



J R C T E C H N I C A L R E P O R T S

Revision of the EU Green Public Procurement (GPP) Criteria for Office IT Equipment

TECHNICAL REPORT

Criteria Areas

(Draft v2) Working Document

Nicholas Dodd, Candela Vidal-Abarca Garrido, Oliver Wolf
(JRC-IPTS)

Kathrin Graulich, Dirk Bunke, Rita Groß, Ran Liu, Andreas
Manhart, Siddharth Prakash (Öko-Institut e.V. – Institute for
Applied Ecology)

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Joint Research Centre
Institute for Prospective Technological Studies (IPTS)

Contact information

Nicholas Dodd

Address: Joint Research Centre, Edificio EXPO, Calle Inca Garcilaso 3, E-41092 Sevilla, Spain

E-mail: nicholas.dodd@ec.europa.eu

Tel.: +34 954 488 486

<http://ipts.jrc.ec.europa.eu/>

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1. INTRODUCTION

This document is intended to provide the background information for the revision of the Green Public Procurement (GPP) criteria for Office IT Equipment. The study has been carried out by the Joint Research Centre's Institute for Prospective Technological Studies (JRC-IPTS) with technical support from the Oeko-Institut. The work is being developed for the European Commission's Directorate General for the Environment.

1.1 The criteria revision process and evidence base

The main purpose of this document is to evaluate the current criteria and discuss if the criteria are still relevant or should be revised, restructured or removed. It also identifies, based on the background technical analysis, new criteria areas for consideration in order to better address key environmental impacts of the product group.

This document is complemented and supported by a set of preliminary technical reports addressing¹:

- Scope and definitions (Task 1 report),
- Market analysis (Task 2 report),
- Technical analysis (Task 3 report),
- Improvement potential (Task 4 report),
- EU Ecolabel criteria proposals (Task 5 report).

Furthermore, during the course of the revision process three general questionnaires on the scope, improvement potential and public procurement experience, as well as queries specific to certain criteria proposals, were sent out to selected stakeholders. The target groups were industry, Member States, public bodies, NGOs and research

¹ The previous Task 1-5 reports and further information can be downloaded at <http://susproc.jrc.ec.europa.eu/computers/stakeholders.html>

institutions. The specific information, views and suggestions arising from questions about the scope, improvement potential and procurement experience are reflected in both the EU Ecolabel criteria proposal document (Task 5) and this criteria document.

The draft version of the EU Ecolabel technical report (Task 5) built the basis for the first Ad-Hoc Working Group (AHWG) meeting which took place in October 2013.

A first version of this document, together with the April 2014 drafts of the EU Ecolabel criteria for the product groups 'Personal and notebook computers' and 'Displays' were presented at a second AHWG in May 2014. The subsequent feedback from the meeting and in written form, together with follow-up research, has been used to revise this document and the associated criteria proposals.

For each of the criteria areas, the current criteria and the most up to date revised criteria proposal (yellow) are presented. A supporting discussion of the rationale for the proposed changes (or not) to the criterion is also provided, based on the stakeholder feedback and technical background research. In some cases proposals for *new* criteria have also been made.

1.2 Criteria definition and scope

Present scope, EU GPP criteria for Office IT Equipment

Office IT equipment as dealt with in this document covers two sets of products:

- Computers - covering both PCs and notebooks
- Monitors

For the purpose of defining these green public procurement criteria (guidelines), this product group includes six categories:

- Personal computer (Desktop Computer, Integrated Desktop Computer, Thin Client)
- Computer display (where supplied with a computer)
- Keyboard (where supplied with a computer)
- External power supply (where supplied with a computer)
- Notebook computers (includes tablet personal computers)
- Discrete graphics processing unit (where supplied with a computer)

Criteria for PCs, notebooks and monitors are grouped together.

1.2.1 Stakeholder feedback to date

In the initial phase of the revision stakeholders were asked to provide feedback on whether the proposed scope reflects Office IT Equipment procurement priorities and if there is a need for a clearer definition of computer displays due to their increasing overlap with television displays.

Feedback from GPP stakeholders earlier in the EU Ecolabel revision process (March 2013) and from a GPP specific questionnaire revealed that the proposed scope was widely accepted. Beyond that, the following points were raised:

- The suggestion was made that mobile phones should be added to the list as the line between tablets and mobile phones is increasingly narrow.
- A contracting authority had procured tablets and telephones together as mobile devices, from mobile service providers, but it was noted that others may have divided their contracts differently.
- Another stakeholder proposed that tablet computers not be included in the scope.
- The demand for desktop PCs has declined and the requirement for notebooks has increased within contracting authorities.
- Like other mobile devices, notebooks are subject to rougher treatment and are reliant on battery power for much of the time. Therefore, the need to ensure that equipment is robust is much more important than it used to be.

With regard to a clearer definition of computer displays due to their increasing overlap with television displays, according to those that responded, there is generally no need for this to be reflected in the scope:

- However, one stakeholder remarked that the current EU GPP criteria for IT products are unclear regarding the scope which refers to “computer display (where supplied with a computer)”. For the revised criteria it is asked to clarify if the criteria do not apply when displays are purchased separately, i.e. without a computer which is very frequent.

- A stakeholder commented that displays sold separately or with a computer may differ from each other. In this regard there is a difference in special purpose displays and “normal” displays used with computers. Special purpose displays (e.g. stereo displays, small size displays) tend not to fulfil the current GPP criteria.
- Another stakeholder shared experience of the last time they had put televisions into a tender specification, with it being apparent that the display resolution, screen size and technological platform (plasma, LCD, LED, OLED) can all cause significant differences in energy efficiency.
- Newer developments such as touchscreens, curved displays and ultra-high definition 4K and 8K displays, may be relevant to either TV’s or displays. The relevance of increasing display resolution increases with screen size, so it may be that the two types of display screen will be divided by resolution, rather than by fundamentally different technology.

1.2.2 Revised criteria proposal

Based on the definitions provided by Energy Star v6.1 for Computers and v6.0 for Displays the revised scope of the EU GPP criteria is proposed to encompass the following products:

Proposed revised scope of the GPP criteria (second proposal, 03/2015)

Stationary computers

- Desktop Computers (incl. Integrated Desktop Computers and Thin Clients)
- Small-scale servers
- Workstations

Display devices

- Computer monitors

Portable computers

- Notebook Computers (including subnotebooks)
- Two-In-One Notebook
- Tablet Computers
- Portable All-In-One Computer
- Mobile Thin Client

These product definitions are inclusive of any external peripherals (e.g. mouse, track pad, keyboard) and power supplies that are supplied with the product, with the criteria instead focussing on the main computer component. Moreover, it is proposed that displays remain separately defined as a specific sub-category which may be procured either with a computer or separately.

1.3 Market analysis

This section provides an overview of the market and the most significant trends. The Task 2 Preliminary report provides for a more detailed background assessment of the economic relevance of the product group, as well as relevant trends, drivers, innovations and market segmentations. Only generalised conclusions can be drawn on public procurement because of the lack of procurement-specific data at EU-28 level.

1.3.1 Stationary and portable computers

In Western Europe, PC shipments totalled 13.6 million units in the second quarter of 2012, a 2.4 percent decline compared with the equivalent period in 2011, according to Gartner. While mobile PC shipments grew 4 percent, desk-based PC shipments declined 12.8 percent in the second quarter of 2012 in Western Europe.

The professional PC market declined 5.3 percent, while the consumer PC market was almost flat, with 0.4 percent growth². Figure 1.3.1 provides global shipment data for desktop PCs, notebook PCs, and tablets from 2010 to 2012 and also offers a forecast until 2017³.

Portable devices

Currently, notebook PCs account for the highest proportion, but are expected to be overtaken by tablet PCs from 2014. In 2010, around 19 million tablets were sold worldwide, while in 2012 the amount reached 128 million units, 6.7 times larger than

² Source: <http://www.gartner.com/newsroom/id/2112815>

³ Source: <http://www.statista.com/statistics/183419/forecast-of-global-sales-of-pcs-by-category/>

2010. It is predicted that the number of worldwide shipped tablet PCs will increase to 352 million by 2017.

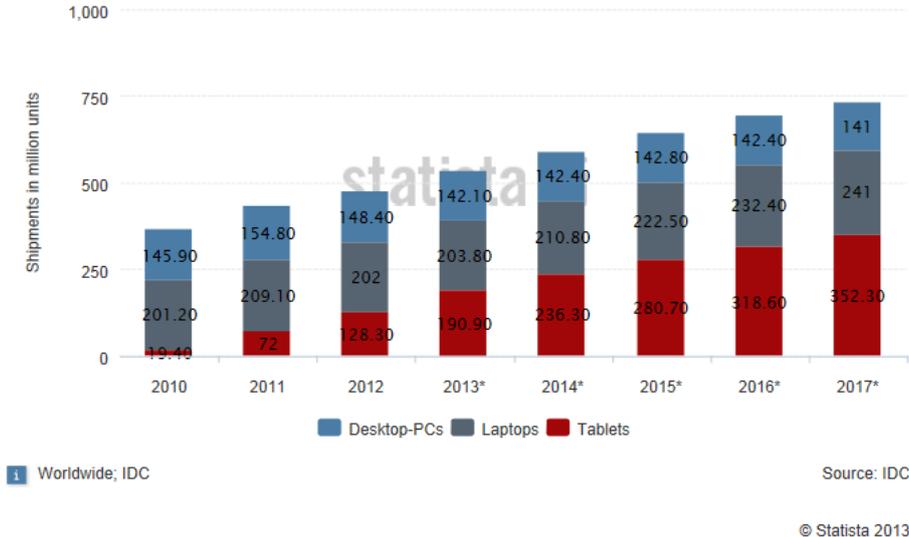


Figure 1.3.1: Forecast for global shipments of tablets, notebook PCs and desktop PCs from 2010 to 2017 (Source: Statista)

Tablets

In Western Europe, sales of media tablets have recorded the most dynamic growth of 142 percent according to GfK. Although it is mostly private customers who are buying these devices, they are also being increasingly bought by business and the public sector, with schools being a good example in some Member States. In fact, in the first half of 2013, businesses and the public sector accounted for more than 13 percent of the total sales of media tablets.

Integrated desktops

According to NPD DisplaySearch⁴, all-in-one (AIO) PCs historically have amounted to no more than 2% of the total desktop display market. A former forecast until 2012

⁴ Source: Display Search, Accessed in 2014
http://www.displaysearch.com/pdf/090407_increased_outlook_for_low_cost_all_in_one_lcd_pcs_not_enough_to_lift_lcd_desktop_display_market.pdf

predicted the worldwide shipments of desktop PCs with built-in displays to be around 8 million units which would be around 5% of the total number of desktop PCs based on the data given in Figure 1.3.1.

Thin clients

Dickinson⁵ reported that in 2012 thin client shipments across the EMEA region (Europe, the Middle East and Africa) reached 1.7 million units, which represents an increase of 9.2% compared to the year before. The market is expected to remain growing, with shipments rising by 6.2% in 2013. A study by IDC⁶ shows that the enterprise thin client market grew by 13.8 % in 2011, and the growth is forecast to be even higher during the period 2012–2016 due to increasing interest in cloud computing.

Workstations

According to Statista / Jon Peddie Research⁷ the number of workstation shipments worldwide increased between 2009 and 2011. About 2.5 million, 3.2 million and 3.8 million workstations were shipped worldwide in 2009, 2010 and 2011, respectively. This shows a continuous increase in shipment numbers, although worldwide workstation shipments fell back to 3.500 million units in 2012.

Small-scale servers

Figure 1.3.2 provides an overview of the server market, providing a general overall picture for servers⁸. Unfortunately, the desk research revealed no sources providing explicit data regarding the small-scale server market. Further input from the stakeholder group would therefore be appreciated.

⁵ Source: Misco, Accessed in 2014, <http://www.misco.co.uk/blog/news/00795/emea-shipments-of-enterprise-thin-clients-rise-9-point-2-percent-in-2012>

⁶ Source: IDC, Accessed in 2014, <http://www.idc.com/getdoc.jsp?containerId=235691>

⁷ Source: Statistica, Accessed in 2014, <http://www.statista.com/statistics/157940/workstation-shipments-worldwide-since-the-3rd-quarter-2008/>

⁸ Source: <http://www.statista.com/statistics/219596/worldwide-server-shipments-by-vendor/>



Figure 1.3.2: Worldwide server shipments from 2009 to 2012 (Source: Statista)

1.3.2 Computer displays

Figure 1.3.3 illustrates the global large-area (9"+) TFT LCD monitor shipments from 2009 to 2011⁹. It can be seen that there is a slight growth from 2009 to 2010 whereas the number of shipments has remained at a rather stable level between 2010 and 2011. In 2010, the average diagonal size of LCD computer displays was 17 inch. According to iSuppli¹⁰, in 2012 the average monitor sold worldwide was already 21 inches, indicating the trend towards increasing screen sizes.

⁹ Source: <http://www.statista.com/statistics/221640/global-large-area-tft-lcd-monitor-shipments-since-2009/>

¹⁰ Source: New York Times, Accessed in 2014, http://www.nytimes.com/2012/02/08/technology/for-multitaskers-multiple-monitors-improve-office-efficiency.html?pagewanted=all&_r=0

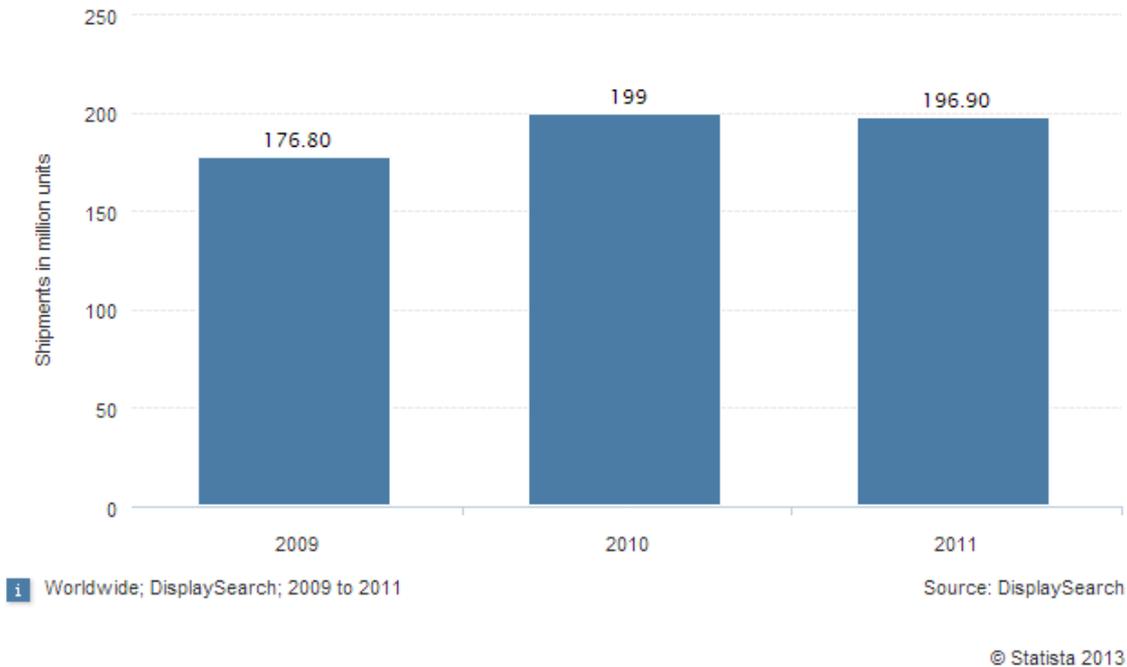


Figure 1.3.3: LCD monitors shipments from 2009 to 2011 (Source: Statista)

Display technologies

Within desktop displays, LCD monitors with LED backlight technology now dominate, accounting for nearly 100% of all desktop displays shipped worldwide while CRT monitors are nearly completely obsolete from the mainstream worldwide computer monitor market. Also within notebook PCs, LED backlit technology was forecast to reach 98% of the market by the end of 2010. Notebooks with CCFL backlight were expected to almost be phased out with only 1.6% of the total market by 2011 (see Table 1.3.1)¹¹.

¹¹ Source:

http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/100610_slim_led_backlit_notebooks_rapidly_gain_market_share.asp

Backlight Type		Q1'09	Q2'09	Q3'09	Q4'09	Q1'10	Q2'10	Q3'10	Q4'10	Q1'11
LED	Slim Type	5.0%	6.8%	7.6%	8.5%	15.9%	22.6%	26.7%	31.1%	34.9%
	Wedge Type	31.0%	49.3%	58.8%	63.7%	65.6%	67.9%	69.5%	66.7%	63.5%
CCFL		64.0%	43.9%	33.6%	27.8%	18.5%	9.5%	3.7%	2.3%	1.6%

Note: Actual results up to Q1'10; data from Q2'10 based on panel makers' shipment targets

Source: *Quarterly LED Backlight Panel Shipment & Forecast Report*

Table 1.3.1: Notebook backlight penetration percentage (Source: NPD DisplaySearch)

In notebook applications there are two types of LED backlighting systems: slim and wedge type. Slim LED backlights for notebooks require thinner components, such as LED array and LGP (the light guide plate) compared to the wedge type. According to NPD DisplaySearch¹² the slim type will continue to grow despite higher costs and assembly issues, as a result of notebook manufacturers' priorities for slimmer form factors despite cost premiums.

1.4 The key environmental impacts of computers and displays

Based on the review of Life Cycle Assessment (LCA) studies and evidence in the Task 3 Preliminary Report the overall findings indicated that the manufacturing of computers and displays and their use are associated with the most significant environmental impacts during the life cycle of Office IT Equipment.

Products for which the use phase is most significant

The relative importance of the manufacturing phase and the use phase varies depending on the product. For stationary computers and their displays the use phase is the most significant. Desktop computers, of all the computer products proposed within the scope, require the most electricity to run.

Within the manufacturing phase of desktop computers, specific environmental 'hot spot' components identified as being of significance are the motherboard (including

¹² Source:

http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/100610_slim_led_backlit_notebooks_rapidly_gain_market_share.asp

the Central Processing Unit) and other Printed Wiring Boards of the desktop unit, the screen (LCD panel), as well as the power supply, CD ROM and the hard disk drive (HDD) units.

Products for which the manufacturing phase is most significant

For notebook and tablet computers the manufacturing phase is relatively more significant because these devices use less electricity. Within the manufacturing phase for notebook and tablet computers, as well as standalone displays, production of the motherboard and the Thin Film Transistor (TFT) display unit are associated with the most significant environmental impacts, followed by production of the battery for notebooks and tablets.

