European Commission - Directorate-General for Energy
Framework Contract ENER/C3/2012-418-Lot 2

REVIEW STUDY ON COMMISSION REGULATION (EC) NO. 278/2009 EXTERNAL POWER SUPPLIES

Draft Final Report

viegand maagøe
energy people

Project Number: 794

Version: Draft Final Report, 13 March 2012

Prepared by: CM, JV

Prepared to: European Commission - Directorate-General for Energy

Quality Assurance: AG

Approved by: JV

Viegand Maagøe

Nr. Farimagsgade 37

1364 Copenhagen K

Denmark

Telephone: +45 33 34 90 00

www.viegandmaagoe.dk

viegand maagøe energy people

Summary

This document addresses “Commission Regulation (EC) No 278/2009 of 6 April 2009 with regard to ecodesign requirements for no-load condition electric power consumption and average active efficiency of external power supplies (EPS)”.

A review of this regulation is due in April 2013, and it is scheduled for discussion at a consultation meeting at this time.This study evaluates the need for a formal redrafting of the regulation, taking into account new products/technologies, scope, improvement potential, and wider environmental considerations.

The report concludes that there is an opportunity to save nearly 3 TWh per year by 2025 through the following changes to the regulation (in order of magnitude):

1. Tiered requirements based off the EU Code of Conduct, timed for introduction after the EU CoC requirements have been in place (Tier 1 2015, Tier 2 2017), and an additional Tier 3 (2019) based off a slightly increased ambition.
2. Inclusion of multi-voltage and high power (>250W) EPS within scope of the measure.
3. Inclusion of wireless chargers in scope, at efficiency requirements in line with other EPS.
4. Inclusion of active efficiency requirements at 10% load.

A breakdown of the savings per change is shown in the table below:

Total potential savings per year in 2025 as a result of a review of the scope of the legislation:

Scope change	**Saving (TWh) per year 2025**	**Test method available?**	**Requirement basis?**
Revised requirements, three Tiers	1.461	Yes	Yes
High power (>250W) EPS in scope	0.002	Yes	Yes
Multiple Voltage Output EPS in scope	0.839	Yes	Yes
Wireless Chargers in scope	0.538 +	No	No
10% loading active efficiency requirement	0.125	No	Yes

Note: Whilst a formal test method for 10% load does not exist, it would require only a small amendment to existing test methods. Wireless car charging has not been assessed in the wireless charger figure above – only low voltage products.

There are also ambiguities in scope and definitions that could be clarified.

Contents

1 Introduction

1.1 Project Scope

This project scope focuses on the Commission Regulation (EC) No 278/2009 of 6 April 2009 with regard to ecodesign requirements for no-load condition electric power consumption and average active efficiency of external power supplies (EPS). The scope was informed by the European Commission as a Request for Services under the Framework Contract EN-ER/C3/2012-418-Lot 2.

A review of this regulation is due no later than four years after entry into force, and a Consultation Forum meeting is scheduled to discuss this regulation on 18 April 2013.

The scope of this project was to:

- Analyse and use existing key documents (i.e. CLASP-analysis) as basis for the review study of the above mentioned regulation, and, if appropriate, relevant legislation in third countries;
- If necessary, collect and evaluate relevant market data;
- Identify new products and technologies that have relevance in the context of the regulations and assess whether the scope of the regulations is still appropriate;
- Conclude on further improvement potential;
- Assess other aspects that might require an adaptation of the regulations:
- Attend the Consultation Forum as technical experts in April 2013 (exact date to be determined);
- Submit the final report by 1 September 2013;
- Revise the reports on the Commission's request and send an amended version within 5 working days;
- And provide technical assistance such as for discussions in the Consultation Forum, the inter-service consultation in the Commission, and discussions in the Regulatory Committee.

1.2 The Regulation

EC regulation no. 278/2009 applies to power supplies that have an output of less than 250W and supply just one output voltage at a time. It applies only to those EPSs that are designed for use with electrical and electronic goods used in the household and the office, such as mobile phone chargers, EPS built into plugs, and separate power packs such as laptop power supplies.

The main requirements of the regulation focus upon no-load power consumption and average efficiency.

There are some specific exemptions from the regulation, including battery chargers that connect directly to removable batteries such as a charger for general AA batteries, and uninterruptable power supplies. Furthermore, product groups as furniture are excluded.

The energy efficiency and no load power demand of external power supplies has been the focus of a number of initiatives in recent years. The main initiatives of specific relevance to an EPS regulation revision are listed in Appendix A, although it should also be noted that there are parallel activities in other continents such as Australia and Japan.

2 Potential for savings as a result of legislation revision

There are various aspects of the revision that could be revised in order to achieve further savings. These include revised requirement levels, but also widening of scope.

2.1 Revised requirement levels

2.1.1 Market status

In terms of the current efficiency status of the market, a best-available-technology medium-power EPS could have around 86% average efficiency, across a wide range of output powers, from 10 to 100% load, with a no load standby level as low as 0.01W. A lower powered EPS, which would tend to be very cost sensitive, could still feasibly achieve 75% efficiency at between 25 to 100% load, and 0.03W in no load/standby. These levels exceed the current ErP criteria which are 70% efficiency and no load 0.3W.[1]

2.1.2 Opportunity for improvement

There are further technical improvements that could be exploited for additional reductions in energy consumption, and trends in new architectures, increased efficiency, smaller form factor, increased power management[2]. In order to improve efficiencies toward 90% (exceeding the US DOE levels) the following would be necessary (at a price premium):

- Larger MOSFET3 to reduce on losses
- Field effect transistors (FETs) and diodes made from exotic materials (compound semiconductors) – not commercially feasible in competitive consumer products.

