0.5	Samsung S4	0.5
Computer USB	0.5	Samsung S3	0.5
Computer USB	0.5	BlackBerry thick USB	0.5
Computer USB	0.5	BlackBerry thin USB	0.5

Note: Figures have been rounded.
Source: http://forum.xda-developers.com/showthread.php?t=2274321&page=13

The above information appears to suggest that not all chargers and Micro-USB cables are equal, at least when it comes to charging the Samsung S4. Evidently, there may be issues when using some non-OEM Micro-USB cables and this could have an influence on the speed at which the device is charged or indeed, may prevent charging altogether. Interestingly, it would seem that some devices will also not charge as effectively when another OEM Micro-USB cable is used. It may be the case that the use of different Micro-USB cables has in the past not been a significant issue, as devices typically charged below 1A. However, as the capabilities of smartphones have increased along with the size of their screens, higher capacity batteries have been incorporated within devices. As a result, the likelihood of not achieving optimal charging rates when using some Micro-USB cables has increased.

This issue is not limited to mobile phones. The results of a test to ascertain which charger and cable combination would ensure a fast charge of the Nook Colour e-reader are also available from the xdadevelopers website. For the purposes of the test, the device was running with the battery at about 70%, with tests lasting around five minutes for each combination. As can be seen in the table below, the fastest charging was achieved with the Nook cable irrespective of the charger used. It may be the case that any charger that provides 2A will be capable of fast charging the Nook Color, provided it is coupled with the Nook cable. Indeed, of those tested, the fastest charge would be achieved using the 2A HP touchpad charger with the Nook cable.

Table 5-17: Fast charging of Nook Color

Charger	Stated output (A)	Cable	Average reading (mA)	MiliVolts increase
Nook	1.9A	Nook	+ 892mA	mV increased 3844mV to 4053mV
Touchpad	2.0A	Touchpad	- 335mA	mV increased 3847mV to 3901mV
Nook	1.9A	Touchpad	-407mA	mV increased 3847mV to 3888mV
Touchpad	2.0A	Nook	+1211mA	mV increased 3826mV to 4081mV

Source: Xdadevelopers, accessed at http://forum.xda-developers.com/showthread.php?t=1646950

The faster charging rate can only be achieved with the connector of the Nook cable because both this cable and Nook Color Micro-USB port have two depths. The first depth within the Micro-USB is compatible with the Micro-USB standard, which means that the device can be charged using a typical Micro-USB cable. However, charging will be at a slower rate, regardless of the charger that is used. The second depth of the Micro-USB port facilitates faster charging. However, this feature can only be exploited by the additional pins that form part of the OEM Micro-USB cable supplied with the Nook Color[310].

[310] PCMag UK, Barnes & Noble Nook Color, accessed at: http://uk.pcmag.com/barnes-and-noble-nook-color/21826/review/barnes-noble-nook-color and Barnes & Noble, Nook Color charger uses special micro-USB connector (07/03/2011), accessed at: http://bookclubs.barnesandnoble.com/t5/NOOK-Talk/Nook-Color-charger-uses-special-micro-USB-connector/td-p/1093812?amp%3Br=1&cm_mmc=AFFILIATES-_-Linkshare-_-TnL5HPStwNw-_-10%3A1

5.4.4 Economic Impacts

Operating costs and conduct of business/SMEs

Option 1

The impact on manufacturers' additional **adjustment, compliance or transaction** costs is likely to differ depending on the product group; however, it is expected that, overall, Option 1 is unlikely to impose costs on manufacturers at a level that would significantly affect their operations, with the main reason being that, should this option have significant negative impacts, manufacturers would quite simply not partake in a voluntary agreement.

As regards **mobile phones**, should manufacturers agree on the use of Micro-USB connectors and allow the use of adaptors, the impacts from Option 1 on manufacturers' operating costs would likely be limited, as this option would merely extend the current voluntary agreement (unless this were to be extended to non-data enabled phones). Should the variant not allowing the use of adaptors be preferred, it is unlikely that Apple (which relies on the use of adaptors) would partake in the voluntary agreement. Should Apple decide to take part in a no-adaptors agreement, it is likely that it would incur additional costs in relation to a) designing multiple versions of its products, b) production and logistics associated with a more diverse product portfolio and c) loss of revenue from the sale of proprietary chargers and accessories.

Similarly, a voluntary agreement signed by manufacturers of **e-readers** would essentially extend and reinforce the current situation as 96% of e-readers sold already use Micro-USB for charging. It is difficult to imagine that an alternative solution would be agreed upon by those manufacturers shipping the larger volumes of devices with this charging solution and it is therefore expected that the voluntary agreement would rely on Micro-USB. For manufacturers of e-readers that are currently using charging solutions other than Micro-USB (the study has identified approximately 11 manufacturers using alternative charging solutions), there will be costs associated with designing new devices (or a next generation of existing devices) based on a solution with which they may not have much experience and for which they may not yet have established relationships with suppliers. It is noted that those companies that would be affected would range from large multinationals to relatively small companies. At this stage it is not possible to quantify the cost impacts as they would vary for each manufacturer but they are not expected to be significant.

Overall, it is likely that a voluntary agreement would entail some adjustment and transaction costs for manufacturers of **digital cameras and camcorders**. The main reason is the limited market share of Micro-USB devices. In fact, the dominance of charging solutions other than Micro-USB casts doubt on the assumption that the voluntary agreement would select Micro-USB as the common charging solution. This is significant as the specific economic impacts would depend on the technical option selected for harmonisation and vary for each manufacturer. Crucially, the cost impacts on manufacturers would depend on whether adaptors are allowed, as this sub-option would ensure that the cost of compliance with the voluntary agreement for manufacturers is minimal. The manufacturer would still incur some costs in designing, developing and providing an adaptor with the product; however, such costs are unlikely to be significant. It is important to note that, due to its voluntary nature, some manufacturers will not sign the agreement. Therefore, the impacts outlined below would primarily affect those manufacturers who choose to become signatories.

The main factors determining the specific impacts of Option 1 for manufacturers of digital cameras and camcorders include the overall diminishing sales of digital cameras due to the increased capabilities of smartphones and the presence on the market of large manufacturers and their ability to contain operating costs due to economies of scale. As noted in Section 4.5, the market for digital

cameras has been decreasing and this development is likely to continue into the future. This suggests that any impacts are likely to be experienced at a time when manufacturers have to contend with reduced sales and as such any cost impacts express on a per unit basis that may appear relatively small today may become significant in the future. As previously mentioned, the global market for digital cameras is not significantly dominated by any one player; however, some manufacturers possess a larger share of the market than others (see Table 4-16). As such, the voluntary agreement would have an impact primarily on the main manufacturers of digital camcorders (e.g. Sony, Panasonic, JVC and Canon), assuming that they have become signatories. However, it is likely that economies of scale would allow these manufacturers to reduce the economic impact of the voluntary agreement and thus contain the increase in operating costs and costs of conducting business. This, however, would not be the case with smaller manufacturers as they would be less able to contain the associated cost increases. In order to harmonise their devices with those offered by large manufacturers, and thus remain competitive in a shrinking market, smaller companies may choose to enter the voluntary agreement and would incur costs from designing compliant devices and/or costs from designing new chargers. However, these impacts would be to some degree cushioned by the fact that smaller manufacturers cater to high-end, professional markets, and it is likely that demand for these niche products is likely not to be very price sensitive.

The nature of the market for **portable media players** would suggest that if all manufacturers are able to reach an agreement, this will likely include the use of adaptors, allowing compatibility between the product and the common charging solution. This would allow a voluntary agreement to be made whilst manufacturers would be able to continue using their (current) charging methods. The provision of adaptors seems the most likely scenario as Apple, which dominates the market, uses a proprietary connector whilst other manufacturers use the Standard USB and Mini-USB connectors. This solution would also ensure that the cost of compliance with the voluntary agreement for manufacturers is minimal or none as Micro-USB/Mini-USB, Micro-USB/USB and Micro-USB/Apple Lightning adaptors are already available. Given the mature stage of the market for portable media players, it is expected that the variant of this option that allows adaptors is likely to be preferred by manufacturers over the 'no adaptors' variant which would likely entail additional costs when designing new products.

Charging **sports devices and activity monitors** by Micro-USB is associated with limitations regarding the need for wearable devices to be waterproof while maintaining their compact size. This raises the question whether manufacturers would voluntarily converge on a connector other than Micro-USB; for example a manufacturer responding to consultation for this study suggested it would be open to a charging clip standard being developed in collaboration with other companies. However, without information from the other manufacturers on this issue, it is not possible to determine whether this is a feasible technical option as those companies that have pioneered this approach may not be willing to share their know-how with their competitors. This suggests that Option 1 is most likely to succeed if adaptors are allowed. In such a case, this option would require investment and research into the development of the adaptor. At present a number of charging solutions exist, including charger clips and other proprietary solutions, therefore it is possible that several adaptors would be developed. Investment costs could be offset by supplying new devices without the charging block and/or data transfer cable, under the assumption consumers will already own a Micro-USB cable and/or charging block with USB port. To some extent, manufacturers have already adopted this policy as Polar devices and Timex Run Trainer are supplied without charging block.

Table 5-18 summarises available information on the size of wearable and non-wearable sports and activity monitors made by Garmin. This table shows that Garmin's sports and activity devices that are not worn on the wrist (i.e. those that are, for example, devices affixed to a bike/golf bag/golf

buggy/pocket of golfing trousers) are on average three times larger than wearable devices, possibly indicating different requirements as regards the charging connector.

Table 5-18: Comparison of size of wearable and non-wearable sports and activity monitors		
Sport	**Device**	**Total Volume (cm^3)**
Wearable devices		
Triathlon	Garmin Forerunner 310XT	61
	Garmin Forerunner 910XT	49
Swimming	Swim (disposable battery)	26
Running	Garmin Forerunner 405	56
	Garmin Forerunner 60/70 (disposable battery)	29 (average of 2 sizes)
	Garmin Forerunner 110	48
	Garmin Forerunner 210	48
	Garmin Forerunner 410	56
	Garmin Forerunner 610	41
	Garmin Forerunner 10	37 (average of 2 sizes)
	Garmin Fenix	41
	Garmin Forerunner 220	26
	Garmin Forerunner 620	26
	Garmin Tactix	41
Golf	Garmin Approach S1	48
	Garmin Approach S2	48
	Garmin Approach S3	48
	Garmin Approach S4	43
Mariner	Garmin quatix	41
Average across wearable devices		***43***
Non-wearable devices		
Golf	Garmin Approach G3	184
	Garmin Approach G5	238
	Garmin Approach G6	102
	Garmin Approach G7	102
	Garmin Approach G8	90
Cycling	Garmin Edge 200	67
	Garmin Edge 500	75
	Garmin Edge 510	100
	Garmin Edge 800	121
	Garmin Edge 810	121
	Garmin Edge Touring (Normal)	121
	Garmin Edge Touring (Plus)	121
Average across non-wearable devices		***120***
Source: Compiled from product manuals accessed through the Garmin website, http://www.garmin.com		

Under the 'no adaptors' variant, there would also be design costs for sports devices and activity monitors that currently use Mini-USB or proprietary chargers, that can switch to direct Micro-USB charging. Operating costs are unlikely to increase significantly as information provided by a manufacturer of sports and activity monitors suggests that the production costs associated with proprietary charging connectors and Micro-USB are broadly equivalent. The Micro-USB charging cable is cheaper than a cable with a proprietary connector but incorporating the Micro-USB charging port into a device is more expensive than would be the case with a proprietary solution. As above, costs would be further reduced due to the possibility of not supplying a data cable.

The market for **personal navigation devices** is dominated by TomTom and Garmin who account for the majority of the market. Analysis of the models available on the EU market for the period covered by the study showed that both of the leading manufacturers have used Micro-USB for the purpose of charging to some degree. The analysis also revealed that other manufacturers, which have a smaller share of the market, have only released models which use Mini-USB. Consequently, it may be the case that switching to Micro-USB would have a disproportionate impact on PND manufacturers with a smaller share of the market and it can be expected that these manufacturers would be more likely to take part in a voluntary agreement that allows adaptors. Should adaptors be allowed, limited or no cost impacts would arise for manufacturers of devices that use Mini-USB as Micro-USB/Mini-USB adaptors already exist. Also, given the widespread use of the Micro-USB for charging in a number of devices, the necessary components would be accessible and not prohibitively expensive. Therefore, even under the 'no adaptors' variant no significant impact on the operating costs and conduct of businesses is expected. Opting for the Micro-USB could lead to manufacturers supplying PND without a charger (car and home) based on the assumption consumers will already possess a compatible charger, potentially enabling manufacturers to accrue savings from this.

Under Option 1, manufacturers of **portable games consoles** would come to a voluntary agreement on a common charging connector. Considering this sector is dominated by proprietary connectors, it is possible that manufacturers would draw upon a non-proprietary standard, such as Micro-USB. A change to Micro-USB should not be too technically challenging, and the economic impacts should reflect this. If permitted by the agreement, manufacturers could supply an adaptor with their products which would allow compatibility between the product and the common charging solution. This solution would also ensure the cost of compliance with the voluntary agreement for manufacturers is minimal. The manufacturer would incur some costs in designing, developing and providing an adaptor with the product, however such costs are unlikely to be significant.

The **personal care products** sector exhibits a number of characteristics that set it aside from the other product groups, including their use in wet applications and a bigger range of voltages used for the charging of these products. These characteristics may explain why during consultation, it was suggested that in the personal care sector a proprietary charger can account for around 5-25% of the total cost of the device. A voluntary agreement based on the Micro-USB connector would thus likely not apply to products for use in wet environments. Analysis of the models available on the EU market for the period covered by the study, however, shows that Philips uses Micro-USB for the purpose of charging some of their personal care products, suggesting that for some products Micro-USB charging is not an unfeasible technical option. The power characteristics of chargers for some personal care products also suggest that this voluntary agreement would need to be based on the USB Power Delivery standard. If this Option were to apply to all personal care products, a company active in this sector suggested that 2017 would not be a feasible timeframe for technical reasons and there would be adaptation costs.

The widespread use of the Micro-USB for charging in a number of other product groups indicates that the necessary components would be accessible and not prohibitively expensive. Therefore, no significant impact on the operating costs and conduct of businesses is expected. If permitted by the agreement, manufacturers could supply an adaptor with their products which would allow compatibility between the product and the common charging solution. This would allow a voluntary agreement to be made whilst manufacturers would be able to continue using their (current) charging methods. This solution would also ensure the cost of compliance with the voluntary agreement for manufactures is limited.

Harmonisation of charging is likely to impact **manufacturers of chargers** in several ways, including

- benefits from reduced operating costs due to greater unification of production and resulting economies of scale;
- increased revenues from use of more expensive components;
- costs of potential changes to existing production lines; and
- lost revenues due to avoided chargers (should decoupling of device and charger sales occur).

The impacts on charger manufacturers would depend on the relative strenth of the factors listed above, with the key determinant of the overall impacts being the rate of decoupling. These impacts are considered in more detail later in this section as part of the assessment of Option 2. Overall, it is expected that the level of decoupling achieved under Option 1 would be lower than under Option 2 and as such any negative pressures on the revenues generated charger and cable manufacturers are likely to be less severe. As noted later in this section, under the 'no adaptors allowed' sub-option, charger and cable manufacturers are likely to incur lossess if the rate of decoupling exceeds 7% (this is because the use of a common charger would mean they would lose revenue from decoupled chargers but are benefit from the use of more expensive components). This is significantly higher than the current rate for mobile phones. The decoupling rate for mobile phones has beet estimated at 0.05% in 2013, up from 0.02% in 2012; if the current trend is sutained, the decoupling rate could reach 2% in 2017, which is still significantly lower than the 7% threshold above which charger and cable manufacturers would incur a loss. Please note that these calculations relate to both mains chargers and cables (as noted elsewhere in this report, some devices are supplied with mains chargers whilst other devices are supplied with a charging cable only).

All in all, Option 1 is unlikely to significantly impact on the **investment cycle**, provided a sufficiently long transition period is afforded to manufacturers. For example, information provided by handset manufacturers indicates that it typically takes less than two years to develop a new mobile phone. It is possible that for less complex products (e.g. portable media players and some e-readers), the product development period may be shorter but given the increasing complexity of consumer electronics in general and the growing popularity of cross-over devices, it is deemed appropriate for this assessment to also use the two year estimate for other devices. This suggests that a transition period of at least two years may be required; 2017 could thus be a realistic target should manufacturers reach a voluntary agreement very soon; should this not be the case, the application of this agreement may need to be delayed. Most of the product sectors considered in this study are characterised by a very high rate of innovation, meaning that manufacturers redesign their product portfolio on a frequent basis to keep up with changing fashion and technology trends. It is therefore expected that for most product groups, there would only be limited impacts on the investment cycle.

For the purposes of this study, the term 'investment cycle' (when used in relation to a specific company or product) is defined as the period from the time when the investment is made (or when the idea to invest is conceived) to the time when the full amount invested is recouped or when the product in question ceases to generate revenue. Neither Option 1or 2 would significantly affect the part of the invest cycle after the product is launched. Considering that the consumer electronics sector is highly competitive and the rate of innovation is high, it appears unlikely that the product development part of this cycle is significantly longer than two years, and as such it is expected that a policy option that is due to come into force in 2017 would be unlikely to affect the stage of the investment cycle prior to product launch. In this respect, it is of interest that the rate of innovation appears to be high in all product sectors under consideration in this study but it is expected to be comparatively lower in markets for products with declining sales. As shown in Section 4 of this report, sales of e-readers, digital cameras and camcorders, portable media devices, PNDs and portable handheld games consoles have been declining and as such it can be expected that the rate of innovation may slow down in the future and the investment cycle may thus lengthen; this

development may be further exacerbated under Option 1 should manufacturers need to invest in developing charging solutions they are not familiar with.

Option 1 would only apply to new models introduced to the market from 2017 and thus would not require the **withdrawal of any products from the market**. Chargers typically account for a limited proportion of the overall cost of the device (perhaps with the exception of the personal care products sector) and as such it is not expected that Option 1 would lead to **new or closing down of businesses**. Option 1 being a voluntary agreement, manufacturers whose existence could be threatened by their participation in this agreement (which in itself is unlikely) would simply abstain from this agreement. For the same reason, it is expected that Option 1 would not result in some **products/businesses being treated differently from others in a comparable situation**. The Micro-USB connector offers an advantage over a proprietary solution, as there are no obstacles in terms of copyright/patents to all market players converging on this standard. In addition, manufacturers would not incur costs for the development of a new common connector which may be an advantage in shrinking market segments such as portable media players. Therefore, the Micro-USB connector provides a good basis for a common solution.

The impacts on **SMEs** are also likely to be limited, although it can be expected that large companies may have more resources to take part in negotiations about the voluntary agreement and in the development of any relevant standards. This would mean that the cost of defining the common solution and the more detailed technical requirements may fall predominantly on the large companies and SMEs may thus benefit from this. However, at the same time, this may somewhat limit SMEs' influence on the outcome of the standardisation process. The proportion of European SME manufacturers differs depending on the products group. In some product groups (digital camcorders, personal media players, personal care products), there appear to be no EU-based SMEs. In such sectors, no impacts on European SMEs can be expected. In other product groups (such as e-readers and digital cameras), there appear to be a number of European SME manufacturers that would experience the impacts described above.

Option 2

In general, Option 2 is not expected to impose significant **additional adjustment, compliance or transaction costs** on businesses. This is mainly because Option 2 would only apply to new models introduced to the market from 2017 and because the Micro-USB standard is widely known and applied in the consumer electronics industry and as such manufacturers are already familiar with it. The product sectors considered in this study are characterised by a high rate of innovation whereby manufacturers develop new connectors/switch between connectors on their devices on a frequent basis; as such, it is not expected that the policy options considered in this report would result in significant additional costs to those that would be incurred by manufacturers under the baseline (provided only new models are affected, sufficient notice is given to manufacturers and waterproof products are exempted). However, when compared with Option 1, the impacts of Option 2 are likely to be greater as manufacturers wishing to avoid costs by non-participation in the voluntary agreement would not be able to do so. In addition, should Option 2 not allow the use of adaptors, companies wishing to comply with the legal requirements by means of adaptors would not be able to do so and would thus have to design products with Micro-USB sockets – this would entail costs for companies such as Apple which currently rely on proprietary connectors.

Option 2 would effectively maintain the current status quo for most **handset** manufacturers (unless the requirement to use Micro-USB were to be extended to non-data enabled phones in which case manufacturers would incur additional costs). Generally speaking, consultation responses from Digital Europe and handset manufacturers appear to prefer standardisation under Option 0 with Option 2 being least popular. The greatest cost would be experienced by Apple under the 'no

adaptors' variant as this company would have to incorporate Micro-USB into their future designs and may conceivably end up producing separate product lines for the European market and the rest of the world. In addition, Apple may incur sunk costs in relation to the investment made into the development of the Lightning connector and would likely lose revenues from the sale and/or licensing of accessories with this connector.

The widespread use of Micro-USB sockets in current **e-readers** suggests that the costs to design models which use this connector and the associated charger/data transfer cable are not prohibitive. This technical option would also ensure that the number of manufacturers impacted is kept to a minimum. Clearly the burden would fall on those manufacturers which produce e-readers using non-Micro-USB charging solutions and based on the figures generated by the model, these accounted for approximately 4% of sales in 2013. However, as stated, designing new products or models to utilise Micro-USB charging is not considered prohibitive and allowing existing models to continue to be sold should enable manufacturers to make the necessary adjustments to their supply chains over an extended period between the entry into force of any legislation (assumed to be 2017 for the purpuses of this impact assessment) and the placing of any new models on the market. As noted earlier in this section, cost impacts on e-reader manufacturers would likely be very small under the 'adaptors allowed' variant as Micro-USB/Mini-USB and Micro-USB/USB adaptors already exist and these would cater for most non-Micro-USB e-readers. An interesting case is the Nook Color device which uses a proprietary socket that is similar to Micro-USB and whose port has two depths. The first depth within the Micro-USB is compatible with the Micro-USB standard, which means that the device can be charged using a typical Micro-USB cable. However, charging will be at a slower rate. The second depth of the Micro-USB port facilitates faster charging. However, this feature can only be exploited by the additional pins that form part of the OEM Micro-USB cable supplied with the Nook Color[311].

Because the Micro-USB connector is already in use in the **digital cameras and camcorders** segment, with some newer models using this connector for data transfer and/or charging, it would appear that it is both economically and technically possible to equip compact digital cameras and camcorders with this connector. Manufacturers would experience some costs of complying with the legislation as not all compact digital cameras or pocket/action camcorders are currently equipped with a Micro-USB connector. Digital cameras currently rely on a range of connectors and as such production procedures would be simplified under Option 2 but such simplification would likely be minimal in the case of European companies due to the fact that these manufacturers have specialised to cater to niche markets. In other words, they do not have mass production like some of their non-EU competitors may have. Should these manufacturers be obliged to switch to Micro-USB when designing new products (i.e. a solution so far only applied to a limited extent, although again, this differs between manufacturers), this may have some cost implications for them but these are likely to be limited, especially when considering that the charging connector is only a minor component in the high end market segment in which European companies operate, where the average value of a digital camera produced in the EU was slightly over €1,000 in 2012 (see Table 4-16 in Section 4).