Factors influencing manufacturing phase impacts

One of the main factors influencing these manufacturing phase environmental impacts is that Critical Raw Materials are concentrated in these components. Their extraction and processing is associated with a number of different impacts including raw material extraction, land transformation and the consumption of energy.

Specific metals are associated with particularly severe environmental impacts related to their extraction and processing, primarily silver, gold and palladium. These three metals are required in the motherboard and other Printed Circuit Boards. In addition, indium and gallium are required in the display and background illumination, and cobalt is present in lithium ion batteries.

How can GPP criteria influence the key impacts?

The potential for the direct influence of the EU GPP criteria on the production of single computer components is considered to be limited. This is in part because of the difficulty in identifying the potential for improvements because of confidentiality, for example, in the case of CPU and motherboard production.

A different focus is therefore required. By improving product design life (e.g. design for durability and upgrading), indirectly extending the lifetime of products by facilitating re-use and by enabling Critical Raw Materials to be easily extracted and recovered from products at the end of their life, the impacts of the manufacturing

phase can be reduced as impacts associated with primary production stages and resource extraction can be avoided. Thus, the allocation of benefits from product lifetime extension and recycling is an area specifically highlighted in the Task 4 Preliminary Report (Improvement potential) and in the criteria proposals.

Product lifetime extension and dismantling are also, as a result of this analysis, a specific new area of focus for both the EU Ecolabel and GPP criteria. Evidence relating to the reasons for early failure or replacement of devices, together with common specifications brought forward by manufacturers with the specific intention of offering customers extended product lifetime and durability, therefore inform the proposals.

The potential for the extraction and recovery of Critical Raw Materials from computer and display products at the end of their life is now a focus of attention for EU Ecodesign implementing measures. Proposals have therefore been developed that seek to harmonise with the state-of-the-art in this area, with a focus on components which have the greatest material and environmental significance.

2. DRAFT CRITERIA AREAS AND PROPOSALS

2.1 Criteria area 1 – Energy Consumption

2.1.1 Current criterion 1.1 – Minimum energy performance

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>All products shall meet the latest ENERGY STAR standards for energy performance, available at www.eu-energystar.org.</p> <p>Verification: Products holding a relevant Type 1 ecolabel fulfilling the listed criteria will be deemed to comply. Other appropriate means of proof will also be accepted, such as a technical dossier of the manufacturer or a test report from a recognised body (e.g. body accredited to issue test reports according to standard ISO 17025) demonstrating that the criteria are met.</p>	<p>All products shall meet the latest ENERGY STAR standards for energy performance, available at www.eu-energystar.org.</p> <p>Verification: Products holding a relevant Type 1 ecolabel fulfilling the listed criteria will be deemed to comply. Other appropriate means of proof will also be accepted, such as a technical dossier of the manufacturer or a test report from a recognised body (e.g. body accredited to issue test reports according to standard ISO 17025) demonstrating that the criteria are met.</p>

2.1.2 Proposals for revised criteria v1 (04/2014) – Minimum energy performance

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>A1. Minimum Energy performance for computers The energy efficiency performance of computers shall meet the appropriate energy-efficiency requirements set out in the Energy Star 6.0 standards. Tablet computers shall be exempted from this requirement.</p> <p>Verification: The tenderer shall submit a test report carried out according to the Energy Star v6.0 test methods for the computer models.</p>	<p>A1. Minimum Energy performance for computers The energy efficiency performance of computers shall meet the appropriate energy-efficiency requirements set out in the latest Energy Star standards. Capability adjustments allowed under the Agreement as amended by Energy Star v6.0 may be applied at the same level, except in the case of discrete graphics processing units (GPUs) where maximum additional allowance shall be given to: <ul style="list-style-type: none"> • Desktop Computers: 90 W; • Notebook Computers: 33 W. Tablet computers shall be exempted from this requirement.</p> <p>Verification: The tenderer shall submit a test report carried out according to the Energy Star test methods for the computer models and as applicable at the time of purchase.</p>

<p>A2. Minimum energy performance of displays</p> <p>The power demand of a computer displays shall not exceed the following Energy Efficiency Index (EEI) determinations in accordance to the equations as set out in Annex II of the <i>Commission Regulation (EU) No. ## of ## implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for electronic displays</i>¹³:</p> <ul style="list-style-type: none"> (a) For electronic displays with a visible area of the screen $\leq 15.9 \text{ dm}^2$: <ul style="list-style-type: none"> (i) At the date of adoption of the Decision: $\text{EEI} \leq 0.50$ (ii) Two years from the date of adoption of the Criteria: $\text{EEI} \leq 0.40$ (b) For electronic displays with a visible area of the screen $> 15.9 \text{ dm}^2$: <ul style="list-style-type: none"> (i) At the date of adoption of the Decision: $\text{EEI} \leq 0.40$ (ii) Two years from the date of adoption of the Criteria: $\text{EEI} \leq 0.30$ <p>Verification:</p> <p>The tenderer shall submit a test report carried out according to the measurement methods indicated in Annex III of the Commission Regulation (EU) No. ## of ## implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for electronic displays and as applicable at the time of purchase.</p>	<p>A2. Minimum energy performance of displays</p> <p>The on-mode power demand of a computer displays shall not exceed the following Energy Efficiency Index (EEI) determinations in accordance to the equations as set out in Annex II of the <i>Commission Regulation (EU) No. ## of ## implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for electronic displays</i>¹⁴:</p> <ul style="list-style-type: none"> (c) For electronic displays with a visible area of the screen $\leq 15.9 \text{ dm}^2$: <ul style="list-style-type: none"> (iii) At the date of adoption of the Decision: $\text{EEI} \leq 0.40$ (iv) Two years from the date of adoption of the Criteria: $\text{EEI} \leq 0.30$ (d) For electronic displays with a visible area of the screen $> 15.9 \text{ dm}^2$: <ul style="list-style-type: none"> (iii) At the date of adoption of the Decision: $\text{EEI} \leq 0.30$ (iv) Two years from the date of adoption of the Criteria: $\text{EEI} \leq 0.20$ <p>Verification:</p> <p>The tenderer shall submit a test report carried out according to the measurement methods indicated in Annex III of the Commission Regulation (EU) No. ## of ## implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for electronic displays and as applicable at the time of purchase.</p>
AWARD CRITERIA	
<p>A3. Minimum energy performance of computers and displays</p> <p>Additional points shall be awarded in proportion to the improvement in energy efficiency of stationary computer devices and displays relative to the minimum requirements in A1 or A2 (as applicable).</p> <p>Verification:</p> <p>Submission by the tenderer of a test report that is in-line with the methods appropriate to the type of device, as specified in A1 and/or A2.</p>	<p>A3. Minimum energy performance of computers and displays</p> <p>Additional points shall be awarded in proportion to the improvement in energy efficiency of stationary computer devices and displays relative to the minimum requirements in A1 or A2 (as applicable).</p> <p>Verification:</p> <p>Submission by the tenderer of a test report that is in-line with the methods appropriate to the type of device, as specified in A1 and/or A2.</p>

¹³ Not yet published.

¹⁴ Not yet published.

	<p>A4. Display power management</p> <p>Additional points shall be awarded to tenderers who are able to supply displays with the following advanced power management features:</p> <ul style="list-style-type: none"> (i) <i>Automatic Brightness Control</i>: The computer monitor shall have a light sensor that automatically adjusts the picture brightness to the ambient light conditions. In on mode at an ambient light level of ≤ 1 Lux the power consumption shall be at least 20 percent lower than in on mode at an ambient light level of 300 Lux. (ii) <i>Other options to be discussed</i> <p>Verification:</p> <p>The tenderer shall submit a test report demonstrating that the on mode power consumption measured according to EN 62087 is met.</p>
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2.1.3 Summary of stakeholder comments on the revision proposals

Summary of AHWG, GPP AG and written stakeholder feedback
<p>With regards to <i>Technical Specification A1</i> a concern was raised by a Member State that EU Ecolabelled products may not comply with the proposed Comprehensive criterion. This is because the Ecolabel is proposed to align with Energy Star v6.0, but in the GPP proposal this would be a Core requirement. A general concern was raised at the GPP Advisory Group about the market penetration of Energy Star being higher than 20-25%.</p> <p>It was queried by a manufacturer whether test reports could be submitted upon award of a contract as a Contract Performance Clause. The example of Germany's Federal procurement guidelines for notebooks was cited (Bitkom, UBA and Federal Procurement Office).</p> <p>In relation to displays, the types of displays covered needs clarification. Several comments highlighted concerns relating to the fact that Ecodesign EEI formulas are used for displays and the Regulation is still in draft form. There may still be changes during and after inter-service consultation.</p> <p>Several stakeholders highlighted that under the Energy Efficiency Directive central</p>

government must purchase Energy Star registered products. A stakeholder expressed the need to link to Energy Star for computer monitors. In relation to computers concern was, however, expressed that tablet computers are currently excluded from Energy Star v6.0.

The scope of different forms of tablets that may be procured and variabilities in energy consumption may require further consideration. For example, Panasonic's tablets have high end performance. It was proposed that the tablet requirements be revised if new requirements are brought in under Energy Star.

With regards to the proposed cap on computer graphics capabilities in *Technical Specification A1* a Member State considered that this should be more ambitious, but other stakeholders noted that high end capabilities may be required for some functions.

The performance of Graphics Processing Units could be made an Award Criteria to encourage lower consumption. It was highlighted by a manufacturer that only a small proportion of discrete GPU's in portable devices are not switchable i.e. they consume no additional energy whilst the capability is not required. This is to preserve battery power.

As regards *award criterion A1* on minimum energy performance a key stakeholder from the advisory group suggested referring to Energy Star TEC limits instead of individual energy modes.

With regards to the power management *award criterion A2* a representative from the GPP Advisory Group suggested to specifically restrict the fast start mode. Moreover, in reference to Automatic Brightness Control it was claimed that although it is tested for in Energy Star the saving potential is considered to be low because of office lighting conditions.

2.1.4 Technical discussion and rationale for criteria revision v2

2.1.4.1 Computer products

Energy consumption during the use of Office IT Equipment accounts for the main environmental impacts of desktop computers and displays. Moreover, these products are the most energy intensive computer form factor as illustrated in Table 2.1.1. The product categories relate to the processing power of the computer as defined in Energy Star and also the EU Ecodesign Regulation No 617/2013.

Table 2.1.1: Maximum TEC allowances for desktop PCs and notebook PCs according to Energy Star Version 5.2

Energy Star Product Category	TEC _{BASE} Desktop PCs (kWh)	TEC _{BASE} Notebook PCs (kWh)
A	148	40
B	175	53
C	209	88.5
D	234	n.a.

A requirement to comply with the latest version of Energy Star is the main current GPP Technical Specification addressing the energy consumption of Office IT Equipment. The Energy Star Program Requirements for computers were used to define the binding implementing measures under the Ecodesign Directive which are broadly identical to those of Energy Star v5.2. The Ecodesign Tier 1 efficiency requirements use the same benchmarks and TEC-calculation formulas. These Tier 1 requirements entered into force on 1 July 2014. Tier 2 (entering into force on 1 January 2016) also uses the same calculation formulas but sets stricter requirements.

The v6.0 revision of Energy Star came into effect in the USA from the 2nd June 2014. These requirements aim to target the top 25% of models currently on the market (Energy Star 2011). This revision was planned to be adopted in the EU as well, but it has now been decided to leapfrog it and adopt v6.1, in which the underlying TEC calculations do not change but there are updates to the scope which are of significance to these criteria.

Following approval by the EU Energy Star Board it is estimated that v6.1 will be adopted by April 2015, with publication as a Decision then following. Moving directly to v6.1 would be of benefit to these criteria because its scope includes tablets, hybrid notebooks and, a new product form factor to have emerged, portable all-in-one computers.

Comparing the Base Allowances for the Typical Energy Consumption (TEC_{BASE}) of Desktop and Notebook computers within the current and upcoming Energy Star and Ecodesign versions it can be seen from Figure 2.1.1 and Figure 2.1.2 that Energy Star version 6.0 (and 6.1) are generally stricter than Ecodesign Tier 2 (in force 1 January 2016) for product sub-categories IA-I3 and G1-G3. Some higher performance D1 and D2 graphics specifications are exempted from requirements in Ecodesign but are addressed under Energy Star.

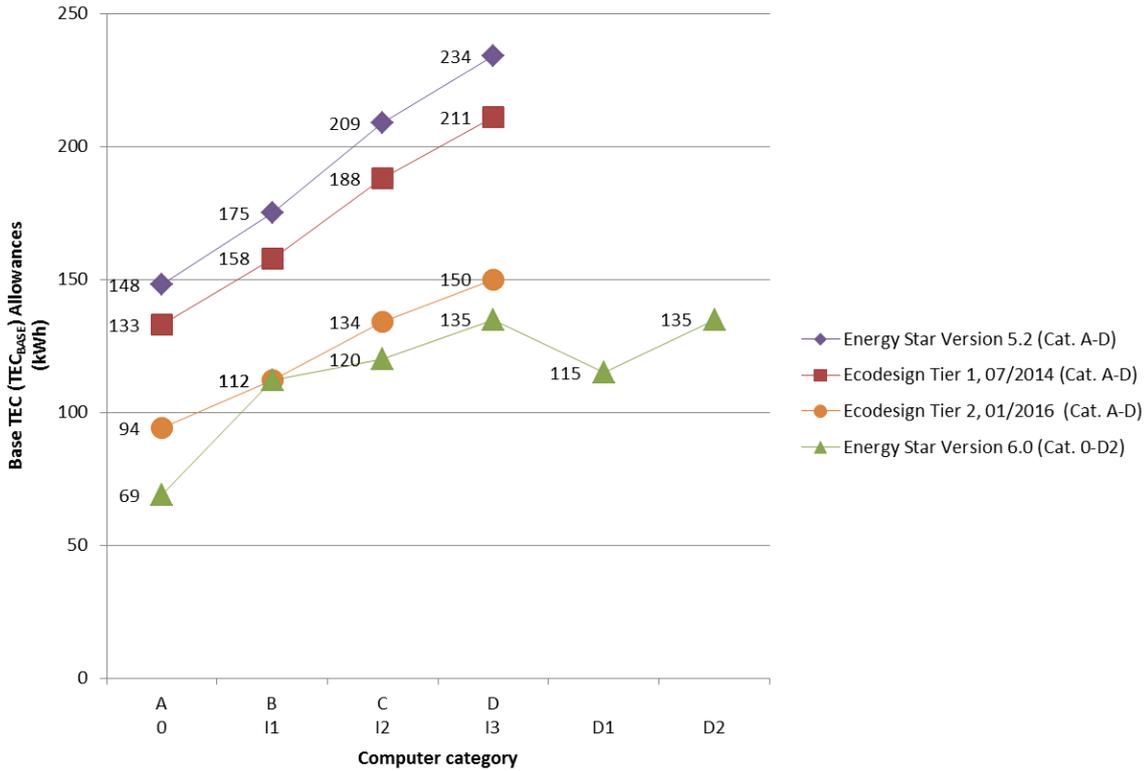


Figure 2.1.1: Comparison of TEC_{BASE} Allowances of Energy Star versions 5.2 and 6.0 with Ecodesign Tier 1 and Tier 2 for Desktop and Integrated Desktop Computers

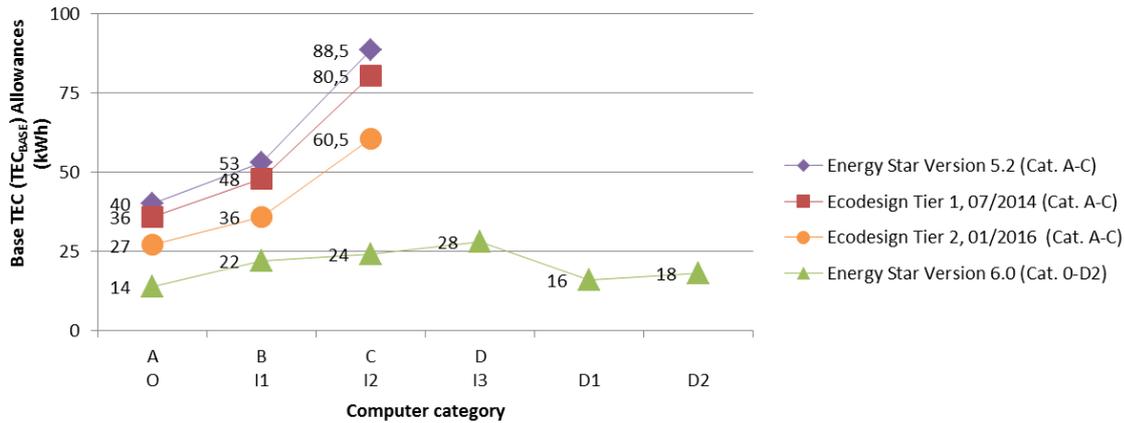


Figure 2.1.2: Comparison of TEC_{BASE} Allowances of Energy Star versions 5.2 and 6.0 with Ecodesign Tier 1 and Tier 2 for Notebook Computers

Allowances for discrete graphics processing units (GPUs):

Graphics capabilities are the most significant influence within the overall E_{TEC_MAX} calculation that sets the qualifying energy benchmark for each computer. The TEC_{BASE} allowance may be between 57% and 96% higher for desktops and integrated desktops and between 14% and 100% higher for notebooks. A further $TEC_{GRAPHICS}$ allowance for *discrete graphics processing units* (categories D1 and D2) may then provide a further uplift of between 52% and 188% for desktops and integrated desktop and between 100% and 429% for notebooks.

Discrete graphics are used for high performance professional applications (HD video, 3D rendering etc.) providing better picture quality and speed compared to integrated graphics, where the GPU is attached to or integrated into the computer's motherboard sharing resources with the central processing unit and system memory. Those are typically less powerful and slower, being sufficient for basic office applications, web browsing etc.

According to written stakeholder feedback, allowances for discrete graphics processing capacity of the kind that may be used to run Computer Aided Design or multi-media applications can sometimes be substantial and can represent as much as the core consumption of the computer in idle mode. Thus it is important to

consider to what extent this capacity is required and if possible to limit its use, particularly in desktops. Options initially explored included:

1. Setting a maximum for the total amount of allowances to ensure a highly consuming PC with several graphic cards is not compliant. This maximum was proposed to be set at 90 kWh for Desktop PCs and 33 kWh for Notebook PCs. This would prohibit the use of G5-G7 discrete graphics cards under Energy Star.
2. Another option is to allow for discrete graphics units only if they are switchable or highly scalable i.e. they are consuming minimal energy when the computer does not need them. This approach is now implemented by Energy Star v6.0/6.1 although an allowance of 18 kWh is given for desktops where switchable graphics are enabled by default.