In order to achieve efficiencies at the levels proposed in the US regulatory approach (DOE rulemaking – see Appendix A) / EU voluntary Code of Conduct (CoC - see Appendix A) Tier 2, less expensive components (cost effective controller ICs) could bring EPS toward the efficiency of 85 to 87% (in the 25 to 100% power range) with a power factor of 0.8 to 0.9 or better. This is supported by data contained in the DOE rulemaking analysis, which shows that their proposed standards can already be met by EPSs currently available on the market[4]. For the rest of the market to meet these efficiency levels, design changes would be required but these could be achieved with relatively small added cost, and the no-load limits would be achievable with no extra cost[5].

No load power of 100mW or less is becoming typical in procurement specifications. Low to medium EPSs can achieve levels of just 10 to 30mW no load power loss.

---

[1] MTP Product Bulletin – External Power Supplies
[2] CLASP 2012: Annex B. External Power Supplies / A Discussion Paper Prioritising upcoming revisions to existing implementing measures under the ecodesign and energy labelling directives
[3] MOSFET means: metal–oxide–semiconductor field-effect transistor – it is a transistor used for amplifying or switching electronic signals.
[4] U.S. Department of Energy: Technical Support Document: Energy Efficiency Program For Consumer Products And Commercial And Industrial Equipment: Battery Chargers And External Power Supplies, March 2012
5 E-mail correspondence with Richard Fassler, Power Integrations, February 2013

2.1.3 Basis for requirements

In light of the further potential for improvements in the EPS market, the following scenario[6] is proposed:

- Tier 1 in line with EU CoC Tier 1 from 1 January 2015 (EU CoC enters into force in January 2014, and DOE requirements more similar to Tier 2 in first part of 2015)
- Tier 2 in line with EU CoC Tier 2 from 1 January 2017 (EU CoC enters into force in January 2016)
- Tier 3 1 January 2019 (More strict than EU CoC Tier 2. No-load ÷ 1.025; efficiency x 1.025)

52% of the 2012 models would need to be redesigned to meet Tier 1 requirements, and 93% redesigned to meet Tier 2[7]. Whilst these levels appear to be achievable at relatively low cost to manufacturers, it is unlikely that a MEPS could be proposed at levels higher than these proposals in the short term. However, more ambitious requirements have been defined as a longer term "Tier 3", to provide adequate time for the market to transform in order that the costs or meeting the requirements are not prohibitive to manufacturers.

2.1.4 Savings as a result of revised requirements

We calculate that the revision described above, without any additional changes to the EPS legislation, could result in savings of 1.46 TWh per year by 2025[8].

2.2 Revised scope

The EPS market has changed and continues to change since the introduction of ErP requirements in 2009. In particular, the US DOE requirements address three product classes in addition to those currently covered by the European EPS regulation – high power, indirect operation and multiple voltage output:

2.2.1 High-Power (>250W) EPS

These EPS could be used with products that are within the defining ErP scope of home and office equipment.

- **Volume: Low.** Whilst they are usually sold as standalone products through specialised distributors some are used as supplies for hobbyist amateur radio units. Volumes are low - the annual shipments of amateur radios in the US are around 3,000 per year[9]. Some EPS for mobile workstations (high specification notebook products) are also nearing the 250W level[10] and could foreseeably reach or exceed the 250W level in future years.
- **Basis for requirements: Yes.** Whilst the EU CoC does not define requirements for these products, the US DOE rulemaking does (see Appendix B) – these could provide the basis for Tier 2 levels for 250W EPS. If Tier 1 levels were required, these would need to be determined, potentially via a small study.
- **Opportunity for improvement: High.** Often these EPS are low efficiency, as linear supplies are favoured for amateur radio in the belief that they generate less transient

[6] This scenario is similar to scenario 1 of the CLASP report, but the timings of the tiers are later, and an additional Tier 3 is included.

[7] CLASP 2012: Annex B. External Power Supplies / A Discussion Paper Prioritising upcoming revisions to existing implementing measures under the ecodesign and energy labelling directives

[8] Note: For the purposes of simplicity, and in line with the CLASP analysis, no assumptions regarding the impact of the Code of Conduct are included in this figure.

[9] U.S. Department of Energy Slides from Stakeholder Meeting 2012 "Energy Conservation Standards Proposed Rulemaking for Battery Chargers and External Power Supplies"

[10] For example: http://h18004.www1.hp.com/products/quickspecs/14316_na/14316_na.html

noise[11]. However, whilst this was an issue with the earlier generation of switched mode EPS, it is unlikely to be an issue now[12]. We calculate that savings by including these requirements under the EPS regulation could be 1.7 GWh per year by 2025.

It can be concluded that there is an opportunity to bring these products under scope of ErP, ensuring consistency of the requirements across energy using products.

2.2.2 Multiple Voltage Output

These power supplies can provide more than one output voltage to an end-use application simultaneously.