If the legislation permits the use of adaptors to allow compatibility with the common connector selected by the European Commission, the economic impacts for manufacturers of **portable media devices** will be relatively insignificant. Manufacturers will have to make available a suitable adaptor

[311] PCMag UK, Barnes & Noble Nook Color, accessed at: http://uk.pcmag.com/barnes-and-noble-nook-color/21826/review/barnes-noble-nook-color and Barnes & Noble, Nook Color charger uses special micro-USB connector (07/03/2011), accessed at: http://bookclubs.barnesandnoble.com/t5/NOOK-Talk/Nook-Color-charger-uses-special-micro-USB-connector/td-p/1093812?amp%3Br=1&cm_mmc=AFFILIATES-_-Linkshare-_-TnL5HPStwNw-_-10%3A1

for consumers, but this is not likely to come at a significant cost to manufacturers, especially considering that the dominant manufacturer (Apple) already offers the Micro-USB/Lightning adaptor and Micro-USB/Mini-USB adaptors are also available. Overall, for product sectors where the extent of use of Micro-USB is limited (such as digital cameras and portable media players), it would be less costly for manufacturers to comply with the new requirements should adapters be allowed. However, if adaptors are not permitted by the legislation, the economic impacts are expected to be more severe, although the actual economic impacts are not possible to quantify and will depend upon the individual manufacturer and the connector selected. For example, if all new iPod models launched from 2017 onwards had to be equipped with the Micro-USB connector, Apple would incur the costs of designing products with a connector that it currently does not use for charging of any of its devices. When introducing legislation concerning harmonisation in the market for portable media players, the maturity of the market must be considered. Indeed, the market for portable media players is decreasing. Currently, there are a limited number of products available on the market and dwindling demand raises questions over the ability and/or willingness of manufacturers to change or design new products in order to adopt a new charging connector.

Charging **sports devices and activity monitors** by Micro-USB directly or via an adaptor would require investment into the development of Micro-USB devices or the adaptor. At present a number of charging solutions exist, including charger clips and other proprietary solutions, therefore it is possible that several adaptors would be developed. There will also be design costs for sports devices and activity monitors that currently use Mini-USB or proprietary chargers so that new models switch to direct Micro-USB charging. In terms of operating costs, these would likely not change as information provided by a manufacturer of sports and activity monitors suggests that the cost per unit of using Micro-USB and proprietary solutions is the same for devices that need to be waterproof. However, limitations in terms of size associated with using Micro-USB suggest that it may be desirable to establish an exemption for wearable products.

As regards **personal navigation devices**, the financial impact would be greatest for those manufacturers that have devices that are currently charged by a method other than Micro-USB. However, these costs are not expected to be significant as this method of charging has already been adopted by industry and is economically and technically feasible.

Manufacturers of **portable handheld games consoles** would experience costs of complying with the legislation as only one portable games console is currently equipped with a Micro-USB connector. It is expected that the associated economic impact of legislation would be less if it allowed the use of adaptors. In this scenario, manufacturers would make available an adaptor to allow compatibility between their products and the prescribed charging connector.

It is assumed that in the **personal care products** sector, manufacturers would need to make new models released from 2017 capable of being charged via the common charger (Micro-USB), unless they are designed for use in wet rooms. However, the overall costs are not expected to be significantly high as this method of charging has already been adopted by industry and is economically feasible (unless the requirement to use Micro-USB is extended to products for use in wet rooms). However, as noted in Section 5.4.3, there are large differences between the voltages/current used in the personal care product segment and in other sectors which raise questions about interoperability of chargers designed for personal care products and other sectors. The associated costs of the legislation would be less if it allowed the use of adaptors. If this Option were to apply to all personal care products (i.e. including those for use in wet rooms), a company active in this sector suggested that 2017 would not be a feasible timeframe for technical reasons and there would be adaptation costs. This assertion appears reasonable considering that standards applicable to the use of devices in wet rooms would need to be developed.

The assessment presented above relates to manufacturers of portable electronic devices. However, as noted in Section 3, these companies typically do not manufacture chargers for their devices but rather purchase these from external suppliers (although consultation carried out for this study shows that not all manufacturers of electronic devices source chargers externally). For this reason, it is also necessary to the impacts that Option 2 would have on **manufacturers of chargers (and cables)**. This requires consideration of the following factors:

- charger manufacturers are likely to benefit from reduced operating costs due to greater unification of production and resulting economies of scale;
- should Option 2 specify requirements at a higher level than is currently the case (e.g. due to the need to supply higher power for other devices or due to the need to use more expensive components), this could boost the revenues of charger manufacturers as may have been the case with some manufacturers producing chargers for the handset sector following the signing of the MoU;
- on the other hand, some manufacturers may incur costs due to the need to invest in changes to their production lines; and
- should Option 2 lead to a large degree of decoupling of device and charger sales, charger manufacturers may suffer reduced revenues. As such, around 50% of the benefits from decoupling accrued by consumers (estimated later in this section) would also represent losses for charger manufacturers (the 50% figure is based on the fact that between around €0.25 of the €0.50 cost increase estimate presented later in this section relates to the charger, with the other 50% relating to changes to the handset). A key exception to this would be sport and activity monitors, where decoupling will always entail costs to consumers and losses for charger manufacturers (this is because in the sports and activity monitor sector, the Micro-USB charging cable is cheaper than the proprietary cable/charger. However, to incorporate the Micro-USB charging port into a device is more expensive).

The impacts on charger manufacturers would depend on the relative strenth of the factors listed above, with the main determinant of the overall impacts being the rate of decoupling. However, the extent to which decoupling is likely to occur is unclear. The assessment later in this Section and in Section 5.4.6 presents two theroretical scenarios modelling different degrees of decoupling: Scenario 1 (2% of devices will be sold without a charger) and Scenario 2 (50% of devices sold without a charger). Scenario 1 is based on an extrapolation of the current decoupling trend for mobile phones (i.e. a sector where charging has already been largely harmonised) and Scenario 2 is seen as the highest possible rate based on the current levels of ownership of devices and expected charging behaviour of consumers (see Section 5.4.6 for details of how this has been estimated).

Whilst benefits/costs from production unification and changes to production lines are unknown, it has been possible to estimate the impacts from the use of different components and the different rates of decoupling under Scenarios 1 and 2. It is of note that under Scenario 1 (2% decoupling), charger and cable manufacturers would gain approximately €70 million over 2017-2021 (i.e. there would be an annualised benefit of around €14 million) whilst under Scenario 2 (50% decoupling), charger manufacturers would lose almost €620 million over the same period (annualised losses of around €120 million). This shows that if the proportion of decoupled devices remained at the same rate as that of mobile phones between 2012-2013, charger and cable manufacturers would still increase their revenues, although by a relatively modest amount. This goes some way towards explaining the support for further harmonisation expressed by charger manufacturers responding to consultation for this study. However, should the rate of decoupling increase significantly in the future, charger/cable manufacturers may lose revenue. These losses would occur at decoupling rates above 7% (under the 'no adaptors allowed' suboption). Please note that these calculations relate to both mains chargers and cables, depending on the product group in question (as noted

elsewhere in this report, some devices are supplied with mains chargers whilst other devices are supplied with a charging cable only).

The impact of this option on the **investment cycle** would depend on the time given to manufacturers to adjust to the new requirements and the product group in question. As noted above, it is expected that this legislation would come into force in 2017 and that it would only apply to new products launched from 2017 onwards. As such, it is assumed that Option 2 would only have a limited impact on the investment cycle (for a definition of the investment cycle used in this study, please refer to the assessment carried out earlier in this Section for Option 1). This is for two main reasons. First, the example of mobile phones where it takes approximately two years to develop a new model suggests that entry into force of these requirements in 2017 would provide manufacturers with sufficient time to adapt to the new requirements. Secondly, the relevant markets are highly dynamic and innovative, with major manufacturers introducing new models on a frequent basis, often trying to capitalise on fashion and technology trends. For example, the market model for **mobile phones** has estimated that the average market lifetime of individual models (i.e. the period from the release of a particular model to its withdrawal from the market) may be around 1.5 years. This value has been estimated on the basis of published information[312] and consultation (a number of consultation responses were used to derive the estimate). Although in reality some models will be sold for longer than 1.5 years while others will not be successful and will be withdrawn sooner, this estimate provides an indication of the average market churn and the rate of innovation in this sector. The high rate of innovation in the handset sector is likely to continue into the future. For example, PWC (2012)[313] expects the performance of mobile handsets to improve significantly between 2014 and 2016. As noted earlier in this report, the typical design-to-production period for mobile phones is approximately 18 to 24 months. This suggests that provided mobile phone manufacturers are informed about any new requirements in good time, the impacts on the investment cycle should be relatively limited. Similarly, the **tablet and PND** market models developed for this study (see Section 4 and Annex 11) estimate the average time for which models remain on the market at 1.5 and 2 years, respectively. The rate of innovation may be somewhat lower in shrinking market segments such as **digital cameras, e-readers and personal media players** but it is still expected that manufacturers in these sectors would not significantly alter their investment cycle.

Option 2 would only apply to new models introduced to the market from 2017 and thus would not require the **withdrawal of any products from the market**. This is the case for all product groups. As regards **opening of new and the closing down of businesses**, chargers (or in sector where only a cable is provided, cables) account for a relatively small proportion of the cost of most of these products (perhaps with the exception of the personal care sector) and as such cannot be expected to have any significant impacts on manufacturers of consumer electronics.

Distributional impacts in the handset manufacturing sector would primarily depend on whether compliance with the legislation can be achieved by means of making an adaptor available. This primarily relates to Apple which has complied with the MoU by means of offering consumers the possibility to purchase an adaptor. Should adaptors not be allowed under Option 2, this would require that all future iPhone releases use the Micro-USB connector instead of Apple's proprietary

[312] See http://www.nbcnews.com/id/29258026/ns/technology_and_science-digital_home/t/planned-obsolescence-cell-phone-models and http://google.brand.edgar-online.com/EFX_dll/EDGARpro.dll?FetchFilingHtmlSection1?SectionID=6482508-45544-112993&SessionID=ae4HHWfPE63d0P7

[313] PWC (2012): The PwC Mobile Innovations Forecast: Making sense of the rapid change in mobile innovation, available at http://www.pwc.com/gx/en/technology/mobile-innovation/mobile-device-technology-components.jhtml

Lightning connector. Under the variant of this option that does not allow adaptors, Apple would also likely suffer further revenue losses due to reduced income from the sales of Apple-branded accessories and licensing deals. As noted in Section 3, Apple's Lightning connector includes an authentication chip and third party manufacturers have to pay a licensing fee to be included in the Made for iPhone licensing programme[314]. Although precise data have not been published, there are indications that this is a significant source of revenue for Apple. For example, in Q4 of 2013, Apple's income from sales of hardware peripherals and Apple-branded and third-party accessories for iPhone, iPad, Mac and iPod exceeded €1 billion[315]; although this includes more than just income from the Made for iPhone licensing programme, it is indicative of the order of magnitude of this revenue stream.

Due to the mandatory nature of legislation and the impossibility to opt out of it in case of companies' unwillingness to incur costs, it is expected that **SMEs** would face some adjustment and compliance costs and, in principle, on a per unit of output basis these would be greater than those incurred by large manufacturers. On the other hand, SMEs can be expected to benefit from harmonisation on the basis of non-proprietary standards as this can facilitate the entry of new companies into the market. As for Option 1, the proportion of European SME manufacturers differs depending on the products group. In some product groups (digital camcorders, personal media players, personal care products), there appear to be no EU-based SMEs and no impacts on European SMEs can thus be expected. However, there are European companies selling own brand mobile phones, e-readers and digital cameras (some of which manufacture their products in the EU), there appear to be a number of European SME manufacturers that would experience the impacts described above. In this respect, it should be noted that European manufacturers of digital cameras are active in the high-end segment of the market in which products command relatively high prices.

The impacts are summarised below using the following scoring system: +++large positive impact; ++moderate positive impact; +limited positive impact; ----large negative impact, --moderate negative impact; -limited negative impact; 0 no impact, 0/- some no impacts and some limited negative impacts (e.g. some devices no impacts, some limited negative or initialy none, in the long term negative, etc.); +/- as above but limited positive and limited negative, etc. This scoring system is also used for other impact categories considered in the remainder of this section.

[314] Apple (nd): MFi Program, available at https://developer.apple.com/programs/mfi/ and Golson (2013): Apple's Strict Requirements for Its Third-Party Lightning Accessory Program Detailed, available at http://www.macrumors.com/2013/02/14/apples-strict-requirements-for-its-third-party-lightning-accessory-program-detailed/

[315] Apple (2014): Q4 2013 Unaudited Summary Data, available at http://images.apple.com/uk/pr/pdf/q4fy13datasum.pdf

Table 5-19: Summary of Main Impacts on Operating Costs, Conduct of Business, SMEs			
Impact	**Option 0**	**Option 1**	**Option 2**
Adjustment, compliance and transaction costs	0	0/- Would differ by product group depending on pre-existing level of compliance but generally low (slightly higher in digital camera, portable media player and portable handheld games consoles)	0/-- As for Option 1, only larger in magnitude
Investment cycle	0	0	0/- but only in shrinking market segments (digital cameras and camcorders, e-readers, portable media players)
Withdrawal of products	0	0	0
Emergence or closure of businesses	0	0	0
Differential treatement	0	0	0
SMEs	0	0	0/- (but the potential for this only exists in sectors where there are European SMEs, e.g. mobile phones, e-readers and digital cameras)

Research and innovation

Option 0

The portable electronic device sector is a rapidly changing one with new products being developed and released onto the market on a frequent basis. The rate of innovation and product development is very high (e.g. several mobile phone manufacturers responding to consultation for this study appear to expect that in the medium term, mobile phone charging will undergo a period of intensive innovation) and research and development are ongoing activities essential to keeping manufacturers competitive. These developments are assessed in more detail in Sections 5.2 and 5.4.2 but in the mobile phone sector include increasing power required by handsets, faster charging (multiple-C charging)/variable power, increasing popularity of wireless charging and the potential for the USB Type-C connector to gain a significant market share.

Under the baseline scenario, manufacturers of all devices would remain free to incorporate whatever charging technologies they deem appropriate. The array of current technological solutions in existence and being developed (including USB 2.0, USB 3.0, USB Battery Charging, USB Power Delivery, wireless charging, different types of connector such as the introduction of Type-C, proprietary solutions, etc.) as well as any new technologies will all be at the disposal of device manufacturers and they will be able to choose whichever solution they wish, for either groups of devices or individual devices. They will also be able to adapt their research and development to changes in battery technology and for any new devices that are being developed currently and in the future, taking into account any new functionality and the industry-envisaged increased power requirements for devices.

The absence of any legislative restrictions or voluntary agreement to restrict charging capabilities to a particular solution will mean that manufacturers can proceed with their product research and development freely in the knowledge that whatever solutions are developed will be allowable on the EU market (subject to any other EU legislation regarding safety, electromagnetic compatibility etc.). Whatever solutions are developed may then subsequently compete in the market. Indeed, for many of these devices, charge time and the length of time the device will operate under a single charge is a key selling point that distinguishes it from the rest of the market.

However, recent history in terms of the MoU for mobile phones as well as the expression of concerns for both the environment and consumer convenience by bodies such as the European Parliament and consumer organisations, and the resulting possibility that legislation determining a particular charging solution may be introduced will be very much in the minds of device manufacturers (mobile phone manufacturers in particular). To an extent, this may act to temper any fragmentation of the market in terms of charging solutions in the short-term and encourage the uptake of common solutions.

Option 1

Under this option, a voluntary agreement would be drawn up between manufacturers of mobile phones, e-readers, digital cameras/camcorders, portable media players, sports and activity monitors, personal navigation devices and personal care products, and a charging solution agreed. Subsequently, all devices placed on the market by the signatories to the agreement would need to be compatible with the agreement, meaning that the charging technology would be fixed.

During consultation for this study, a number of device manufacturers have argued that this would be restrictive in terms of product development and consequently have a negative impact on innovation. The impacts would depend on the precise technical requirements (form factor only or power limitations, etc.). Consultation with device manufacturers suggests that restrictions on charging technology may be problematic as the power requirements for devices increase with additional functionality. For example, a company active in the portable handheld gaming sector indicated that there are different models of gaming devices with different capabilities, abilities to use peripheral devices etc. and which consequently have different internal battery capacities requiring different chargers. The result of having to standardise chargers would, they suggest, would limit manufacturers' ability to develop more powerful handheld game consoles with greater functionality. It is noted also that this sector is dominated by only two major manufacturers and that product differentiation in terms of functionality is considered very important. Manufacturers of mobile phones have indicated that limiting their ability to develop new charging solutions at this current time, especially considering that the current Li-ion battery is being "pushed to the limits with today's devices" (as suggested by a handset manufacturer responding to consultation for this study), will be limiting since it is expected that future devices will charge at higher power and require chargers to deliver more than the currently harmonised charger. A potential impact of this would be that companies invest less in R&D and innovate less (or at a slower rate if dependent on how long any voluntary agreement is set to be in place). Alternatively, where manufactures of devices believe that their ability to develop new products and expand functionality is being hampered, they may simply refuse to participate in such an agreement. This is more likely to be the case for manufacturers of devices that do not already use Micro-USB and those that are currently faced with declining demand anyway, such as e-readers, portable media devices and digital cameras/camcorders, although it is noted that for e-readers, the majority of sales and stock are already using Micro-USB and as a result, R&D decisions would not be greatly affected under a voluntary agreement specifying this solution already adopted.

A potential variation on the participation in a voluntary agreement scenario may be that manufacturers comply for their devices for which the technical restrictions of the harmonised charger are compatible, but then develop other solutions for other devices for which there are e.g. higher power requirements (e.g. current generation handsets vs. next generation handsets). Under such ascenario, there would be little or no impacts on R&D. Under this scenario, it may be the case that the voluntary agreement would need to be updated in order to cater for such devices once production/sales reached a point at which it was considered significant.

Those companies which do not participate in the agreement from the start or which withdraw when they feel that charging restrictions are preventing the development of existing or new devices may subsequently invest more in R&D and potentially gain competitive advantage in the markets they operate in as a result. The validity period of any voluntary agreement is something that is likely to affect the degree of participation amongst manufacturers of different devices and could potentially mitigate against developments in the industry moving ahead of the technology adopted, it is important that any agreement should be reviewed on a regular basis, for example every 3-5 years in order to ensure that the industry keeps pace with new technology. However, stakeholder consultation carried out for this study suggests that some companies may believe that revisions should be considered on a significantly more frequent basis than every 3-5 years; a large multi-national retailer responding to consultation for this study noted that requirements would have to be reviewed every 1 to 2 years if the requirements were to remain relevant.

Regarding the 'adaptors allowed suboption', permitting their use would enable manufactures of all devices to continue R&D into new products and launching products with different charging technologies into the market as they mature without having to wait until the end of the validity period of any voluntary agreement. It should be noted that this situation has in fact happened anyway in the context of mobile phones even when an agreement has been in place.

Option 2

Under Option 2, there will be some limited differences to Option 1 with respect to the impacts on R&D and innovation. The legislative option would require all manufacturers of mobile phones, e-readers, digital cameras/camcorders, portable media players, sports and activity monitors, personal navigation devices and personal care products to supply devices with Micro-USB charging solutions. This will mean that R&D investments in other charging solutions could only occur in addition to the use of Micro-USB and as such it is not clear whether manufacturers will have a sufficient incentive to fully utilise alternative technologies (such as wireless charging and the USB Type C connector currently under development).

As this option would mean that no manufacturers can opt out, the potential negative impacts on innovation identified under Option 1 are likely to be intensified under Option 2. A number of manufacturers of devices consulted during the study have indicated that restrictions on charging capabilities are likely to hinder the development of new devices and functionalities, in particular where increased power requirements are concerned. Option 2 would prevent any manufacturers from launching new devices on the market that are unable to charge with the prescribed harmonised charger. Consequently, investment in R&D to develop such devices would likely be constrained during any period covered by the legislation, unless it is feasible to incorporate both the harmonised and new charging solutions together in the same device, or manufacturers pursue R&D with the intention of launching it after the expiry of any period set out in the legislation. The latter would clearly involve greater risks to manufacturers and levels of investment would likely be lower as a result.

Investment in R&D for charging technology itself may also be impacted negatively as there would be an inevitable delay between whenever technology is fully developed and when it could possibly be implemented, with associated uncertainties around whether or not the particular technology developed ends up being the selected option during any update of legislation in the future.

Generally speaking, the degree to which research and innovation in a certain product sector would be affected depends on the current extent of Micro-USB prevalence and the prevailaing market trend in that particular sector. It can be expected that product groups that already heavily rely on Micro-USB charging (mobile phones and e-readers) would not be impacted to any significant degree, whilst impacts on innovation would be greater in product groups where Micro-USB use is not widespread (digital cameras, portable media players, sports and activity monitors, portable handheld games consoles, and personal care products). For an overview of the current prevalence of Micro-USB, please refer to Sections 3 and 4 and Section 5.4.2. Second, there may be a higher impact on product groups with declining sales, such as portable media players, digital cameras and camcorders and personal navigation devices.

All in all, based on the information available to the study team, it appears unlikely that Option 2 would result in a significant diversion of R&D resources to the adjustment to Micro-USB charging. The Micro-USB specifications are available for manufacturers to use and are widely known in the consumer electronics sector. Based on the limited impacts from the MoU reported by mobile phone manufacturers (see Section 3), it can be expected that a significant diversion of R&D resources is unlikely.

Allowing the use of adaptors under Option 2 would enable manufacturers of devices to continue to develop products irrespective of their charging requirements and incorporate alternative charging solutions as necessary and desirable since the adaptor would enable the device to be charged with a harmonised charger. This may be particularly important for devices which are currently in declining markets such as digital cameras/camcorders and portable media players since it will allow new products to be put onto the market without the manufacturer incurring additional costs from adjusting production when demand is falling anyway. Without the ability to make an adaptor available, some manufacturers of such devices may simply choose not to make new models available in Europe, even though the costs associated with designing such products to incorporate Micro-USB charging requirements are considered to be relatively small.

Allowing adaptors would mean that other solutions, such as charging cradles and wireless chargers, would comply with Option 2. For example, some of the handsets in the 'easy-to-use'/senior citizen market segment rely on the use of a charging cradle. Some charging cradles appear to be fitted with a Micro-USB socket into which a Micro-USB charger is plugged and large pins onto which the phone is mounted. Under the variant of this option allowing adaptors, such handsets would thus likely comply with Option 2. Similarly, wireless charging pads that can be connected to a Micro-USB charger would be allowed and as such this sub-option is seen to be more effective in terms of stimulating innovation. Continued investment in R&D for the development of such alternative charging devices would be facilitated by allowing the use of adaptors.

A summary of the key impacts on research and development and innovation identified are presented in Table 5-20.

Table 5-20: Summary of main impacts on research and innovation			
Impact Area	**Option 0**	**Option 1**	**Option 2**
Innovation	0 R&D will continue with manufacturers seeking to develop both new charging technologies and new devices without restriction	- Restrictions on charging capabilities would place some restriction on the potential for developing new devices and/or functionality with resulting lowering of incentives to invest in R&D (although R&D would still be carried out for new devices that would be compatible). However, companies could opt out of any voluntary agreement or continue to develop products through R&D	-- No opt out possibility for manufacturers would likely result in greater reductions in R&D, with potentially less R&D on alternative charging technologies. Devices currently using Micro-USB (mobile phones, e-readers) would be impacted less, sectors with limited Micro-USB use would be impacted more (digital cameras, portable media players, sports and activity monitors, portable handheld games consoles, and personal care products). Manufacturers of products declining in demand (digital cameras, portable media players) may reduce R&D more.
Impact from allowing adaptors	0	0 Allowing adaptors would permit manufactures to continue to develop products with alternative charging solutions so would not reduce levels of innovation/R&D	0/- Allowing adaptors would permit manufactures to continue to develop products with alternative charging solutions so would not significantly reduce levels of innovation/R&D

Consumers

Please note that this section only deals with economic impacts on consumers, i.e. consumer choice and the price that consumers pay for portable rechargeable devices and chargers. Impacts on consumer convenience are assessed separately in the section dealing with Social Impacts.