Analysis of the US Energy Star database (January 2015) indicates that 261 desktop models currently qualify in the discrete graphics D1 and D2 category, equating to 19% of models. In contrast only 10 notebook models currently qualify in the D1 and D2 category, equating to 0.4% of models.

A study carried out in 2012 by CLASP and NRDC in the USA looked at the impact of discrete graphics cards on desktop energy consumption¹⁵. Tests were carried out in order to compare the additional energy consumption of graphics cards. The study suggested that for high end (G6 and G7 capabilities) energy consumption related to the unit can vary considerably and does not always increase in function of the capability. An indicative level of performance improvement is reflected in NRDC/CLASP's recommendations for the 10th and 20th percentile of the market in Table 2.1.2, which are notable for the lower G6 and G7 allowances.

Moreover, mainstream manufacturers such as AMD and NVIDIA are bringing forward units that demonstrate a significant improvement in performance over the Energy

¹⁵ CLASP and NRDC, *The impact of graphics cards on desktop computer energy consumption*, September 2012.

Star v6.1 allowances. This is supported by manufacturer claims, which focus on reducing idle power consumption, for example by powering down the GPU in long idle mode¹⁶. This additional requirement is estimated to have the potential to increase the improvement potential for high end GPUs from 15% to 20%.

Table 2.1.2. CLASP/NRDC recommended Energy Star v6.0 target adder levels for desktops

dGfx category (Gigabytes/second) ¹	TEC Allowance (kWh/year)	
	20 th percentile	10 th percentile
G1 (≤ 16)	32	30
G2 ($16 < FB_BW \leq 32$)	40	37
G3 ($32 < FB_BW \leq 64$)	51	47
G4 ($64 < FB_BW \leq 96$)	67	62
G5 ($96 < FB_BW \leq 128$)	82	76
G6 ($FB_BW > 128$) with data width < 192 bit)	82	76
G7 ($FB_BW > 128$) with data width ≥ 192 bit)	97	90
Notes: 1. Categories are defined according to the frame buffer bandwidth in gigabytes per second (GB/s)		

An analysis of the improvement potential from applying the 10th percentile dGfx allowances recommended by CLASP/NRDC is presented in Table 2.1.3. The improvement potential has been calculated and compared for Energy Star v6.1 category D1 and D2 computers and Ecodesign category C and D on the basis of comparative TEC specifications.

¹⁶ AMD, *ZeroCore Power technology*, <http://www.amd.com/en-us/innovations/software-technologies/enduro>

Table 2.1.3 Indicative TEC improvement potential of dGfx graphics allowances proposed for the EU Ecolabel versus Energy Star v6.1 and Ecodesign Tier 2 allowances

Category D1 Desktop TEC_{MAX} improvement ¹					
Graphics category	Energy Star 6.1 TEC_{MAX} (kWh)	EU Ecolabel TEC_{MAX} (kWh)	% improvement	Ecodesign category C E_{TEC} (kWh)	% improvement
G1	179.5	173.5	3.3%	179	3.1%
G2	194.5	180.5	7.2%	191	5.5%
G3	207.5	190.5	8.2%	199	4.3%
G4	226.5	205.5	9.3%	215	4.4%
G5	248.5	219.5	11.7%	233	5.8%
G6	258.5	219.5	15.1%	251	12.6%
G7	273.5	233.5	14.6%	283	17.5%
<i>Notes:</i>					
1. Base case used: 2 GB memory, 1 ethernet port, 1 HDD, no EPS allowance					
Category D2 Desktop TEC_{MAX} improvement ¹					
Graphics category	Energy Star 6.1 TEC_{MAX} (kWh)	EU Ecolabel TEC_{MAX} (kWh)	% improvement	Ecodesign category C E_{TEC} (kWh)	% improvement
G1	201	195	3.0%	197	1.0%
G2	216	202	6.5%	209	3.3%
G3	229	212	7.4%	217	2.3%
G4	248	227	8.5%	233	2.5%

G5	270	241	10.7%	251	4.0%
G6	280	241	13.9%	269	10.4%
G7	295	255	13.6%	301	15.3%
<i>Notes:</i> 1. Base case used: 4 GB memory, 1 ethernet port, 1 HDD, no EPS allowance					

2.1.4.2 Computer display products

The European Commission is currently preparing a new Ecodesign and Energy Labelling Regulation for Electronic Displays, bringing televisions and displays into one Implementing Measure. The discussion paper on the review of the Ecodesign and Energy Labelling Regulation for TVs proposed to apply different calculations according to display size also to the setting of labelling classes. However, in order to avoid a full re-classification of displays on the market, for the Energy Label only the EEI values associated with the energy classes from A+ upwards have been adapted and not the underlying equations used to calculate the EEI¹⁷. This also means that the Energy Labelling classes will still be based on a linear regression line in the future.

The Topten catalogue is a project funded by Intelligent Energy Europe¹⁸. Selected best appliances on the market were selected from the Topten catalogue and were analysed in order to explore the proportion on new Energy labelling classes. Energy

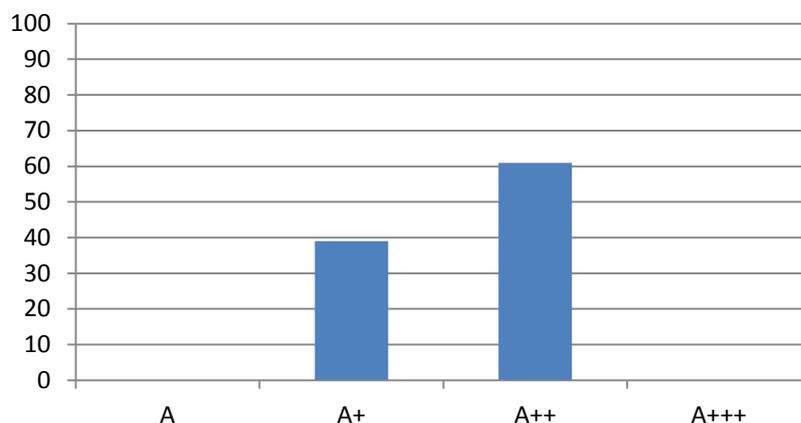
¹⁷ Source: Draft Version of Commission Regulation with regard to Ecodesign requirements for electronic displays; not published yet

¹⁸ Topten is a consumer-oriented online search tool, which presents the best appliances in various product categories. Because only the best-performing products are listed, the selection is much narrower than typical labelling systems, making it easier for consumers to choose from among the thousands of products available. The selection is based on existing regulations and international energy measurement standards.

labelling classes have been calculated using the EEI threshold proposed at the draft Regulation.

The following Figure 2.1.3 represents the results of the indicative calculations of 64 appliances. More than 50% of best appliances selected by Topten showed an A++ energy class. The distribution of energy classes was found to be equally distributed along the different screen sizes.

Figure 2.1.3: Energy labelling classes (draft regulation) of 64 monitor models from Topten.



Stakeholders highlighted that under the Energy Efficiency Directive¹⁹ central government must purchase either products meeting the highest energy efficiency labelling class or Energy Star requirements. Moreover, it can be seen that for computer monitors, all relevant eco-labels (EU Ecolabel, Nordic Ecolabelling, TCO, Blue Angel, and EPEAT) refer to a specific version or, more generally, to the most recently published Energy Star program requirements for displays.

Unlike televisions, external computer displays are included in the Agreement between the Government of the US and the European Community (EU) to co-

¹⁹ Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC

ordinate the energy labelling, thus Energy Star criteria on displays are also valid in Europe²⁰.

The Energy Star Program Requirements for Displays (Version 5.1)²¹ have been the most established benchmark for the energy requirements of computer displays. In 2011, on average 85 % of all new computer displays sold in the USA were already certified according to this specification. In general, the experience shows that approximately two years after a new Energy Star version becomes effective, a large proportion of devices fulfils the energy requirements, especially when they build the basis for Green Public Procurement (e.g. computer displays).

The new Energy Star Program Requirements for Displays, Version 6.0 became effective from June 2013 (Energy Star Displays 2013²²). Energy Star Version 6.0 specification establishes a number of new requirements including:

- On Mode power consumption requirements for displays with a viewable diagonal screen size from 12 to 30 inches and for computer displays greater than 30 inches.
- A new maximum Sleep Mode power requirement of 0.5 watts for all displays, and a power management requirement that all computer displays must enter Sleep Mode after the connection to a host is discontinued.

²⁰ Commission Decision of 26 October 2009 determining the Community position for a decision of the management entities under the Agreement between the Government of the United States of America and the European Community on the coordination of energy-efficiency labelling programmes for office equipment on the revision of the computer monitor specifications in Annex C, part II, to the Agreement (Text with EEA relevance) (2009/789/EC)

²¹ See

https://energystar.gov/products/specs/sites/products/files/Version_5.1_ENERGY_STAR_Displays_Program_Requirements_Post-Clarification.pdf

²²

http://energystar.gov/products/specs/sites/products/files/Final_Version_6%200_Displays_Program_Requirements.pdf?8a38-1944

- A hierarchy under the Test Method for testing network connected products in Sleep Mode and lighting conditions for testing products with automatic brightness control (ABC) enabled by default.

Several of the more efficient models for different size categories from the Energy Star database for computer monitors have been analysed in order to know the improvement capacity of on mode energy performance when compared to the limit allowed ($P_{on\ max}$). A reading across to the Draft Energy labelling measure has been done in order to determine the equivalent energy Classes. Moreover, for each model the $P_{on\ max}$ limit has been calculated. In most cases the appliances were found to be 30-60% more efficient than the limit established for the $P_{on\ max}$ for its category size. (See Table 2.1.4)

Table 2.1.4. Efficient models equivalent energy classes (source energy star)

Model	Resolution (pixels)	Screen Size (in.)	Screen Area (sq. in.)	Power Consumed in On Mode (Watts)	Equivalent Energy Class (Draft)	Calculated $P_{on\ max}$	Equivalent Energy Class (Draft) to $P_{on\ max}$	Meets ENERGY STAR Most Efficient 2015 Criteria
1	800 x 600	8	30.51	4.17	A+	7.4	A	yes
2	1024 x 600	10.1	43.25	4.34	A+	8.84	A	yes
3	768 x 1366	15.6	103.4	4.65	A++	12.82	A	yes
4	1600 x 900	14	84	5.43	A++	14.98	B	yes
5	1600 x 900	17.3	127.5	8.03	A++	12.52	A	yes
6	1366 x 768	18.5	146.51	9	A+	13.12	A	yes
7	1920 x 1080	23.5	236.9	14.2	A+	22.65	A	yes
8	1920 x 1080	23.6	236.92	14.85	A+	22.65	A	yes

It was found that 73 models in the Energy Star 6.0 database already meet the proposed more efficient Energy Star v6.1 criteria. In order to recognise this potential in the market, it is possible to either increase the ambition level of the comprehensive criterion or award extra points if energy consumption is lower than Energy Star

requirements. A good example can be found in the approach proposed by the Sustainable Procurement Guidelines of United Nations (UNSP) for IT Equipment²³.

Power management requirements

With regards to Automatic Brightness Control (ABC) literature was consulted in order to estimate the improvement potential of the criteria. A recent article on ambient light levels during Television viewing²⁴ analysed the ambient light levels during television viewing in 60 homes over seven days. The study revealed that the vast majority of viewing (79.5%) occurred at illuminance levels below 50 lux, while very little viewing (3.6%) occurred at illuminance levels greater than 300 lux. Advanced Brightness Control is a feature which, if calibrated correctly to reflect the real-life lighting conditions that users may experience, has been estimated to have the potential to save 20-30% of display energy use. However, as noted by a stakeholder, this might not be of such relevance for computer monitors as working conditions at an office are normally over 300 lux.

With reference to “Quick Start” functionality a report created by Defra’s Market Transformation Programme in 2011²⁵ showed that there appear to be two current means of achieving the “quick start” function in Televisions. Where power is maintained to the processor, additional power consumption requirements (above the 1W regulatory level) may be around 11 to 12 W, but could be as high as 30 to 38W for high specification products. However where additional memory (NVRAM) is provided, the additional power consumption can be negligible (fractions of a watt).

²³ UN Sustainable Procurement Guidelines, https://www.ungm.org/Areas/Public/Downloads/UNSP_Computers%20and%20Monitors_Product%20Sheet.pdf

²⁴ Invited Paper: Ambient Light Levels During Television Viewing. Kyle Sills, Konstantinos Papamichael, Keith Graeber, My Ton and Chris Wold (2014 Society for Information Display, SID Symposium Digest of Technical Papers, San Diego, CA, June 1–6, 2014, Volume 45, Issue 1, pages 599–602, June 2014)

²⁵ BNCE TV07: Power Impacts of “Quick Start” Standby Functionality in Televisions

This functionality was found by DEFRA to be only present in the high-end models of three manufacturers. There is no available representative data of the proportion of televisions that currently present such function and their power demand to establish a threshold. Moreover, no information on the relevance of fast start function on computer monitors could be found.

For more details see the EU Ecolabel and GPP for displays Technical report, Criteria Proposals – Revision v3 (October 2014).

2.1.4.3 Life Cycle Costing (LCC)

As an alternative to awarding points for greater energy efficiency, procurers can opt for an LCC approach whereby more than only the purchase price is included in the costs when assessing the tenders. The rules for the use of LCC are set out in article 68 of Directive 2014/24/EU on public procurement. Procurers have to indicate the data to be provided by the tenderers and the method which the contracting authority will use to determine the life-cycle costs on the basis of this data. It is necessary that the monetary value of the cost elements can be determined and verified.

In the case of Office IT Equipment, one option could be to determine the costs of the offer by adding the electricity costs over the expected life-time of the IT product to the purchase price. In this case, in order to avoid double-counting, no extra points must then be given for higher energy efficiency.

The Commission is currently working on an LCC tool for selected products, to be used on a voluntary basis, which will help public authorities to take costs that go beyond the purchase price into account, thus favouring products with lower running costs. The tool is expected to be published in 2016.

2.1.5 Proposals for revised criteria v2 – Minimum energy performance

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>A1. Minimum Energy performance for computers</p> <p>The energy efficiency performance of computers shall meet the energy efficiency requirements of the latest version of the Energy Star standard.</p> <p><i>The version in force at the time of publication is 6.1 and updates can be followed at this weblink:</i></p> <p>http://www.eu-energystar.org/</p> <p><i>Annex III of Directive 2012/27/EU on energy efficiency, requires that computers purchased by central government shall meet the latest EU version of Energy Star.</i></p> <p>Verification: The tenderer shall submit test reports carried out according to the test methods laid down in the latest version of the Energy Star. These shall be supplied upon award of the contract. Energy Star registrations under the latest version in the USA shall be accepted provided that testing according to European input power requirements have been carried out.</p> <p>Products holding the EU Ecolabel for personal, notebook and tablet computers (Commission Decision 201xx/xxx/EUxx) or another relevant Type 1 Eco-label fulfilling the listed requirements will be deemed to comply.</p>	<p>A1. Minimum Energy performance for computers</p> <p>The energy efficiency performance of computers shall meet the energy efficiency requirements of the latest version of the Energy Star standard.</p> <p><i>The version in force at the time of publication is 6.1 and updates can be followed at this weblink:</i></p> <p>http://www.eu-energystar.org/</p> <p><i>Annex III of Directive 2012/27/EU on energy efficiency, requires that computers purchased by central government shall meet the latest EU version of Energy Star.</i></p> <p>Verification: The tenderer shall submit test reports carried out according to the test methods laid down in the latest version of the Energy Star. These shall be supplied upon award of the contract. Energy Star registrations under the latest version in the USA shall be accepted provided that testing according to European input power requirements have been carried out.</p> <p>Products holding the EU Ecolabel for personal, notebook and tablet computers (Commission Decision 201xx/xxx/EUxx) or another relevant Type 1 Eco-label fulfilling the listed requirements will be deemed to comply.</p>
<p>A2. Minimum energy performance of monitors</p> <p>The energy efficiency performance of monitors shall meet the energy efficiency requirements of the latest version of the Energy Star standard..</p> <p><i>The version in force at the time of publication is 6.0 and updates can be followed at this weblink:</i></p> <p>http://www.eu-energystar.org/</p> <p><i>Annex III of Directive 2012/27/EU on energy efficiency, requires that computers purchased by central government shall meet the latest version of Energy Star.</i></p> <p>Verification:</p> <p>The tenderer shall submit test reports carried out according to the Energy Star test methods for the monitor models. These shall be supplied upon award of the contract. Energy Star registrations in the USA shall be accepted provided that testing according to European input power requirements have been carried out.</p> <p>Products holding the EU Ecolabel for Displays (Commission Decision 201xx/xxx/EUxx) or another relevant Type 1 Eco-label fulfilling the listed</p>	<p>A2. Minimum energy performance of monitors</p> <p>The energy efficiency performance of monitors shall meet the energy efficiency requirements of the latest version of the Energy Star standard.</p> <p><i>The version in force at the time of publication is 6.0 and updates can be followed at this weblink:</i></p> <p>http://www.eu-energystar.org/</p> <p><i>Annex III of Directive 2012/27/EU on energy efficiency, requires that computers purchased by central government shall meet the latest version of Energy Star.</i></p> <p>Verification:</p> <p>The tenderer shall submit test reports carried out according to the Energy Star test methods for the monitor models. These shall be supplied upon award of the contract. Energy Star registrations in the USA shall be accepted provided that testing according to European input power requirements have been carried out.</p> <p>Products holding the EU Ecolabel for Displays (Commission Decision 201xx/xxx/EUxx) or another relevant Type 1 Eco-label fulfilling the listed</p>

requirements will be deemed to comply.	requirements will be deemed to comply.
AWARD CRITERIA	
<p>A3. Improvement in the energy consumption upon the specified Energy Star standard</p> <p>Points will be awarded If the product is more energy efficient than the E_{TEC_MAX} value for computers and the PON_MAX value for monitors. These shall be calculated in comparison with the minimum Energy Star performance requirement (see Criterion A1 and A2). A maximum of x points may be awarded. Points shall be awarded in proportion to the improvement in energy efficiency as follows:</p> <ul style="list-style-type: none"> • over 80% lower: x points • 60-79% lower: 0.8x points • 40-59% lower: 0.6x points • 20-39% lower: 0.4x points • 10-19% lower: 0.2x points <p><i>An improved energy efficiency could alternatively be awarded on the basis of Life Cycle Costing, with the improvement potential expressed as lower electricity costs over the expected service life of the product.</i></p> <p>Verification: The same as for A1 and A2</p>	<p>A3. Improvement in the energy consumption upon the specified Energy Star standard</p> <p>Points will be awarded If the product is more energy efficient than the E_{TEC_MAX} value for computers and the PON_MAX value for monitors. These shall be calculated in comparison with the minimum Energy Star performance requirement (see Criterion A1 and A2). A maximum of x points may be awarded. Points shall be awarded in proportion to the improvement in energy efficiency as follows:</p> <ul style="list-style-type: none"> • over 80% lower: x points • 60-79% lower: 0.8x points • 40-59% lower: 0.6x points • 20-39% lower: 0.4x points • 10-19% lower: 0.2x points <p>For computers with discrete graphic display units the overall points available for criterion A3 and A4 shall be awarded in the proportion 60:40.</p> <p><i>An improved energy efficiency could alternatively be awarded on the basis of Life Cycle Costing, with the improvement potential expressed as electricity costs over the expected service life of the product.</i></p> <p>Verification: The same as for A1 and A2.</p>