- **Volume: Medium.** The only use of a multiple voltage EPS that the DOE rulemaking research was able to identify is a video game console. Estimated US shipments were at nearly 8,000 in 2013.
- **Basis for requirements: Yes.** As these EPS tend to operate at between the at 50% and 75% maximum load levels, DOE introduced the idea of averaging the efficiency measurements at just these levels for a multiple voltage output supply.[13]
- **Opportunity for improvement: Medium.** These EPS are on average reasonably efficient, but could still be improved by regulatory requirements. We calculate that savings by including these requirements under the EPS regulation could be 0.84TWh per year by 2025.

It seems feasible that these power supplies could be included, however, the consequences of changing or removing the scope statement (b) “it is able to convert to only one DC or AC output voltage at a time” would have to be carefully assessed.

2.2.3 Indirect Operation

“Indirect operation” EPS are defined in the US DOE draft requirements as EPS not capable of powering a consumer product without the assistance of a battery. The product the EPS powers only works when a battery is installed and it is drawing power from it, and the EPS must first deliver power to charge the battery before the product can function. Such a product could be a home security alarm for example.

- **Volume: Medium.** In the US DOE analysis shipments in 2013 are estimated at around 77 thousand.
- **Basis for requirements: No.** The DOE viewed these EPS as a part of the battery charging system and assessed them via their battery charger engineering analysis[14]. It is likely therefore that these products would come under the “battery charger” exclusion of

[11] U.S. Department of Energy 2012: Technical Support Document: Energy Efficiency Program For Consumer Products And Commercial And Industrial Equipment: Battery Chargers And External Power Supplies, March 2012
[12] http://ludens.cl/Electron/PS40/PS40.html
[13] U.S. Department of Energy Notice of proposed rulemaking (NOPR) and public meeting : Energy Conservation Program: Energy Conservation Standards for Battery Chargers and External Power Supplies
[14] U.S. Department of Energy 2012: Technical Support Document: Energy Efficiency Program For Consumer Products And Commercial And Industrial Equipment: Battery Chargers And External Power Supplies, March 2012

the current EPS legislation. A specific charger-related regulation may address these products more successfully and consistently.

- **Opportunity for improvement: Not assessed**

In addition to these additional DOE defined product classes, there are also the following considerations:

2.2.4 Wireless chargers

This is a charging approach that is increasing in popularity in applications such as mobile phones and electric vehicles. A base charging unit (usually a plate or platform containing an induction coil) is necessary, plus added componentry in the product for charge. In the case of mobile phones is often provided by means of an additional casing. The wireless charging unit could be connected to the mains either via:

1. A separate EPS that connects physically to the base charging unit (and can be disconnected from the charging unit by the user)
2. A hard-wired EPS connection to the base charging unit.

In either case, with the current definitions the EPS would be covered under the ErP legislation, but the charging base unit would not be considered as part of the system in scope, due to requirement (e) "it is connected to the device that constitutes the primary load via a removable or hard-wired male/-female electrical connection, cable, cord or other wiring;"

- **Volume: High.** Wireless technology is improving rapidly, and prices reducing as a result, although there are still issues of competing wireless standards to be resolved. Whilst the technology is still at an early stage, there have been various predictions of rapid increases in sales expected in future years. A 2010 study predicted sales of product-specific wireless charging solutions nearing 250 million units worldwide by 2014[15], whilst a less optimistic study suggested that by 2015 there could be around 100 million devices that support wireless charging on the market, compared with the 5 million sold in 2012[16]. Another 2012 study suggested that sales of products with wireless power capability will triple in the next eight years[17], with some sources suggesting that it could even be a standard feature in new products by 2016/2017[18]. Wireless charging could be extended to larger-scale appliances.
- **Basis for requirements: Needs work.** Wireless charging was not addressed in any detail in the DOE rulemaking analysis. There is currently a lack of comprehensive data on which to base such requirements, although given sufficient time it is reasonable to expect that wireless charging units perform in line with other EPS serving the same purpose (perhaps with a small extra "wireless" allowance). A "mini-preparatory study" may be necessary to consider potential requirements and test approaches for these products.
- **Opportunity for improvement: High.** Wireless charging is currently likely to be less efficient than wired charging as there can be increased resistive heating, and charging can be slower. The transfer efficiency of wireless charging has been stated at around 70%[19] (in addition to the efficiency of the connection of the EPS to the mains supply).

[15] http://eetimes.com/electronics-news/4201059/Rapid-growth-wireless-charging-devices
[16] http://www.smartplanet.com/blog/report/why-wireless-charging-is-bigger-than-you-think/1190
[17] http://www.forbes.com/sites/davidferris/2012/07/24/how-wireless-charging-will-make-life-simpler-and-greener/
[18] http://tech2.in.com/features/general/wireless-charging-will-it-become-an-industry-standard/756752
[19] http://www.wirelesspowerconsortium.com/technology/total-energy-consumption.html

Top efficiencies in the region of 87% have been reported[20] (but are unlikely to be found in current market products), which shows that considerable improvements are possible. We calculate that savings by including these requirements under the EPS regulation could be 0.54 TWh per year by 2025 for just low voltage products. Car charging has not been considered in this figure, and could result in much higher additional savings.