<u>Option 0</u>

It is likely that device manufacturers would, in the near future, continue supplying devices with the current charging connectors and as such consumers would not experience any cost impacts. However, Option 0 would not encourage greater decoupling of devices from their chargers and consumers would continue to be sold a charger with most devices, in particular where these make

use of proprietary charging solutions and as a result, consumers would purchase more chargers than they need since already a number of devices can be charged with the same charger.

The expected shift towards higher power devices may necessitate the use of more expensive and higher power chargers. However, as indicated in Sections 3 and 4, the average selling price for a number of devices has been declining in recent years and this is likely to offset, at least to some extent, any potential cost increases from the need to use more powerful chargers. As an example, the Average Selling Price (ASP) of smartphones in Europe declined by over 20% between 2009 and 2013 in nominal terms and the European feature/basic phone ASP declined by 33% over the same period (again, in nominal terms). Sales of certain devices such as digital cameras and camcorders, e-readers, PNDs and portable media devices have all decreased in recent years due to the incorporation of their functions into smartphones and tablets and prices of the products have fallen accordingly. It is expected that this trend will continue with or without intervention in the market and the introduction of a common charging solution.

Options 1 and 2

Cost impacts for consumers resulting from compliance with a voluntary agreement or legislation requiring a Micro-USB connector for the devices considered are, in general, expected to be limited across devices, although consumers of some specific devices are likely to be affected slightly more than others.

For example, should the requirement to use Micro-USB connectors be extended to non-data enabled phones, a higher impact would likely be felt by users of feature/basic phones. The individual effect would still be limited however, since the cost of a charger currently accounts for very small proportion of the overall price of a handset (for more on this please see Section 3 of this report). Some manufacturers of mobile phones consulted during the study felt that incorporating a data connector into chargers for non-data enabled phones would confuse consumers. It was further stated that requiring this on chargers for feature phones would be a design constraint as the phone would then need to communicate with the charger, resulting in a more expensive phone as well as charger. Since price is a very significant part of the feature phone market, insisting on a charger with a data connector (such as Micro-USB) would be detrimental. The smaller connector used on proprietary chargers also makes a contribution to keeping costs down. Cost impacts for consumers purchasing non-data enabled phones are likely to be similar to those that occurred during the shift to Micro-USB following the adoption of the MoU. In this respect, it is of note that handset manufacturers responding to consultation for this study noted that MoU compliant chargers are more expensive than a non MoU charger due to additional filter components (due to tighter immunity and ripple specifications), etc. The price difference was estimated in Section 3 at €0.50 covering both the charger and the handset. Given that the same components will need to be incorporated for other devices in order to make them compliant with any standards stipulated in legislation or an MoU, it can be assumed that costs to consumers will be similar across the majority of devices (with the exception of perhaps personal care products and sports and activity monitors which often have specialised proprietary connectors).

However, as noted in Section 3.6.2 in relation to mobile phones, the cost impacts from the MoU per device were limited when compared with the cost of each phone sold. Between 2011 and 2013, the estimated difference between a handset with and without a Micro-USB charger (€0.50) represented 1.6% of the European feature/basic phone ASP. It is also of interest that information collected through consultation for this study suggests that the wholesale/production cost of a charger depends on the power delivered, with a 5V/2A charger being approximately 40-70% more expensive than a 5V/1A charger (although, when compared with handset ASPs, it is still relatively cheap at less than €2 or €3). Information provided by a manufacturer of chargers suggested that a common

charger suitable for multiple devices (using the USB PD standard) would be around 70-80% more expensive than current chargers, although this could drop to 50% in the future.

Across all devices considered in this section of the report, the overall costs to consumers of Options 1 and 2 in comparison with the baseline scenario Option 0 will be determined by the numbers of new devices which will be required to be made compatible with either a voluntary agreement or legislation. It is expected that under Option 1, a number of manufacturers will either not sign up to an agreement or will make some devices compliant but potentially not others which require higher power than might be permitted under the specifications agreed upon. Consequently, they would continue placing some devices on the market without incurring additional costs of incorporating Micro-USB sockets into devices and supplying Micro-USB chargers as they would have done under the baseline Option 0. Therefore, it is expected that Option 1 would generate lower costs for consumers as the increased design and production costs resulting from manufacturing devices with Micro-USB charging are expected to be passed on by manufacturers. It is difficult to project how many manufacturers would react to Option 1 by either not participating in an agreement at all or only partially, and consequently costs are estimated below for Option 2 which would require all manufacturers to comply.

In order to generate overall estimates of costs to consumers under Option 2, a model has been developed to estimate future sales and Micro-USB use and the costs involved in switching to Micro-USB across the product groups considered in this section of the report. In order to develop this model, a number of assumptions have been made as follows:

- estimates of the percentages of sales of devices with Micro-USB connectors have been made in Table 5-21. The estimates have been based on projections for sales in 2017;
- total sales in years after 2017 are constant;
- the replacement cycle of all devices is the same at two years and the equivalent of half of the percentage of models which would under Option 0 not have Micro-USB in 2017 have Micro-USB under Option 2 as devices are replaced with new models and all sales have Micro-USB in 2018;
- design and production costs incurred as a result of the shift to Micro-USB charging would be passed onto the consumer;
- overall costs are calculated on the basis of devices being equipped with a Micro-USB connector and not on using an adaptor;
- the additional cost of devices equipped with Micro-USB connectors which otherwise under the baseline would not have had Micro-USB connectors plus the additional cost of the Micro-USB charger over and above the cost of a non Micro-USB charger is estimated to be €0.50 for all devices (see Section 3), with the exception of sports/activity monitors which is estimated at €0.00[316]; and
- costs are discounted at 4% based on costs in 2013.

The approach adopted for making the calculations is set out in Box 5-1 which illustrates the calculation using digital cameras and camcorders as an example.

[316] Operating costs are unlikely to increase significantly as information provided by a manufacturer of sports and activity monitors suggests that the production costs associated with proprietary charging connectors and Micro-USB are broadly equivalent. The Micro-USB charging cable is cheaper than a cable with a proprietary connector but incorporating the Micro-USB charging port into a device is more expensive than would be the case with a proprietary solution.

Box 5-1: Methodology for calculating costs to consumers
Total estimated sales of digital cameras and camcorders in 2017 = 42,400,000 Share of digital cameras and camcorders estimated to have a Micro-USB connector at the start of 2017 = 10% Total digital cameras and camcorders having a Micro-USB connector at the start of 2017 = 42,400,000 x 10% (= 4,240,000) Total digital cameras and camcorders which will have a Micro-USB connector in 2017 = share of digital cameras estimated to have a Micro-USB connector in 2017 (10%) + 50% of the share of digital cameras estimated to **not** have a Micro-USB connector in 2017 (90%*0.5=45%) = 55% Total sales of digital cameras and camcorders in 2017 with Micro-USB connectors would therefore be 42,400,000 x 55% = 23,313,000 It is assumed that proportion of sales of digital cameras and camcorders with Micro-USB connectors would remain the same as at the start of 2017 (i.e. 4,240,000). Therefore, the difference in sales of devices with Micro-USB between the baseline scenario and Option 2 in 2017 would be 23,313,000 – 4,240,000 = 19,075,000 The additional cost of making a device and its charger compliant is estimated to be €0.50 so the cost of making an additional 19,075,000 devices compliant under Option 2 and discounted at 4% over the period to 2021 would be 19,075,000 x €0.4247 = €8,101,000 It is assumed that all of these costs will be passed on to consumers by the manufacturers of digital cameras and camcorders.

The key caveats for this model include the fact that this model does not take into account the potential for another non-proprietary connector (such as USB Type C) or wireless charging to replace Micro-USB, the fact that the Apple Lightning connector is treated as any other proprietary connector with regard to its cost (but this may not be the case in reality), and the fact that the extent of a potential exemption for waterproof/wearable devices is not known and as such has not been taken into account in the model. In addition, it should be noted that forecasting developments in these highly innovative and dynamic sectors over a seven year period is highly uncertain, especially considering that novel charging solutions such as USB Type-C and wireless charging may gain increasing popularity in the future. Despite these caveats, the model provides a good indication of the order ot magnitude of the potential costs and benefits for consumers from harmonisation on the basis of Micro-USB connectors, and of the factors affecting these costs and benefits.

Table 5-21 presents the proportion of sales for each device which are expected to be equipped with Micro-USB connectors in 2017,2018 and 2019 and these have been utilised in Table 5-22 along with estimates of overall sales of devices in 2017 to predict the sales of new models that will be equipped with Micro-USB connectors over and above what would have been the case under the baseline scenario in 2018 and beyond. Costs to consumers are then estimated based on a cost of €0.50 per device (€0 for sports/activity monitors) for changes on bothe the device and charger side. Baseline sales figures for the devices have been gathered by desk research and where sale forecasts were not available, historic sales figures and trends have been used, in some cases using judgement of the study team (based on information provided in, for example, Section 5.4.2). Where only worldwide figures are available, these have been apportioned to give sales in Europe based on expert judgement and market analysis data (as a general rule, i.e. unless there are indictations suggesting a higher or lower market share, the European share in global sales has been estimated to be 30%).

Table 5-21: Percentages of sales estimated to have Micro-USB connectors				
Product group	Baseline		2017	2018 onwards
	Micro-USB	Non-Micro USB		
Mobile Phones	79%	21%	90%	100%
E-readers	96%	4%	98%	100%
Digital Cameras	10%	90%	55%	100%
Portable Media Players	10%	90%	55%	100%
Sports/Activity Monitors	5%	95%	53%	100%
PNDs	27%	73%	64%	100%
Handheld Games Consoles	5%	95%	53%	100%
Personal Care Products	5%	95%	53%	100%

The additional costs to consumers identified in Table 5-22 are based on the assumption that there is no decoupling of chargers (and charging cables) from devices. In the event that chargers and cables were decoupled from devices, the cost to manufacturers (and therefore to consumers assuming any costs are passed on) would actually be slightly less in terms of making devices compliant since only adjustments would be required on the device side. Table 5-23 (which follows after Table 5-22) shows the comparable costs to consumers resulting from price rises incurred due to the need to adjust the connector on the device as well as the charger/cable under three scenarios – 0%, 2% and 50% decoupling. The calculations cater for the fact that some devices are primarily supplied with only a cable (e-readers, PNDs, Personal Media Players and Sports Devices) and a cost of €0.25 per device has been assumed for these (as no adjustment would be made on the cable/charger side when the device is sold wihout a charger or cable). For devices supplied with a cable and charger, a cost of €0.50 is assumed.

Box 5-2 below explains how these calculations have been made.

Box 5-2: Calculations of costs to consumers catering for cost savings arising from decoupling

Cost to consumers as a result of changes made to digital cameras/camcorders in 2017 = 8,101,000

Cost savings from decoupled devices only incurring costs on the device side = (8,101,000) minus (percentage of devices that are decoupled x number of devices that need to be made compliant) x (cost of making device complaint on the device side only discounted at 4%)

Hence, the cost to consumers would be:

8,101,000 – (2% x 19,075,000) x €0.42467/2 = €8,019,000 under the 2% decoupling scenario.

8,101,000 – (50% x 19,075,000) x €0.42467/2 = €6,075,000 under the 50% decoupling scenario.

Table 5-22: Estimate sales of devices with Micro-USB connectors, volumes that will be made compliant over the baseline and costs to consumers								
		Baseline	2017	2018	2019	2020	2021	Total
Mobile Phones	Sales Micro-USB/'000s	168,270	190,635	213,000	213,000	213,000	213,000,000	1,042,635
	Additional sales to be compliant/'000s		22,365	44,730	44,730	44,730	44,730	201,285
	Extra consumer cost/€'000s		9,498	18,236	17,506	16,806	16,134	78,180
E-readers	Sales Micro-USB/'000s	1,806	1,843	1,881	1,881	1,881	1881	9,367
	Additional sales to be compliant/'000s		38	75	75	75	75	339
	Extra consumer cost/€'000s		16	31	29	28	27	131
Digital Cameras	Sales Micro-USB/'000s	4,240	23,313	42,388	42,388	42,388	42,388	192,866
	Additional sales to be compliant/'000s		19,075	38,149	38,149	38,149	38,149	171,672
	Extra consumer cost/€'000s		8,101	15,553	14,931	14,332	13,760	66,678
Portable Media Players	Sales Micro-USB/'000s	1,740	9,570	17,400	17,400	17,400	17,400	79,170
	Additional sales to be compliant/'000s		7,830	15,660	15,660	15,660	15,660	70,470
	Extra consumer cost/€'000s		3,325	6,384	6,129	5,884	5,648	27,371
Sports/ Activity Monitors	Sales Micro-USB/'000s	1,124	11,801	22,478	22,478	22,478	22,478	101,714
	Additional sales to be compliant/'000s		10,677	21,354	21,354	21,354	21,354	96,094
	Extra consumer cost/€'000s		0	0	0	0	0	0
PNDs	Sales Micro-USB/'000s	26	62	97	97	97	97	451
	Additional sales to be compliant/'000s		36	71	71	71	71	320
	Extra consumer cost/€'000s		15	29	28	27	26	124
Handheld Games Consoles	Sales Micro-USB/'000s	247	2,595	4,943	4,943	4,943	4,943	22,368
	Additional sales to be compliant/'000s		2,348	4,696	4,696	4,696	4,696	21,132
	Extra consumer cost/€'000s		997	1,914	1,838	1,764	1,694	8,208
Personal Care Products	Sales Micro-USB/'000s	600	6,300	12,000	12,000	12,000	12,000	54,300
	Additional sales to be compliant/'000s		5,700	11,400	11,400	11,400	11,400	51,300
	Extra consumer cost/€'000s		2,421	4,648	4,462	4,283	4,112	19,925

Table 5-23: Costs to consumers resulting from making devices compliant under different decoupling scenarios (€)							
Decoupling rate	**Device**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
0%	Mobile phones	9,498,000	18,236,000	17,506,000	16,806,000	16,134,000	78,180,000
	E-readers	16,000	31,000	29,000	28,000	27,000	131,000
	Digital cameras	8,101,000	15,553,000	14,931,000	14,332,000	13,760,000	66,678,000
	Portable media	3,325,000	6,384,000	6,129,000	5,884,000	5,648,000	27,371,000
	Sports monitors	0	0	0	0	0	0
	PNDs	15,000	29,000	28,000	27,000	26,000	124,000
	Games consoles	997,000	1,914,000	1,838,000	1,764,000	1,694,000	8,208,000
	Personal care	2,421,000	4,648,000	4,462,000	4,283,000	4,112,000	19,925,000
2%	Mobile phones	9,401,000	18,053,000	17,331,000	16,638,000	15,973,000	77,398,000
	E-readers	16,000	30,000	29,000	28,000	27,000	130,000
	Digital cameras	8,019,000	15,397,000	14,782,000	14,190,000	13,623,000	66,011,000
	Portable media	3,292,000	6,321,000	6,068,000	5,825,000	5,592,000	27,097,000
	Sports monitors	54,761	105,310	101,259	97,365	93,620	452,315
	PNDs	15,000	29,000	28,000	26,000	25,000	123,000
	Games consoles	987,000	1,895,000	1,820,000	1,747,000	1,677,000	8,126,000
	Personal care	2,396,000	4,601,000	4,417,000	4,240,000	4,071,000	19,726,000
50%	Mobile phones	7,123,000	13,677,000	13,130,000	12,605,000	12,100,000	58,635,000
	E-readers	12,000	23,000	22,000	21,000	20,000	99,000
	Digital cameras	6,075,000	11,665,000	11,198,000	10,750,000	10,320,000	50,009,000
	Portable media	2,494,000	4,788,000	4,597,000	4,413,000	4,236,000	20,528,000
	Sports monitors	1,369,000	2,633,000	2,531,000	2,434,000	2,341,000	11,308,000
	PNDs	11,000	22,000	21,000	20,000	19,000	93,000
	Games consoles	748,000	1,436,000	1,378,000	1,323,000	1,270,000	6,156,000
	Personal care	1,815	3,486	3,346	3,212	3,084	14,944
Note: Costs in € are discounted at 4% based on 2013 prices.							

The figures in Table 5-23 above show that in the event of a 2% decoupling of chargers/cables from devices, there would be an approximate saving to consumers of 1% of the cost passed on to them from manufacturers having to make adjustments on devices and their chargers/cables. Similarly, if there were to be a 50% decoupling, average savings would be in the region of 25% of these costs. This suggests that on the cost side, significant decoupling would need to take place in order reduce

the costs to consumers resulting from manufacturers having to make adjustments to devices/chargers.

However, this does not take into consideration savings that consumers would make from not paying the cost of a charger/cable when purchasing a device that is sold without a charger. Table 5-24 sets out these savings for consumers that would be made under each device category if chargers were decoupled from their devices at rates of 2% and 50%. Information received through consultation with manufacturers of mobile phones and chargers suggests that the average price of a charger for small devices requiring similar power outputs to mobile phones and when supplied with a device is approximately €1.25. In the absence of additional information from manufacturers of other devices, this figure has been applied across all the devices included in Table 5-24. In addition, since some devices are currently predominantly supplied only with a cable, it has been assumed that the cost of supplying a cable with a device is €0.625. The methodology for the calculations is described in Box 5-3 below.

Box 5-3: Calculations of savings to consumers arising from not having to pay for a charger/cable under different decoupling scenarios

Volume of sales of harmonised digital cameras/camcorders in 2017 = 23,313,000

Cost of a charger/cable in 2013 is assumed to be €1.25 (note that for devices predominantly supplied with a cable only, the figure used is €0.625)

Savings made from decoupling in 2017 = (sales of harmonised devices x percentage of devices that are decoupled x cost of charger/cable discounted at 4%).

Hence, savings to consumers from not having to pay for a charger for digital cameras/camcorders in 2017 are:

23,313,000 x 2% x €1.0685 = €498,000 under the 2% decoupling scenario.

23,313,000 x 50% x €1.0685 = €12,455,000 under the 50% decoupling scenario.

Table 5-24: Consumer savings resulting from decoupling of chargers from devices (€)

Rate	Device	2017	2018	2019	2020	2021	Total
2%	Mobile phones	4,074,000	4,377,000	4,208,000	4,047,000	3,891,000	20,597,000
	E-readers	20,000	19,000	19,000	18,000	17,000	93,000
	Digital cameras	498,000	871,000	837,000	805,000	774,000	3,786,000
	Portable media	102,000	179,000	172,000	165,000	159,000	777,000
	Sports monitors	126,000	231,000	222,000	214,000	205,000	998,000
	PNDs	660	1,000	1,000	1,000	1,000	4,000
	Games consoles	55,000	102,000	98,000	94,000	90,000	439,000
	Personal care	135,000	247,000	237,000	228,000	219,000	1,065,000
50%	Mobile phones	101,847,000	109,419,000	105,211,000	101,164,000	97,273,000	514,914,000
	E-readers	492,000	483,000	465,000	447,000	429,000	2,316,000
	Digital cameras	12,455,000	21,775,000	20,937,000	20,132,000	19,358,000	94,658,000
	Portable media	2,556,000	4,469,000	4,297,000	4,132,000	3,973,000	19,428,000
	Sports monitors	3,152,000	5,774,000	5,552,000	5,338,000	5,133,000	24,948,000
	PNDs	17,000	25,000	24,000	23,000	22,000	111,000
	Games consoles	1,386,000	2,539,000	2,442,000	2,348,000	2,257,000	10,973,000
	Personal care	3,366,000	6,164,000	5,927,000	5,699,000	5,480,000	26,637,000

Note: Costs in € are discounted at 4% based on 2013 prices.

These savings are likely to be overestimated for a number of reasons. Firstly, the cost of a charger and cable has been assumed to be €1.25 which is based on the cost of production and this has been assumed to be passed on to the consumer as a reduced price in the event that a charger is not sold with a device. However, in the event of decoupling of chargers and devices, consumers will still need to own a certain minimum number of chargers in order to charge multiple devices and if their portfolio of devices have all been purchased without chargers, they will need to purchase chargers at retail prices (i.e. higher than the €1.25 saving they have made from not being supplied with a charger by the device manufacturer).

Secondly, the different decoupling rates have been assumed to "kick-in" in full in 2017. In the case of the 50% decoupling rate, this is unlikely, particularly in light of the very low decoupling rates that have been observed for mobile phones over the life of the current MoU when there have been significant increases in levels of harmonisation of charging solutions. It is more likely that decoupling rates would increase gradually, leading to lower savings on an annual basis and overall.

However, when comparing Table 5-24 with the previous Table 5-23, it is clear that the savings to be made under the different decoupling scenarios clearly outweigh the costs for all devices (with the exception of portable media devices) in the 50% decoupling scenario, whereas the opposite is true in the 2% scenario (with the exception of sports activity monitors). This implies that the extent of of decoupling is an important factor in whether or not the savings to consumers will outweigh the costs incurred in making devices compliant with any standard. The costs and savings calculated based on decoupling rates of 2% and 50% along with the decoupling rate required for breakeven between costs and savings has been calculated for each of the devices considered in Table 5-25.

Table 5-25: Total costs and savings to consumers (€) and breakeven decoupling rates

Device		2% decoupling	50% decoupling	Breakeven decoupling rate
Mobile phones	Costs	77,398,000	58,635,000	7%
	Savings	20,597,000	514,914,000	
	Difference	-56,801,000	456,279,000	
E-readers	Costs	130,000	99,000	3%
	Savings	93,000	2,316,000	
	Difference	-37,000	2,217,000	
Digital cameras	Costs	66,011,000	50,009,000	30%
	Savings	3,786,000	94,658,000	
	Difference	-62,225,000	44,649,000	
Portable media	Costs	27,097,000	20,528,000	52%
	Savings	777,000	19,428,000	
	Difference	-26,320,000	-1,100,000	
Sports monitors	Costs	452,000	11,308,000	0%
	Savings	998,000	24,948,000	
	Difference	546,000	13,640,000	
PNDs	Costs	123,000	93,000	44%
	Savings	4,000	111,000	
	Difference	-119,000	18,000	
Games consoles	Costs	8,126,000	6,156,000	32%
	Savings	439,000	10,973,000	
	Difference	-7,687,000	4,817,000	
Personal care	Costs	19,726,000	14,944,000	32%
	Savings	1,065,000	26,637,000	
	Difference	-18,661,000	11,693,000	

Table 5-25 suggests that for devices such as mobile phones and e-readers, lower rates of decoupling are required in order for consumers to benefit overall than for the other devices (portable media devices, PNDs, games consoles, personal care products and digital cameras) which require decoupling rates of 30% and above. It is noted that these rates are far in excess of decoupling rates seen to date for mobile phones under the MoU between manufacturers signed in 2009.

It is noted that mobile phones and e-readers already exhibit a high degree of compliance with the Micro-USB charging solution, and therefore costs associated with making new models similarly compliant will inevitably be relatively small as they relate to a relatively small number of devices. The other devices exhibit a much smaller usage of Micro-USB charging solutions and therefore the switch to Micro-USB would need to cover a greater volume of devices which obviously incurs greater costs. This leads to the conclusion that a greater degree of harmonisation of charging solution within a device category would require a lower level of decoupling in order for the savings made by consumers to outweigh the costs.

Use of Adaptors

Option 1 and Option 2 may both be implemented either allowing or not allowing the use of adaptors. Where adaptors are permitted, consumers will incur the additional cost of purchasing an appropriate adaptor if they have a device which does not have a Micro-USB socket on the device and they wish to charge it with a Micro-USB charger. The main example of an adaptor currently in circulation is that made available under the MoU for mobile phones by Apple for its iPhones. Adaptors are available which are compatible with the Apple 30-pin connector as well as the newer Lightning connector and they are also compatible with iPads and iPods. The cost to consumers appears relatively high, given that the Apple Store UK retails the Micro-USB/Lightning adaptor at €18 and the Micro-USB/30-pin adaptor for €9[317]. It is noted, however, that third party versions are available at significantly lower prices.