<p>A4. Discrete graphics units in desktop and integrated computers</p> <p>Points shall be awarded for improvements upon the performance of discrete graphics cards (dGfx) in desktop and integrated desktop computers.</p> <p>A maximum of x points may be awarded. Points shall be awarded in proportion to the verified improvement upon the Energy Star TEC_{graphics} allowance:</p> <ul style="list-style-type: none"> • over 50% lower: x points • 40-49% lower: .0.4x points • 30-39% lower: 0.6x points • 20-29% lower: 0.4x points • 10-19% lower: 0.2x points <p><i>An improved energy efficiency could alternatively be awarded on the basis of Life Cycle Costing, with the improvement potential expressed as electricity costs over the expected service life of the product.</i></p> <p>Verification:</p> <p>The applicant shall provide test reports obtained from the graphics unit manufacturer verifying the total energy demand of the unit for all Energy Star modes. These shall be supplied upon award of the contract.</p>	<p>A4. Discrete graphics units in desktop and integrated computers</p> <p>Points shall be awarded for improvements upon the performance of discrete graphics cards (dGfx) in desktop and integrated desktop computers.</p> <p>A maximum of x points may be awarded. Points shall be awarded in proportion to the verified improvement upon the Energy Star TEC_{graphics} allowance:</p> <ul style="list-style-type: none"> • over 50% lower: x points • 40-49% lower: 0.8x points • 30-39% lower: 0.6x points • 20-29% lower: 0.4x points • 10-19% lower: 0.2x points <p><i>An improved energy efficiency could alternatively be awarded on the basis of Life Cycle Costing, with the improvement potential expressed as electricity costs over the expected service life of the product.</i></p> <p>Verification:</p> <p>The applicant shall provide test reports obtained from the graphics unit manufacturer verifying the total energy demand of the unit for all Energy Star modes. These shall be supplied upon award of the contract.</p>
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Summary rationale for the proposals

Computer devices

- The criteria for energy savings are proposed to be aligned to the latest version of the Energy Star requirements for computers, which at the time of publication will be version 6.1. This will reflect the often dynamic response of the market.
- Energy Star v6.1 includes tablet computers within its scope, responding to a specific point raised by stakeholders who noted that some tablets may have high end performance and so energy criteria should apply to them.
- Requirements for power management such as display sleep mode being activated after 10 minutes of user inactivity have become legally binding under the Ecodesign regulation from 1 July 2014. These requirements are already strict and no evidence could be found for significant further improvement potential of criteria of the kind currently specified in the EU Ecolabel.

- Verification shall be based on testing of the model(s) carried out in line with Energy Star's testing specification and method (IEC 62301) or any other equivalent specification.
- Evidence suggests that the market and technology can adapt quickly, so an award criterion is proposed for products that are able to perform better than Energy Star.
- In addition, and recognising that discrete graphics card energy allowances can be significant for some high performance computers, an award criteria is also proposed where discrete graphics units are specified.
- At the high end (G6 and G7 graphics capabilities) the improvement potential is estimated to be up to 20% upon Energy Star v6.1 and is an area of innovation in the market.

Display devices

- The core criteria for energy savings are proposed to be aligned to the underlying performance requirements of the latest version of the Energy Star requirements for displays, which at the time of publication will be version 6.0.
- Award criteria would give extra points if energy consumption is lower than Energy Star requirements, in proportion to the improvement in energy efficiency.
- Additional criteria on power management have not been proposed. Requirement for Automatic Brightness Control is addressed within the Energy Star standard and no evidence could be found for significant further improvement potential from stricter power management requirements for displays.
- Verification shall be based on testing of the model(s) carried out in line with Energy Star's testing specification or any other equivalent specification.

2.2 Criteria area 2 – Hazardous substances

2.2.1 Current criteria

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>The background lighting of LCD monitors shall not contain more than 3.5 mg of mercury on average per lamp.</p> <p>Verification:</p> <p>All products carrying the EU Ecolabel will be deemed to comply. Other type I Ecolabels fulfilling the above criteria can also be accepted. Other appropriate means of proof will also be accepted. Note that after 31st December 2011 this issue will be regulated through Regulation 2011/65/EU (3.a).</p>	<p>The background lighting of LCD monitors shall not contain mercury.</p> <p>Verification:</p> <p>All products carrying the EU Ecolabel will be deemed to comply. Other type I Ecolabels fulfilling the above criteria can also be accepted. Other appropriate means of proof will also be accepted.</p>
	<p>Plastic parts heavier than 25g do not contain flame retardant substances or preparations that are assigned any of the following risk phrases as defined in Council Directive No. 1272/2008:</p> <ul style="list-style-type: none"> - R45 (may cause cancer). - R46 (may cause heritable genetic damage). - R60 (may impair fertility). - R61 (may cause harm to the unborn child). <p>Verification:</p> <p>Products holding a relevant Type 1 ecolabel fulfilling the listed criteria will be deemed to comply. Other appropriate means of proof will also be accepted.</p>

2.2.2 Proposals for criteria revision v1 (04/2014)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>B1. Mercury in display backlights</p> <p>Mercury shall not be present in LCD backlights at a concentration of greater than 0.1 mg per lamp.</p> <p>Verification:</p> <p>Tenderers shall provide an analytical testing report for the LCD backlights showing compliance or shall demonstrate that an alternative technology is used that does not require mercury.</p>	<p>B1. Mercury in display backlights</p> <p>LCD backlights shall be mercury free.</p> <p>Verification:</p> <p>Tenderers shall demonstrate that an alternative technology is used that does not require mercury.</p>

	<p>B2. Flame retardants in Printed Circuit Boards and casings</p> <p>With reference to the EU Ecolabel hazard list where a flame retardant is used then the only hazard classifications they may carry are H412 and H413.</p> <p>Verification:</p> <p>The hazard classification or non-classification of the flame retardants used shall be independently verified by a third party toxicologist or by reference to Governmental or third party verified evidence studies. Evidence from the use of third party verified screening tools which provide results that are equivalent shall be accepted.</p>
	<p>B3. Plasticisers in external cables</p> <p>With reference to the EU Ecolabel hazard list plasticisers used in external cables may only carry the hazard classifications H412 and H413.</p> <p>Verification:</p> <p>The hazard classification or non-classification of the flame retardants used shall be independently verified by a third party toxicologist or by reference to Governmental or third party verified evidence studies. Evidence from the use of third party verified screening tools which provide results that are equivalent, shall be accepted.</p>
AWARD CRITERIA	
	<p>B4. Flame retardants in other components</p> <p>With reference to the EU Ecolabel hazard list points shall be awarded according to the restriction of hazards in internal connectors, CPU's, disc drives, Optical drives (e.g. DVD) and power supply units.</p> <p>The flame retardant is used may only carry the hazard classifications H412 and H413.</p> <p>Verification:</p> <p>The hazard classification or non-classification of the flame retardants used shall be independently verified</p>

	<p>by a third party toxicologist or by reference to Governmental or third party verified evidence studies. Evidence from the use of third party verified screening tools which provide results that are equivalent, shall be accepted.</p>
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2.2.3 Summary of stakeholder comments on revised proposals v1

Summary of AHWG, GPP AG and written stakeholder feedback
<p>With regard to the mercury content requirement a Member State claimed that it should not be of relevance given the prevalence of LED technology. While another stakeholder suggested keeping it as a safety net given the potential for mercury backlit LCD's to still be on the market. It was also commented that 'Mercury free' shall be defined and a test method specified.</p> <p>In terms of the components covered, it was felt by one stakeholder that external cables should be a core criterion. An award criterion was proposed by industry stakeholders for excluding halogenated flame retardants in motherboard laminate material. The test method IEC61249-2-21 can be used for verification.</p> <p>In terms of the hazards restricted, permitted substances used to define the derogations shall be provided. At the moment the hazards listed would be too restrictive. The hazard based approach is self declared and verification by analytical testing of some kind would be preferred. In some cases such as the motherboard hazards related to flame retardants are not considered relevant because the substances is reacted into the epoxy resin.</p> <p>It was felt by industry representatives that the proposed approach was on the borderline of what a procurer could understand and verify. Procurers like to 'check boxes' and prefer to specify materials that can be used/not used. Are there resources/websites that could be provided with supporting information?</p>

2.2.4 Technical background and rationale for revised criteria proposal v2

A range of hazardous substances are used in the manufacturing of office IT equipment and may be present in the final products. A specific background report was prepared to for the EU Ecolabel and GPP to scope and identify hazards that may be present²⁶. This scoping identified the following broad forms in which hazardous substances may be present in the final product:

- Metals and alloys that are used in solders, connectors, switches and relays *e.g. lead solder, cadmium in metal contacts, nickel scratch proof coatings;*
- Plastic additives that impart a function that may be physical/mechanical, safety or design related *e.g. colourants, fillers, plasticisers, stabilisers, flame retardants;*
- Materials, solvent and salts that together serve a function as part of the design and chemistry of sub-assemblies *e.g. lithium ion batteries, liquid crystals in display units;*
- Contaminants and process residues in plastic and glass *e.g. Polyaromatic Hydrocarbons in plastic and man-made rubber, arsenic in screen glass;*
- Intentionally added biocides that address consumer hygiene issues associated with day to day use of a computer *e.g. biocide added to keyboard plastic;*

A number of substances formerly used in electrical devices, or that are being phased out, including the flame retardant TBBPA, plasticiser DEHP and lead solder are now classified in the EU as Substances of Very High Concern or are restricted under the RoHS Directive 2002/95/EC which applies to electronic equipment.

In some cases specific substances are required to be used to ensure products can meet regulatory standards. So, for example, flame retardants are required to meet EN 60065 which stipulates that TV and display casings shall achieve a V1/FR4 fire protection rating, requiring the use of brominated or phosphorus-based flame

²⁶ JRC-IPTS, *Findings of the EU Ecolabel Chemicals Horizontal Task Force – Proposed approach to hazardous substance criteria development*, 24th February 2014

retardants. In this case substances such as TBBPA are still widely used because alternatives may not yet provide technically equivalent substitutes.

The presence of mercury in computer displays

A substance of significant concern during the production stage and during the disposal/recycling of products with older LCD backlight units is mercury. The Energy Star database for computer monitors was reviewed in order to check for the prevalence of old mercury technologies amongst current efficient products. No models with LCD backlights that would be likely to contain mercury were found. All computer monitors on the Energy star database are now LED technology, which does not incorporate mercury.

Moreover, the draft Ecodesign Regulation for televisions and displays will introduce a reporting requirement for displays containing mercury. It defines mercury-free as follow:

“Mercury Free” shall mean a product in which concentration values of mercury (Hg) by weight in homogeneous materials do not exceed 0.1% as defined in Directive 2011/65/EU of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

The current Ecolabel for personal computers, which includes computer monitors, includes a 'safety net' by not permitting the RoHS exemption for backlighting containing mercury. Other schemes as Swedish public procurement program²⁷ and United Nations green procurement guidelines also restrict the use of mercury lamps.

Stakeholders commented that they would like to see 'mercury-free' defined by a threshold and test method so that it could be verified. The UNSP²³ sets a limit of 3 mg of mercury on average per lamp and restricts the number of lamps to a maximum

²⁷ <http://www.konkurrensverket.se/en/publicprocurement/sustainable-public-procurement/use-sustainable-criteria/sustainable-procurement-criteria/it-and-telecom/>

of 8. Points are awarded if background lighting of LCD monitors does not contain mercury and the following verification referring to the US Ecolabel EPEAT is required:

The vendor is required to submit independent certification or a self-declaration that this criterion is met, such as an EPEAT certificate that indicates compliance with the criterion 4.1.3.3 “Elimination of intentionally added mercury used in light sources”, or the ECO DECLARATION (version 2006 or later) with point P7.20 marked “yes”.

Cross-checking the restriction lists of a number of major manufacturers highlighted a control threshold of 0.1 mg/kg of mercury and the use of the test method EN 62321-4, which is used for RoHS compliance. An alternative option to testing could be to include within a contract a requirement for visual inspection of products supplied for LED backlights instead of cold cathode tube or gas discharge lamp technologies.

Restricting hazardous plasticisers used in power cords and casings

As part of the revision of the EU Ecolabel criteria for computer and display products a screening of the state-of-the-art in hazard substitution by leading manufacturers has been carried out. Flame retardants and plasticisers have been the main focus for planned substitutions of hazardous substances by leading manufacturers. The outcome from the EU Ecolabel screening exercise is the identification of substances that are being phased out and the identification of substitutes that are being used to replace those being phased out.

In the EU Ecolabel safer plasticisers are derogated for use based on their hazard classification. There is increasing interest from manufacturers in third party verification of substance hazard profiles to inform decisions on which substitutes to use. Leading manufacturers seek to anticipate future regulatory restrictions so as to minimise costs. However, substitutes should have a better hazard profile than those they substitute.

Concern were raised by some industry stakeholders that hazardous substance criteria should be designed to ensure that there is no risk of requiring manufacturers

to make 'regrettable substitutions' of hazardous substances with known effects for substances for which there are major data gaps in their hazard profile and therefore could be proven later to have a comparable or worse hazard profile.

An example are flame retardants in plastic casings, where alternatives to the Candidate List substance decaBDE (for example, BPADP or RDP) offer only a modest improvement, if any, in their hazard profile and, moreover, in some cases may give rise to 'breakdown products' that are of a similar level of concern to those of decaBDE ²⁸. This is further supported by JRC-IPTS's provisional screening of alternative flame retardants and plasticisers for the EU Ecolabel computer and display hazardous substance criteria.

Third party certified schemes such as the US Green Screen are being used as an internal tool by some manufacturers to make comparisons of alternatives and inform decision-making. Green Screen benchmark levels are currently being introduced into the electronics Ecolabel TCO ²⁹.

However, according to stakeholders' feedback, this approach as presented in the first revision proposal is complex for procurers and public authorities to verify. Moreover, verification based on hazard classifications would not verify the actual chemistry of the product supplied, i.e., whether a safer plasticiser had actually been used.

It is therefore proposed for GPP to identify and request verification for the plasticisers that are being phased out by leading manufacturers. The following substances were identified from the restriction lists of major manufacturers:

- Phthalates: DEHP, BBP, DBP, DIBP, DMEP, DIPP, DPP, DnPP and DnHP
- Medium Chained Chlorinated Paraffins (MCCP's) Alkanes C14-17

²⁸ Clean Production Action, *Evaluating flame retardants for TV enclosures*, Version 1.0, USA, March 2007

²⁹ TCO Development, *Criteria review: non-halogenated substances*, 14th April 2014
<http://tcodevelopment.com/news/criteria-review-non-halogenated-substances-pre-draft-open-for-comment/>

Taking the example of Dell, verification may take the form of random analytical testing of components from different suppliers. An approach based on verification for restricted substances would be a familiar format for manufacturers who generally have more extensive restriction lists which they communicate to suppliers.

Cross-checking the restriction lists of a number of major manufacturers highlighted a control threshold of 0.01% per substances and the use of the test methods EN 14372 and IEC 61249-2-21 (detection of chlorine) for phthalates and MCCPs respectively.

Addressing hazardous emissions from the improper disposal of products

A number of stakeholders during the EU Ecolabel revision process highlighted the need to address the improper disposal of computers in the end of life phase. The environmental impacts associated with the informal recycling and improper treatment of printed circuit boards and cables to recover precious metals and copper³⁰ are of particular concern and have been analysed in a range of studies, the most notable of which include the EU FP7 ENFIRO project³¹ and the US EPA's Design for the Environment programme³².

Analysis from fire simulations and samples of environmental pollution from waste treatment sites has shown that there is the potential for a range of toxic emissions, including species of polychlorinated and polybrominated dibenzo-p-dioxins and

³⁰ Oeko-Institut, *Recycling critical raw materials from waste electronic equipment*, Commissioned by the North Rhine-Westphalia State Agency for Nature, Environment and Consumer Protection, 24th February 2012

³¹ ENFIRO *Life Cycle Assessment of Environment-Compatible Flame Retardants (Prototypical Case Study)*, WP8: D8.5 LCA report, January 2013

³² Sidhu.S, Morgan.A, Kahandawala.M, Muddasani.K, Gullett.B and D.Tabor, *Use of the cone calorimeter to identify selected polyhalogenated dibenzo-p-dioxins/furans and polyaromatic hydrocarbon emissions from the combustion of circuit board laminates*, Final report by the University of Dayton and U.S. Environmental Protection Agency, 22nd October 2013

furans^{33 34}. These uncontrolled emissions have led to the exposure of communities and the pollution of local environments³⁵.

The ENFIRO project's LCA modelling provides a comparison of the potential for hazardous emissions from various WEEE disposal scenarios for a notebook computer (see Figure 2.2.1). The aggregated, normalised results illustrate the significance of the contribution of dioxin and furan emissions to the human toxicity midpoint for a notebook incorporating mainly brominated flame retardants within the plastic casing, circuit boards and cable sheaths.