Taking into account this potential for rapid growth, and the potentially low efficiencies found currently in these products, the scope of the EPS legislation could be widened to include wireless charging base units by changing the text in stipulation e) along the following lines:

"it is connected to the device that constitutes the primary load via a removable or hard-wired male/-female electrical connection, cable, cord or other wiring, **OR a wireless connection**;"

2.3 Additional active efficiency requirements

2.3.1 10 % Loading Efficiency

It is possible for EPS that appear efficient on the normal four-point measurement scale (25%, 50%, 75% and 100% load) to still perform badly at the 10% loading level. Active efficiency requirements at the 10% loading level would address this issue.

- **Volume: High.** Telecom operators have commented that "*ever more (external) power supplies for ICT products will work at the 10-30% load range."*[21] There is a likelihood that many products in low-network-availability (LONA) network standby will be in this load range. However, the advantages of addressing efficiency in 10% loading conditions would not apply to mobile phone EPS[22],
- **Basis for requirements: Yes.** Requirements at 10% load have been proposed in the CoC redraft. Although manufacturers suggested that such additional requirements should be tailored depending upon EPS application, this could add complexity. The CoC draft took the simple approach of defining 10% loading efficiency requirements for both low and standard voltage EPS.
- **Opportunity for improvement: Medium.** As the suggestion of measurement of efficiency at the 10% level is a recent one for external power supplies, there is not an extensive evidence base to facilitate analysis of the potential impacts of these requirements. However, results as shown in the figure below have been found in preliminary work to support ENERGY STAR computer specification revisions. The four sample units measured in the figure have very similar average efficiency (88 to 89%), but perform very differently at low loading levels (0 to 20% load). If these EPS are to be used with products that frequently operate at the 10% load level, the actual variation in performance could be up to 7 percentage points from the four-point efficiency average. Savings by including a 10% efficiency requirement are estimated at 0.13 TWh per year in 2025.

[20] http://www.thenewstribe.com/2013/02/21/samsung-vs-apple-wireless-charging-race-samsung-galaxy-4-and-iphone-6-to-have-new-technologies/
[21] EU CoC meeting minutes from September 2012 meeting.
[22] Note: Mobile EPS are unlikely to benefit from 10% efficiency improvements as they either charge the battery at full load or are unplugged or in no load condition.

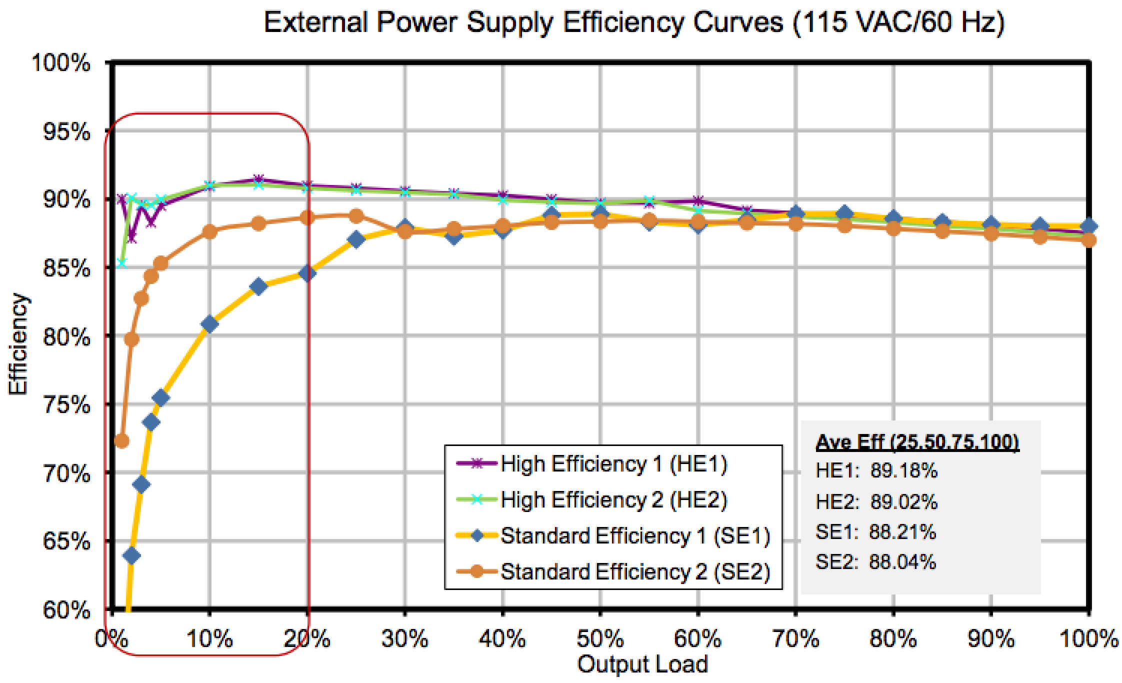

Figure 1 – Large differences in low-load EPS efficiency[23]

2.4 Summary of potential savings

Total potential savings per year in 2025 as a result of a review of the legislation:

Scope change	Saving (TWh)	Test method available?	Requirement basis?
Revised requirements, three Tiers	1.461	Yes[24]	Yes
High power (>250W) EPS	0.002	Yes[25]	Yes
Multiple Voltage Output EPS	0.839	Yes[26]	Yes
Wireless Chargers	0.538	No	No
10% loading active efficiency requirement	0.125	No	Yes

Note: Whilst a formal test method for 10% load does not exist, it would require only a small amendment to existing test methods. Wireless car charging has not been assessed in the wireless charger figure above – only low voltage products.