The overall cost to consumers in the EU from purchasing adaptors cannot be calculated in the absence of information regarding the uptake of adaptors. Consultation does however suggest that when the sales of adaptors are compared with the sales of iPhones, the uptake seems extremely low, and obviously even lower when compared with the sales of iPhones, iPads and iPods together. Therefore, under the 'adaptors allowed' suboption of Options 1 and 2. costs would be lower than under the 'no adaptors' suboption but they would still be higher than under Option 0.

A summary of the key economic impacts on consumers identified are presented in Table 5-26. The key issue as regards summarising the cost impacts on consumers is that they hinge on the extent to which decoupling would occur. The cost impacts for consumers associated with the provision of more expensive Micro-USB chargers have been estimated at just over €200 million between 2017 and 2021 in the event of 0% decoupling of chargers from their device and around €170 million if 2% decoupling occurs. In the event of 50% decoupling, consumers would accrue net benefits of around €530 million over 2017-2021 (which can be annualised at around €100 million per year).

[317] See http://store.apple.com/uk/product/MD820ZM/A/lightning-to-micro-usb-adaptor and http://store.apple.com/uk/product/MD099ZM/A/apple-iphone-micro-usb-adaptor

Table 5-26: Summary of Main Economic Impacts on Consumers			
Impact Area	**Option 0**	**Option 1**	**Option 2**
Costs to consumers	0 No additional costs of connectors for consumers, but decoupling of devices from their chargers would not be encouraged beyond the current trend, resulting in consumers paying for more chargers than under Scenarios 1 and 2	+/- As for Option 2 but lesser magnitude.	++/-- There would be costs or benefits, depending on the rate of decoupling. These range from €200 million costs for 0% decoupling to €530 million for 50% decoupling (both over 2017-2021). For devices such as mobile phones and e-readers, lower rates of decoupling (7% and 3%) are required for consumers to benefit overall than for portable media devices, PNDs, games consoles, personal care products and digital cameras, which require decoupling rates of 30% and above for consumers to break even.
Impact from allowing adaptors	0	As above but lesser in magnitude.	As above but lesser in magnitude.

Competition

Option 0

Option 0 is expected to have a positive impact on consumer choice and competition by establishing an environment where new solutions and connectors can be freely used. Options 1 and 2, on the other hand, may restrict competition in the sense that the uptake of novel charging solutions may be slower or may be delayed. However, they are also likely to enhance competition among charger manufacturers in the sense of enlarging the market for the common solution.

By way of a summary, there are large differences between the number of manufacturers and models in each of the product sectors considered in this report. In some sectors, the market is dominated by a handful of manufacturers; this include the market for **PNDs, portable handheld games consoles, digital cameras and portable media players, personal care products** and **sports and activity monitors**. A number of manufacturers currently exist within the **e-reader** and **mobile phone** markets.

At the global level, there is a number of companies producing wired chargers and as such this sector can be characterised by a high degree of competition.

Option 1

The existence of a feasible technical option is clearly an important factor determining the extent and success of any agreement. In some market sectors, such as **PNDs and digital cameras,** a voluntary agreement is unlikely to hinder or disrupt competition amongst the established players as the standard could readily be adopted by new entrants to the market. Evidence for this may be found in the **e-reader** market which is highly competitive with a number of companies offering devices that can be charged via Micro-USB. Despite the fact that Micro-USB is only used for a minority of **sports devices and activity monitors,** if introduced it would not hinder competition within the EU. Any agreement whould however require the participation of at least the two main manufacturers. Although a voluntary agreement for the **portable games consoles** and **portable media market** appears less likely than in some of the other sectors (although the 'adaptors allowed' variant appears to be feasible for portable media players as it basically amounts to Option 0), such an agreement would not impact competition. Within the **personal care products** sector, it is presumed that a voluntary agreement will only be successful if the two leading companies agreed to use Micro-USB. It is possible that Phillips may have a small advantage as they produce some products that currently use Micro-USB; however, this is a very small proportion of their product range. Overall, it is not anticipated that consumer choice would be significantly reduced, simply because companies not able/willing to comply with the voluntary agreement would be able to continue selling their products in the EU.

It is possible that some manufacturers within the respective sectors would not sign up to the voluntary agreement. These manufacturers may gain a competitive advantage if they were to develop significantly differentiated charging solutions and were able to integrate them in products that were subsequently more competitive than others. Ensuring that the technical option is appropriate and the agreement is reviewed on a regular basis would help to ensure that competition is not negatively impacted. This option is also likely to enhance competition in the sense of enlarging the market for the common solution and thus increasing the number of charger manufacturers competing in this market.

Again, across sectors, the use of an adaptor would enable manufacturers to continue to develop their own charging solutions and may be beneficial to competition as it could reduce any negative effects that might arise from some manufacturers not complying with a voluntary agreement and the advantages they might gain as a result. Consequently, it might be expected that this would increase the proportion of manufacturers signing any agreement.

Option 2

In general terms, legislation to harmonise the method of charging for devices is unlikely to hinder competition and prohibit new entrants onto the market for a number of reasons. These include the fact that charging via Micro-USB is technically feasible, standards are widely available, there are no significant design costs and parts and components are easily sourced. Therefore, it is unlikely that this option will negatively impact competition. In spite of this, it would be advisable to review the legislation regularly to ensure that it remains relevant and applicable and that it is not damaging the level of competition among manufacturers of electronic devices. Any potential negative impacts of legislation (which are expected to be limited in any event) could be further reduced by permitting the provision of adaptors by manufacturers.

As regards manufacturers of chargers, Option 2 (like Option 1) is likely to enhance competition by enlarging the market for Micro-USB chargers and thus increasing the number of charger manufacturers competing in this market segment.

Table 5-27: Summary of Main Impacts on Competition			
Impact	**Option 0**	**Option 1**	**Option 2**
Competition (manufacturers of electronic devices)	0	0/- Limited impacts expected Limited impacts expected, especially if adaptors allowed	0/- Limited impacts expected, especially if adaptors allowed
Competition (charger manufacturers)	0	+ Expected to increase competition in the Micro-USB charger segment	++ Expected to increase competition in the Micro-USB charger segment

Competitiveness, trade and investment flows

Option 0

The markets for the portable rechargeable devices included in this study exist on a global scale, with Europe accounting for a relatively significant proportion of the market in most cases. The leading manufacturers are international and most have production facilities located in Asia. There is strong competition within the markets and limited barriers to trade, as evidenced by the number of manufacturers within the sectors and the fact that new manufactures continue to enter the markets. Under the baseline scenario this situation would not be expected to change.

Option 1

In the presence of the MoU on data-enabled mobile phones, sales of smartphones have increased by a significant margin and Europe continues to account for a large proportion of these sales. During this period, the bulk of handset and charger production has remained located outside of the EU. Even though production in Europe has decreased in the past decade or so, this cannot in any way be attributed to requirements on mobile phone charging. Therefore, it can be concluded that in the mobile phone sector, the MoU has had limited impacts in relation to competitiveness, trade and investment flows. It is expected that this will also be the case for the other devices.

As the agreement is entirely voluntary, those manufacturers which have not signed the agreement would not be prohibited from selling their products in Europe, therefore there will be no barriers to trade between the EU and third countries. The voluntary nature of Option 1 means that global competitiveness of EU companies will not be negatively impacted, as they can choose to not be part of the agreement.

Option 2

The legal requirement for new models of portable rechargeable devices released onto the EU market from 2017 onwards to use a Micro-USB connector for charging could potentially cause some manufacturers to discontinue sales in the EU, particularly those whose sales are predominantly outside of the EU; however, the extent of this is expected to be limited. The cost of compliance may make it unprofitable to market devices in the EU, which could be the case for those devices which are experiencing falling sales, such as **e-readers, portable media players and PNDs**. Although, as the associated costs with the Micro-USB charging solution are not significant, as discussed previously, this is not likely to occur on a significant scale.

There is also a concern among global manufacturers that any new requirements for a common charger for the EU market could result in fragmentation of the product portfolio, which is both costly and less efficient. This is likely to be most harmful to European companies who sell a significant

proportion of their products in Europe. The splitting of production lines is most likely to occur under the 'no adaptors' allowed variant of Option 2. For this reason, it is important that the technical requirements do not conflict with requirements in other countries. Thorough consultation, testing and the use of international standards would avoid creating barriers to trade. In this regard, it is important that the Micro-USB technology is already well established within many of the device sectors and the parts and specifications are widely available and used throughout the world.

Manufacturing is not expected to shift from Asia; therefore there will be no impacts on investment flows.

Permitting the use of adaptors would allow manufacturers to continue with their manufacturing and design to suit all markets whilst still meeting the legal requirements of the EU market.

Impacts on competitiveness, trade and investment flows are summarised in Table 5-28.

Table 5-28: Summary of Main Impacts on Competitiveness, Trade and Investment flows

Impact	Option 0	Option 1	Option 2
Competitiveness of EU companies	0	0	0/- Potential portfolio fragmentation for European companies if technical option not the same as that demanded in non-EU countries (e.g. in the sports and activity monitors sector) but sectors using Micro-USB globally (e.g. e-readers) would not be affected
Trade barriers	0	0	0/- Possibly a barrier to non-EU companies in product groups falling sales, such as e-readers, portable media players and PNDs but not expected to be significant
Investment flows	0	0	0

Public authorities

Option 0

Public authorities are currently required to carry out surveillance activities in order to ensure compliance with various legislation and safety requirements. Under the baseline scenario, these responsibilities will not change but would need to respond to new charging solutions as they are developed.

Option 1

It is possible that the work pattern of market surveillance authorities could alter under Option 1. For example, if chargers were decoupled from new devices, the sales of standalone chargers could increase, leading to a greater workload, particularly if the chargers came from multiple smaller companies.

If manufacturers were permitted to use adaptors, then this would be an additional product which requires inspection by authorities in order to ensure safety and compliance. Consultation with mobile phone manufacturers has suggested that the use of a common charger could lead to an increase in unsafe chargers. The increased incidence of non-compliant chargers has the potential to create an additional burden for authorities and is more likely if chargers are decoupled from new devices. This issue is also considered in the Health and Safety subsection of Section 5.4.5. At this stage, it is not possible to ascertain the precise extent of any alterations to the workload of market surveillance authorities.

The extent of these impacts will depend on the degree to which sales of chargers and new devices will be decoupled, with higher rates of decoupling increasing the demand for standalone chargers. These impacts are likely to be lesser for devices experiencing decreasing sales (e-readers, portable media players, PNDs, digital cameras) and those that do not require frequent charging (e-readers).

Option 2

A legislative requirement for a common charger in portable electronic devices could change the workload of market surveillance authorities if the sales of standalone chargers increased as a result of chargers being decoupled from new devices. As previously mentioned, for those devices which are experiencing falling sales and require infrequent charging, the impacts are likely to be lesser than for those devices for which a significant number of standalone chargers would be purchased. Again, the increased incidence of unsafe chargers could increase with the legislative requirement for a common charger but this will depend on the extent of decoupling that will occur, and the resulting increase in the sales of standalone chargers.

At the European level, the European Commission will have to ensure the legislation has been implemented adequately in Member States. Individual Member States will also have to implement the legislation and monitor the market to ensure that all products placed on the markets comply with the new legislation. Such requirements are routine and are not expected to bring about a significant additional burden for authorities.

The extent of impacts on public authorities is summarised in Table 5-29.

Table 5-29: Summary of Main Impacts on Public Authorities

Impact	Option 0	Option 1	Option 2
Additional administrative burden	0	- Shift in workload of market surveillance authorities as a result of increased sale of standalone chargers	-- Shift in workload of market surveillance authorities as a result of increased sales of standalone chargers. Lesser impacts for devices experiencing decreasing sales (e-readers, portable media players, PNDs, digital cameras) and those that do not require frequent charging (e-readers).
Budgetary consequences	0	0	0

Third countries and international relations

Option 0

The markets for the portable rechargeable devices covered by this study exist on a global scale, with the vast majority of manufacturing taking place outside the EU, primarily in Asia. As such, trade and investment flows occur between the EU and third countries. Given that manufactures are able to choose the charging method of devices, including proprietary solutions, there are no concerns with regard to international standards, etc.

Option 1

A voluntary agreement would in effect extend the MoU for data-enabled phones; therefore the impacts on the **mobile phone** market would be limited (unless it were to be extended to non-data enabled phones). However, consultation with a handset manufacturer expressed concerns that if EU legislation were to apply to non-data enabled phones may inadvertently make CE marking of devices without Micro-USB connectors impossible even where these are intended for sale outside the EU (information provided by a handset manufacturer indicates that in some markets outside the EU, for example in some Asian countries, network operators request non-Micro-USB connectors but also request that handsets are CE marked; it is reportedly also common that these devices conform to the requirements set by the US Federal Communications Commission, FCC). Considering the point above, it is worth noting that the EU is often seen as the frontrunner and compliance with European requirements may be requested in other countries.

Any impacts would be minimised by the use of international standards, for example, the International Telecommunication Union's Recommendation ITU-T L.1000 which is suitable for **mobile phones, portable media devices, cameras and PNDs**.

Option 2

As above for Option 1, the impacts of Option 2 are likely to be limited. These impacts could be further minimised by reliance on international standards, such as the above-mentioned ITU Recommendation ITU-T L.1000 which is suitable for **mobile phones, portable media devices, cameras and PNDs**.

Table 5-29: Summary of Main Impacts on Third countries and International Relations

Impact	Option 0	Option 1	Option 2
Third countries	0	0	0
International relations	0	0	0

5.4.5 Social Impacts

Consumer convenience

Option 0

Under the baseline scenario, future development of charging solutions and interfaces would be unrestricted and manufacturers would be expected to select the commercial and technical solutions they felt were most appropriate for their devices.

In the absence of any requirement for manufacturers of the devices being considered within this group to meet specific charging specifications, the potential is that different devices will have different charging solutions in the future, restricting interoperability across models of a single

device-type made by different manufacturers as well as across different devices. For the vast majority of devices, consumers would be provided with a charger/charging cable at the point of sale. Indeed, extrapolating the current decoupling trend in the mobile phone sector, suggests that, although it is increasing, in 2017, 98% of devices will still be sold with chargers.

From a consumer's perspective, this represents an inconvenience since, in the most extreme case, they would require a different charger for each device, leading both to clutter around the house as well as inconvenience when they travel as they would be required to carry multiple chargers with them. In the event that a consumer mistakenly travels without their charger for a specific device, they would then have to rely on there being one available, with this being less likely than if chargers were standardised across device groups and devices.

Earlier research has indicated that both the sales and stocks of a number of devices with Micro-USB being considered in this group have been increasing in recent years. Table 5-30 provides the modelled percentages of different devices with Micro-USB. For devices such as mobile phones and e-readers with very high levels of devices using Micro-USB, consumer convenience is likely to be high in respect of interoperability with other models within the same product group and also between product groups, such as between e-readers and mobile phones. A lower level of interoperability will exist for PNDs, although stocks with Micro-USB charging have still increased since 2009.

Table 5-30: Stocks of Devices with Micro-USB charging capability

	2009	2010	2011	2012	2013
E-reader	60%	73%	84%	88%	91%
PND	0%	10%	22%	31%	31%
Mobile phones (all)	-		57%	73%	87%

As time goes on, in the absence of any restrictions on charging technology (both voluntary and legislative), there may be some drift away from the convergence on the Micro-USB charging solution in the medium to long term and this would represent a decline in consumer convenience, as fewer devices would be compatible with chargers of other devices. Section 4 concludes that whilst it is difficult to attribute the convergence of other devices on the Micro-USB charging solution to the MoU for mobile phones, the convergence has indeed happened across a number of other devices over a similar period. In this sense, the absence of any MoU for mobile phones (or other devices, and an absence of any legislative measures in its place) could result in a reduction of consumer convenience across a number of devices.

As regards the other devices (e.g. **portable media players, sports and activity monitors and personal care products**), where there has been no significant move towards adopting Micro-USB charging solutions to date, it is not expected that there will be any significant changes to the charging of devices under this baseline scenario in terms of the adoption of a single standard.

Option 1

Given the diverse landscape of manufacturers across the range of devices being considered (see Sections 3 and 4 for overviews of European and global device manufacturers), it is highly unlikely that Option 1 would succeed in ensuring the participation of all companies that sell own brand devices on the European market. Some devices, such as certain personal care products and sports activity devices, are considered to be less suitable for Micro-USB charging solutions due to the nature of their usage, e.g. watches for use whilst swimming. The functionality or even safety of such devices may be compromised as a result of using a Micro-USB charging solution and as a result, it

may well be the case that manufacturers of these devices would not agree to sign up to a voluntary agreement.

However, the high level of compliance with the MoU/LoI for mobile phones among non-signatory companies suggests that voluntary agreements can be highly effective even when they are not signed by all relevant companies, provided the largest market players are involved. The fact that a relatively small number of manufacturers have a large market share in a number of the device markets grouped together (e.g. in the e-reader market, Amazon's Kindle represents approximately 50% - 60% of the market) would assist in ensuring that a high percentage of devices would likely be covered under any agreement.

As mentioned previously, a number of devices have shown a trend in recent years towards the Micro-USB charging solution (e.g. mobile phones, e-readers, personal navigation devices and to a degree, portable handheld consoles). With the ability to use the same charger across multiple devices, consumers would be able to use a single charger with more than one device, thereby reducing the need to travel with multiple chargers and increasing their ability to use friends' or colleagues' chargers if they inadvertently leave theirs behind. The fact that multiple devices would be able to use the same charger also increases the probability that a consumer would be able to find a compatible charger wherever they travel. However, it is important to note that although different types of device would use a Micro-USB charger, it does not necessarily mean there would be complete interchangeability between chargers and devices, see the Technical Issues section (5.4.3) for further details.

Of course, enabling consumers to charge different devices using a single charger may undermine consumer convenience in other ways. For example, should Option 1 lead to manufacturers of sports devices switching to Micro-USB on sports devices that are usually worn on the wrist and currently use proprietary clips for charging, the device may not be as small or as robust. Clearly, manufacturers of sports devices would may need to carefully conisder how much they value these aspects of consumer convenience before deciding to adopt a common charging standard.

Future sales of particular devices will have a bearing on the extent of any improvements in consumer convenience under this option, since they will influence the number of chargers that consumers have that can be used across different devices. For example, the sales of e-readers and to an extent, digital cameras/camcorders and portable media devices, appear to be in decline with their functions being taken up in multi-function devices such as mobile phones or tablets. For consumers which had previously bought separate products but are now purchasing such multi-function devices, the issue of having compatible chargers will have declined, and if the trend continues, will continue to decline in importance in the future, thereby limiting any improvements in consumer convenience that would result under the Option. The fact that sales for such devices are declining would also likely influence whether or not manufacturers not currently equipping devices with Micro-USB decide to sign-up for any voluntary agreement in the first place. The cost of designing products with a different charging solutions and changing supply chains might be deemed unprofitable in the face of falling sales and any decision not to participate in a voluntary agreement would reduce the number of devices that would be compatible with a harmonised charger, thereby reducing consumer convenience.

Similarly, consumer needs in terms of the frequency of charging will also have a bearing on the extent of any improvements in consumer convenience that might result from including different devices under any voluntary agreement. Devices such as e-readers and some personal care products require infrequent charging and consumers can use these devices for long periods after charging at home. The importance for consumers of having constant access to a charger is thus less for these devices and increasing access through the harmonisation of chargers would not necessarily provide

consumers with greater utility as it would with devices which are in constant use and require daily charging such as mobile phones.

The extent to which consumer convenience is likely to increase under Option 1 will also depend on the number of device groups that will be covered by a voluntary agreement. For some of the devices listed in Table 5-30, the EU stock modelled already shows a high percentage of devices with Micro-USB charging solutions. For devices such as mobile phones, e-readers and PNDs, Option 1 would thus likely lead to only a limited increase. For other devices which have not been part of any voluntary agreement and which exhibit a lower prevalence of Micro-USB charging, the increase in consumer convenience would be greater. It is also necessary to consider any potential fragmentation of charging solutions that might occur in the longer term under the baseline and that might be avoided under Option 1. Option 1 could thus act to maintain the stock of devices with a common charging solution across the device groups included at current or potentially higher levels (depending on sales).

With supply chains established, it is not expected that the majority of manufacturers of devices would suddenly move away from Micro-USB, making it more likely that a voluntary agreement could be established for those devices. Some consumer organisations have, however, doubted the ability of voluntary agreements between manufacturers to deliver the desired results, particularly in terms of consumer convenience, and a joint consultation response from ANEC and BEUC states that they are "sceptical of voluntary agreements […] as the level of compliance is generally very low." Their consultation response further notes that "consumer organisations have traditionally expressed strong reservations about voluntary agreements (VAs) and self-regulation in general, in particular for ICT and environmental sectors. […]".

A key issue in terms of consumer convenience relates to whether Option 1 (as well as Option 2 for that matter) would allow the use of adaptors. The use of adaptors, whilst providing manufacturers with flexibility in terms of the charging infrastructure installed in devices, are likely to result in restrictions in utility for consumers (with respect to the ability to use chargers from other similar devices).

Since the entry into force of the MoU, Apple replaced one proprietary connector (30 pin) with another one (the Lightning connector), ensuring compliance with the MoU by means of making adaptors available for purchase. Given that Apple has adopted the same proprietary charging solutions (with adaptors made available) for iPhones, iPads and iPods, it would seem likely that they might not sign up if adaptors were not permitted under a voluntary agreement. This would significantly reduce consumer convenience due to the large market share of Apple products in the mobile phone and portable media player markets as consumers owning such Apple devices would not be able to make use of other Micro-USB chargers belonging to them, their colleagues or friends.

Clearly, if adaptors were permissible under Option 1, consumers may require multiple adaptors in order to achieve interoperability with different chargers purchased for other devices which are compatible with any voluntary agreement.

Whilst the size of an adaptor is much smaller than another charger, having to co-ordinate and purchase multiple adaptors (with some costing as much as a second charger) would represent a definite inconvenience to consumers. Greatest inconvenience would be caused to those consumers who omit to take along their adaptors or chargers when they travel and who may be faced with having to purchase an additional charger or chargers in the event that their devices rely on an adaptor to charge via Micro-USB, or may not be able to charge at all.

The issues assessed in Section 5.4.3 (technical issues associated with the use of a common charger) suggest that consumers would need to be educated about issues to do with the charging capacity of the different chargers and devices. In this regard, it is of interest that a large multi-national retailer responding to consultation for this study noted that consumers are generally not aware of the differing power levels associated with charging and would therefore use a mobile phone charger to charge a tablet if the connector fits. A manufacturer of easy to use handsets further noted that it would be helpful to devise a marking system should a common charger be implemented in a number of product groups, for example colours which denote the power output of the charger.

Option 2

Under this option, there are only limited differences for consumer convenience when compared with Option 1. The legislative option would require all manufacturers of mobile phones, e-readers, digital cameras/camcorders, portable media players, sports and activity monitors, personal navigation devices and personal care products to supply devices with Micro-USB charging solutions. For consumers, this would mean that chargers for one device could be used for all the others, although as mentioned in the technical issues section (Section 5.3.4) there would still be limitations depending on the requirements of each device and the supplied chargers. If decoupling of chargers from device sales were to occur (although this is by no means certain), this would mean that consumers would require a reduced number of chargers (determined by the desire/need for simultaneous charging) and would mean that consumers could pretty much charge their device anywhere using other people's chargers if they neglected to carry theirs with them.