³³ Gullett, B.K.; Linak, W.P.; Touati, A.; Wasson, S.J.; Gatica, S.; King, C.J *Characterisation of air emissions and residual ash from open burning of electronic wastes during simulated rudimentary recycling operations*, Journal of Material Cycles & Waste Management 9: 69-79, 2007

³⁴ Duan et al, *Characterization and Inventory of PCDD/Fs and PBDD/Fs Emissions from the Incineration of Waste Printed Circuit Board*, Environmental Science & Technology, 2011, 45, 6322–6328

³⁵ Oeko-Institut, *Informal e-waste management in Lagos, Nigeria – socio-economic impacts and feasibility of international recycling operations*, UNEP SBC project, June 2011

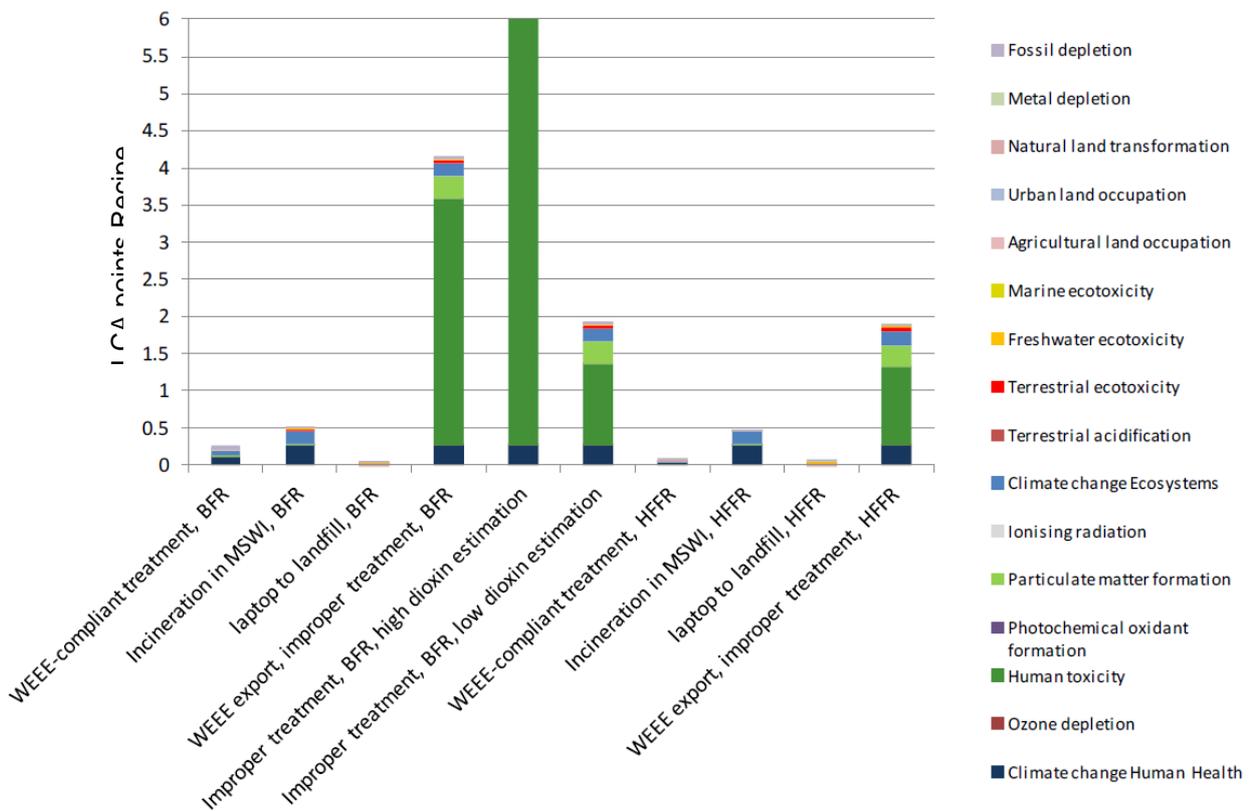


Figure 2.2.1. Influence of dioxin formation during improper WEEE treatment on the total environmental impact of the waste treatment of one laptop.

Source: ENFIRO project (2013)

Concerns relating to toxic emissions from improper treatment in the end-of-life phase of electrical products has driven action by computer manufacturers to phase-out those materials and flame retardants for which evidence exists of the potential for greater toxic emissions³⁶. A proposal was received from three major computer

³⁶ Chem Sec, *Leading Electronics companies and Environmental organisations urge EU to restrict more hazardous substances in electronic products in 2015 to avoid more global dioxin formation*, 19th May 2010, http://www.chemsec.org/images/stories/publications/ChemSec_publications/RoHS_restrictions_Company__NGO_alliance.pdf

manufacturers that halogen-free components should be made an EU GPP Award Criterion. The following text was proposed:

Additional points will be awarded for computers that have low bromine and chlorine content in the product motherboard laminate, excluding components, with the maximum substance concentrations as defined in IEC61249-2-21

This proposal reflects industry's progress in moving away from brominated flame retardants, even for Printed Circuit Boards, although it is understood that for some electrical products this continues to pose a technical challenge. IEC 61249-2-21 defines a concentration limit of 900ppm for bromine present in the resin of a PCB.

Whilst IEC 61249-2-21 provides a verification option that is based on laboratory testing, this could be too restrictive if specific substances are required to still meet fire safety standards or if new chemical structures for brominated flame retardants are developed – for example, EBP (CAS No. 84852-53-9) which has been demonstrated in testing to have very low dioxin emissions.

An alternative approach proposed for the EU Ecolabel is to fire-test material and flame retardant combinations for hazardous emissions. This form of testing is already used for cables, with standard tests used for the emissions of halogen acid gases (EN 50267-2-1) and smoke density (EN 61034).

The testing of emissions from the simulated burning of printed circuit boards and cables can be used to assess the potential for toxic emissions in the end-of-life phase. Testing for toxic emissions of high concern for the environment - notably dioxins, furans and PAHs - was carried out for the US EPA's Design for the Environment programme, Work Package 8 of the FP7 ENFIRO project, as well as in studies by, amongst others, Gullett et al (2007), Hull et al (2008) and Li et al (2009).

These types of fire tests have shown that halogen free products, such as thermoplastic elastomer cables, may still produce dioxin and furan emissions due to low levels of chlorine still being present – for example, as evidenced by a series of

tests carried out in Sweden³⁷. The comparative results from cable fire testing using a large chamber test method (IEC 60332-3-10) have been used to establish a threshold limit for cable emissions. The proposed limit of 0.14 ng I-TEQ/g reflects the highest reported result for the non-halogenated cable typologies, representing an approximate 95% reduction in comparison to the reference PVC cable typology.

For motherboards, a range of literature was reviewed but difficulty was found to make a consistent comparison of the findings due to variations in sample preparation, test methods, sample train analysis and the reporting of results. The most comparable results that could be identified suggest emissions in the range of 0.24 - 2.5 µg I-TEQ/g for an epoxy/brominated FR system. A reduction of 95% in emissions comparative to the evidence for cables is initially proposed (0.125 µg I-TEQ/g), but further investigation is required to establish the final 'safety net' thresholds for both motherboards and cables.

The US EPA and ENFIRO studies also highlighted the significance of carcinogenic PAHs emissions, which are understood to mainly relate to combustion of the polymer substrate or cable sheathing. PAHs formation in char or in smoke will depend on the mechanism of the flame retardant, with non-halogenated systems having the benefit of reducing smoke by increasing char formation. The formation of PAHs, together with other toxic emissions from fires, may also warrant consideration as part of an overall control on the hazardous potential of improper WEEE disposal.

Simulation of the improper thermal treatment of WEEE waste can be approximated based on evidence of how this is carried out in different locations. Fire performance test methods and scenarios such as those described in ISO 19700 (IEC 60695-7-50) and ISO 5660 have the potential for use to simulate toxic emissions. EN 1948 and ISO 11338 are understood to be suitable for polychlorinated and polybrominated

³⁷ Andersson et al, *Fire LCA model: Cable case studies I and II*, Swedish National Testing and Research Institute, 2001 and 2005.

dibenzo-p-dioxin/furan and PAHs quantification, respectively. The initial fire simulation element of the test, is understood to cost approximately €1,000/sample.

Feedback from the University of Dayton in the USA highlights the likely need for modifications to the emissions capture stage. Modifications based on experience of simulated burning/pyrolysis tests could potentially be provided as a guidance annex to the GPP criteria.

Candidate List 'Substances of Very High Concern'

In the EU Ecolabel criteria a restriction is made on the presence of SVHCs identified under the REACH system in Europe. A threshold of 0.1% for the non-presence of SVHCs is set, reflecting the legal requirements for notification upon request by consumers under Article 33(2) of the REACH Regulation, which manufacturers and their suppliers are familiar with as they are under a legal requirement to provide such declarations.

A practical issue faced by manufacturers is that not all Candidate List substances are relevant for electronics. The IEC 62474 substance declaration list³⁸ is used as a tool to pre-screen the Candidate List for relevance. This list includes notes on what functions substances serve and in which products and/or components they may be present. This is then provided to suppliers who must then provide declarations down to concentration limit of 0.1%. The IEC list is updated in line with updates to the Candidate List. It may therefore be an option to introduce a selection criterion which requires a supplier chemical management system based on a combination of screening and supplier declarations for Candidate List substances, to be in place.

Whilst suppliers must, according to the law, provide a notification of the presence of SVHC in articles placed on the EU market, it would be prohibitive to verify such a notification, because analytical testing would be required for all substances on the Candidate List, or at least those identified as being relevant to the product. It is

³⁸ International Electrotechnical Commission (IEC), *IEC 62474: Material declaration for products of and for the electrotechnical industry*, <http://std.iec.ch/iec62474>

therefore considered that at this stage only the act of providing the declaration would be required as a technical specification.

2.2.5 Proposals for revised criteria (v2)

Core criteria	Comprehensive criteria
SELECTION CRITERIA	
	<p>B1. Supplier chemical management system</p> <p><i>This criterion shall be used in conjunction with Criterion B2 which requires declarations based on the system..</i></p> <p>The tenderer shall demonstrate implementation of a supplier chemical management system to identify and monitor the presence of REACH Candidate List substances at concentrations of greater than 0.10% (weight by weight) in the product.</p> <p>The system shall, as a minimum, comprise the following elements:</p> <ul style="list-style-type: none"> • Use of screening tools such as the IEC 62474 declarable substance list ³⁹ to identify Candidate List substances of relevance to the product, which can then be communicated to suppliers; • Periodic requests for declarations from suppliers identifying substances that may be present in sub-assemblies; • Random spot testing for selected Candidate List substances of relevance to the product(s) <p>Verification:</p> <p>The tenderer shall provide documentation which describes the system and its procedures, as well as documentary evidence of implementation.</p>

³⁹ International Electrotechnical Commission (IEC), *IEC 62474: Material declaration for products of and for the electrotechnical industry*, <http://std.iec.ch/iec62474>

TECHNICAL SPECIFICATIONS

B2. Declaration for REACH Candidate List substances

The tenderer shall provide a declaration of the presence of any REACH Candidate List substances in the product in accordance with Article 33(2) of the REACH Regulation.

Verification:

The tenderer shall provide a declaration identifying specific substances that are present.

B2. Declaration for REACH Candidate List substances

The tenderer shall provide a declaration of the presence of any REACH Candidate List substances in the product in accordance with Article 33(2) of the REACH Regulation.

Verification:

The tenderer shall provide a declaration identifying specific substances that are present.

B3. Plasticisers in external cables

The following plasticisers shall not be present in the external AC and DC power cords.

(a) Phthalate plasticisers: DEHP, BBP, DBP, DIBP, DMEP, DIPP, DPP, DnPP and DnHP.

Maximum allowable concentration limit: 0.01% by weight of the cable sheath per phthalate

(b) Medium Chained Chlorinated Paraffins (MCCP's) Alkanes C14-17

Maximum allowable concentration limit: 0.01% by weight of the cable sheath.

Verification:

Verification shall be according to the specified test method and control concentration limits:

(a) Phthalate plasticisers: DEHP, BBP, DBP, DIBP, DMEP, DIPP, DPP, DnPP and DnHP.

Test method: EN 14372.

(b) Medium Chained Chlorinated Paraffins (MCCP's) Alkanes C14-17

Test method: IEC 61249-2-21 (detection of chlorine)

The tenderer shall provide a test report for the power cords of each model supplied

AWARD CRITERIA

B4. Hazardous end of life emissions from motherboard laminates and power cords

Points shall be awarded if the product uses motherboard laminate and power cord materials that are demonstrated in fire testing simulations of improper disposal to have reduced Toxic Equivalent emissions for the following substances:

- Polybrominated dibenzo dioxins and furans;
- Polychlorinated dibenzo dioxins and furans.

The total emissions from the materials upon testing shall be less than or equal to the following thresholds:

- Motherboard laminate: 125 ng I-TEQ/g
- Power cord: 0.14 ng I-TEQ/g

The following test methods shall be used:

- Motherboard laminate: ISO 5660 or equivalent
- Cables: ISO 19700 or equivalent.
- Quantification of emissions: EN 1948 and ISO 11338 or their equivalent.

The simulated conditions shall be IEC 60695-7-50 fire type 1b with a heat flux of 50 kW/m² for laminates and fire type 3a for power cords.

Verification:

The tenderer shall provide a test report with the emissions results for the motherboard laminate material and power cord used in each model supplied..

Summary rationale:

- A comprehensive selection criterion has been added requiring implementation of a chemical management system for REACH Candidate List substances. This reflects the best practice of major computer and display manufacturers.
- All tenderers would be required to provide a declaration of the presence of Candidate List substances in accordance with Article 33(2) of REACH.

- A criterion restricting mercury is felt to now be of less relevance due to the significant market decline of cold cathode tube or gas discharge lamp technologies, which on the basis of evidence from Energy Star database would not be able to meet modern energy efficiency standards, and on this basis it is therefore proposed to delete the restriction.
- It is proposed that a comprehensive criterion is specified to test for the non-presence of hazardous plasticisers in power cords that are being phased out by manufacturers, some of which are Candidate List SVHCs. A threshold limit and test method is specified for two types of plasticisers.
- Recognising the potential for *toxic emissions from the improper disposal of circuit boards and cables outside of the EU*, where they may be burnt or pyrolysed to recover metals and critical raw materials, an award criterion is proposed to encourage manufacturers to use materials that minimise the most hazardous end-of-life emissions.
- To be awarded points, suppliers would need to demonstrate through the means of fire tests of motherboard and cable materials that polybrominated and polychlorinated di-benzo dioxin and furan emissions are reduced in comparison with thresholds that achieve a reduction of 80-90% in toxic equivalent emissions compared to those arising from reference PCB's containing TBBPA FR and PVC cables .
- An approach based on emissions testing is considered to have the advantage of being a technology-neutral means of encouraging safer chemistry.
- Further dialogue is proposed with stakeholders to agree the final thresholds and test methods, as well to the possible need to introduce a complementary threshold for Poly Aromatic Hydrocarbons (PAHs) which are also emitted by combinations of motherboard resins and cable polymers with both halogenated and non-halogenated FR chemistries.

2.3 Criteria area 3 – Product lifetime extension

The research results of Task 3 (Life Cycle Assessment evidence) and Task 4 (Improvement Options) revealed that attention should be paid to the extension of the lifetime of computers in order to reduce the overall environmental impacts caused by shorter lifespans, raw material extraction and manufacturing processes. In the current criteria requirements that influence the lifetime of computers are very limited in their scope, addressing only upgradeability and the future availability of spare parts. A number of potential new criteria addressing product lifespan are proposed for discussion.

2.3.1 Criterion 3.1 – Upgradeability, replaceability and repairability

2.3.1.1 Current criteria

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>PCs shall be designed so that:</p> <ul style="list-style-type: none"> - The memory is readily accessible and can be changed or upgraded. - The hard disk (or parts that perform functions of hard disk), and if available the CD drive and/or DVD drive, can be changed. <p>Verification: Products holding a relevant Type 1 ecolabel fulfilling the listed criteria will be deemed to comply. Other appropriate means of proof will also be accepted.</p>	<p>PCs shall be designed so that:</p> <ul style="list-style-type: none"> - The memory is readily accessible and can be changed or upgraded. - The hard disk (or parts that perform functions of hard disk), and if available the CD drive and/or DVD drive, can be changed. <p>Verification: Products holding a relevant Type 1 ecolabel fulfilling the listed criteria will be deemed to comply. Other appropriate means of proof will also be accepted.</p>
<p>Notebooks shall be designed so that the memory is easily accessible and can be changed or upgraded.</p> <p>Verification: Products holding a relevant Type 1 ecolabel fulfilling the listed criteria will be deemed to comply. Other appropriate means of proof will also be accepted.</p>	<p>Notebooks shall be designed so that the memory is easily accessible and can be changed or upgraded.</p> <p>Verification: Products holding a relevant Type 1 ecolabel fulfilling the listed criteria will be deemed to comply. Other appropriate means of proof will also be accepted.</p>
<p>The tenderer shall guarantee the availability of spare parts for at least 3 years from the time that production ceases.</p>	<p>The tenderer shall guarantee the availability of spare parts for at least 5 years from the time that production ceases.</p>

<p>Verification:</p> <p>Products holding a relevant Type 1 ecolabel fulfilling the listed criteria will be deemed to comply. Other appropriate means of proof will also be accepted.</p>	<p>Verification:</p> <p>Products holding a relevant Type 1 ecolabel fulfilling the listed criteria will be deemed to comply. Other appropriate means of proof will also be accepted.</p>
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2.3.1.2 Revised criteria proposal v1(04/2014)

Proposed revised criteria

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>C1. Warranty period</p> <p>The tenderer shall provide a minimum of a 2 year warranty or service agreement for the computer product. For rechargeable batteries, if applicable, the period should be at least one year.</p> <p>Verification:</p> <p>A copy of the warranty or service agreement shall be provided in the tender.</p>	<p>C1. Warranty period</p> <p>The tenderer shall provide a minimum of a 3 year warranty or service agreement for the computer product. For rechargeable batteries, if applicable, the period should be at least one year.</p> <p>Verification:</p> <p>A copy of the warranty or service agreement shall be provided in the tender.</p>
<p>C2. Continued availability of spare parts</p> <p>The tenderer shall guarantee the availability of spare parts for at least 3 years from the time of purchase.</p> <p>Verification:</p> <p>The tenderer shall provide a declaration that original or backwardly compatible spare parts, including rechargeable batteries (if applicable), will be available to the contracting authority or through a service provider.</p>	<p>C2. Continued availability of spare parts</p> <p>The tenderer shall guarantee the availability of spare parts for at least 5 years from the time of purchase. Parts with improved specifications shall be backwardly compatible.</p> <p>Verification:</p> <p>The tenderer shall provide a declaration that original or backwardly compatible spare parts, including rechargeable batteries (if applicable), will be available to the contracting authority or through a service provider.</p>
<p>C3. Upgradeable and replaceable parts</p> <p>The following components of computers, if applicable, shall be easily accessible and replaceable by the use of universal tools (i.e. widely used commercially available tools as screwdriver, spatula, plier, or tweezers):</p> <p>Computers</p> <ul style="list-style-type: none"> (i) HDD/SSD, (ii) Memory, (iii) Rechargeable battery, <p>Displays</p> <ul style="list-style-type: none"> (i) Screen assembly and LCD backlight (ii) Power and control circuit boards (iii) Stands <p>Guidance to be provided in an Annex on tools and</p>	<p>C3. Upgradeable and replaceable parts</p> <p>The following components of computers, if applicable, shall be easily accessible and replaceable by the use of universal tools (i.e. widely used commercially available tools as screwdriver, spatula, plier, or tweezers):</p> <p>Computers</p> <ul style="list-style-type: none"> (i) HDD/SSD, (ii) Memory, (iii) Rechargeable battery, (iv) Screen assembly and LCD backlight, (v) Keyboard and mouse pad, and (vi) Cooling fan. <p>Displays</p> <ul style="list-style-type: none"> (i) Screen assembly and LCD backlight