[23] NRDC presentation under ENERGY STAR computer v6.0 specification discussions http://energystar.gov/products/specs/sites/products/files/V6_D2_NRDC-Stakeholder_Presentation.pdf

[24] Test Method for Calculating the Energy Efficiency of Single-Voltage External Ac-Dc and Ac-Ac Power Supplies; Chris Calwell, Suzanne Foster, and Travis Reeder, Ecos Consulting, Arshad Mansoor, Power Electronics Application Center (EPRI-PEAC), August 11, 2004, funded by the Public Interest Energy Research (PIER) programme, California Energy Commission
http://efficientpowersupplies.epri.com/pages/External_Power_Supply_Efficiency_Test_Method_8-11-04.pdf

[25] DOE Test Procedures for Battery Chargers and External Power Supplies (Standby Mode and Off Mode) Final Rule on March 27, 2009. 74 FR 13318. http://www.regulations.gov/#!documentDetail;D=EERE-2009-BT-TP-0019-0020

[26] DOE Test Procedures for Battery Chargers and External Power Supplies (Standby Mode and Off Mode) Final Rule on March 27, 2009. 74 FR 13318. http://www.regulations.gov/#!documentDetail;D=EERE-2009-BT-TP-0019-0020

3 Additional changes to consider at revision

The following changes may be necessary if a revision is to be undertaken, although their impact has not been quantified in this study:

3.1 Ambiguity in scope

The CLASP paper suggests that there may be some ambiguity in the scope – especially regarding EPSs that are sold with products already covered by ErP.

The regulation states that the following are not in scope:

“external power supplies placed on the market no later than 30 June 2015 as a service part or spare part for an identical external power supply which was placed on the market not later than one year after this Regulation has come into force, under the condition that the service part or spare part, or its packaging, clearly indicates the primary load product(s) for which the spare part or service part is intended to be used with.”

This is only in reference to replacement parts for products placed on the market in the first year of the Regulation being in force, so it seems reasonably clearly defined.

However, in an EC FAQ document[27]published by the Commission, the following statement is made in reference to EPSs for products that are not in scope of the ecodesign directive:

“The market surveillance authority’s opinion is that power supplies with standard connectors are within the scope only if they can be bought and used by the end-user independently of the product and all the elements of the 'external power supply' definition are met. Power supplies intended only for use with a product not in scope of 1275/2008 are not in scope of 278/2009, even if sold separately, but the intended use must be clearly stated.”

This could lead to a misunderstanding that only power supplies that are bought separately to the product are within scope. It is suggested that the intention was for the statement to read:

“The market surveillance authority’s opinion is that power supplies with standard connectors **for use with products that are not in scope of 1275/2008** are within the scope only if they can be bought and used by the end-user independently of the product and all the elements of the 'external power supply' definition are met. Power supplies intended only for use with a product not in scope of 1275/2008 are not in scope of 278/2009, even if sold separately, but the intended use must be clearly stated.”

3.2 Low voltage power supply definition

The definition used in the CoC for these products is:

“a Low Voltage external power supply is defined as an external power supply that satisfies both of the following criteria:

- a nameplate output voltage of less than 6 volts and
- a nameplate output current greater than or equal to 550 milliamps.”

This is consistent with the definition in the current ErP regulation:

[27] ”Frequently Asked Questions (FAQ) on the Ecodesign Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products and its Implementing Regulations”, http://ec.europa.eu/enterprise/policies/sustainable-business/documents/eco-design/guidance/files/faq_en.pdf

'low voltage external power supply' means an external power supply with a nameplate output voltage of less than 6 volts and a nameplate output current greater than or equal to 550 milliamperes"

The 2009 amendment to the standby regulation (contained within the EPS regulation) states the following:

"This Regulation shall not apply to electrical and electronic household and office equipment placed on the market with a low voltage external power supply."

It is assumed that the intention of this amendment was to remove mobile phone chargers from the standby regulation. However, there are smartphones currently on the market that may sit outside this exemption and therefore be considered under scope of the standby regulation, in comparison to the majority of mobile phone chargers. Thus, the definition of a low voltage EPS may need to be reconsidered to ensure future consistency across this EPS group.

The other issue to consider is whether other EPS should also be excluded from the standby regulation.

3.3 USB Adaptor plugs in scope

Many handheld products, such as e-readers, are being placed on the market only with a USB connector for charging via a computer. Adaptor plugs are available, for use with the USB cable in order that it can be charged directly from the mains. These plugs may have one USB connection, or multiple USB connections (able to charge more than one device at a time from the same wall socket).

Whilst these chargers are already likely to be efficient, we suggest that if a review of the legislation is undertaken, the following clarifications be made to ensure they are included in scope:

- Remove the following clause so that plugs with more than one output are included: (b) it is able to convert to only one DC or AC output voltage at a time"
- Clarify (via FAQ, guidance or amendment to the regulation) the statement regarding a connection along the following lines:

  "(e) it is connected to the device that constitutes the primary load via a removable or hard-wired male/- female electrical connection, cable, cord or other wiring, **that may or may not be placed on the market with the power conversion component;**

3.4 Chargers with integrated backup batteries in scope

There are products now available on the market that contain battery back up, and in some cases also feature solar trickle charging capability[28]. They often feature more than one USB connection, in order to charge multiple products at the same time.