Expecting that consumers cease to purchase chargers altogether is clearly unrealistic. Two scenarios of the potential rate of decoupling of the sales of chargers and portable electronic devices have been used in this report to estimate the impacts on prices paid by consumers and the environment (see Sections 5.4.4 and 5.4.6). These are:

- Scenario 1 (2% of devices will be sold without a charger, extrapolating the current trend for mobile phones); and
- Scenario 2 (50% of devices sold without a charger, representing what is seen as the maximum possible rate of decoupling).

As noted above, a 50% decoupling rate is seen as the highest possible rate based on the current levels of ownership of devices and expected charging behaviour of consumers. The methodlogy for deriving this estimate is set out in Section 5.4.6.

As a result, Option 2 would be more effective in terms of improving consumer convenience since it is likely to cover more devices and lead to an increased availability of compatible chargers than under Option 1. Whereas under Option 1, the possibility not to sign up to a voluntary agreement exists and might be attractive for manufacturers of devices that do not currently have Micro-USB charging solutions for any or many of their devices (e.g. portable media players, sports and activity monitors, and personal care devices), this possibility would not exist under Option 2

However, this effectiveness would likely be reduced if adaptors were allowed. This is due to the fact that, if the experience of the MoU for mobile phones is repeated, a number of device manufacturers may opt to make an adaptor available to use with a proprietary connector on the device side. This may be particularly attractive for manufacturers producing multiple devices currently using a single proprietary connector. With different proprietary connectors being used for different devices produced by different manufacturers, this would mean that consumers would be required to purchase multiple adaptors in order use a harmonised charger across devices.

The consultation response by ANEC and BEUC shows a clear preference for Option 2 in respect of mobile phones. The two organisations support the inclusion of interoperability requirements in the relevant European legislation (revision of the R&TTE Directive, External Power Supply Regulation No 278/2009), together with the development of relevant standards. ANEC and BEUC see many shortcomings in voluntary approaches and stress the role of legislation and mandatory provisions to ensure the basic needs of consumers, such as safety or environmental protection. This shows a clear preference for Option 2, although as stated above, the MoU for mobile phone chargers has demonstrated that a high level of compliance in terms of numbers of devices sold is achievable.

As noted, there are a number of products that appear to be in declining markets (e.g. e-readers, portable media devices and digital cameras/camcorders) and unlike under Option 1, manufacturers of these products would not be able to opt out of providing the harmonised charging solution for their products. In the event that design costs and supply chain changes were considered too expensive in the face of a declining market, there may be a slowdown in the introduction of new product lines to the market and this would result in a loss of consumer convenience in terms of choice of products; these impacts are, however, likely to be limited. Additionally, manufacturers have stated that restricting the charging technology may have impacts on research, innovation and development as new functionality and devices are likely to require increasing levels of power over the current ones. This being the case, consumers may miss out on the opportunity to benefit from such products and functionality if they cannot be delivered at the power levels permitted by the harmonised charger.

Research indicates that consumers' purchasing decisions are informed by multiple considerations, of which the presence and type of charger is only one. The factors that influence the consumer's decision when purchasing a smartphone for example have been considered by a number of articles and studies over many years. There does not appear to be a consensus regarding what the most important factors are for consumers; however, chargers and charging requirements do not appear to feature heavily in such studies, whereas functionality does. For example, Forbes (2013) considers what consumers want when buying a new smartphone and notes that the most important factors are: improved battery life, a more durable device, better voice recognition and better security.[318] However, a study by Nokia, puts 'features' as the most important factor for consumers when buying a smartphone (50%), followed by the build quality (21%), price (10%), look (7%) and brand (6%).[319]

Furthermore, a study by Business Insider (2011) which asked 2,000 smartphone buyers what the most important factors are when purchasing a smartphone found that the platform was the most important factor for 38% of respondents, followed by features (33%), App selection (8%), easy data migration (4%), price (3%), the mobile network (7%) and other factors (7%)[320]. However, another study conducted in 2011 by the media agency OMD CZ of 545 respondents, found that the most important smartphone functions were (in order of importance): price, battery duration, Bluetooth, USB port, size, camera resolution and Wi-Fi.[321] Indeed, this study argues that the most important functions of a smartphone are the same as those of a feature phone and the advanced features

[318] Forbes (2013): Buying a Smartphone? These are the only features that matter, available from http://www.forbes.com/sites/sethporges/2014/02/24/buying-a-smartphone-these-are-the-only-features-that-matter/

[319] NokNok (2013**):** Smartphone users vote features and build quality as key buying decisions, available from http://www.noknok.tv/2013/02/07/smartphone-buyers-want-features-and-build-quality/

[320] Business Insider (2011): The Truth About Smartphones: Our exclusive survey on iPhone vs Android, available from http://www.businessinsider.com/smartphone-survey-results-2011-4?op=1

[321] OMD (2011): Most important smartphone functions considering purchase, available from http://www.omd.cz/en/about-us/research/snapshots/2011/1/20/most-important-smartphone-functions-considering-purchase.html

(used mainly for entertainment) of smartphones are not as important when considering the purchase of a new device321. Therefore, it is clear that where harmonisation of charging leads to a restriction in function of devices, consumers would be negatively impacted since functionality and features are important criteria when selecting devices.

It was also noted by a handset manufacturer responding to consultation for this study that the advantage of harmonisation by means of specifying a minimum performance level for chargers is that it does not force all chargers to incorporate expensive components, and support higher charge rates than is necessary for the products they are shipped with. Opting for a lower performance specification would, however, result in slower charging times for higher power devices, and conversely, a higher specification would make chargers more expensive. For technical issues associated with the use of chargers for higher/lower-powered devices, please refer to Section 5.4.3. Given that there appears to be a trend towards higher power charging, it is noted that should chargers not be provided with new phones any more, this could mean that consumers wanting to charge a device requiring higher power with a smaller power charger would have to put up with longer charging times if they purchased a new device.

As for Option 1, technical issues associated with the use of a common charger set out in Section 5.4.3 mean that consumers would need to be educated about issues to do with the charging capacity of the different chargers and devices. In this regard, it is of interest that a large multinational retailer noted that consumer awareness about different power levels is very low and a manufacturer of easy to use handsets further noted that it would be helpful to devise a marking system should a common charger be implemented in a number of product groups, for example colours which denote the power output of the charger.

A summary of the key impacts on consumer convenience identified are presented in Table 5-31 below.

Table 5-31: Summary of Main Ompacts on Consumer Convenience

Impact Area	Option 0	Option 1	Option 2
Coverage of devices (no adaptors)	0/- In the short term, significant proportion will continue to utilise Micro-USB charging, but potential fragmentation in mid-/long term will lead to reduction in consumer convenience	++ Relatively high in terms of products on the market as those with high market shares likely to participate.	+++ All products covered, most effective in terms of consumer convenience.
Coverage of devices (adaptors allowed)		++/- Likely to increase participation in agreement by manufacturers. Consumers will be able to charge multiple devices with single charger but may have to purchase multiple adaptors. May encourage use of proprietary connectors by manufacturers.	+++/- Consumers will be able to charge multiple devices with single charger but may have to purchase multiple adaptors. May encourage use of proprietary connectors by manufacturers.

Table 5-31: Summary of Main Ompacts on Consumer Convenience			
Impact Area	**Option 0**	**Option 1**	**Option 2**
Product choice	0	0 Manufacturers of products in declining markets unlikely to sign up to voluntary agreement, so no impacts.	- Some manufacturers in declining markets may choose not to introduce new models in the EU, leading to reduction in choice for consumers.

Health and safety

Option 0

Under Option 0, only a minority of handset manufacturers is likely to choose not to supply devices with chargers. There is little to suggest that the sale of replacement or additional chargers will be impacted. Some consumers will continue to purchase chargers online, particularly online marketplaces. Without the impetus for change, it may be the case that the regulation of these marketplaces does not change and that consumers will continue to purchase, either wilfully or inadvertently, phone chargers which, on occasion, do not comply with the standards.

Although it may be the case that chargers have accounted for some of the fire incidents across Europe, particularly given recent media reports, it must be recalled that these represent only a very small minority of cases of all chargers sold. However, if it is the case that the market for counterfeit mobile phone chargers is increasing, perhaps indicated by the increase in confiscations by enforcement authorities, then the risk may have the potential to increase in the future.

Under Option 0, manufacturers of **e-readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care devices** will be free to determine whether they choose to supply a charger with their device. There is likely to be variation across the different sectors and indeed amongst manufacturers within each sector. For example, Polar for sports devices, Garmin for PND, Apple iPods and most manufacturers of e-readers do not supply mains chargers alongside their device when it is sold. On the other hand, all portable handheld games consoles, personal care products and most digital cameras and camcorders are supplied with a mains charger.

An overview of chargers notified to RAPEX and ICSMS is given in Section 3. The low number of notified chargers for these products makes it difficult to discern any trends other than the fact that there were no entries in 2008 and 2009 compared with latter years. Indeed, from 2010, through to and including 2013, 12 products were notified, all of which were non-OEM (seven personal music player chargers, four chargers for iPhones/iPod and one camera charger). This number of chargers is still relatively low. However, it is possible that the number of non-compliant/unsafe chargers could increase in the future, and that the risk posed to the consumer becomes unacceptable.

Options 1 and 2

Some stakeholders believe the harmonisation of chargers for **mobile phones** and other devices may have an unintended side effect in that it would increase the market for poor quality, potentially dangerous and counterfeit chargers. For example, the consultation response received from Digital Europe suggests that:

"an undesirable side effect of a common charging solution for a broad range of products may be an increase in the volume of poor quality chargers placed on the Union which may not meet the essential requirements of applicable EU directives. With a common charging solution, irresponsible manufacturers of such chargers may enjoy an increased and simplified market for their products with fewer concerns about trade mark or patent infringement. This can only lead to a less safe environment for consumers and we would encourage great vigilance by market surveillance authorities against such a trend. We envisage that responsible manufacturers will continue to retain ownership for the safety and compliance of their products by providing a high quality charger with each device."

Electrical Safety First in the UK (formerly the Electrical Safety Council, ESC) has also noted the possibility that problems with counterfeit chargers will increase as mobile phones begin to be sold without a charger. For example, Steve Curtler of the ESC is quoted on Sky News as claiming: "there is possibly going to be an increase in the problem due to them agreeing to sell mobile phones without the chargers in the box and that's to comply with European mandate to reduce electrical waste"[322]. A market surveillance authority responding to consultation for this study also suggested that harmonisation of the charging method may inadvertently undermine consumer safety. Here, it was specifically stated that some consumers who require a charger with their device will elect not to purchase it at the point of purchase, but instead choose a cheaper charger not manufactured by the OEM (as would consumers purchasing replacement chargers), for which, it is argued, there may be a greater risk of non-compliance with European Safety Requirements.

The increased uptake of unsafe chargers would be most likely should the decoupling of the markets for handsets and chargers occur due to Options 1 and 2, with some consumers perhaps opting for cheaper, counterfeit or low quality chargers from non-OEM manufacturers/suppliers. An industry association has also noted that counterfeit mobile phones and chargers present a significant problem that poses a real risk to the health and safety of consumers. In their view, measures should be put in place to prevent the increased import of counterfeit chargers into the EU before manufacturers are encouraged via harmonisation to sell chargers separately from mobile phones. Equally, PlugSafe believe that there is, in principle, no problem with the harmonisation of chargers, provided that regulation is strengthened and properly enforced.

Under Options 1 and 2, agreement among the majority of manufacturers to use a common charger may result in the omission of chargers with new devices under the assumption that consumers already have a compatible charger, although, as previously stated, the precise extent of decoupling is unknown and could range from very small to around 50%. As a result of harmonisation and the practices of online market places where many mobile chargers are purchased, it is possible that the sale of counterfeit/unsafe chargers could increase, although appropriate steps taken by market surveillance and enforcement authorities could reduce the potential increase in the risk posed to consumers.

As with mobile phones, some stakeholders may believe that is the possibility that harmonising the charging method for e-**readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care devices** may inadvertently undermine consumer safety, unless accompanied by improvements in market surveillance and enforcement.

The increased uptake of unsafe chargers is linked to the decoupling of the markets for electronic devices and chargers which may occur due to Options 1 and 2, with some consumers perhaps opting

[322] Sky News (2013): Mobiles: Phony Chargers Spark Safety Concerns, available at http://news.sky.com/story/1127100/mobiles-phony-chargers-spark-safety-concerns

for cheaper, counterfeit or low quality chargers from non-OEM manufacturers/suppliers. The extent of the uptake of such chargers, however, cannot be predicted.

Perhaps of greater concern will be the extent to which the goal of effective and safe charging is fulfilled, across a range of devices that may have different charging requirements, without undermining the safety of chargers for consumers. Indeed, Digital Europe has stated that international standardisation bodies are working on this issue, but that specific issues are still to be resolved by experts to ensure the protection against:

- fire hazards (e.g. due to over-voltage and over-current failures);
- electric shock hazards (e.g. due to higher leakage currents than specified by the manufacturer); and
- thermal hazards.

Until these matters are resolved, Digital Europe considers it "premature and very undesirable to introduce measures for a common charger at this stage". This would appear to be particularly relevant for personal care products.

Under Options 1 and 2, should the majority of manufacturers of e-readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care devices agree on a common charging method devices may be sold without a charger based on the assumption that consumers already have a compatible charger. However, this approach can only be adopted for those devices which share similar charging requirements. Moreover, above all other considerations, the method of charging the device must not undermine the level of health and safety currently in place.

As has been discussed at the beginning of Section 5.4, e-readers, portable media players, sports and activity monitors, PNDs, and portable handheld games consoles have broadly similar voltage charging requirements. Harmonisation of the charging methods may therefore be feasible for these devices without undermining the level of safety currently achieved. However, a manufacturer of one of the above devices strongly objected to harmonisation, as it would remove the possibility of designing their own charger and undermine the ability of the company to ensure a high level of safety for their consumers. The views of Digital Europe were also echoed, with this manufacturer stating that a common charger would increase the likelihood of consumers coming into contact with unsafe chargers purchased from third parties. This was a particular concern as any accident, even if caused by a counterfeit charger, would affect their reputation even though it was caused by a charger beyond their control. While the above concerns are valid, they reinforce the importance of effective regulation. Provided products placed on the market comply with all relevant safety requirements and public authorities undertake effective market surveillance and enforcement, these concerns should not be an issue.

The harmonisation of personal care products from the perspective of consumer safety may be more problematic given that that the upper and lower voltage charging requirements range from 2V to 18V. If the method of charging were harmonised for these devices, it is possible that a consumer may attempt to use an 18V personal care product charger to charge a PND. Given that this device is unlikely to have been designed to receive 18V, it is possible that using such a charger could damage the device, the charger and/or endanger the consumer. For this reason, careful consideration should be given to the proposal to harmonise the charging method of personal care products.

Also of pertinence is the issue of ensuring that devices operating in a wet environment (e.g. bathroom or those worn on the wrist) such as personal care products and sports and activity monitors can be charged and used safely. It is the case that chargers for personal care products

must be waterproof if they are to be sold in Europe (excluding the UK). To ensure that the safety of these devices is not compromised, personal care products for use in wet enshould be permitted to continue to use proprietary chargers. Two manufacturers of personal care product expressed concerns regarding safety issues associated with the use of a common charger for a range of products that include but are not limited to personal care devices. One of these suggested that while it would be technically possible to use Micro-USB on personal care products, existing standards are geared towards IT products and they would have to be adapted to ensure an adequate level of safety of personal care products. In addition, use in the bathroom requires that both the product and the charger are waterproof, otherwise there is a risk of electric shock. This suggests that there could potentially be a problem with the safety of using existing USB chargers in wet environments as these have been designed for IT products and not for personal care products. For this reason, it may be produdent to address the issue of safety of wet room charging before proceeding with harmonisation of charging in dry and wet rooms. It was suggested by a company responding to consultation that this issue means that customers would need reeducating; they would need to be shown that other chargers for personal care products are safe to use but older chargers designed for IT devices may not be safely used in wet environments. According to this company, ensuring that consumers do not use chargers not designed for wet enviroments in the bathroom would be difficult.

The extent to which the harmonisation of charging for these products will pose a risk to consumers will also be influenced by the size of their respective markets and future outlook. For many of these devices, the market has peaked, is in decline and replacement cycles are low (e.g. digital cameras and camcorders, PND, e-readers, portable media players, portable handheld consoles and PND). This decline in sales across these devices can in part be attributed to the growth in the sales of smartphones which have cannibalised the respective markets. This means that the number of consumers who may potentially purchase one of these devices supplied without a charger is significantly smaller than the number of consumers that may potentially purchase a mobile phone supplied without a charger. Evidently, while the relative risk of implementing Options 1 and Options 2 for these devices is comparable to that of mobile phones, the number of consumers that may potentially purchase an additional or replacement counterfeit/unsafe charger is likely to be smaller for these devices.

Some of the above-mentioned risks could be mitigated by means of educating consumers on the charging requirements of the different devices, and the risks involved in using chargers that are not safe or not suitable for the power requirements of the device in question. As noted earlier in this report, it is of interest that a large multi-national retailer responding to consultation for this study noted that consumers are generally not aware of the differing power levels associated with charging and would therefore use a mobile phone charger to charge a tablet if the connector fits. A manufacturer of mobile phones responding to consultation for this study also noted that it would be helpful to devise a marking system should a common charger be implemented across a number of product groups, for example colours which denote the power output of the charger.

Impacts on consumer safety are summarised in Table 5-32.

Table 5-32: Summary of Main Impacts on Health and Safety			
Impact	**Option 0**	**Option 1**	**Option 2**
Consumer health and safety	0	- There are data suggesting that there are incidents involving chargers, with these most likely to be cheaper non-OEM, counterfeit, unbranded chargers. The number of incidents may increase under Option 1, should decoupling occur on a significant scale. There may be a negative impact to consumers if personal care products for use in wet environments remain within the scope of this proposal due to their high charging requirements and the need for a charging method that is suitable for wet rooms. There would be a need to consider issues relating to higher voltages used by some personal care products.	- There are data suggesting that there are incidents involving chargers, with these most likely to be cheaper non-OEM, counterfeit, unbranded chargers. The number of such incidents may increase under Option 2. There may be a negative impact to consumers if personal care products for use in wet environments remain within the scope of this proposal due to their high charging requirements and the need for a charging method that is suitable for wet rooms. There would be a need to consider issues relating to higher voltages used by some personal care products.

Employment

Figures from Eurostat indicate that there are 1.14 million people in Europe employed in the "Manufacture of computer, electronic and optical products", which includes all the devices considered under this study as well as numerous others (see Section 3.2.2 for more information). Desk-research and consultation indicates that the vast majority of portable rechargeable devices are manufactured outside of the EU, particularly in Asia. However, there are notable instances of manufacturing, assembly and research and development and its associated employment in Europe for the devices covered by this study.

Whilst there is limited manufacturing of **mobile phones** in the EU, which has declined substantially over the past decade or so, there are indications that at least two major manufacturers have produced mobile phones in the EU over the period considered in this study (2009-2013); RIM (Blackberry) and Nokia. In the past, other major handset manufacturers have had production facilities in Europe, including BenQ, Motorola, Mitsubishi Electric, Phillips and Sony Mobile. A number of European companies selling own brand handsets have been identified; see Table 3-7; however production is mostly based outside of the EU.

Production of **digital cameras** in Europe has increased year on year since 2008, despite a drop in sales. According to Eurostat, employment in the manufacturing of optical instruments and photography in Europe was 44,500 in 2010. Leica, a manufacturer of digital compact cameras, does manufacture within Europe, however it is not known what proportion of production is cameras. In some cases, it appears that cameras are merely assembled in the EU with production of the components occurring outside of the EU. The vast majority of digital cameras and camcorders are produced by Japanese manufacturers. Polar, a Finnish manufacturer of **sport devices** has production facilities in Finland. The company employs 1,200 people worldwide but it is not known how many are employed in the EU. In 2010, 90% of PNDs were manufactured in Taiwan. Interestingly, TomTom currently employs around 3,500 employees worldwide and in 2010, around a third of these were working in its headquarters in the Netherlands. Eurostat figures indicate that **personal care products** are manufactured in Europe, with a marked decrease in 2012. Braun and Philips have production facilities in Europe; although their employment data cannot be used for the purposes of this study as it is highly likely that they also reflect the manufacture of other products.

Desk-research and consultation indicate that **chargers** for portable rechargeable devices are typically manufactured outside the EU. Four manufacturers of wired chargers headquartered in Europe have been identified. During consultation, Mayamax reported that around 30 people are employed in France in the production of chargers. Friwo may have production facilities in Germany and Avenir Telecom employs 2,000 people in Europe, although it is not clear how many are involved with the production of chargers.

Option 0

The market trends for the devices considered in this impact assessment are variable, with sales of smartphones increasing significantly, while others such as e-readers and portable media devices experienceing falling sales. In some instances, there is a causal link, for example the increasing sales of smartphones, which can perform a number of functions, has led to declining sales of portable media devices and compact digital cameras. Without any action from the European Commission to harmonise chargers in portable rechargeable devices, any fluctuations in the levels of employment will be a result of market forces.

Option 1

Desk-research and consultation indicate that the proportion of manufacturing, and hence the associated employment, of portable rechargeable devices occurring in Europe is relatively small. There is also some employment resulting from research and development and retail activities. Therefore, any impacts on employment within the EU will be insignificant.

Marginal changes to the levels of employment within the EU and more widely are possible but would not be significant. In the short term, levels of employment could increase as expertise is required at the design phase to ensure the technical requirements of the common charger are met and implemented into devices. However, manufacturers already have design teams that are accustomed to meeting such requirements and the USB specifications are widely known. As previously highlighted, an agreement to use a common charging solution would reduce research and development into charging solutions; however this is just a single technical aspect of the device.

Subject to the agreed technical option, there could be an impact on charger manufacturers; this has been assessed in Section 5.4.4 where it has been noted that should decoupling rates above 7% occur, revenues generated by charger manufacturers would be negatively impacted, with knock-on effects on employment, mainly outside the EU.

Option 2

As discussed above, the levels of employment associated with each of the devices in the EU is low compared to other regions of the world. There could be marginal losses and gains to employment in the short-term but these will not be significant. Any impacts on employment are most likely to be in the assembly plants that operate outside of the EU. Any impacts would not be significant as line adjustments occur on a frequent basis to accommodate new models or design features.

The decoupling of chargers from new devices would become more feasible with legislation, as such manufacturers of chargers could experience a reduction in sales, and consequently employment.

Table 5-33: Summary of Main Impacts on Employment in the EU			
Impact	**Option 0**	**Option 1**	**Option 2**
Creation of jobs	0	0	0
Loss of jobs	0	0	0

5.4.6 Environmental Impacts

The inclusion of chargers which are not needed is inefficient and can impact the environment in two ways. Firstly, the production of a charger will lead to a degree of environmental damage and pollution during the extraction of raw materials and result in the emission of greenhouse gases where fossil fuels are used for energy generation. Secondly, the inability to use an existing charger will ultimately result in its disposal.

The inclusion and decoupling of chargers represent the opposite ends of the spectrum in terms of raw material consumption. However, there is some scope for improvement even where a charger is supplied with a device. For example, instead of including a captive charger and data transfer cable, it is more efficient to opt for a detachable charger which will negate the need for a separate data transfer cable. Indeed, it may even be possible to only include the data transfer cable; under the assumption consumers can use an existing charging block or PC.

Renewable and non-renewable resources

The extent of environmental benefits from further harmonisation will depend on the degree to which the sales of chargers decouple from the markets for new devices. As noted in Section 3, in the mobile phone sector, harmonisation of charging has not resulted in large scale decoupling. Although the trend is increasing, extrapolation on the basis of the current trends suggests that in 2017, only 2% of handsets will be sold without chargers.