<p>access to define easily replaceable.</p> <p>Verification: A manual shall be provided by the tenderer which shall include an exploded diagram of the device illustrating the parts that can be accessed and replaced. It shall also be confirmed which parts are covered by service agreements under the warranty.</p>	<p>(ii) Power and control circuit boards (iii) Stands</p> <p>Guidance to be provided in an Annex on tools and access to define easily replaceable.</p> <p>Verification: A manual shall be provided by the tenderer which shall include an exploded diagram of the device illustrating the parts that can be accessed and replaced. It shall also be confirmed which parts are covered by service agreements under the warranty.</p>
<p>C4. External interfaces The following interfaces and external device connections shall be provided as a minimum:</p> <p>(i) Notebook PCs and Mobile Thin Clients:</p> <ul style="list-style-type: none"> • Presence of at least 3 USB interfaces, of which at least one USB 3.0. <p>(ii) Tablet PCs:</p> <ul style="list-style-type: none"> • Presence of at least 1 USB interface. <p>Verification: The tenderer shall declare the compliance of the product with these requirements to the procuring authority.</p>	<p>C4. External interfaces The following interfaces and external device connections shall be provided as a minimum:</p> <p>(i) Notebook PCs and Mobile Thin Clients:</p> <ul style="list-style-type: none"> • Presence of at least 3 USB interfaces, of which at least one USB 3.0. • One additional interface for an external monitor <p>(ii) Tablet PCs:</p> <ul style="list-style-type: none"> • Presence of at least 1 USB 3.0 interfaces. • Support for external monitor, keyboard and mouse. <p>Verification: The tenderer shall declare the compliance of the product with these requirements to the procuring authority.</p>
<p>AWARD CRITERIA</p>	
<p>C5. Continued availability of spare parts The tenderer shall provide a price list for the main component parts (list to be specified/inserted) that are replaceable during the 3 year period stated in C2. Points shall be awarded according to the competitiveness of the replacement costs.</p> <p>Verification: The tenderer shall provide a price list for original or backwardly compatible spare parts, including rechargeable batteries (if applicable).</p>	<p>C5. Continued availability of spare parts The tenderer shall provide a price list for the main component parts (list to be specified/inserted) that are replaceable during the 5 year period stated in C2. Points shall be awarded according to the competitiveness of the replacement costs.</p> <p>Verification: The tenderer shall provide a price list for original or backwardly compatible spare parts, including rechargeable batteries (if applicable).</p>
	<p>C6. Warranty period Additional points shall be awarded to each additional year of warranty or service agreement offered more than the minimum technical specification for the computers and batteries, where applicable, and for displays.</p> <p>Verification: A copy of the warranty or service agreement shall be provided in the tender.</p>

2.3.1.3 Summary of stakeholder comments on revision criteria proposal v1

Stakeholder feedback and follow-up evidence

Summary of AHWG, GPP AG and written stakeholder feedback

A Member State asked whether batteries provided can be easily changed on site by the contracting authority/their IT services. Battery replacement services could be considered.

A manufacturer did not see expansion ports as a significant issue. Their *performance* is, however, important in some procurement exercises. It was queried as to whether a wireless solution would be permitted. This would, for example, support next generation display and keyboard connectivity. Tablet micro-USB ports should be specified. A stakeholder stated that they would support the proposal if it were to be clear that early failure is an issue that affects product lifetime.

A Member State proposed that upgradeability and guarantee periods be dealt with as part of a Whole Life Costing approach within the ITT. It was queried by DG ENV to what extent Life Cycle Costing was really used by Member States or public authorities.

A stakeholder questioned why the GPP proposal varied from the Ecolabel's 5 year parts availability. The wording relates to the time of purchase whereas the Ecolabel proposal relates to when production of the model ends.

Concerning reparability a manufacturer stakeholder expressed initial support for the criteria and the aim to provide more information. A Member State highlighted the relevance of the availability of repair manual and availability of spare parts to lifetime extension. A stakeholder requested that diagnostic tools (in addition to repair manual) be made publicly available.

However, manufacturers saw an issue on making such a manual publicly available. They showed a preference to provide the manual on a web interface or upon request. Industry stakeholders stated that they have contracts with several service centres to guarantee quality. There was concern on the difficulty of estimating the use/storage

capacity required for spare parts.

In relation to guarantees a Member State expressed that if a commercial guarantee is finally proposed it needs to be clear if it is paid or not.

2.3.1.4 *Technical background and rationale for criteria revision v2*

Upgradeability and the availability of spare parts feature in the current criteria set and were cited by stakeholders as an important consideration for the public sector in seeking to extend the lifespan of computer products. To avoid an early replacement of the whole computer in the case of poor performance or worn-out or defective single components, the upgradeability and reparability of products are major factors to consider.

Provision of product warranties

Regarding longer product warranties, research by WRAP⁴⁰ concluded that the provision of longer standard guarantees or warranties reflects on manufacturer's confidence in the lifetime of their product. An overview of standard warranties provided by a sample of manufacturers is presented in Table 2.3.1.

In the EU Ecolabel criteria reference is made to Directive 99/44/EC which addresses the sale of goods to consumers. In the case of GPP conformity will be with the contractual terms and conditions, although reference is also possible to Member State or international law on contracts of sale, for example the UN Convention on Contracts for the International Sale of Goods⁴¹.

Stakeholders asked for it to be clarified that the warranty period referred to would be included in any legal period of conformity (for example two years under the UN Convention), and the nature of the services provided. Generally the warranty is for a

⁴⁰ WRAP, *Electrical and electronic product design: product lifetime*, UK, January 2013; <http://www.wrap.org.uk/sites/files/wrap/WRAP%20longer%20product%20lifetimes.pdf>

⁴¹ UN (2010) *Convention on Contracts for the International Sale of Goods*

period of time commencing from purchase/delivery. The potential for longer warranties to be provided is possible in the market, for example to 4 years taking the examples of Toshiba and Samsung, and so can be encouraged with an award criterion. 3 years is a requirement in the EPEAT Ecolabel.

It should also be clarified whether warranties are to be provided at additional cost. Generally, warranty extensions beyond 1 year come at an additional cost. Pick-up and return and battery replacement are services offered in many warranties at a further additional cost, so they are proposed as an added value to be offered by potential contractors.

Table 2.3.1: Overview of commercial warranties provided by different manufacturers

Manufacturer	Commercial warranty provided by product form factor				Opening of hardware allowed?
	PCs	Notebooks/Netbooks	Notebook battery	Monitors	
Acer	<ul style="list-style-type: none"> Consumer PCs: 1-2 years Business PCs: 1-3 years 	<ul style="list-style-type: none"> Notebooks: 1-2 years Netbooks: 1 year 	6 months	<ul style="list-style-type: none"> Consumer LCDs: 2 years Professional LCDs: 3 years 	Upgrade of hardware not generally forbidden, but defects caused by improper repairs or incorrect components not covered by warranty
Apple	Generally 1 year				Allowed, when in handbook the exchange of components like RAM or HDD are described explicitly; if not in the manual, hardware may only be opened by Authorized Apple Service Provider (AASP)
Asus	2 years	2 years	1 year	3 years	Exchange of RAM and HDD allowed
Dell	Service against payment of a fee: 1 year				Components like RAM, HDD or cards are allowed to exchange
Fujitsu	2 years	2 years	1 year	3 years	Yes, e.g. RAM; generally warranty covers only original configurations
HP	2 years for certain product series	2 years for certain product	Excluded from standard	n.a.	Upgrade of hardware not generally forbidden, e.g. RAM, but defects

Manu- facturer	Commercial warranty provided by product form factor				Opening of hardware allowed?
	PCs	Notebooks/ Netbooks	Notebook battery	Monitors	
		series	warranty		caused by improper repairs or incorrect components not covered by warranty
Lenovo	1-3 years depending on model	1-3 years depending on model	1 year	n.a.	Yes, e.g. RAM
LG	2 years	2 years	6 months	3 years	No, only by authorized / specialized dealers
Toshiba	n.a.	1-3 years depending on model	1 year	n.a.	Upgrade of hardware not generally forbidden, e.g. RAM, but defects caused by improper repairs or incorrect components are not covered by warranty

Commercial battery guarantees

Stakeholders to the EU Ecolabel commented that, in contrast to the one year battery guarantee generally offered by manufacturers, the guarantee must not be shorter than the legal guarantee period for the whole product, which is a minimum of 2 years.

In practice manufacturers distinguish between physical defects that may occur – for example if the battery does not accept charge or prevents the computer switching on⁴² - and a gradual reduction in the charge capacity of the battery, which is an inevitable function of the chemical nature of batteries. For a typical lithium ion battery with a capacity of 300-500 cycles the decline will, in the majority of cases, occur within the first two years of ownership.

Some manufacturers offer a three or four year commercial warranty with the option for battery replacement in the event of a defect occurring and, where longer cycle prismatic batteries are provided, there is a reduction in charging capacity below a

⁴² Asus, *Battery information centre*, <http://www.asus.com/us/support/Article/604/>

stated threshold⁴³. It should be noted, however, that the customer must pay for this replacement service because it extends the legal minimum coverage (if this is considered to be 2 years) beyond what could be defined as a defect.

Upgrading, reparability and spare parts

The nature of the requirements will depend on the form of the computer. For the public sector it must be possible to update and adapt to new software. This can, to some extent, now be addressed via thin clients and remote connections to servers, but memory must still be readily upgradeable. With 'the cloud', the use of mobile thin clients and external drive capacity certain memory upgrades for portable applications may no longer be needed, but this will to a greater extent depend on security considerations.

Stakeholders highlighted the importance of spare parts being available. Many large public bodies will have in-house IT teams with the capability to carry out repairs that do not invalidate product warranties. It has been suggested that it is important that spare parts do not have to be those originally designed for the product but that "backwardly compatible" parts are also acceptable. Regarding the current criterion on the availability of spare parts general feedback from stakeholders suggests that 3 instead of 5 years may be more realistic, so this is proposed as a core requirement. 5 years is set as an optional requirement in the EPEAT criterion and is used in the EU Ecolabel proposals for both computers and monitors.

Regarding the pricing of parts it was agreed in discussions that it is not possible to dictate this in criteria. The price of parts is a concern because OEMs may maintain prices for specific or compatible parts at levels that may discourage replacement or repair. There was, however, support for the initial proposal to request indicative pricing so as to encourage competitive responses from potential contractors.

⁴³ Toshiba, *Toshiba EU warranty extensión*, <http://www.toshiba.eu/services/warranty-extension/laptops-tablets/ext103eu-vba/tab/terms-and-conditions/>

Research by WRAP highlights that with rapidly changing technology repairs become difficult as parts are not always easily available or interchangeable. Repair costs tend to be high, relative to residual value, because of the high proportion of devices suffering screen damage across all the model types.

Upgradeability applies specifically to computer products, where the potential can be seen to differ significantly depending on the form factor:

- Desktop computers, desktop workstations and small scale servers: Certain components can more or less be easily upgraded (HDD, SSD, memory) or expanded by additional slots (graphics),
- Notebooks:
 - HDD/SSD, memory, CD/DVD/Blu-ray drive, rechargeable battery: Some are easily upgradeable, some are now glued into the casing.
 - Videocards for notebooks are not exchangeable as mainly on-board graphic processing unit (GPU) are now used, i.e. integrated on the motherboard
- Ultrabooks as sub-category of notebooks: The thinner and smaller the form factor makes upgrades more complicated.
 - In general, neither HDD/SSD nor RAM are exchangeable against new components; either being secured with special screws or soldered to the motherboard⁴⁴.
 - Rechargeable batteries are mostly glued in and are only replaceable by manufacturers.
- In general: The motherboard and CPU are difficult to upgrade; whilst exchange of the CPU is theoretically possible it is often soldered to the motherboard to facilitate better heat dissipation.⁴⁵

⁴⁴ Sources: www.com-magazin.de/praxis/hardware/20-fakten-zu-ultrabooks-7388.html;
www.heise.de/newsticker/meldung/Oeko-Logo-EPEAT-winkt-Ultrabooks-durch-1729666.html
15.10.2012

- A case study by WRAP (2011)⁴⁶ of three LCD models to illustrate and encourage the durability and repair summarizes the following most common faults that cause failure and shorten the product's lifetime:
 - Screen faults – due to damage, sometimes caused by impact;
 - Power circuit board faults;
 - Main circuit board faults – including hardware and microchip software;
 - Damage to connections – often between circuit boards; and
 - Damage to television stands.

Tablet batteries, and in some cases ultrabook batteries, were identified by stakeholders as being an issue. They often cannot be easily removed to replace them, often requiring return to a dealer or IT provider in order to change batteries, costing time and money. Battery replacement is now specifically dealt with in the EU GPP and Ecolabel criteria proposals, the basis for which is discussed in the next section.

Ensuring that batteries can be easily changed

Consideration of how easy it is for a notebook or tablet battery to be changed was raised by a number of stakeholders and is now considered by the Ecodesign Regulation for computers which imposes a requirement that from July 2014:

'If a notebook computer is operated by battery/ies that cannot be accessed and replaced by a non-professional user....manufacturers shall provide in the technical documentation, and make available on free-access websites and on the external packaging of the notebook computer, the following information 'The battery[ies] in this product cannot be easily replaced by users themselves'.'

⁴⁵ www.gamestar.de/hardware/praxis/notebooks/2323984/notebook_tuning_teil_1.html

⁴⁶ Cf. <http://www.wrap.org.uk/sites/files/wrap/TV%20case%20study%20AG.pdf>

Moreover, Annex VII of the WEEE Directive and the Battery Directive 2013/56/EC require Member States to ensure that manufacturers design appliances to allow the readily removal of waste batteries by end-user or by qualified professionals that are independent of the manufacturer.

In order to define 'ease of extraction' benchmarks for the EU Ecolabel a sample of sub-notebook and tablet computers were analysed by JRC-IES. The analysis of sub-notebooks took as its starting point the 28 models addressed by the Electronics Takeback Coalition in their 2012 briefing⁴⁷. The analysis of tablets took as its basis a study published by Fraunhofer IZM which disassembled and analysed 21 models⁴⁸. In both cases JRC-IES analysed the steps required to access and extract the battery packs. The steps required were codified and the number of models falling under each code determined.

Table 2.3.2 presents the results of the analysis carried out for the 28 subnotebook models. In addition to the number of steps, the tools required to extract the battery and the number of units from the sample found with such features are also included. The last column refers to the units (in percentage) that meet each of the dismantling codes defined.

A small number of subnotebook and tablet units on the market have battery packs that are easily removed by spring load release, most require the use of universal tools and/or the removal of glued or soldered-in contacts and fixings. The most common number of steps needed to extract battery packs *using only universal tools* are three for subnotebooks, and four for tablets.

For 46% of the subnotebook models studied, the battery can be extracted by removing the base cover, unplugging the battery from the main printed circuit board (PCB) and then unscrewing it from the laptop chassis. Among the tablet models

⁴⁷ Electronics Takeback Coalition, *Ultra-inconvenient*, 15th August 2012

⁴⁸ Fraunhofer IZM, *Disassembly analysis of slates: Design for repair and recycling evaluation*, Final report, August 2013.

studied, 20% could be opened by using a spudger and screwdriver to open the casing, followed by unscrewing up to three connectors.

Table 2.3.2. Steps required to extract batteries in selected sub-notebook models

Code	Embedded battery?	Steps	Number of steps	Tools	Number of units	% units
A	No	Spring-loaded release	1	none	1	4
B	No	Unscrew battery pack	1	Screwdriver	1	4
C	Yes	Remove base cover, unscrew and unplug battery pack	3	Screwdriver	13	46
1+C	Yes	Steps described in C plus one pre-step. For example, remove rubber feet and connector cover on the side	4	Screwdriver	2	7
2+C	Yes	Steps described in C plus two pre-step. For example, remove rubber feet, connector shell on the side and remove additional screws	5	Screwdriver	2	7
1+C+1	Yes	Steps described in C plus one pre-step and one post-step. For example, remove rubber feet, connector shell on the side, remove adhesives and unplug additional cables	5	Screwdriver	2	7
D	Yes	Remove base cover, remove adhesive, unscrew and unplug battery pack	4	Screwdriver	2	7
2+D	Yes	Steps described in D plus two pre-steps. For example, remove rear panel and HDD unit	6	Screwdriver	1	4
E	Yes	Remove base cover, connectors, lift tape, unscrew and unplug battery pack, and pull without disconnecting speakers cables	6	Screwdriver	2	7
F	Yes	Unscrew base cover, turn the computer and press the tab in to loosen the keyboard, unplug the keyboard cable, unplug and remove the palm rest, unscrew battery and lift it out of the laptop	6	Screwdriver	1	4
5+F	Yes	Steps described in E plus 5 pre-steps. For example, remove SD blank, unscrew and remove access door, remove the memory and remove screws	11	Screwdriver	1	4

Source: JRC-IES (2014 draft). *Analysis of material efficiency for EU Ecolabel criteria: the example of two product groups. Environmental Footprint and Material efficiency support for product policy.*

Hardware interfaces and connectors

The integration of sufficient hardware interfaces and connectors such as USB was included in early proposals for the EU Ecolabel for computers and in the first proposal for revised GPP criteria. Stakeholders did, however, question the benefit

and need for these criteria and suggested that it should only be addressed if early failure of connectors is a constraint on the lifespan of products.

In some cases storage expansion or USB type A interfaces for tablets may be overly selective in the market, and in practice wireless capabilities may be used instead. No more evidence could be found to substantiate potential problems identified with the susceptibility of multiple USB connections to faults on the mainboard.