Whilst these chargers are already likely to be efficient, we suggest that if a review of the legislation is undertaken, the following clarifications be made to ensure they are included in scope:

[28] For example, see: http://revolveusa.com/index.php?p=1_17

- Remove the following clause so that plugs with more than one output are included: (b) it is able to convert to only one DC or AC output voltage at a time"
- Amend the definition of a battery charger to ensure these are in scope, as follows: "A 'battery charger' is defined as "a device, which connects directly to a removable battery at its output interface, **with the primary purpose of charging that battery**."

3.5 Common external power supply requirements

A 2012 ITU press release and report stated that "standards for the manufacture of external power supplies (EPS) could enhance their reliability and extend their lifecycle while decreasing their average weight by up to 30 per cent."[29] They would also be likely to reduce the volumes of EPS placed on the market. Such savings provide a case for wider lifecycle impacts to be taken into account in the revision of the regulation. Whilst the ITU standards are very high-level, progress has already been made on more detailed EN standards, which could provide the basis for requirements related to common EPS design to be included in a revision of the ecodesign measure. In the interim, the expired MoU on a common external power supply (see appendix A) could be renewed by its signatories, to ensure that parties continue to include such ecodesign considerations in their products.

3.6 Power factor

It was decided not to place requirements on power factor at 230V in the ENERGY STAR EPS specification for the following reasons:

1. Manufacturer comments suggested that power factor losses are less significant at 230V than 115V, because as the current halves, the conduction losses become one-quarter of what they would be at 115V.
2. Manufacturers stated that a specific 0.9 power factor requirement at 230 volts could result in a shift from single stage to dual stage power factor correction architecture. This could be less cost and resource effective than the single stage approach and have a detrimental effect on active mode efficiency.
3. Products sold in Europe are required to meet the standard for harmonic currents (EN 61000-3-2), and thus are effectively covered for power quality at 230V.

The CLASP report stated that "Although power factor is clearly endorsed in the full load criteria for EPS regulatory and voluntary policy, it should receive greater consideration in non-load criteria for EPS."

29 http://www.itu.int/net/pressoffice/press_releases/2012/59.aspx

Appendix A – Existing Studies and Activities

CLASP Analysis

CLASP is an international non-profit organisation working in the area of appliance energy efficiency. They published a discussion paper on 20th February 2013 on "Estimating potential additional energy savings from upcoming revisions to existing regulations under the ecodesign and energy labelling directives.[30]" The paper assesses the additional energy savings potential from seven product groups due for review between now and the end of 2014, and one of the chapters addresses external power supplies (EPS).

The paper provides the most recent study on the size, energy impact and potential for savings in the EU PSU market, and has been used as one of the main references of this report. In particular, the CLASP model has provided the basis for the exploration of various potential savings scenarios for this report.

EU Code of Conduct

The EU Codes of Conduct (CoC) are voluntary initiatives involving for industry, experts and Member States. They provide a mechanism for setting ambitious commitments on energy efficiency, through an ongoing dialogue on market developments and product / system performance. The goal is for the CoCs to provide more ambitious targets than would be proposed in MEPS / legislation, so that the best performing companies can gain recognition for their efficient products.

The current revision (version 4[31]) of the CoC on External Power Supplies, that entered into force in April 2009, aligns with ENERGY STAR v2.0 / EPS ecodesign regulation requirements, but also specifies more stringent requirements for power supplies of 8W and less (aimed at EPS for small handheld products like mobile phones).

Two meetings were held in 2012 to discuss revisions to these requirements, and a draft of version 5 was released in September 2012. The goal of this draft was that it would be more ambitious than mandatory measures in order to provide manufacturers with additional recognition for their products. It was also viewed as important to make clear in the definitions the difference between low voltage EPS and other EPS.

The proposed requirements include:

- Tier 1 (2014), efficiency less ambitious than DOE rulemaking proposals, including 10% loading requirements for non-low voltage EPS.
- Tier 2 (2016), efficiency in line with DOE rulemaking proposals, including 10% loading requirements as above.
- No load values: Values less ambitious than the DOE proposals for Tier 1, and more ambitious than DOE proposals for Tier 2.

30 http://www.clasponline.org/~/media/Files/SLDocuments/2013/Estimating%20Potential%20Additional%20Energy%20Savings.pdf

31 Code of Conduct on Efficiency of External Power Supplies - Version 4 of 8.4.2008 - valid from 27.04.2009, http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative.htm

For full detail of the proposal please see Appendix B. Note: The Tier 2 levels are still under discussion and may align with the US DOE approach depending upon how the finalisation of drafts for each initiative synchronises.

US Department of Energy

The US DOE is nearing the end of its process to develop revised efficiency MEPS for external power supplies (referred to as a “rulemaking” procedure). As part of this rulemaking procedure, they have created detailed documentation examining the power supply area (which provided the foundation for some of the CLASP analysis).