For the purposes of this study, two theroretical scenarios modelling different degrees of decoupling have been assessed (in earlier sections this report, they were assessed together with a scenario where 0% decoupling occurs). These two scenarios are:

- Scenario 1 (2% of devices will be sold without a charger, extrapolating the current trend for mobile phones); and
- Scenario 2 (50% of devices sold without a charger, representing what is seen as the maximum possible rate of decoupling).

Expecting that consumers cease to purchase chargers altogether is clearly unrealistic. As noted above, a 50% decoupling rate is seen as the highest possible rate based on the current levels of ownership of devices and expected charging behaviour of consumers. These aspects are summarised in Table 5-34 which estimates the number of chargers that an average household would

need, should Option 2 with 'no adaptors allowed' be adopted. Please note that this table is based on the assumption that only one type of charger would be needed. However, as noted earlier in this report, it is advisable that the requirements on a common charger are frequently reassessed and adapted to technical progress, which may mean that at a given point in time, for example, one charger is required for an older model owned by one member of a household but a different charger is required for a more recent model owned by another member of the same household, while Table 5-34 assumes that both models could be charged using the same charger. In reality, consumers may thus need more charges than indicated in Table 5-24. In this respect, it is of note that for some devices the length of the replacement cycle and intended review cycle of the legislation are roughly the same, meaning that significant decoupling may never occur.

Exemptions for sports and activity monitors and personal care products for use in wet environments are not taken into account in Table 5-34; however, their inclusion or omission has little bearing on the final result.

Table 5-34: Consumer Charging Behaviour and Maximum Decoupling Rate

Product group	Number of devices per household	Number of charges per device per year	Number of chargers needed
Mobile phones	3.148	300	2.588
E-readers	0.042	12	0.001
Digital cameras	1.058	12	0.035
Camcorders	0.091	12	0.003
Portable media players	0.257	53	0.037
Sports and activity monitors	0.609	53	0.088
PNDs	0.003	53	0.000
Portable handheld games consoles	0.134	53	0.019
Personal care products	0.325	106	0.094
Total	***5.667***	***654****	***2.867***

*Note: * total for all devices*
Sources: Stock of devices estimated based on market data in Sections 3 and 4. Number of times each device is charged each year are estimates of the study team. Please note that this reflects average charging behaviour and as such may not correspond to the charging behaviour of most users. Mobile phones are estimated to be charged 300 times per year. This reflects the high frequency of smartphones which are charger by many users every day (or even several times every day by some users)[323] while feature phones are charged less frequently. For other devices, it has been estimated that they are charged monthly or weekly.

The table above suggests that each household would on average own 5.7 portable rechargeable electronic devices with a Micro-USB connector and would need 3.4 chargers to charge them. This suggests a possible degree of decoupling of around 50%. These calculations do not take into account harmonisation of tablets and laptops as these have higher power requirements and should be considered separately. This estimate is somewhat lower than the rate achieved by existing decoupling schemes in the mobile phone segment[324] but this is deemed acceptable as many

[323] Approximately 30% of people charge their phone at least once per day. Source: IHS (2014): Wireless charging coming to all US Starbucks - but incompatible with most enabled devices, available at https://technology.ihs.com/503159/wireless-charging-coming-to-all-us-starbucks-but-incompatible-with-most-enabled-devices

[324] The proportion of handsets supplied without chargers by Fairphone and O2's Charger Out of the Box scheme has been 60-70% and 82%, respectively. Another network operator responding to consultation also estimated that 70% of the Motorola Moto G handsets supplied by them have been sold without a charger.

households may wish to charge several devices simultaneously and a significant degree of decoupling would mean that the demand for chargers replacing lost or stolen chargers would be somewhat higher than today (while this is exogenous to the decoupling rate, it needs to be taken into account when considering the impacts of charger harmonisation on the environment and consumers).

For each of the two decoupling scenarios, the potential annual reduction in the use of raw materials has been calculated. The main assumptions underpinning the model estimating the reduction of resource use include:

- 2017 sales figures are based on published forecasts gathered by desk research and where these were not available, 2017 sales have been estimated by the study team, using one of the following three methods: 1) holding the most recent sales figure constant for devices for which no change in the overall sales volumes is expected or for which there is no information on future sales trends, 2) estimating possible future sales on the basis of information on expected trends, and 3) extrapolation of future sales based on past trends;
- where only worldwide figures were available, these have been apportioned to Europe using the general estimate of Europe representing 30% of global sales (except for where there is an indictation suggesting a higher or lower market share). 30% is an estimate based on a comparison of the European and global markets for several portable rechargeable devices in 2011;
- average weight of a charger calculated based on sample of chargers weighed by the study team;
- it is assumed that e-readers, personal media players, PNDs and sports and activity monitors will continue to be supplied with a cable while other devices will continue to be supplied with a mains charger;
- potential exemptions for certain sports and activity monitors and personal care products have not been taken into account; and
- it is assumed that chargers have on average 30% of recycled content[325], meaning that the total raw material requirement is only 70% of the weight of the relevant charger.

Using study team estimates of the market size and baseline prevalence of Micro-USB, the following estimates of raw material savings have been calculated for 2017 for mobile phones, e-readers, digital cameras and camcorders, portable media players, sports and activity monitors, personal navigation devices, portable games consoles and personal care products: Scenario 1 (2% decoupling): 300 tonnes and Scenario 2 (50% decoupling): 7,600 tonnes. These are annual reductions when compared with a 0% decoupling scenario.

Estimates for individual devices are reproduced in Table 5-35.

[325] Environmental Leader (2012): AT&T Launches Low-Energy, Recycled Content Chargers, available at http://www.environmentalleader.com/2012/09/04/att-launches-low-energy-recycled-content-chargers/

Table 5-35: Scenarios for Reduced Primary Raw Material Consumption Due to Decoupling (2017)						
Device	**Sales in 2017**	**Reduction in chargers sold with devices (units per year)**		**Average weight of charger/ cable (g)**	**Raw material saving (tonnes per year)**	
		Scenario 1 (2% decoupling)	**Scenario 2 (50% decoupling)**		**Scenario 1 (2% decoupling)**	**Scenario 2 (50% decoupling)**
Mobile phones	213,000,000	4,260,000	106,500,000	60	179	4,473
Tablets	173,000,000	3,450,000	86,300,000	119	288	7,190
E-readers	1,900,000	40,000	940,000	30*	1	20
Laptops	51,600,000	1,030,000	25,800,000	440	318	7,942
Digital cameras	39,000,000	780,000	19,500,000	139**	76	1,899
Camcorders	3,400,000	67,000	1,700,000	139	7	163
Portable media devices	17,400,000	348,000	8,700,000	30*	7	183
Sports devices	22,500,000	450,000	11,200,000	30*	9	236
PNDs	100,000	2,000	50,000	30*	0.04	1
Portable handheld games consoles	4,900,000	100,000	2,500,000	139	10	240
Personal care products	12,000,000	240,000	6,000,000	89	15	374
All devices	***540,000,000***	***10,800,000***	***269,200,000***		***909***	***22,721***
All devices (excluding tablets and laptops)	***310,000,000***	***6,300,000***	***157,100,000***		***304***	***7,589***
*Note: * Cable only; **Some action cameras already use Micro-USB chargers and as such some chargers weight less than the indicated weight, estimated around 60-80 grams*						

Waste generation/recycling

As noted in Section 3, in the long run, any reduction in raw material consumption can be expected to translate into a reduction in e-waste but there will be some delay. For example, it is estimated that only 5% of consumers dispose of their old handset when they purchase a new one and a typical consumer keeps an old handset for 2.37 years before it enters the waste tream. The same delay is assumed to apply to chargers.

International Environmental Impacts

Options 1 and 2 could have international environmental impacts for two reasons. Firstly, a reduction in the use of raw materials also entails a reduction in CO_2 emissions; this relates both the reductions calculated in Table 5-35 as well as those relating to reduced packaging. Secondly, , it is possible that the cost of logistics and the weight of goods transported could be reduced, as they no longer need to hold a charger.

Given the number of devices shipped from the manufacturing hub of Asia (where around 90% of chargers are manufactured) to Europe, the potential international environmental impact may be notable. Indeed, consultation suggests that the box containing a new handset is around 25% lighter when a charger is not included and many more can be fitted on each pallet during transport. As an indicative guide, Fairphone have estimated that by not providing a charger, they have saved the equivalent of 1.6 kg CO_2-equivalent (CO_2e) per charger avoided. This estimate reflects a complete assessement of the processes to manufacture and distribute a charger, such as sourcing material to manufacture charger, transporting material to production facility, etc.)[326].

In 2013, the Royal Institute of Technology[327] produced a report to determine the global warming potential of smartphones, including the impacts associated with the charger. The Life Cycle Assessment used a Sony Xperia T smartphone. The charger is composed of plastics, metals and other unclassified materials. Valuable metals make up the largest proportion (approx. 10%), followed by other materials, other metals and plastics (Royal Institute of Technology, 2013). Life-cycle assessment (based on ISO 14040 and 14044 standards) of these materials revealed that most of the environmental impact are associated with the electronics rather than the plastic and metal components of the casing (ITU, 2011)[328]. The production stage of a smartphone (including accessories) has the largest impact on Global Warming Potential (GWP), accounting for approximately 32 kg CO_2e, with the charger accounting for less than 1 kg CO_2e (Royal Institute of Technology, 2013). This may seem suprising considering that the weight of the charger can represent as much as 30-40% of the total amount of material used in constructing a mobile phone (ITU, 2011). The relatively insignificant impact of the accessories supplied with a mobile phone can be explained by the relatively low technological processes used during the production. The charger accounts for a higher proportion of the GWP of the raw material acquisition (24%) as a result of the relatively large weight of these parts (Royal Institute of Technology, 2013).

The ITU (2011) have estimated the Global Warming Potential of a sample of chargers with varying output currents:

[326] Fairphone (2014), Guvendik, Next step in Life Cycle Assessment: Inventory analysis, accessed at: https://www.fairphone.com/2014/06/20/next-step-in-life-cycle-assessment-inventory-analysis/

[327] Royal Institute of Technology (2013): Global Warming Potential of a Smartphones, accessed at http://kth.diva-portal.org/smash/get/diva2:677729/FULLTEXT01.pdf

[328] ITU (2011): Environmental benefits of a universal mobile charger, accessed at https://itunews.itu.int/en/1944-Environmental-benefits-of-a-universal-mobile-charger.note.aspx

- 550mA - ~900 g CO_2e;
- 700mA - ~1,050 g CO_2e;
- 800mA - ~580 g CO_2e; and
- 1200mA - ~1,000 g CO_2e.

Using a range of estimates from the three sources quoted above, it can be estimated that each avoided mobile phone charger results in a reduction in CO_2e of between 580 g (LOW) and 1.6 kg (HIGH). Applying these estimates to data in Table 3-35 suggests that decoupling at 2% (Scenario 1) would be associated with CO_2e reduction between in 3,600 and 10,000 tonnes in 2017 and Scenario 2 (50% decoupling) would be associated with a reduction between 80,000 and 220,000 tonnes (see Table 5-36). The overwhelming majority of these gains are associated with mobile phone chargers.

Table 5-36: Scenarios for CO_2e Reduction Due to Decoupling (tonnes in 2017)

Device	Sales in 2017	Reduction in tonnes under Scenario 1 (2% decoupling)		Reduction in tonnes under Scenario 2 (50% decoupling)	
		Low (580 g per charger)	High (1.6 kg per charger)	Low (580 g per charger)	High (1.6 kg per charger)
Mobile phones	213,000,000	2,471	6,816	61,770	170,400
E-readers	1,900,000	22	60	22	60
Digital cameras	39,000,000	453	1,249	11,321	31,231
Camcorders	3,400,000	39	107	972	2,680
Portable media devices	17,400,000	202	557	202	557
Sports devices	22,500,000	261	719	261	719
PNDs	100,000	1	3	1	3
Portable handheld games consoles	4,900,000	57	158	1,434	3,954
Personal care products	12,000,000	139	384	3,480	9,600
All devices (excluding tablets and laptops)	***310,000,000***	***3,645***	***10,054***	***79,462***	***219,204***

*Note: * Devices indicated in Table 3-35 as supplied only with a cable are assumed to result in a 580 g CO_2e reduction under both the high and low scenarios.*

A summary of the main impacts on resource use, waste generation/recycling, international environmental impacts is provided in Table 5-37.

Table 5-37: Summary of Main Enviromental Impacts			
Impact	**Option 0**	**Option 1**	**Option 2**
Resource use, waste generation/recycling, international environmental impacts	0	0/+ Reduced resource consumption when chargers are decoupled from new devices	0/++ Decoupling of chargers more likely, therefore postive impact more significant

5.5 Tablets – Assessment of the Most Significant Impacts

5.5.1 Summary of Policy Options

Option 0

Under the 'do nothing' scenario there would be no action from the European Commission to harmonise the chargers supplied with tablets. Although the majority of tablets released onto the EU market since 2010 have required a proprietary charger, there has been a gradual shift towards the use of chargers with a USB 2.0 Micro-USB connector. In 2013, almost half of the tablets sold were supplied with a Micro-USB charger. Possible explanations for this shift include the benefits of the Micro-USB connector, e.g. small size and multi-functionality, consumer preferences and portfolio standardisation. It is also possible that the MoU has played a role in this as many of the leading tablet manufacturers are signatories of the MoU for data-enabled mobile phones. Under this option, it is assumed that without intervention, tablets will continue to be supplied with a charger that is considered by the manufacturer to be most appropriate for the purposes of each model, which may or may not be a Micro-USB charger. For example, a manufacturer of tablets and laptops responding to consultation for this study noted that it has no plans to start delivering tablets without chargers, especially those with high-power requirements, as there are many concerns in terms of product safety/compliance, user experience and warranties.

Option 1

Under the facilitation of the European Commission, tablet manufacturers would be encouraged to rach a consensus on the use of a common charger in new devices released after 2017. Earlier models which are still available would be exempt. Owing to the nature of this option, it is possible that some companies would not sign such an agreement, although there would need to be a majority consensus in order to be credible. Technical options would be appraised by manufacturers, with assistance from external actors or standardisation mandates by the Commission where necessary. At this stage, it is not possible to anticipate the outcome of this process, however, as the USB 2.0 Micro-USB connector is being more widely used in tablets, this will be used in this report to demonstrate any impacts of this policy option. Micro-USB connectors conforming to the USB Power Delivery specification (compatible with both USB 2.0 Micro-USB and USB 3.0 Micro-USB connectors) could deliver sufficient connectors for most tablets (up to 60W) but some tablets require higher charging power and as such would have to charged though Standard-USB connectors. Devices using this technology are expected to be released onto the market in 2014. The new USB Type C connector, due to be released in 2014, could also be considered as an alternative charging solution.

As tablets requiring the common charger emerge onto the market, it may become feasible to decouple chargers from new devices after several product cycles (dependant on the length of replacement cycle); under the assumption that consumers already have a compatible charger.

Allowing the use of an adaptor will be explored under this option. In this scenario, manufacturers would be able to use a proprietary connector on the device and make available a separate adaptor which allows the use of the agreed common charger.

Option 2

Under this Option, the European Commission would propose legislation requiring that all new models of tablets introduced onto the EU market after 2017 to have a prescribed connector for the purpose of charging. Models released prior to this date would be exempt. The technical option being proposed is the USB Power Delivery (PD) specification (compatible with the USB 2.0, 3.0 and BC specifications) with the USB 2.0 Micro connector, which can supply up to 60W of power and is capable of transferring data. It is important to note that in order to realise the maximum power output of this specification, the device, cable and host port (charger or PC/laptop) must be PD "aware". Where one of these is not PD "aware" the charging rate will be slower and, depending on the device and maximum output of the charger, the device may not charge (see summary of technical issues in Section 5.4.3 for further information). Some tablets require charging rates above 60W and as such would have to charged though Standard-USB connectors.

As tablets using the common charger emerge onto the market, it may become feasible to decouple chargers from new devices after several product cycles (depending on the length of replacement cycle) under the assumption that consumers already have a compatible charger. The option of decoupling tablets and chargers is raised under several areas, however this is not expected to be realised to any great extent in the short-term as a result of safety/compliance concerns, warranties and consumer expectations. In addition, should power requirements of tablets increase in the future, consumers may need to continue to be supplied with chargers together with new devices, should the old generation of chargers be insufficient to charge them.

Allowing the use of an adaptor will be explored under this option. In this scenario, manufacturers would be able to use a proprietary connector on the device and supply a separate adaptor which allows the use of the common charger.

5.5.2 Summary of Current Charging Requirements

As noted in Section 4, the majority of tablet models within the sample reviewed for this study that were available within the EU between 2009 and 2013 used a proprietary charger (63%). However the use of Micro-USB chargers has increased and in 2013, just over half of all tablets reviewed used a Micro-USB charger (54%). In addition to consultation with industry stakeholders, the charging requirements of tablets have been determined by means of reviewing the charging requirements of 60 tablets (please note that this was not the same sample of products that were reviewed for the purpose of determining the prevalence of Micro-USB). Tables 5-38 and 5-39 display the range of voltages, amperages and wattages outputted by Micro-USB and proprietary chargers for tablets, as well as the average for both Micro-USB and proprietary chargers.

Table 5-38: Charger output of Micro-USB and proprietary chargers for tablets (connectors)

Connector	Charger output					
	Volts (min – max)	Average Volts	Amps (min – max)	Average Amps	Watts (min – max)	Average Watts
Micro-USB	5.0 - 5.1	5.0	1.8 - 2.0	1.97	9.0 - 10.0	9.88
Proprietary	5.0 - 19.5	11.65	0.85 - 3.42	1.88	4.25 - 65.0	22.13
Source: *Data related to the charger output of laptops has been collated from a variety of sources.*						

Table 5-39: Charger output of Micro-USB and proprietary chargers for tablets (screen size)						
Screen size	Charger output					
	Volts (min – max)	Average Volts	Amps (min – max)	Average Amps	Watts (min – max)	Average Watts
Less than 9 inches	5.0 - 12.0	5.6	0.85 - 2.4	1.85	4.25 - 18.0	10.19
9 inches and above	5.0 - 19.5	10.51	1.2 - 3.42	1.92	7.5 - 65.0	20.23
Source: *Data related to the charger output of laptops has been collated from a variety of sources.*						

Comparing Micro-USB and proprietary chargers, it is evident that the range of outputs is greater for proprietary chargers. Looking at the output of Micro-USB chargers, it can be seen that the average power output is around 10W, whereas the average power output of proprietary chargers is more than double this at over 22W. Interestingly, the average current output for proprietary chargers is lower, which means the higher power output is achieved as a result of the proprietary chargers providing a significantly higher voltage. Whereas the typical output for Micro-USB is 5V, the average output for proprietary chargers is 11.65V.

When comparing the characteristics of each connector and device screen size, it would appear that the continued use of proprietary chargers is a result of the higher power requirements of larger screened devices. Chargers for devices with a screen size below 9 inches have a remarkably similar power output to Micro-USB chargers. Indeed, the majority of tablets (78%) which use a Micro-USB charger are the smaller screened devices whose batteries have a lower capacity.

In this regard, it is of interest that a tablet and laptop manufacturer responding to consultation for this study noted that there are essentially two types of tablets: those derived from laptops and those that are an evolution of personal digital assiatance (PDA) devices, although there may be devices that sit somewhere between these two categories. These two categories are said to have very different power characteristics: PDA-derived devices have components that operate at 5V while tablets that originate from laptop architecture have not only components operating at 5V but also components requiring higher voltages such as 12V. Charging requirements correspond to the power requirements of their components: 5V/2A (10W) chargers are sufficient for PDA-derived devices (meaning that Micro-USB charging can be used) while laptop-architecture devices use chargers that resemble laptop chargers (19V and e.g. 65-90W).

5.5.3 Economic Impacts

Operating costs and conduct of businesses/SMEs

Option 0

There would be no impact on the operating costs and conduct of businesses which manufacture tablets. All developments would be driven purely by market forces.

Option 1

The financial implications of the agreed technical option would be an important consideration for tablet manufacturers. A range of charging solutions are currently used in tablet sector and the number of manufacturers impacted would depend on the agreed technical option and the current charging solution(s) of their portfolio. With regard to the USB 2.0 Micro-USB connector charger, it is of note that over half of tablet manufacturers used this connector for the purpose of charging in all

or part of their portfolio. Any other technical options, including the USB 3.x Micro connector and USB Type C connector would impact more manufacturers. However, Table 5-37 shows that Micro-USB is currently only used for tablets that charge at less than 10W and as such manufacturers of larger tablets would be comparatively more impacted and as a result may be less willing to partake in a voluntary agreement; for this reason, a voluntary agreement may need to allow the use of Standard-USB connectors for larger tablets.

The costs associated with adopting the common charger would vary for each business and depend on the technical option. Consultation with manufacturers of chargers has suggested that there are no significant costs to businesses associated with switching from a proprietary connector to a USB 2.0 Micro-USB connector for charging. However, the example of mobile phones suggests that Micro-USB chargers are typically more expensive than their proprietary counterparts. However, this may also be the case with alternative solutions such as USB Type-C. Consultation feedback from a manufacturer of tablets and laptops also suggests that USB Type C chargers are likely to be more expensive, at least in the initial stage of USB Type C adoption. The cost differential between a proprietary and USB Type C charger has been estimated at €2-€4 but this is expected to decline as the uptake of USB Type C increases and production costs decline.

Permitting the use of an adaptor would reduce the costs for manufacturers which would be free to decide whether they wish to comply with the voluntary agreement by means of making adaptors available or providing a common charger.

Option 2

In 2013, 47% of tablet models sold in the EU were supplied with a USB 2.0 Micro-USB connector charger, an increase from 17% in 2011. Of those manufacturers which have been identified as selling tablets in the EU, 51% used the USB 2.0 Micro-USB connector in all or part of their portfolio in 2013. The shift towards the Micro-USB connector for charging suggests there are no significant financial implications to the operating costs and conduct of businesses, at least for smaller tablets. As such, there are no expected financial impacts from adopting the USB Power Delivery Specification with the USB 2.0 Micro-USB connector. However, larger tablets currently use proprietary charging solutions and impacts for manufacturers of these devices could thus be comparatively more significant.

Again, permitting an adaptor would ease pressure on manufacturers to comply with the legislation.

No SMEs have been identified in the EU tablet sector.

A summary of main impacts on operating costs, conduct of business and SMEs is provided in Table 5-5-40.

Table 5-40: Summary of Main Impacts on Operating Costs, Conduct of Business, SMEs			
Impact	**Option 0**	**Option 1**	**Option 2**
Adjustment, compliance and transaction costs	0	0/- Would differ by manufacturer depending on pre-existing level of compliance but generally low	0/-- As for Option 1, only larger in magnitude; manufacturers of more powerful tablets would be comparatively more affected
Investment cycle	0	0	0
Emergence or closure of businesses	0	0	0
Differential treatement	0	0	0
SMEs	0	0	0/-- Use of an adaptor would allow more flexibility and could potentially reduce costs

Innovation and research

Option 0

The technological development of tablets is rapid and there is an increasing trend towards more powerful devices and increased functionality which requires higher powered batteries. Long battery life and fast charging rates are highly regarded among consumers and manufacturers strive to improve these aspects in new models. Without a common charger, there would be no limitations for the development of tablets and charging solutions.

Option 1

In discussions between manufacturers, the technical options would be appraised and their suitability determined. Contrariwise to Option 0, the agreement on a common charger would ultimately mean the acceptance of its limitations and for those which have agreed, there may be implications for the future development of their portfolio. In addition, participating manufacturers are likely to reduce their investment into research and development of charging solutions. However, those which are not part of the agreement would not be subject to any such limitations, possibly resulting in a competitive advantage (considered below). Regular review of the voluntary agreement would ensure that the industry is able to keep pace with developments in technology. Given the current rate of development, for example the forthcoming Type C Micro connector, which has the potential to support tablet development, it would be prudent to review at frequent intervals.