2.3.1.5 Revised criteria proposals (v2)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>C1. Warranty and service agreements The tenderer shall provide a minimum two year warranty effective from delivery of the product. This warranty shall cover repair or replacement and include a service agreement with a pick-up and return option. The warranty shall guarantee that the goods are in conformity with the contract specifications at no additional cost. It shall cover battery defects⁴⁹.</p> <p>Verification: A copy of the warranty and service agreement shall be provided by the tenderer. They shall provide a declaration that they cover the conformity of the goods with the contract specifications, including all indicated usage.</p>	<p>C1. Warranty and service agreements The tenderer shall provide a minimum three year warranty effective from delivery of the product. This warranty shall cover repair or replacement and include a service agreement with a pick-up and return option. The warranty shall guarantee that the goods are in conformity with the contract specifications at no additional cost. It shall cover battery defects⁴⁹.</p> <p>Verification: A copy of the warranty and service agreement shall be provided by the tenderer. They shall provide a declaration that they cover the conformity of the goods with the contract specifications, including all indicated usage.</p>
<p>C2. Continued availability of spare parts The tenderer shall guarantee the availability of spare parts, including as a minimum those identified in criterion C3, for at least three years from the date of purchase. Parts with improved specifications shall be backwardly compatible⁵⁰.</p> <p>Verification: The tenderer shall provide a declaration that backwardly compatible spare parts, including</p>	<p>C2. Continued availability of spare parts The tenderer shall guarantee the availability of spare parts, including as a minimum those identified in criterion C3, for at least five years from the date of purchase. Parts with improved specifications shall be backwardly compatible⁵¹.</p> <p>Verification: The tenderer shall provide a declaration that backwardly compatible spare parts, including</p>

⁴⁹ Defects shall be considered to include failure to charge as well as detection of the battery's connection. A progressive drop in battery capacity due to usage shall not be considered to be a defect.

⁵⁰ Compatible with previous models

<p>rechargeable batteries (if applicable), will be made available to the contracting authority or through a service provider.</p>	<p>rechargeable batteries (if applicable), will be made available to the contracting authority or through a service provider.</p>
<p>C3. Design for reparability</p> <p>The following components of computers, if applicable, shall be easily accessible and replaceable by the use of universal tools (i.e. widely used commercially available tools as screwdriver, spatula, plier, or tweezers):</p> <p>Computers</p> <ul style="list-style-type: none"> (i) HDD/SSD, (ii) Memory, (iii) Rechargeable battery, <p>Displays</p> <ul style="list-style-type: none"> (iv) Screen assembly and LCD backlight (v) Power and control circuit boards (vi) Stands <p>The tenderer shall provide clear disassembly and repair instructions (e.g. hard or electronic copy, video) to enable a non-destructive disassembly of products for the purpose of replacing key components or parts for upgrades or repairs. This shall be made available in hard copy or via a service provider and/or the manufacturer's webpage.</p> <p>Verification:</p> <p>A manual shall be provided by the tenderer which shall include an exploded diagram of the device illustrating the parts that can be accessed and replaced. It shall also be confirmed which parts are covered by service agreements under the guarantee.</p>	<p>C3. Design and support for reparability</p> <p>The following components of computers, if applicable, shall be easily accessible and replaceable by the use of universal tools (i.e. widely used commercially available tools as screwdriver, spatula, plier, or tweezers):</p> <p>Computers</p> <ul style="list-style-type: none"> (i) HDD/SSD, (ii) Memory, (iii) Rechargeable battery, (iv) Screen assembly and LCD backlight, (v) Keyboard and mouse pad, <p>Displays</p> <ul style="list-style-type: none"> (iv) Screen assembly and LCD backlight (v) Power and control circuit boards (vi) Stands <p>The tenderer shall provide clear disassembly and repair instructions (e.g. hard or electronic copy, video) to enable a non-destructive disassembly of products for the purpose of replacing key components or parts for upgrades or repairs. This shall be made available in hard copy or via a service provider and/or the manufacturer's webpage.</p> <p>Verification:</p> <p>A manual shall be provided by the tenderer which shall include an exploded diagram of the device illustrating the parts that can be accessed and replaced. It shall also be confirmed which parts are covered by service agreements under the guarantee.</p>
<p>C4. Ease of replacement for rechargeable batteries</p> <p>Rechargeable batteries shall not be glued or soldered into portable products.</p> <p>Simple instructions on how the rechargeable battery packs are to be removed shall be marked on the base cover of the product or provided in the user instructions.</p> <p>Verification:</p> <p>The tenderer shall provide photographic evidence of how the battery is installed in the product, the steps required to remove and cover markings. A copy of relevant user instructions shall also be provided.</p>	<p>C4. Ease of replacement for rechargeable batteries</p> <p>Rechargeable batteries shall not be glued or soldered into portable products. The rechargeable battery shall be easy to extract by a professional user or repair service provider, complying with the following requirements:</p> <ul style="list-style-type: none"> - For notebooks and portable all-in-one computers manually without tools; - For sub-notebooks in a maximum of three steps⁵¹ using a screwdriver; - For tablets and two-in-one notebooks in a

⁵¹ A step consists of an operation that finishes with the removal of a part or with a change of tool.

<p>The Contracting Authority reserves the right to request a visual inspection of a random selection of the supplied products.</p>	<p>maximum of four steps using a screwdriver and spudger;</p> <p>Simple instructions on how the rechargeable battery packs are to be removed shall be marked on the base cover of the product or provided in the user instructions.</p> <p>Verification:</p> <p>The tenderer shall provide photographic verification of how the battery is installed in the product, the steps required to remove it and cover markings. A copy of relevant user instructions shall also be provided.</p> <p>The Contracting Authority reserves the right to request a visual inspection of a random selection of the supplied products.</p>
AWARD CRITERIA⁵²	
<p>C5. Cost competitiveness of spare parts</p> <p>The tenderer shall provide a price list for, as a minimum, the component parts listed in C3. Points shall be awarded according to the competitiveness of the replacement costs.</p> <p>Verification:</p> <p>The tenderer shall provide a price list for original or backwardly compatible spare parts, including rechargeable batteries (if applicable).</p>	<p>C5. Cost competitiveness of spare parts</p> <p>The tenderer shall provide a price list for, as a minimum, the component parts listed in C3. Points shall be awarded according to the competitiveness of the replacement costs .</p> <p>Verification:</p> <p>The tenderer shall provide a price list for original or backwardly compatible spare parts, including rechargeable batteries (if applicable).</p>
<p>C6. Longer warranties and services agreements</p> <p>Additional points shall be awarded to each additional year of warranty and service agreement offered that is more than the minimum technical specification. This shall be awarded</p> <p>A maximum of x points may be awarded.</p> <ul style="list-style-type: none"> • +4 years or more: x points • +3 years: 0.75x points • +2 years: 0.5x points • +1 year: 0.25x points <p>Verification:</p> <p>A copy of the warranty and service agreement shall be provided by the tenderer. They shall provide a declaration that they cover the conformity of the goods with the contract specifications, including all indicated usage.</p>	<p>C6. Longer warranties and service agreements</p> <p>Additional points shall be awarded to each additional year of warranty and service agreement offered that is more than the minimum technical specification. This shall be awarded</p> <p>A maximum of x points may be awarded.</p> <ul style="list-style-type: none"> • +3 years or more: x points • +2 years : 0.6x points • +1 year: 0.3x points <p>For portable devices 0.3x additional points shall also be awarded where a commercial guarantees provides a battery replacement in the case of defects or a capacity loss of more than 50%.</p> <p>Verification:</p> <p>A copy of the warranty and service agreement shall be provided by the tenderer. They shall provide a declaration that they cover the conformity of the goods</p>

⁵² Instead of setting two separate award criteria on spare parts and warranties, this could be merged into one criterion, evaluating the overall offer including the length of the warranty, its comprehensiveness and the spare parts offer.

	with the contract specifications, including all indicated usage.
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Draft document

Summary rationale

- A technical specification for the provision of a warranty with a minimum period of 3 years (core) and 5 years (comprehensive) is proposed in line with current practices in the market that are intended to reflect confidence in products, but to be provided at no extra cost (to those included in the bid). It is proposed that this explicitly covers the replacement of batteries.
- A new award criterion is proposed inviting manufacturers to offer extended warranties.
- With regards to spare parts, the periods of three years (core) and five years (comprehensive) during which parts shall remain available have been retained as technical specifications. The criterion has been improved to require that they are “backwardly compatible”.
- An award criterion would encourage tenderers to put forward prices for spare parts, thereby encouraging competition to drive down prices in support of repairs and upgrading.
- A technical specification is proposed detailing the major components that shall be easily upgradeable or repairable. The focus is on those components that appear to have a high failure rate or tend to have a strong influence on the lifespan of the whole product. This listing also forms a minimum requirement for the criterion on spare parts availability (C2).
- At a core level of ambition a technical specification is proposed that places requirements for rechargeable batteries to be easily removed (extracted) for replacement and recycling, i.e., they shall not be glued or soldered into the product. At a comprehensive level of ambition, and reflecting the EU Ecolabel, the maximum number of steps is defined reflecting the results from the disassembly steps for samples of subnotebook and tablet products on the market.

- *A criterion on a minimum number of interfaces has been deleted. This is because of general feedback that it is not a significant issue influencing the lifespan of products.*

2.3.2 Criterion 3.2 – Notebook battery quality and lifetime

2.3.2.1 Criteria proposal v1 (04/2014)

Core criteria	Comprehensive criteria
AWARD CRITERIA	
<p>D1. Battery life and endurance Points shall be awarded for additional battery life and endurance cycles greater than a minimum of 7 hours and 400 cycles (with 70% capacity retention) respectively. Cycle endurance shall be weighted higher than battery life.</p> <p>Verification: The tenderer shall provide test reports showing the batteries performance in the areas chosen:</p> <ul style="list-style-type: none"> (i) Battery life shall be verified and benchmarked using Mobilemark software or an equivalent tool (see Annex x for minimum software requirements – <i>to be defined</i>). (ii) Battery endurance shall be verified according to the IEC EN 61960 'endurance in cycles' test carried out at 25°C and at a rate of either 0.2 I_t A or 0.5 I_t A (accelerated test procedure). 	<p>D1. Battery life and endurance Points shall be awarded for additional battery life and endurance cycles greater than a minimum of 7 hours and 500 cycles (with 80% capacity retention) respectively. Cycle endurance shall be weighted higher than battery life.</p> <p>The cycle performance may be achieved using software which partially charges the battery. In this case the applicant shall pre-install the software as the default charging routine. The maximum partial charge shall provide a minimum battery of 7 hours.</p> <p>Verification: The tenderer shall provide test reports showing the batteries performance in the areas chosen:</p> <ul style="list-style-type: none"> (i) Battery life shall be verified and benchmarked using Mobilemark software or an equivalent tool (see Annex x for minimum software requirements – <i>to be defined</i>). (ii) Battery endurance shall be verified according to the IEC EN 61960 'endurance in cycles' test carried out at 25°C and at a rate of either 0.2 I_t A or 0.5 I_t A (accelerated test procedure).

2.3.2.3 Summary of stakeholder comments on criteria proposal v1

Summary of AHWG, GPP AG and written stakeholder feedback

A manufacturer highlighted the different physical forms and performances of lithium ion batteries, which can be cylindrical or prismatic. One is larger/cheaper the other thinner/lighter but more expensive.

Further definition is needed for how the battery time will be measured. The performance requirements for public tenders can vary, for example schools may only require 5 hours and a warranty may be requested for the battery.

A proposal was made by a manufacturer for a minimum performance of 80% charge retention after 300 cycles.

2.3.2.4 Technical background and rationale for criteria proposal v2

For notebook computers and tablet computers, the lifetime of the rechargeable batteries has been identified as a potential limiting factor to the overall lifetime of the whole product. This is particularly the case where the battery cannot easily be removed and replaced, as is the case for some notebooks and tablets. Battery replacement incurs additional costs and sending a device for battery replacement incurs both downtime and cost.

The influence of user behaviour

User behaviour is also an important factor in battery life. So-called 'intelligent charging' has been identified by stakeholders as an important feature. If a notebook is plugged into the mains power a long time then this may deteriorate the battery. It is understood that most modern notebooks now take power directly from the mains once the battery is fully or, if set accordingly, to a partial charge.

Nonetheless there may be scope to provide guidance to users on how to maximise battery life. Factors that can be controlled including ensuring the computer is well ventilated and doesn't overheat, that power management settings are used when unplugged and that partial charging systems are used where available.

Battery life and cycle length within today's market

Battery lifetime declarations are now required to be made for notebooks under the non-energy related requirements of the Ecodesign Implementing Measure Regulation (EU) 207/2013 Annex II Part 7.1 'Information to be provided by manufacturers' (from 1st July 2014) which requires a declaration of:

(o) the minimum number of loading cycles that the batteries can withstand (applies only to notebook computers);

Cycles are the number of times a battery can fully charge and discharge power before they start to deteriorate and hold less charge. Battery life generally refers to how long the user can work in hours before needing to recharge the battery.

Early declarations under Ecodesign provide an indication as to the standard cycles and the main test method used by manufacturers. For example, Dell declares that all their notebook and tablet batteries meet the accelerated endurance procedure of IEC EN 61960⁵³ retaining 60% capacity over 300 cycles. Commentators suggest that 300-500 cycles is the de facto standard for lithium ion batteries⁵⁴. The ITU (International Telecommunication Union) recently published Recommendation L.1010 on 'Green Batteries' which proposes retention of 80% of capacity after 500 cycles as a benchmark for a long lasting battery⁵⁵. Industry stakeholders proposed that the minimum performance threshold for GPP should be 80% retention after 300 cycles.

A closer look at the market, however, reveals that longer battery life and cycle claims appear to be increasingly important, particularly for computers sold to public

⁵³ Dell (2014) *ErP Lot 3 Technical documentation*, http://www.dell.com/downloads/global/corporate/envIRON/comply/ErP_Lot_3_Public_Information.pdf

⁵⁴ Battery University, *How to prolong lithium based batteries*, http://batteryuniversity.com/learn/article/how_to_prolong_lithium_based_batteries

⁵⁵ ITU, *Green batteries solution for mobile phones and other hand-held information and communication technology devices*, Recommendation ITU-T L.1010, February 2014, <http://www.itu.int/rec/T-REC-L.1010-201402-P>

organisations and private enterprises. A review of leading products on the market, together with feedback from leading manufacturers, suggests that *battery life* claims are the most frequently communicated to and valued by users, so this should be balanced against any cycle performance specifications.

Of the notebook manufacturers that dominate the EU market share Acer, Dell, Asus, HP and Toshiba offer business models with 800 or 1000 cycle batteries. In some cases this also allows the OEM to provide an extended warranty for the battery itself of up to 3 years. Notable amongst the leading OEM's is Apple who offers 80% retention of charge after 1,000 cycles as standard on new MacBook Pro and Air models⁵⁶. However it is considered that Apple may represent a niche product for public procurers.

In terms of battery life in hours, for 15 inch+ screen desktop replacement notebooks battery life can now extend to an estimated 7-8 hours+ (dependant on hardware combinations). For Ultrabook notebook forms it can extend from an estimated 8-9 hours to up to 16 hours in one example. Industry stakeholders commented that requirements on battery life will vary depending on the specific end-use of a product. An example was cited of tablets for schools, which would probably not need more than 5 hours.

Consultation with selected notebook and battery manufacturers highlights that the cost of these batteries is higher, in some cases up to 80% more expensive than 300-500 cycle performance. A leading lithium ion battery manufacturer suggested that it is more important to specify longer cycle endurance for notebooks where the battery cannot be readily changed by the consumer e.g. in some Ultrabook and Tablet models.

Extending battery life using intelligent charging

The battery life cycle can be extended through the use of 'intelligent charging' systems that control how a battery is charged and discharged. Battery life span

⁵⁶ Apple, *Determining battery cycle count*, Accessed March 2014, <http://support.apple.com/kb/ht1519>

degrades more rapidly if there is a deep charge and discharge i.e. if a battery is charged to near 100% capacity and is then subjected to near full discharge. Minimising the ‘depth of discharge’ will therefore extend the lifespan of the battery, as illustrated in Table 2.3.3.

Pre-installed software is now provided with some notebooks, for example with Apple, Asus and Toshiba products, limiting the charging to approximately 80% of battery capacity. This has the potential to extend the battery life cycle by approximately 50%, although in practice this reduces battery life, which we have already highlighted as being important for consumers.

Table 2.3.3: Relationship between depth of discharge and number of cycles

Depth of discharge	Discharge cycles
100% DoD	300 – 500
50% DoD	1,200 – 1,500
25% DoD	2,000 – 2,500
10% DoD	3,750 – 4,700

Source: Battery University (2014)

Benchmarking and verifying battery performance

For the measurement of battery cycle endurance the industry standard is IEC EN 61960. IEC 61960 specifies both a standard endurance in cycles test at 0.2 I_t A and an accelerated endurance in cycles test routine based on increased charge of 0.5 I_t A within the tolerance of the battery.

Battery life can be verified using a range of different software packages and test routines. Two of the most commonly used software packages for benchmarking battery life are understood to be Powermark by Futuremark⁵⁷ and Mobilemark by BAPCo⁵⁸. These softwares can be used to simulate combinations of different tasks

⁵⁷ Futuremark, *Powermark*, Accessed 2014, <http://www.futuremark.com/benchmarks/powermark>

⁵⁸ BAPCo, *Mobilemark 2012*, Accessed 2014, <http://bapco.com/products/mobilemark-2012>

using typical combinations of mainstream software on a portable computer until the battery power is run down.

Futuremark is a private enterprise with a community of developers that includes Apple, Asus, Dell, HP, Lenovo and Microsoft. BAPCo is a non-profit enterprise established to develop benchmarking tools for its members who include Asus, Dell, HP, Lenovo, Microsoft, Samsung and Toshiba – although its origins with Intel raise concerns with some commentators that it has/continues to favour products with Intel processors⁵⁹. BAPCo has a ‘government network’ and claims its software is used in public procurement by 24 EU states.