The requirements as currently proposed are detailed in Appendix B. They would come into effect around 2015.

The EU CoC proposes to apply requirements on the basis of four-point average efficiency (measured at 25%, 50%, 75% and 100% of rated output current), and additional requirements for the efficiency measured at the 10% level. However, the US DOE requirements do not currently address this 10% loading scenario.

Memorandum of Understanding on a Common External Power Supply

In 2009 an EU memorandum of understanding (MoU) was established between the mobile phone industry and the European Commission on compatibility of new data-enabled mobile phones with a common EPS interface agreed by the signatories. This reduces the need for individual EPSs to be placed on the market with mobile devices, is more convenient for users, and reduces waste impacts due to redundant chargers when users change mobile phone. The agreement expired at the end of 2012, so it now due for renewal.

In order to establish the technical standards to act as a foundation for the MoU, the European Commission issued a standardisation mandate to CEN, CENELEC and ETSI on a common "Charging Capability for Mobile Telephones." The following progress was then made on standards:

- A CENELEC task force was created to develop the specifications, and they were published in December 2010 as EN 62684:2010, "Interoperability specifications of common external power supply (EPS) for use with data-enabled mobile telephones."[32] This standard defines the common charging capability and specifies interface requirements for the EPS.
- The International Electrotechnical Commission (IEC) released its version of the standard as IEC 62684:2011 In January 2011[33],
- The IEEE working group (WG/P1823) are addressing this area.
- The International Telecommunication Union (ITU) published high level smart universal power adapter standards in June 2012[34]

[32] "New standard for common mobile chargers". cenelec.eu, http://www.cenelec.eu/pls/apex/f?p=WEB:NEWSBODY:3695278126835242::NO::P300_NEWS_ID:21

[33] "One size-fits-all mobile phone charger: IEC publishes first globally relevant standard". International Electrotechnical Commission. http://www.iec.ch/newslog/2011/nr0311.htm

[34] ITU-T Recommendations L.1001 and L.1000 for a universal charger solution for mobiles, http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=11348

In terms of wider environmental impacts, continued progress in this area has the potential to result in considerable reductions at the end of life stage. Now that progress is being made on standards, a revision of the EPS regulation could include reference to these standards as a requirement.

Appendix B – Levels under discussion under various EPS initiatives

Table 1 - Requirements in Current Ecodesign Regulation for EPS[35] - Tier 1

No-load Power (not to exceed Wattage) – April 2010		
Nameplate Output Power (P_{no})	Standard Voltage	Low Voltage (Mobile handheld battery driven and $P_{no} < 8W$)
$0.3\ W \leq P_{no} < 49\ W$	Shall not exceed 0.50W	
$50\ W \leq P_{no} < 250\ W$	Shall not exceed 0.50W	N/A
$250\ W < P_{no}$	N/A	N/A
Four Point Average Active Efficiency (not less than %) – April 2011		
Nameplate Output Power (P_{no})	Standard Voltage	Low Voltage
$0 < P_{no} \leq 1.0\ W$	$P_o < 1.0\ W$	
$1.0\ W < P_{no} \leq 49.0\ W$	$1.0\ W \leq P_o \leq 51.0\ W$	
$49\ W < P_{no} \leq 250\ W$	$P_o > 51.0\ W$	
$250\ W < P_{no}$	N/A	N/A

Table 2 - Requirements in Current Ecodesign Regulation for EPS[36] - Tier 2

No-load Power (not to exceed Wattage) – April 2010			
Nameplate Output Power (P_{no})	AC-AC EPS, except low voltage EPS	AC-DC EPS except low voltage EPS	Low Voltage (Mobile handheld battery driven and $P_{no} < 8W$)
$0.3\ W \leq P_{no} < 49\ W$	0.50 W	0.30 W	0.30 W
$50\ W \leq P_{no} < 250\ W$	0.50 W	0.50 W	N/A
$250\ W < P_{no}$	N/A	N/A	N/A
Four Point Average Active Efficiency (not less than %) – April 2010			
Nameplate Output Power (P_{no})	AC-AC and AC-DC EPS, except low voltage EPS		Low Voltage
$P_o < 1.0\ W$	$0.480 \times P_o + 0.140$		$0.497 \times P_o + 0.067$
$1.0\ W \leq P_o \leq 51.0\ W$	$0.063 \times \ln(P_o) + 0.622$		$0.075 \times \ln(P_o) + 0.561$
$P_o > 51.0\ W$	0.870		0.860
$250\ W < P_{no}$	N/A		N/A

[35] Table copied from "CLASP 2012: Annex B. External Power Supplies / A Discussion Paper Prioritising upcoming revisions to existing implementing measures under the ecodesign and energy labelling directives"
[36] Table copied from "CLASP 2012: Annex B. External Power Supplies / A Discussion Paper Prioritising upcoming revisions to existing implementing measures under the ecodesign and energy labelling directives"

Table 3 - Requirements Proposed for US DOE Regulation for EPS (as at March 2012)[37]