Permitting the use of an adaptor would prevent any negative impacts on innovation by allowing manufacturers to use the most appropriate charging connector on the device and would encourage investment in research and development.

Option 2

Proposing legislation which requires manufacturers of tablets to use a specified charger (for new models), in this case the USB 2.0 Micro-USB connector with the USB Power Delivery specification or the Standard-USB connector with Power Delivery would likely reduce the investment in research and development for charging solutions. Whilst there are benefits to this technical option, including the ability to provide power, transfer data and its small size, locking the industry into a specific solution would likely reduce the rate of innovation. As above, it would be prudent if any legislation was frequently reviewed to ensure development of novel devices is not impaired.

An adaptor would avoid any negative impacts on innovation, as manufacturers would be able to utilise the most suitable connector on the device itself.

Table 5-41: Summary of main impacts on research and development

Impact Area	Option 0	Option 1	Option 2
Innovation	0 R&D will continue with manufacturers seeking to develop both new charging technologies and new models without restriction	- Minimial incentive to invest in R&D of charging solution for signatories. Facility for manufacturers to opt out of any voluntary agreement if undesirable impacts were to occur. Manufacturers more likely to continue to invest in R&D than under Option 2.	-- Legislation would require all tablets to use the common charger. As such the potential impacts on innovation are increased. There is likely to be a reduction in R&D investment of charging solutions.
Impact from allowing adaptors	0	0 Allowing adaptors would permit manufactures to continue to develop products with alternative charging solutions so would not reduce levels of innovation/R&D	0/- Allowing adaptors would permit manufactures to continue to develop products with alternative charging solutions so would not significantly reduce levels of innovation/R&D

Consumers

Option 0

Research has shown that the average selling price of tablets has decreased from €411 in 2010 to an estimated €227 in 2013 and is expected to continue to fall in the coming years under the baseline scenario. This is beneficial for consumers and will increase the number of consumers who are able to access this technology.

Option 1

The production costs of a charger vary depending on the power output, size and type. Irrespective of the type of charger, it represents a miniscule proportion of the final retail price and any impact on

the overall cost of a device to consumers would be negligible. Consumers are unlikely to experience any negative economic impacts given the fact that almost half of tablets released in 2013 used a Micro-USB charger.

The agreement of a common charger for tablets among the majority of manufacturers could result in manufacturers supplying new devices without a charger, although information provided through consultation for this study suggests that manufacturers may be reluctant do unbundle charger and device sales for reasons to do with safety concerns, legal compliance, warranties and consumer expectations. Should large scale decoupling occur, consumers could benefit from cost saving; however, given the charger makes up a very small proportion of the retail price of a tablet, on a per device basis, these savings can be expected to be relatively small.

Any financial impact on consumers surrounding adaptors would depend on the individual's situation, for example, if someone frequently charged their tablet away from home, it may be more convenient to carry an adaptor rather than the proprietary charger; however an adaptor is likely to be an additional cost to the consumer. For those who charge exclusively at home, there would be no financial impact, as the supplied charger would be used. Both situations assume the device is supplied with a charger, but in the event it was not supplied, the consumer would either need to purchase a standalone proprietary charger or an adaptor to use an existing charger.

Option 2

Similarly to Option 1, any additional costs associated with the adoption of the USB Power Delivery specification and USB 2.0 Micro-USB or Standard-USB connector charger may be passed onto the consumer. As the charger does not represent a significant proportion of the final retail price there would be no financial impact on consumers. If manufacturers choose to supply new devices without a charger, there would also be no significant benefit to each individual consumer, although at the aggregate level, consumers a whole would likely accrue relatively significant benefits. In this respect, it is of note that the magnitude of these benefits is dependent on the degree of decoupling. However, as noted above, tablet manufacturers are likely to be reluctant to unbundle new devices and chargers.

As described under Option 1, there is the potential for some consumers to face the additional cost of purchasing an adaptor; however this is dependent on individual circumstances and entirely the decision of the consumer.

Table 5-42: Summary of Main Economic Impacts on Consumers

Impact Area	Option 0	Option 1	Option 2
Costs to consumers	0 /- No additional costs for consumers, however, any savings from the decoupling of chargers from new devices would not be realised.	+/- Depends on extent of decoupling, which, however, can be expected to be low. The charger represents a small proportion of the retail price of a tablet.	++/-- Depends on extent of decoupling, which, however, can be expected to be low. The charger represents a small proportion of the retail price of a tablet. Overall, impacts larger than under Option 1.
Impact from allowing adaptors	0	As above but lesser in magnitude.	As above but lesser in magnitude.

Competition

Option 0

Since tablets became a consumer product in 2010, the number of manufacturers in the market has significantly increased and subsequently there is a diverse range of tablets available to suit the varying requirements of consumers. The market is subject to strong competition which has resulted in the average selling price decreasing, a trend which is set to continue. It is therefore expected that continuing with the status quo would have no impact on competition.

Option 1

In order to assess the impact on competition, it is useful to refer to the MoU for data-enabled mobile phones. During the course of the MoU, the diversity of devices available to consumers has increased and the average selling price decreased. Therefore it is envisioned that Option 1 would not impact competition within the tablet market negatively or otherwise. Owing to the voluntary nature of this option, it is possible that some manufacturers would not be party to the agreement and may gain a competitive advantage, for example theough the development of proprietary charging solutions. Ensuring that the agreement is frequently reviewed would ensure the technical option keeps pace with technological development and reduces any competitive disadvantage to signatories.

Allowing the use of an adaptor would negate any possible negative impacts on innovation and thus increase the number of manufacturers signing up to such an agreement.

Option 2

The legal requirement for tablet manufacturers to use the USB Power Delivery specification with the USB 2.0 Micro-USB or Standard-USB connector on new products would create a level playing field and therefore intra-sectoral competition would not be impacted. However, it is important to bear in mind that the use of common charger may slow down technological development and thus affect inter-sectoral competitiveness. There is a risk that taking a prescriptive approach could result in an unfavourable technical option for some manufacturers. In order to avoid this possibility, it would be advisable to conduct regular reviews of the legislation.

On the other hand, enlarging the market for Micro-USB and Standard-USB connectors would likely increase the level of competition between charger manufacturers.

Again the use of an adaptor would reduce negative impacts on innovation and avoid any impairment of inter-sectoral competition.

Table 5-43: Summary of Main Impacts on Competition			
Impact	**Option 0**	**Option 1**	**Option 2**
Competition (manufacturers of electronic devices)	0	0/- If adverse impacts manufacturers can opt out of the agreement.	0/- Some limited impacts and no possibility for those impacted to opt out.
Competition (charger manufacturers)	0	+ Expected to increase competition in the Micro-USB charger market	++ Expected to increase competition in the Micro-USB charger market

Competitiveness, trade and investment flows

Option 0

There is strong competition within the tablet market and no barriers to trade, as evidenced by the high number of players within the sector and the fact that new companies continue to enter the market. Maintaining the status quo will allow this situation to endure.

Option 1

No large differences between the EU and non-EU markets have been identified, at least as regards charging requirements. No significant impacts on competitiveness, trade and investment flows are expected, in particular considering that manufacturers that would be impacted could opt out of any voluntary agreement.

Permitting the use of an adaptor would further reduce any impacts.

Option 2

As above, no impacts on the competiveness of EU companies are expected. Impacts on international trade could occur, should non-EU manufacturers not be willing to switch to Micro-USB/Standard-USB for high-power laptops. Some manufacturers may suffer from portfolio fragmentation issues, should they be unwilling to switch to Micro-USB/Standard-USB for high-power devices for technical reasons set out for laptops in Section 5.6.

Table 5-44 Summary of Main Impacts on Competitiveness, Trade and Investment flows			
Impact	**Option 0**	**Option 1**	**Option 2**
Competitiveness of EU companies	0	0	0
Trade barriers	0	0	0
Investment flows	0	0	0

Public authorities

Option 0

Under the status quo there would no additional burden to government or public authorities.

Option 1

Member State public authorities are required to inspect shipments of electrical and electronic equipment to ensure they are compliant with standards. It is possible that the work pattern of market surveillance authorities could alter if new devices were sold without chargers, and consequently, the importation of standalone chargers increased. Consultation with manufacturers of mobile phones has suggested that the agreement of a common charger could increase the incidence of unsafe chargers, suggesting that market surveillance and enforcement authorities may face increased workload.

Option 2

Legislating for the use of a common charger in tablets, could increase the sales of standalone chargers which may require increased market surveillance and enforecement as previously mentioned.

Table 5-45: Summary of Main Impacts on Public Authorities

Impact	Option 0	Option 1	Option 2
Additional administrative burden	0	- Shift in workload of market surveillance authorities as a result of increased sale of standalone chargers	-- Same as for Option 1 but larger in magnitude.
Budgetary consequences	0	0	0

Third countries and international relations

Option 0

The current tablet market is global, with major markets in Europe, the US and increasingly China and other developing markets. Many of the main manufacturers are based in Asia and manufacture within their national country in most instances. Indeed, most tablet manufacturers have facilities or commission companies in Asia to produce their tablets. As manufactures are able to choose the charging method of devices, including proprietary, there are no concerns with regard to international standards, etc.

Option 1

Should the agreed technical option have negative impacts, e.g. costly components or hindering innovation, it is possible that some manufacturers of tablets would not sign the agreement. However, owing to the voluntary nature of Option 1, those manufacturers who are not party to the agreement would still be able to trade within the EU.

Permitting the use of an adaptor would largly avoid any negative impacts and likely increase the number of manufacturers agreeing to a common charger.

Option 2

Option 2 would apply to all tablets sold in the EU and should the technical option have negative impacts, manufacturers may cease to sell their devices in the EU. However, this is a worst case scenario and is most likey to be the case for manufacturers that supply high power devices and whose sales are largely outside of the EU and which do not hold a large market share in the EU. The

USB specifications are widely available, therefore it is not envisaged that there will be any impacts concerning international standards.

Permitting the use of an adaptor would reduce any negative impacts and consequently the chance of manufacturers discontinuing sales of the devices in the EU.

Table 5-46: Summary of Main Impacts on Third countries and International Relations			
Impact	**Option 0**	**Option 1**	**Option 2**
Third countries	0	0	0
International relations	0	0	0

5.5.4 Social Impacts

Consumer convenience

Option 0

Without an agreement or legislation for a common charger, manufacturers will be free to choose the most appropriate type of charger for a particular tablet. There has been a migration towards Micro-USB chargers, particularly for smaller devices. Should this trend continue, consumers could be able to use tablet chargers of friends and family when away from the home or indeed use the chargers from other portable rechargeable devices, e.g. mobile phones. However, it must be noted that Micro-USB chargers supplied with tablets have a higher output than those supplied with other devices and as such the charging time of the tablet would be significantly lengthened when using such a charger (for an overview of technical issues associated with the use of different chargers, including slow and no charging, see Section 5.4.3). Tablets will almost certainly be shipped with a charger, which appears unnecessary in some cases. However, it is worth noting that the inclusion of a charger with any new device is often expected by consumers. Indeed, if a consumer chooses to sell their old devices the inclusion of a charger with new devices is beneficial.

Option 1

A voluntary agreement among manufacturers to use a common charger for tablets would have a positive impact on consumer convenience by increasing the possibility of being able to use an existing tablet charger or or one for another product group using Micro-USB chargers (subject to the technical issues described for other devices in Section 5.4.3). Such benefits would be primarily accrued by users of low-powered tablets using Micro-USB chargers. However, the extent of this beneficial impact would depend on the number of manufacturers that signed up to the agreement and if implemented in isolation from other devices, may only be fully realised after several product cycles.

Such an agreement may result in manufacturers not including chargers with new devices when the majority of existing chargers are compatible with the technical option. This action would reduce the number of chargers consumers own and minimise clutter. As the majority of tablets on the market since 2010 have used a proprietary charger this would only be a sensible arrangement after at least one product cycle.

Permitting the use of an adaptor would in all likelihood increase the number of manufacturers signing an agreement and therefore could increase consumer convenience. An adaptor would allow existing compatible chargers to be used and when away from home.

Option 2

This option has the potential to provide the greatest improvement to consumer convenience as it would maximise interoperability (again, subject to the limitations described in Section 5.4.3). The proposed technical option is the USB Power Delivery (PD) specification with the USB 2.0 Micro-USB or Standard-USB connector. The Micro-USB PD connector is backwards compatible with the USB 2.0, 3.0 and BC specifications. Therefore, it would be theoretically possible to use any charger with a USB 2.0 Micro connector to charge a tablet. However, unless the charger is PD "aware" the charging rate would be slower and depending on the manufacturer, the device may not charge if the power output of the charger is too low.

Under this option, the possibility of omitting chargers as a standard inclusion with new low-powered tablets becomes more feasible as many consumers already have a USB 2.0 Micro connector charger. However, in order to ensure devices charge within a satisfactory time period, Power Delivery "aware" chargers would need to be included with new devices for several product cycles. In this respect, it is of note that devices using the USB Power Delivery specification and USB 2.0 Micro connector are expected to become more popular after 2015[329], increasing the likelihood that consumers will be able to charge their tablet with an existing charger.

Table 5-47: Summary of Main Impacts on Consumer Convenience

Impact Area	Option 0	Option 1	Option 2
Consumer convenience (no adaptors)	+ At present, there appears to be a migration towards Micro-USB charging, particularly in smaller tablets. Should this trend continue consumer convenience will increase, although proprietary chargers will still be used.	+ Relatively high in terms of products on the market as those with high market shares likely to participate	++ All products covered, most effective in terms of consumer convenience
Consumer convenience (adaptors allowed)	0	0/+ Likely to increase participation in agreement but consumers will need to purchase adaptors if no charger supplied	0/++ Permitting adaptors could encourage the use of proprietary connectors which is less convenient for consumers

Health and safety

Option 0

There are currently no issues with the health and safety of individuals concerning the charging of tablets. Without a common charging solution all tablets will be supplied with a charger manufactured by the OEM which conforms to all the relevant standards.

[329] BGR website: The key to an energy – efficient future: USB everywhere, accessed at http://bgr.com/2013/10/22/usb-energy-efficiency-standard/

Option 1

Agreement among the majority of manufacturers to use a common charger may result in the omission of chargers with new devices under the assumption that consumers already have a compatible charger.

As noted in Section 5.4.5 for other rechargeable devices, some stakeholders believe that decoupling the sales of chargers and devices could potentially increase the prevalence of unsafe chargers on the market, unless market surveillance and enforcement increases to deal with this issue.

Option 2

As above, some stakeholders believe that should the decoupling of the sales of chargers and devices occur, this could potentially lead to an increase in the existence of unsafe chargers on the market if this were not accompanied by increased market surveillance and enforcement.

It can be expected that impacts would differ depending on the type of tablet in question. Smaller 5V tablets would thus face issues similar to those described in Section 5.4 for mobile phones, e-readers, PNDs, portable media players, sports and activity monitors and personal care products. However, larger tablets requiring higher voltages would face issues more akin to those described in Section 5.6 for laptops.

Table 5-48: Summary of Main Impacts on Health and Safety

Impact	Option 0	Option 1	Option 2
Consumer health and safety	0	- Possible increase of un-safe chargers if decoupled from devices	- Possible increase of un-safe chargers if decoupled from devices

Employment

Option 0

The tablet market has continued to grow in terms of companies, sales and revenue since 2010. Assuming the market trends will persist for a number of years, proceeding with the status quo, it is highly likely that new jobs would be created.

Option 1

Desk-research indicates there is currently no manufacturing of tablets within the EU, although it is likely that there is a small amount of employment in relation to research and development and retail activities. Therefore, any impacts on employment within the EU will be insignificant.

Option 2

The possible effect on employment is similar to that outlined under Option 1 and no significant impact is expected. Tablets continue to become more innovative with each product cycle and the design teams are experienced in meeting legal requirements. Those manufacturers who are not already using Micro-USB chargers might be at a slight disadvantage.

As discussed above, the levels of employment associated with tablets in the EU is low compared to other regions of the world. Any impacts are thus unlikely to be significant.

The decoupling of chargers from new devices would become more feasible with legislation; as a result, manufacturers of chargers could experience a reduction in sales, and consequently employment. Any impacts would not be realised in the short-term, as devices are expected to be shipped with chargers for at least one product cycle. Indeed, decoupling may not be possible for some devices given the length of the replacement cycle and intended review cycle of the legislation are roughly the same.

Table 5-49: Summary of Main Impacts on Employment in the EU			
Impact	**Option 0**	**Option 1**	**Option 2**
Creation of jobs	0	0	0
Loss of jobs	0	0	0

5.5.5 Environmental Impacts

Resource use, waste generation/recycling

Option 0

Receiving a charger with a new tablet and being unable to use an existing charger is not beneficial to the environment for two reasons. Raw materials are required to produce each charger, some of which may be rare and environmentally damaging to extract and process. The inability to use an existing charger inevitably means that this must be disposed of, even if it is in full working order. In this situation, the most appropriate option would be to recycle the charger; however it is much more efficient to treat waste further up the waste hierarchy through reuse or preventing its creation in the first place. As noted earlier, an increasing number of manufacturers use USB 2.0 Micro-USB connector chargers and one manufacturer, Amazon, does not include the charging unit with new devices (data transfer cable included). At present it is not possible to conclude whether this trend is likely to continue and lead to any tangible environmental benefits.

Option 1

As discussed previously, the adoption of a common charger among the majority of tablet manufacturers could result in their decoupling from new devices, although it was noted by a manufacturer of tablets responding to consultation for this study that this would be associated with product safety/compliance, user experience and warranty issues, meaning that this particular manufacturer would be reluctant to unbundle the sales of devices and chargers. This has the obvious benefit of reducing e-waste by enabling the reuse of an existing charger (assuming it is compatible) and avoiding the creation of new chargers. Realisations of such benefits are unlikely in the short-term, as manufacturers currently opt to include chargers to meet health and safety requirements, warranty purposes and consumer expectations. If the technical option is capable of charging and data transfer, it would be possible to reduce e-waste by supplying a charger with a detachable cable, which removes the need to supply a separate charger and data transfer cable[330].

[330] Tech Week Europe website: Universal Charging Standard to Include Tablets, Cameras, accessed at http://www.techweekeurope.co.uk/news/universal-charging-standard-to-include-tablets-cameras-28689

Option 2

Legislation requiring the use of a common charger, in this case the USB 2.0 Micro-USB or Standard-USB connector with the USB Power Delivery specification, would make it more realistic to decouple chargers from new tablets, but as noted above, manufacturers may in some instances be unwilling to unbundle chargers and devices, especially for higher-powered devices. The impacts of decoupling would be a reduction of e-waste and raw material consumption. As discussed above these benefits are unlikely to be realised in the short-term, firstly due to manufacturer's preferences and secondly, limited prevalence of Power Delivery "aware" technology.

Decoupling scenarios and methodology used in Section 5.4.6 to calculate savings in raw material consumption for mobile phones, e-readers, PNDs, personal media players, sports and activity monitors, digital cameras and camcorders and personal care devices can also be applied to tablets. Table 5-35 in Section 5.4.6 thus also contains estimates of raw material savings from 2% and 50% decoupling in the tablet sector. The estimated annual savings are less than 300 tonnes from 2% decoupling and 7,200 tonnes from 50% decoupling.

Table 5-50: Summary of Main Enviromental Impacts

Impact	Option 0	Option 1	Option 2
Resource use, waste generation/recycling, international environmental impacts	0 Inclusion of charger with the majority tablets	0/+ Reduced resource consumption when chargers are decoupled from new devices	0/++ Decoupling of chargers more likely, therefore postive impact more significant

5.6 Laptops – Assessment of the Most Significant Impacts

5.6.1 Summary of Policy Options

Option 0

Under the 'do nothing' scenario, no action would be taken by the European Commission to harmonise the chargers used in laptops. With the exception of Chromebook 11 from Google and HP, which uses a Micro-USB connector charger, all laptops require a proprietary charger, which is largely a result of their high power requirements. At this stage it is not possible to discern whether the use of Micro-USB and Standard-USB chargers would increase without intervention by the European Commission but it is recognised that recent developments in USB standards now allow significantly higher power delivery through the Micro-USB connector (up to 60W) and Standard-USB connector (up to 100W).

Option 1

Under Option 1, through the facilitation of the European Commission, manufacturers of laptops would come to a voluntary agreement regarding a common charging solution for new devices released onto the EU market from 2017. Models already on the market in 2017 would be exempt. A range of options would likely be discussed by manufacturers; these could include the USB Power Delivery (PD) specification or the technical specification for a single external charger for laptops

released by the International Electrotechnical Commission (IEC)[331], perhaps in conjunction with the upcoming USB Type-C connector. The PD specification is capable of providing up to 60W through the Micro-USB connector (USB 2.0 or 3.0) and 100W with the Standard-USB connector. There is currently no standardisation of charging solutions for laptops and it is not possible to speculate as to the mostly likely agreed technical option. For this reason, although Micro-USB/Standard-USB connectors are used as a point of reference for this impact assessment, this is not meant to suggest they represent the most likely or the most suiatable option for harmonisation of laptop charging.

Allowing the use of an adaptor will be explored under this option. In this scenario, manufacturers would be able to use a proprietary connector on the device and make available a separate adaptor which allows the use of the agreed common charger.

Option 2

Under Option 2, the European Commission would propose legislation requiring all new laptop models introduced to the EU market from 2017 onwards to be equipped with a prescribed charging connector.

Owing to the uncertainty surrounding the power requirements of laptops in the future, the impact assessment will consider the impacts of both the Micro-USB and Standard USB connector with the Power Delivery specification. However, it should be highlighted that neither connector would provide sufficient power for all laptop models currently on the market.

Allowing the use of an adaptor will be explored under this option. In this scenario, manufacturers would be able to use a proprietary connector on the device and make available a separate adaptor which allows the use of the agreed common charger.

5.6.2 Summary of Current Charging Requirements

Although some consultation responses have indicated that the power requirements of laptops are currently around 40W to 45W and are expected to decrease further in the future, another consultation response (from a laptop and tablet manufacturer) suggests that laptops typically need 45W-90W, with some laptops needing between 120W to 220W, although these high-powered laptops are not as common as a few years ago. In addition, a sample of 80 laptops currently available in the EU have been reviewed by the study team and the charger output in this sample ranged from 10W to 240W, averaging 70W. In this case, Micro-USB PD connectors are not sufficient for the average laptop and even the USB PD specification with the Standard USB connector would not be sufficient for high powered gaming and multimedia models which require a charger output above 100W.

Table 5-51 displays the range of voltages, amperages and wattages used for the charging of the sample of 80 laptops reviewed for this study. It should be noted that with the exception of the HP Chromebook 11 which uses Micro-USB, all laptops are supplied with a proprietary charger. From the sample of laptops, it would seem that there is a clear relationship between the size of the laptop (screen size has been used a proxy) and the output of the supplied charger. There is a notable increase in the range of outputs as well as the average output as the screen of the laptop increases. It must also be noted that most chargers (73%) deliver 19V at anything between 1.58A to 12.63A.

[331] International Electrotechnical Commission website: Major Milestone: single charger for notebook computers will significantly reduce e-waste, accessed at http://www.iec.ch/newslog/2013/nr2713.htm

Table 5-51: Charger outputs of laptop chargers						
Screen size	Charger					
	Volts (min – max)	Average Volts	Amps (min – max)	Average Amps	Watts (min – max)	Average Watts
Below 11 inches	5.0 - 19.0	15.9	1.58 - 3.42	2.13	10.0 - 65.0	34.22
11 to 14 inches	5.3 - 19.0	16.8	1.75 - 7.89	3.19	15.75 - 150	54.15
14.1 to 15.6 inches	14.5 - 19.0	18.5	2.37 - 7.11	3.79	45.0 - 135.0	70.34
15.6 inches and above	19.0 - 19.5	19.1	3.42 - 12.63	7.1	65.0 - 240.0	135.1
Source: Data related to the charger output of laptops has been collated from a variety of sources.						

5.6.3 Technical Issues Associated with the Use of Micro-USB Charging

The key technical issue relates to the fact that most Micro-USB chargers currently owned by consumers were designed for devices charging a power levels that are significantly lower than those used by laptops. This means that consumers that own a smartphone Micro-USB charger would expect to be able to use it to charge their laptop but would be unable to do so due to the inability of smartphone chargers to deliver sufficient power.

A manufacturer of laptops and tablets responding to consultation was highly sceptical of the use of Micro-USB for the charging of laptops (and other larger devices) and highlighted a range of potential technical issues, including:

- a mobile phone charger is primarily for charging, with only limited device use while charging. However, laptops are generally expected to operate (most of the time) while plugged into the mains, the requirements on the charger are very different;
- current Micro-USB chargers are typically designed to deliver 5V/7.5W but (as noted above), the power requirements of laptops are significantly higher;
- some companies allegedly use the Micro-USB connector to deliver higher power than that envisaged in the specification. However, there is no good way for the laptop to know if it is connected to a 7.5W Micro-USB charger or one that can deliver higher power (e.g. 15W or 30W), meaning that if a Micro-USB charger is connected a laptop, it can attempt to draw too much power and overheat the charger;
- Micro-USB is not sturdy enough for use with laptops, which tend to be significantly heavier than small rechargeable devices. For example, pulling on a cable of a charger connected to a mobile phone through Micro-USB simply typically moves the handset. However, pulling on a cable of a charger connected to a laptop may in some instances break the connector.

Another issue relates to the possibility that a high-power laptop charger is used to charge a low-powered device, such as a mobile phone, which is associated with safety concerns. For a general overview of safety issues please see Section 5.4.3.

Overall, this manufacturer stated that in the mobile phone sector, there are also technical issues but due to the low charging power, these are not very significant. However, the higher charging power of laptops means that these issues would be amplified in the laptop sector. Another technical issue highlighted with regard to the development of a common charger is the need to comply with EMC requirements; a manufacturer of laptops and tablets expressed doubts about the possibility of common chargers passing EMC, especially when purchased 'off the shelf' from external suppliers.

The above technical issues were highlighted by the manufacturer as more important than cost considerations. It was further noted by this manufacturer that some of these issues will be addressed in the USB Type-C specification which is expected to become public in 2014. This specification will reportedly resolve the above-mentioned problem of laptops not being able to correctly identify the power capability of a charger and will also ensure that laptop chargers can be used for smartphones.

In this regard, it is of interest that the HP recently temporarily halted the sale of HP Chromebook 11 (the only laptop identified by this study as relying on Micro-USB for charging) after reports of chargers melting during use, leading to "one customer sustaining a minor injury and another burning a pillow" (Ghosh, 2013)[332]. Google and HP have subsequently recalled chargers sold before 1st December 2013 and offered consumers a replacement charger (Ghosh, 2013 and CPSC, 2013)[333]. This was a charger designed and manufactured by a third party and consumers were advised that it was safe to continue using Micro-USB chargers supplied with other products such as smartphones and tablets (Google, not dated)[334].

5.6.4 Economic Impacts

Operating costs and conduct of business/SMEs

Option 0

As no harmonisation would occur under Option 0, there would no impacts on the operating costs and conduct of businesses.

Option 1

The economic impacts would be an important aspect of any discussions between manufacturers with regards to a voluntary agreement of a common charger for laptops. The extent of any impacts on the operating costs and conduct of businesses would depend on the agreed technical option. As there is currently a wide range of chargers in use, it is reasonable to assume that all manufacturers would be impacted equally. There will be costs associated with designing devices and chargers that are compliant, however without knowing the technical option and the precise requirements placed on it, it is not possible to determine whether the production costs would increase significantly.

Permitting the use of an adaptor would allow manufacturers to adopt a more flexible approach to compliance by continuing to supply devices with a proprietary charging connector on the device itself. The use of an adaptor would minimise costs of implementing the common charger.

Option 2

Under Option 2, all manufacturers of laptops would be required to utilise the common charger on all new models released onto the EU market from 2017 onwards. The technical option being proposed is the USB Power Delivery specification, with either the Micro-USB or Standard-USB connector.

[332] Ghosh (2013): Google recalls melting HP Chromebook 11 chargers, available at http://www.pcpro.co.uk/news/386143/google-recalls-melting-hp-chromebook-11-chargers

[333] CPSC (2013): Google and HP Recall HP Chromebook 11 Chargers Due to Fire and Burn Hazards; Charger Can Overheat and Melt, available at http://www.cpsc.gov/en/Recalls/2014/Google-and-HP-Recall-HP-Chromebook-11-Chargers

[334] Google (not dated): Important update on the HP Chromebook 11, available at https://support.google.com/chromebook/answer/3723447?hl=en-GB

Currently, there is only one device which relies on Micro-USB for charging. The USB Power Delivery specification has a power output capable of delivering up to 60W or 100W which is sufficient for a number of laptops. As laptops are already equipped with standard USB ports, it is reasonable to assume that the use of such ports for charging the device, albeit meeting the required specification, would not be prohibitively expensive. Similarly, USB components are widely available and as such are not expected to be significantly more costly than those of a proprietary charger; indeed, there may be some costs savings through economies of scale.

As regards alternative, the USB Type-C could be considered. In this respect, it is of interest that a laptop manufacturer estimated that the use of USB Type-C will make laptop charging €2-€3 more expensive when compared with proprietary chargers (per notebook, covering both the device side and the charger). However, as USB Type C becomes widespread, its production cost is expected to decline significantly over the coming five years. However, it is reported that power delivery through the Type-C connector may also be limited to 100W[335].

Permitting manufacturers to utilise an adaptor would facilitate a flexible approach to compliance, minimising any economic impacts.

Table 5-52: Summary of Main Impacts on Operating Costs, Conduct of Business, SMEs

Impact	Option 0	Option 1	Option 2
Adjustment, compliance and transaction costs	0	0/- Unknown but could be limited negative impacts	0/- Unknown but could be limited negative impacts
Investment cycle	0	0	0
Emergence or closure of businesses	0	0	0
Differential treatement	0	0	0
SMEs	0	0	0

Innovation and research

Option 0

Under the 'do-nothing' scenario, manufacturers would be able to use the charging solution which is most appropriate for the device and there will be no constraints on product innovation. Manufacturers can benefit from new charging solutions and are thus likely to invest in the research and development in this area.

Option 1

Under a voluntary agreement, it can be presumed that manufacturers will select the technical option which provides the least negative impacts on innovation. Laptops require significantly more power than other portable rechargeable devices. If the charging solution does not provide sufficient power it is possible that technological development of laptops could be hindered. In order to ensure the innovation of the market or a particular type of laptop is not impacted, it is advisable to review any agreement at regular intervals. Regular review will also encourage manufacturers to remain part of the voluntary agreement. Thorough appraisal of the possible technical options should also help to avoid any negative impacts in this area. The financial investment into research and development of

[335] Merriman (2014): Design for next generation reversible USB 3.1 cable is revealed, available at http://www.theinquirer.net/inquirer/news/2338243/design-for-next-generation-reversible-usb-31-cable-is-revealed

charging solutions may decrease under Option 1. However, those manufacturers which are not party to the agreement can benefit from new charging solutions and therefore will continue to invest in this area of research.

Allowing the use of an adaptor could minimise any negative impacts on innovation, as manufacturers would be free to use the most appropriate charging solution for the laptop.

Option 2

Legislating for the use of a common charger in laptops, in this case the USB Power Delivery specification, with either the Micro-USB or Standard-USB connectors, may slow down innovation as these cannot deliver sufficient power for some models. As previously suggested, it would be wise to review the legislation regularly to ensure the latest charging solution is employed and innovation is not negatively impacted. All manufacturers would be subject to the legislation, therefore investment into research and development of charging solutions could be reduced.

Again, the use of adaptors would help reduce the potential impacts on innovation as manufacturers could use the most suitable connector on the device itself and supply an adaptor which permits the use of the common charger.

Table 5-53: Summary of main impacts on research and development

Impact Area	Option 0	Option 1	Option 2
Innovation	0 R&D will continue with manufacturers seeking to develop both new charging technologies and new models without restriction	- It is possible that agreement on a common charger for laptops would restrict the develop and functionality of new models Minimial incentive to invest in R&D of charging solution for signatories Facility for manufacturers to opt out of any voluntary agreement if undesirable impacts, who would also continue to invest in R&D	-- Legislation would require all laptops to use the common charger. As such the potential impacts on innovation are increased. There is likely to be a reduction in R&D investment of charging solutions.
Impact from allowing adaptors	0	0 Allowing adaptors would permit manufactures to continue to develop products with alternative charging solutions so would not reduce levels of innovation/R&D	0/- Allowing adaptors would permit manufactures to continue to develop products with alternative charging solutions so would not significantly reduce levels of innovation/R&D

Consumers

Option 0

As there are no changes under Option 0, no economic impacts on consumers are expected.

Option 1

When considering the technical option for the common charger, the economic impacts on both business conduct and the final retail price for consumers will undoubtedly be an important consideration. Manufacturers are unlikely to decide on a solution which will result in the price of laptops increasing significantly, especially given the increasing level of competition with other product groups such as tablets. Consultation with charger manufacturers has indicated that the cost to produce a laptop charger is higher than other portable rechargeable devices as the components are capable of delivering significantly higher power. As such the charger accounts for a higher proportion of the retail cost of laptops than is the case for other product groups and any increase to production costs could noticeably increase the retail price.

The possibility of decoupling chargers from new devices has been discussed within the impact assessments of the other portable rechargeable devices being considered in this study. As for tablets, at least one product cycle may be necessary before decoupling becomes feasible. Consultation with laptop manufacturers has reported that the average replacement cycle for laptops is five years; therefore it would be many years before decoupling could be viable. Given the high charging requirements of laptops, it is highly unlikely that chargers for other product groups could be used for laptops even where the same connector was used. It is worth noting that given the length of the replacement cycle for laptops and review period of the agreement may be similar, decoupling chargers may never be a viable option for laptops.

Permitting manufacturers to use adaptors where appropriate will have no economic impact on consumers in the short-term. As discussed above, new devices are expected to be sold with chargers for the foreseeable future and there would be little benefit to consumers from purchasing an adaptor. In the longer-term, should manufacturers decide to decouple chargers and new laptops, consumers may face an additional cost if they choose a device with a proprietary connector.

Option 2

As previously mentioned under the Operating Costs and Business Conduct section, the proposed technical option under Option 2 is largely untested in terms of charging of laptops. As such it is not possible to ascertain whether there will be any economic impacts on consumers. If the costs of using the USB Power Delivery specification (Micro-USB or Standard-USB connector) were significant, manufacturers may opt to pass a proportion of these costs onto the consumer. Similarly to Option 1, the possibility of decoupling chargers from new devices could only be considered after at least one product cycles. This is not expected to occur in the short-term and depending on the outcomes from legislation review, may never be viable. In which case there would be no economic impact on consumers. The economic impacts of an adaptor are largely the same as Option 1 as new devices will be sold with chargers in the foreseeable future, whether proprietary or not.

Table 5-54: Summary of Main Economic Impacts on Consumers

Impact Area	Option 0	Option 1	Option 2
Costs to consumers	0 /- No additional costs for consumers, however, any	0/- This is an untested solution but if costs	0/- This is an untested solution but if costs

Table 5-54: Summary of Main Economic Impacts on Consumers			
Impact Area	**Option 0**	**Option 1**	**Option 2**
	savings from the decoupling of chargers from new devices would not be realised.	similar to USB Type-C, there is a potential for increased costs, decoupling unlikely	similar to USB Type-C, there is a potential for increased costs, decoupling unlikely
Impact from allowing adaptors	0	As above	As above

Competition

Option 0

There is a high degree of competition within the laptop market, with an extensive choice of laptops for consumers, with a variety of technical specifications and prices, which will continue under Option 0. However inter-sectoral competition, mainly from tablets and smartphones, has negatively impacted the sales of laptops in Europe and other regions.

Option 1

Negative impacts in other areas, such as innovation or business operating costs, could result in a reduction in consumer choice and higher prices. This could also impact the competitiveness of the laptop market, for example, if the retail price of devices increased, consumers may choose to purchase a tablet with a lower price or a desktop computer for the same price which has higher specifications. Owing to the voluntary nature of Option 1, it is a possible that some laptop manufacturers would not agree to the use of a common charger, resulting in a possible competitive advantage, anti-competitive behaviour and market segmentation. Unless the manufacturers agreeing to the common charger accounted for the majority of the market, this option would not be feasible.

The use of an adaptor could avoid any negative impacts.

Option 2

The use of legislation which would apply to all manufacturers selling laptops in the EU creating a level playing field and thus minimising any market segmentation and anti-competitive behaviour. As discussed earlier, due to the fact that the USB Power Delivery specification (Micro-USB or Standard USB connector) has not been applied to laptops, it is not possible to conclude whether there would be any impacts in other areas which would lead to a reduction in consumer choice or higher prices. The final technical option which the Commission legislates will require regular review to ensure it is not unfavourable for any manufacturers.

Again, the use of an adaptor could avoid any negative impacts for manufacturers in other areas which could lead to impacts on competition.

Table 5-55: Summary of Main Impacts on Competition			
Impact	**Option 0**	**Option 1**	**Option 2**
Laptop manufacturers	0	0/- If adverse impacts manufacturers can opt out of the agreement.	0/- Some limited impacts and no possibility for those impacted to opt out.
Charger manufacturers	0	+ Expected to increase competition in the Micro-USB charger market	++ Expected to increase competition in the Micro-USB charger market

Competitiveness, trade and investment flows

Option 0

The laptop market is global, with the large players operating across the world. Under Option 0, there will be no negative impacts on the competitiveness of EU companies, trade barriers or cross-border investment flows.

Option 1

A voluntary agreement to use a common charger for laptops would have no impact on the competitiveness of EU companies. There would be no impact on trade barriers and cross-border investment flows.

Option 2

Similarly to Option 1, there would be no impacts on competiveness, trade and investment flows.

Table 5-56: Summary of Main Impacts on Competitiveness, Trade and Investment flows			
Impact	**Option 0**	**Option 1**	**Option 2**
Competitiveness of EU companies	0	0	0
Trade barriers	0	0	0
Investment flows	0	0	0

Public authorities

Option 0

There would be no changes under Option 0, and consequently no change to the work pattern of public authorities or any additional burden.

Option 1

Market surveillance authorities are required to check that imported electrical goods meet the necessary standards and legislative requirements. As laptops are expected to be shipped with a charger for the foreseeable future, there will be no additional burden on these authorities in relation to standalone chargers. Decoupling is unlikely as manufacturers are expected to be concerned about safety issues, EMC compliance, etc. However, should decoupling occur, the workload of market surveillance and enforcement authorities is likely to increase.

Option 2

The impacts would be similar to those outlined above for Option 1.

Table 5-57: Summary of Main Impacts on Public Authorities			
Impact	**Option 0**	**Option 1**	**Option 2**
Additional administrative burden	0	0 (Decoupling unlikely)	0 (Decoupling unlikely)
Budgetary consequences	0	0	0

Third countries and international relations

Option 0

There would be no impacts on third countries or international relations under Option 0.

Option 1

As the agreement for a common charger would be voluntary, those manufacturers which have not agreed are still able to sell their products within the EU. Therefore there will be no impact on third countries and international relations. It would be advisable to ensure that the common charger is agreeable at the international level, e.g. an international standard.

Option 2

Legislation proposed by the European Commission may not be the same as requirements in other countries but this is not expected to have a negative impact on international relations. Appropriate consultation with manufacturers would reduce the likelihood of this occurring. Coordination of emerging international standards (e.g. those being developed by the International Electrotechnical Commission, IEC)[336] would be advisable.

Table 5-58: Summary of Main Impacts on Third countries and International Relations			
Impact	**Option 0**	**Option 1**	**Option 2**
Third countries	0	0	0
International relations	0	0	**0**

5.6.5 Social Impacts

Consumer convenience

Option 0

Under Option 0, the current arrangement for including a proprietary charger with new laptops will continue. This is not beneficial for those consumers who already have a compatiable charger from a previous model. As noted above, decoupling is unlikely to occur. In addition, laptops have a variable battery life which decreases over time and requires frequent charging, therefore the inclusion of a charger with each device is necessary in most cases.

[336] International Electrotechnical Commission website: Major Milestone: single charger for notebook computers will significantly reduce e-waste, accessed at http://www.iec.ch/newslog/2013/nr2713.htm

Option 1

An agreement for the use of a common charger would have a positive impact on consumer convenience, although to a lesser degree than other portable rechargeable devices, as explained below. For those laptops which are released after 2017, it will be possible to use the charger from another laptop, although this will depend on the brand of the laptop and those manufacturers which have signed the agreement. This could possibly negate the need to take a charger when using the device from home or the office. However, the charging requirements for different laptops means the technical issues described in Section 5.5.3 for other devices may restrict consumer benefits in terms of charging laptops using somebody else's charger. As highlighted above, the inclusion of a charger with laptops can be convenient for consumers as they require frequent charging when in use. In any case a reduction in the number chargers as the possibility of decoupling chargers from new laptops is unlikely in the short-term due to the high incidence of proprietary chargers in the current generation of laptops and the relatively long replacement cycle.

The use of adaptors is likely to increase the number of manufacturers agreeing to a common charger, therefore the possibility of being able to use the charger from another laptop is further increased, which is beneficial to consumer convenience. An adaptor represents a marginal improvement in convenience for consumers whose laptop uses a proprietary charger.

Option 2

Requiring all laptop manufacturers to use a common charger would be most beneficial for consumer convenience. As previously discussed, the potential to improve consumer convenience in terms of reducing the number of chargers owned is limited and is perhaps undisireable for those consumers whose laptops have heavy use and poor battery life. The USB Power Delivery specification can be used in conjunction with the Standard USB connector and Micro-USB connector, both of which are not capable of supplying sufficient power for all current models of laptop. The result would be slow charging rates, an obvious inconvenience for consumers.

Under this option the use of an adaptor will result in the persistence of proprietary chargers.

Table 5-59: Summary of main impacts on Consumer Convenience

Impact Area	Option 0	Option 1	Option 2
Consumer convenience (no adaptors)	0	0/+ Some improvement likely	0/++ All products covered, most effective in terms of consumer convenience
Consumer convenience (adaptors allowed)	0	0/+ Likely to increase participation in agreement but consumers will need to purchase adaptors if no charger supplied	0/++ Permitting adaptors could encourage the use of proprietary connectors which is less convenient for consumers

Health and safety

Option 0

Without a common charging solution all laptops would be supplied with a charger produced by the manufacturer which is suitable to charge the device and conforms to all relevant standards.

Option 1

Consultation with manufacturers of mobile phones and chargers has reported that the use of a common charger can lead to an increase in the occurrence of unsafe chargers. This could also be the case for the common laptop charger. As mentioned earlier, there is only one case of a laptop being supplied with a Micro-USB connector charger, which was in fact recalled due to safety issues, although consumers have been offered a replacement Micro-USB charger and were advised that other Micro-USB chargers are safe to use.[337] Safety concerns relating to technical issues mentioned in Section 5.6.3 would also need to be addressed.

Option 2

Again, the increased incidence of unsafe chargers and above mentioned technical issues a possible health and safety issue under Option 2. Potential safety issues may also arise should the Micro-USB connector be adopted for laptops as well as other portable rechargeable devices that require lower power, such as mobile phones. It can be expected that some consumers would attempt to use a Micro-USB charger designed for a laptop to charge their handset, resulting in issues described in Section 5.4.3. This suggests that careful consideration should be given to potential interactions and safety implications of policy action with regard to low-powered devices such as mobile phones, e-readers, etc. and high-powered devices such as laptops anc tablets.

Table 5-60: Summary of Main Impacts on Health and Safety

Impact	Option 0	Option 1	Option 2
Consumer health and safety	0	-	-

Employment

Option 0

Under Option 0, the levels of employment within the EU and outside will be determined by market forces. The market for laptops has decreased in recent years. Should this trend persist, it is possible that levels of employment within the sector could be negatively impacted.

Option 1

It is not anticipated that Option 1 will have any impact on employment. If sufficient manufacturers reached an agreement on a common charger, Option 1 could result in minor short-term changes to the levels of employment, mostly within research and design departments/companies.

[337] See, for example, https://www.cpsc.gov/en/Recalls/2014/Google-and-HP-Recall-HP-Chromebook-11-Chargers/, http://www.androidcentral.com/hp-chromebook-11-chargers-recalled-due-fire-and-burn-hazards, http://www.pcpro.co.uk/news/386143/google-recalls-melting-hp-chromebook-11-chargers

Option 2

The impacts on employment would be the same as those outlined under Option 1, although on a slightly larger scale as all manufacturers would be required to utilise the common charging solution for laptops. Overall there will be no significant impact on employment in the laptop market.

Table 5-61: Summary of Main Impacts on Employment in the EU			
Impact	**Option 0**	**Option 1**	**Option 2**
Creation of jobs	0	0	0
Loss of jobs	0	0	0

5.6.6 Environmental Impacts

Resource use and waste production/generation/recycling

Option 0

Under Option 0, the 'do nothing' scenario, all laptops will continue to be supplied with a charger and there will be little possibility of using an existing charger. This has a negative impact on the environment by increasing the need for raw material extraction and generating electrical waste.

Option 1

As previously mentioned, the use of a common charging solution could in principle result in the decoupling of chargers from new devices, which would reduce the use of raw materials for the production of new chargers and also reduce electrical waste as existing compatible chargers could be reused.

However, this is not feasible for laptops in the short-term, as virtually all current generation laptops use a proprietary charger and it will take several years for the common charger to reach consumers due to the long replacement cycle of laptops (five years according to consultation with a laptop manufacturer). As a full product cycle is needed for all consumers to have a charger conforming to the voluntary agreement, should this agreement be revised at about five yearly intervals, decoupling would not occur. In addition, a manufacturer of laptops responding to consultation for this study noted that due to issues related to safety/compliance, user experience and warranty, they would be reluctant to unbundle the sales of the device and chargers.

Option 2

The impacts on the environment are broadly the same as under Option 1, however as all laptop manufacturers would be subject to the legislation for a common charging solution, the potential for decoupling would be increased, although as noted above, manufacturers may be reluctant to decouple chargers from devices.

It is possible that there will be a reduction in electrical waste and raw material extraction in the future, although any positive impacts on the environment would be on a smaller scale compared to the other devices covered by this study. Whilst it is possible to calculate the annual reductions in raw material consumption under the different scenarios (around 300 tonnes under 2% decoupling and 7,900 tonnes under 50% decoupling; see Table 5-35 in Section 5.4.6), achieving significant decoupling rates would be much more difficult in the laptop sector than for some of the other portable electronic devices.

A stakeholder responding to consultation for this study also cautioned that prior to mandating a common charger, consideration should be given not only to safety issues but also to energy efficiency as laptops rely on complex charging technologies to best manage energy consumption.

Table 5-62: Summary of Main Enviromental Impacts			
Impact	**Option 0**	**Option 1**	**Option 2**
Resource use, waste generation/recycling, international environmental impacts	0 No decoupling	0 Decoupling unlikely	0 Decoupling unlikely

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