No-load Power (not to exceed Wattage) – approx 2015		
Nameplate Output Power (P_{no})	Standard Voltage	Low Voltage (output voltage < 6V, nameplate output current ≥ to 550 mA)
P_{no} < 50 W	≤ 0.100 W	≤ 0.100 W
50 W < P_{no} ≤ 250 W	≤ 0.210 W	≤ 0.210 W
250 W < P_{no}	≤ 0.500 W	≤ 0.500 W
Four Point Average Active Efficiency (not less than %) – approx 2015		
Nameplate Output Power (P_{no})	Standard Voltage	Low Voltage
P_{no} ≤ 1.0 W	≥ 0.5 × P_{no} + 0.16	≥ 0.517 × P_{no} + 0.087
1.0 W < P_{no} ≤ 49.0 W	≥ 0.071 × ln(P_{no}) – 0.0014 × P_{no} + 0.67	≥ 0.0834 × ln(P_{no}) – 0.0014 × P_{no} + 0.609
49 W < P_{no} ≤ 250 W	≥ 0.880	≥ 0.870
250 W < P_{no}	0.875	0.875

[37] Table copied from "CLASP 2012: Annex B. External Power Supplies / A Discussion Paper Prioritising upcoming revisions to existing implementing measures under the ecodesign and energy labelling directives"

Table 4 - Requirements proposed for EU Code of Conduct Revision - Tier 1 (as at Sep 2012)

No-load Power (not to exceed Wattage) – Jan 2014		
Nameplate Output Power (P_{no})	Standard Voltage	Low Voltage (Mobile handheld battery driven and P_{no} < 8W)
0.3 W ≤ P_{no} < 49 W	≤ 0.150 W	≤ 0.075 W
50 W ≤ P_{no} < 250 W	≤ 0.250 W	N/A
250 W < P_{no}	N/A	N/A
Four Point Average Active Efficiency (not less than %) – Jan 2014		
Nameplate Output Power (P_{no})	Standard Voltage	Low Voltage
0 < P_{no} ≤ 1.0 W	≥ 0.5 × P_{no} + 0.145	≥ 0.5 × P_{no} + 0.085
1.0 W < P_{no} ≤ 49.0 W	≥ 0.0626 × ln(P_{no}) + 0.645	≥ 0.0755 × ln(P_{no}) + 0.585
49 W < P_{no} ≤ 250 W	≥ 0.890	≥ 0.880
250 W < P_{no}	N/A	N/A
10% Load Average Active Efficiency (not less than %) – Jan 2014		
Nameplate Output Power (P_{no})	Standard Voltage	Low Voltage
0 < P_{no} ≤ 1.0 W	≥ 0.50 × P_{no} + 0.045	≥ 0.50 × P_{no}
1.0 W < P_{no} ≤ 49.0 W	≥ 0.0626 × ln(P_{no}) + 0.545	≥ 0.0755 × ln(P_{no}) + 0.485
49 W < P_{no} ≤ 250 W	≥ 0.790	≥ 0.780
250 W < P_{no}	N/A	N/A

Table 5 - Requirements proposed for EU Code of Conduct Revision - Tier 2 (as at Sep 2012)

No-load Power (not to exceed Wattage) – Jan 2016		
Nameplate Output Power (P_{no})	Standard Voltage	Low Voltage
0.3 W $\leq P_{no} <$ 49 W	≤ 0.075 W	≤ 0.075 W
50 W $\leq P_{no} <$ 250 W	≤ 0.150 W	N/A
250 W $< P_{no}$	N/A	N/A
Four Point Average Active Efficiency (not less than %) – Jan 2016		
Nameplate Output Power (P_{no})	Standard Voltage	Low Voltage
0 $< P_{no} \leq$ 1.0 W	$\geq 0.50 \times P_{no} + 0.160$	$\geq 0.517 \times P_{no} + 0.087$
1.0 W $< P_{no} \leq$ 49.0 W	$\geq 0.071 \times \ln(P_{no}) – 0.0014 \times P_{no} + 0.670$	$\geq 0.0834 \times \ln(P_{no}) – 0.0014 \times P_{no} + 0.609$
49 W $< P_{no} \leq$ 250 W	≥ 0.890	≥ 0.880
250 W $< P_{no}$	N/A	N/A
10% Load Average Active Efficiency (not less than %) – Jan 2016		
Nameplate Output Power (P_{no})	Standard Voltage	Low Voltage
0 $< P_{no} \leq$ 1.0 W	$\geq 0.50 \times P_{no} + 0.060$	$\geq 0.517 \times P_{no}$
1.0 W $< P_{no} \leq$ 49.0 W	$\geq 0.071 \times \ln(P_{no}) – 0.0014 \times P_{no} + 0.570$	$\geq 0.0834 \times \ln(P_{no}) – 0.0014 \times P_{no} + 0.509$
49 W $< P_{no} \leq$ 250 W	≥ 0.790	≥ 0.780
250 W $< P_{no}$	N/A	N/A

Table 6 - Three CLASP illustrative scenarios for EPS requirements

Scenario	Tier 1	Tier 2
1	CoC Tier 1 from 2015	CoC Tier 2 from 2016
2	CoC Tier 1 from 2014	Modified CoC Tier 2 (Tier 2+) from 2016, no-load ÷ 1.025; efficiency x 1.025
3	Modified CoC Tier 1 (Tier 1+) from 2014 no-load ÷ 1.025; efficiency x 1.025	Modified CoC Tier 2 (Tier 2++) from 2016, no-load ÷ 1.05; efficiency x 1.05