2.3.2.5 Revised criterion proposal (v2)

Core criteria	Comprehensive criteria
AWARD CRITERIA	
<p>C7. Rechargeable battery life and endurance Points shall be awarded for improved endurance greater than 300 cycles (with 80% capacity retention) respectively.</p> <p>A maximum of x points may be awarded.</p> <ul style="list-style-type: none"> • 1000 cycles or more: x points • 800 cycles or more : 0.75x points • 500 cycles or more: 0.5x points • Up to 499 cycles: 0.25x points <p><i>The minimum battery life in hours shall be set according to the Contracting Authority's requirements.</i></p> <p>Verification: The tenderer shall provide a test report for the battery cells or packs showing compliance according to the IEC EN 61960 ‘endurance in cycles’ test carried out at 25°C and at a rate of either 0.2 I_t A or 0.5 I_t A (accelerated test procedure), or equivalent. Partial charging may be used to comply as long as the software is factory-installed as the default setting and the tender requirements on battery life are met at the partial charging level complying with the cycle requirement.</p>	<p>C7. Rechargeable battery life and endurance Points shall be awarded for improved endurance greater than 500 cycles (with 80% capacity retention) respectively⁶⁰.</p> <p>A maximum of x points may be awarded.</p> <ul style="list-style-type: none"> • 1000 cycles or more: x points • 800 cycles or more : 0.6x points • Up to 799 cycles: 0.3x points <p><i>The minimum battery life in hours shall be set according to the Contracting Authority's requirements.</i></p> <p>Verification: The tenderer shall provide a test report for the battery cells or packs showing compliance according to the IEC EN 61960 ‘endurance in cycles’ test carried out at 25°C and at a rate of either 0.2 I_t A or 0.5 I_t A (accelerated test procedure), or equivalent. Partial charging may be used to comply as long as the software is factory-installed as the default setting and the tender requirements on battery life are met at the partial charging level complying with the cycle requirement.</p>

⁵⁹ Bright Side News, *Are benchmarks worthless?* 19th April 2012, <http://www.brightsideofnews.com/2012/04/19/opinion-are-benchmarks-worthless/>

⁶⁰ The cycle performance may be achieved using software which partially charges the battery. In this case the applicant shall pre-install the software as the default charging routine.

Summary rationale:

- Given uncertainty related to price and availability it is proposed to retain only an award criterion with the main focus on battery cycle endurance.
- Points could be awarded for additional endurance cycles over and above 300 (core) or 500 (comprehensive) cycles based on an 80% capacity retention, respectively. Points shall be awarded on a weighted scale up to 1000 cycles which represents the best performance on the market.
- Battery life is an important factor in some decisions to purchase notebooks and tablets but comments suggested that it is very tender specific. It is not therefore proposed to retain a battery life requirement.
- IEC 61960 is considered to represent an international reference point for the comparable verification of battery cycle endurance. It shall be possible to verify either cells or packs. The accelerated test option offers a lower cost of verification.
- Moreover, in recognition of the importance of depth of discharge on battery lifespan it is proposed to specifically allow partial charging to be used to comply with the award criteria, as long as the minimum battery life is complied with for the declared cycle performance.

2.3.3 Criterion 3.3 – Disk drive reliability and durability

2.3.3.1 Criteria proposals v1 (04/2014)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>E1. Stationary computer drives</p> <p>The data storage drive or drives used in desktops, workstations and thin clients shall have an Annual Failure Rate (AFR) of less than 0.9%.</p> <p>For small-scale servers the Annual Failure Rate shall be less than 0.6% and a Bit Error Rate of <1 in 10^{16} bits.</p> <p>Verification:</p> <p>The tenderer shall provide a specification for the drive or drives integrated into the product. This shall be obtained from the drive manufacturer and shall be supported by a technical report verifying that the drive complies with the specified performance requirements.</p>	<p>E1. Stationary computer drives</p> <p>The data storage drive or drives used in desktops, workstations and thin clients shall have an Annual Failure Rate (AFR) of less than 0.6%.</p> <p>For small-scale servers the Annual Failure Rate shall be less than 0.6% and a Bit Error Rate of <1 in 10^{16} bits.</p> <p>Verification:</p> <p>The tenderer shall provide a specification for the drive or drives integrated into the product. This shall be obtained from the drive manufacturer and shall be supported by a technical report verifying that the drive complies with the specified performance requirements.</p>
<p>E2. Notebook computer drives</p> <p>The primary data storage drive used in notebooks shall be designed to withstand a shock of 400 G (operating) and 1000 G (non-operating).</p> <p>Verification:</p> <p>The applicant shall provide a specification for the drive or drives integrated into the product. This shall be obtained from the drive manufacturer and shall be supported by a test report verified according to IEC 62131, or equivalent.</p>	<p>E2. Notebook computer drives</p> <p>The primary data storage drive used in notebooks shall be designed to withstand a shock of 400 G (operating) and 1000 G (non-operating).</p> <p>Verification:</p> <p>The applicant shall provide a specification for the drive or drives integrated into the product. This shall be obtained from the drive manufacturer and shall be supported by a test report verified according to IEC 62131, or equivalent.</p>
AWARD CRITERIA	
	<p>E3. Notebook computer drives</p> <p>Additional points shall be awarded if notebook primary data storage drives meet one of the following specifications:</p> <ul style="list-style-type: none"> (i) The HDD drive head should retract within a maximum of 300 milliseconds upon detection of the notebook having been dropped. (ii) The drive installed is Solid State. <p>Verification:</p> <p>The applicant shall provide a specification for the drive or drives integrated into the product. This shall be obtained from the drive manufacturer and shall be supported by a technical report verifying that the drive complies with the specified performance requirements.</p>

2.3.3.2 *Summary of stakeholder feedback on criteria proposals v1*

Summary of AHWG, GPP AG and written stakeholder feedback

A manufacturer highlighted that drive failure tended to be reflected in warranty claims. However, this additional cost is not always factored into decision-making.

An industry stakeholder asked whether a high error rate was an indicator of better or worse performance. Would this be experienced from a consumer's point of view? A manufacturer responded that it could result in a loss of data. JRC-IPTS responded that they understood it to be more relevant to servers because they will run for longer during their lifetime.

An industry stakeholder stated that the lack of market compliance data means that this should only be an award criterion. Moreover, the test specifications require further development and the proposal lacks reference to an international test specification.

2.3.3.3 *Technical background and rationale for revised criteria v2*

Hard disk drives (HDD) are one of the computer components where according to WRAP (2011)⁶¹ the most common faults are reported by several studies and product surveys. It is also understood that there can be significant variations in the reliability of HDD products. Several HDD products reviewed, as well as examples of OEM procurement procedures for HDD⁶², specify the reliability of HDD using metrics such as 'Mean Time Between Failures' and 'Operating Shock'.

⁶¹ See <http://www.wrap.org.uk/sites/files/wrap/Laptop%20case%20study%20AG.pdf>

⁶² Hewlett Packard, *Hard Disc Drive quality system – the driving force for reliability*, November 2006

Summary of findings from a manufacturer enquiry and literature search

As a starting point a follow-up enquiry was made to OEMs with a view to gathering more information on drive quality and physical specifications to improve their durability and reliability. This included a focus on both HDD and newer Solid State Drives (SSD) which have no moving parts (i.e. they are akin to high capacity USB). The main points are summarised in Table 2.3.4.

Table 2.3.4: Summary of OEM feedback on HDD and SSD specifications

Hard Disc Drives (HDD)	
Reliability and durability specifications	Responses confirmed a set of standard OEM requirements for quality control including: <ul style="list-style-type: none"> • Error rate • Mean Time Between Failure • Annual Failure Rate • Load/unload endurance Operating shock, vibration and temperature range were particularly highlighted for mobile applications. Most defects are related to shock and vibration.
Physical design features	For notebooks free-fall sensors (accelerometers) are used in some drives for business models. Shock absorption is also specified, in some cases instead of free-fall sensors.
Improvement potential of features	No information was provided to verify the improvement potential of the quality control parameters.
Verification	Standard quality control and supplier qualifications processes are used, with all HDD required meeting the same requirements for each OEM. In the case of portable HDD protection by shock absorption this is verified by notebook drop and vibration tests.
Solid State Drives (SSD)	
Exemption from the criterion?	In general SSD should be exempted from general quality requirements. Most HDD failures are related to moving parts, which SSD do not have.
Reliability and durability specifications	General reliability and durability parameters are still required as part of quality control for SSD e.g. error rate, MTBF, AFR.

Although a limited response was received it was from leading manufacturers in the market. The feedback suggests that similar quality parameters are applied across all HDD purchases for specific computer form factors. For notebooks, however, two physical design features were highlighted – free-fall sensors and shock absorption – both specified in response to feedback from users on the common stresses on a drive. SSD is an alternative solution because it has no moving parts.

Technical research by drive manufacturer Western Digital and research by Strom et al (2007) for Samsung and Seagate suggested that physical protection of the HDD from external shocks that could damage the disk surface should be a priority for the EU Ecolabel and GP. This is because head clearance – the air gap (or 'headspace') between the magnetic read/write head and the surface of the rotating disk – are now the most significant physical reliability issue for HDD, as highlighted in Figure 2.3.1.

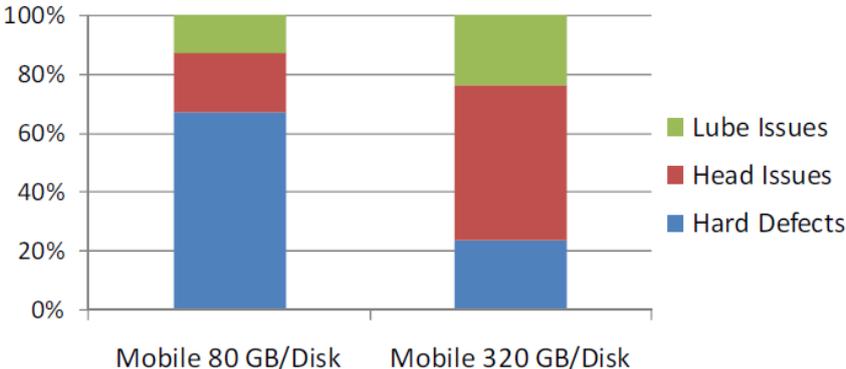


Figure 2.3.1. Reasons for field failures in notebook HDD

Source: Western Digital (2013)

Benchmarking desktop and server drive reliability

The potential to use the metric ‘Mean Time Between Failure’ (MTBF) was discussed and was highlighted as being based on a statistical calculation across thousands of drives. Manufacturer Seagate instead recommend the use of Annual Failure Rate as a clearer indication of the probability of a HDD failing during its lifespan⁶³. The AFR is calculated as follows:

$$AFR = 1 - \exp(- \text{Annual Operating Hours} / MTBF)$$

So a MTBF of 1,600,000 hours represents an AFR of 0.55% for a server HDD running 24/7.

⁶³ Seagate, *Diving into MTBF and AFR: Storage reliability specs explained*, 26th April 2010, <http://enterprise.media.seagate.com/2010/04/inside-it-storage/diving-into-mtbf-and-afr-storage-reliability-specs-explained/>

A Mean Time Between Failure (MTBF) for enterprise (server) drives of between 1,600,000 and 2,000,000 would represent a good performing drive which, based on a duty cycle of 168 hours per week, would translate into Annualised Failure Rates (AFR) of between 0.44% and 0.55%. For business or consumer desktops it is more difficult to determine a good performance based on available information, primarily because manufacturers do not tend to report MTBF for consumer or business drives. Intel suggests a MTBF of 700,000 which, assuming a duty cycle of 20% (1,752 hours) would equate to an AFR of 0.25%.

Another metric relevant to enterprise (server) drives is 'bit error rate'. It is understood that bit errors (unrecoverable data) are symptomatic of head and writing problems. Expert commentary⁶⁴ suggests that a bit error rate of 1 in 10^{14} bits would not impact on a consumer or business desktop user but would not be suitable for enterprise (server) use. Instead bit error rates in the range of 1 in 10^{15} to 1 in 10^{16} bits are highlighted for enterprise grade drives.

Notebook drive protection features

Portable drives should be protected from shock, vibration and sudden drops during use. Common features identified included shock protection, free-fall sensors and solid state drives:

- The use of *physical damping to protect against vibration and shock* was identified as a design feature of 'rugged' and 'semi-rugged' notebooks (see section 3.3.4). Specifications for operational and non-operational shock tolerance of notebook HDD of four major manufacturers – Seagate, Western Digital, HGST and Toshiba – suggests a performance range of 300-400 (operational) to 900-1,000 (non-operational) G force. Industry stakeholders highlighted the use of IEC 62131 as a test method.

⁶⁴ Newman, H, *How to choose a hard drive*, Enterprise Storage Forum, 27th February 2014, <http://www.enterprisestorageforum.com/storage-management/how-to-choose-a-hard-drive-1.html>

- *Free-fall sensors* are either fitted externally or internally to a HDD and detect a sudden motion associated with a fall. The free-fall sensor specifications of four major manufacturers – Seagate, Western Digital, HGST and Toshiba – suggest a performance range of 150 – 300 milliseconds. In the worst case, this would still protect against a drop whilst being carried by hand.

The increasing trend towards specification of solid state drives was also identified as a means of improving data protection because this type of drive has now moving parts. As was highlighted in the initial market analysis the price of SSD is still higher than standard drives but they are rapidly increasing market share and it is understood that prices are falling as a result of volume production.

2.3.3.4 Revised criterion proposal (v2)

Core criteria	Comprehensive criteria
AWARD CRITERIA	
	<p>C8. Notebook computer drives</p> <p>Points shall be awarded where the primary data storage drive used in notebooks is tested and verified to meet at least one of the following requirements:</p> <ul style="list-style-type: none"> (i) The HDD drive shall withstand a half sine wave shock of 400 G (operating) and 900 G (non-operating) for 2 ms without damage to data or operation of the drive. (ii) The HDD drive head should retract from the disc surface in less than or equal to 300 milliseconds upon detection of the notebook having been dropped. (iii) A solid state storage drive technology such as SSD or eMMC is used. <p>Verification:</p> <p>The applicant shall provide a specification for the drive or drives integrated into the product. This shall be obtained from the drive manufacturer and for option (i) shall be supported by a test report according to IEC 62131 or equivalent and for option (ii) IEC 60068, Part 2-31: Ec (Freefall, procedure 1)</p>

Summary rationale:

- Given the greater potential for damage caused by external forces it is proposed to focus the criterion on portable drives.
- Given concerns raised by stakeholders about the limited market insight on price and uptake of the notebook drive specifications an award criterion is proposed that invites tenderers to provide one of the three most common forms of drive protection:
 - The shock resistance method IEC 62131 was highlighted by stakeholders and is proposed as the verification for option (i).
 - The IEC standard 60068, Part 2-31: Ec (Freefall, procedure 1) is proposed as means of verification for the free-fall sensor option (ii).
 - The SSD option (iii) has distinct physical characteristics which have the potential for visual verification.

2.3.4 Criterion 3.4 – Notebook durability testing

2.3.4.1 Criteria proposal v1 (04/2014)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
	<p>F1. Notebook durability: Drop test</p> <p>The applicant shall submit the notebook model for durability testing. This shall consist of a122 cm drop height onto a 5.0 cm of plywood surface on concrete, 4-6 drops per sample to a total of 26 drops covering each face, edge and corner.</p> <p>The notebook shall be non-operational during the test but shall function following the test.</p> <p>Verification:</p> <p>A third party verified test report shall be provided by the tenderer showing compliance with the requirements according to US Department of Defence standard MIL-STD-810G, 516.6, Procedure IV, or equivalent.</p>
	<p>F2. Notebook durability: Water ingress</p> <p>The applicant shall submit the notebook model for durability testing. This shall consist of 0.2 litres of water being poured evenly over the main body of the open keyboard face of the notebook, drained after 3</p>

	<p>seconds, inverted on its side for 45 seconds and then tested after 2 minutes.</p> <p>The notebook shall be operational during and after the test.</p> <p>Verification:</p> <p>A third party verified test report shall be provided by the tenderer showing compliance with the requirements according to US Department of Defence standard MIL-STD-810G, 506.5, Procedure III or IEC 60529, or equivalent.</p>
AWARD CRITERIA	
	<p>F3. Notebook durability: Screen resistance</p> <p>The applicant shall submit the notebook model for durability testing. This shall consist of a 25kg loading to be applied to the centre of the screen lid with the notebook placed on a flat surface. The screen to then be inspected for lines, spots and cracks.</p> <p>Verification:</p> <p>The applicant shall provide test reports showing that the model has been tested and has met the benchmarks for durability. Testing and verification shall be carried out by a third party.</p> <p><i>No formal test method exists as a reference; stakeholder input is required. There is potential to refer to panel pressure test methods. An separate screen specification may also be considered.</i></p>
	<p>F4. Notebook durability: Keyboard lifespan</p> <p>The applicant shall submit the notebook model for durability testing. This shall consist of a 10 million random keystrokes simulation for <i>(to be specified)</i> product samples. The keys to then be inspected for their integrity.</p> <p>Verification:</p> <p>The applicant shall provide test reports showing that the model has been tested and has met the benchmarks for durability. Testing and verification shall be carried out by a third party.</p> <p><i>No formal test method exists as a reference; stakeholder input is required.</i></p>

2.3.4.2 Summary of stakeholder comments on criteria proposal v1

Summary of AHWG, GPP AG and written stakeholder feedback
<p>The aim of the criterion should be clarified – is it that the computer still works following each test or only that the data is protected?</p> <p>An industry stakeholder commented that the lack of data on market penetration suggested that this criteria area should become award criteria. A Member State</p>

queried the ability of SMEs to provide products tested to these requirements.

A local authority stakeholder highlighted tablet screen glass toughness as a factor to be addressed. Corning and Schott were highlighted as manufacturers of glass that is pressure and scratch resistance. Pressure is applied in testing to each side of the product.

An industry stakeholder highlighted the need to refer to international technical standards in order to support bid comparison.

A stakeholder queries why there were no core proposals for some of the criteria.

2.3.4.3 Technical background and rationale for revised criteria v2

Whilst criteria proposals have been put forward that address reparability and upgradeability, other key factors to consider are the durability of the product and its components and, in particular for portable products, the real-life conditions and stresses that they may be subjected to.

With notebooks computers set to shortly become the most common form factor for computers in the market, the conditions in which computers are used are changing significantly. Notebooks may be exposed to a range of stresses and environmental conditions depending on whether they are used in offices, for business travel or out in the field on, for example, site work. Tablets may be used in offices, classrooms or in the field.

In this section we therefore look at the market concept of 'rugged' notebooks, which has now been extended to include mainstream notebook products using the terms 'semi-rugged' and 'business rugged'. The term is also now being applied to tablets, given their increasing market prevalence.

Failure and repairs required as a result of common accidents and stresses

A study by US warranty providers Squaretrade of 30,000 new laptops over their first three years of ownership was referenced in the EU Ecolabel Preliminary report in October 2013⁶⁵. The study highlighted a hardware failure rate of 20.4% and accidental damage of 10.6%. It also highlighted a significant variation in reliability between leading brands, ranging from 15.6% to 25.6%.

Market analysts IDC, sponsored by Panasonic, who manufactures popular 'Rugged' notebook models⁶⁶, carried out a survey of 300 businesses in the USA. The study found that on average each year:

- 14.2% of notebooks required repair or replacement due to physical failure,
- 9.5% of notebooks required repair or replacement due to an accident.

The most commonly damaged component was the keyboard (72%) followed by the screen (66%), battery (58%) and hard disk drive (51%). Damage could therefore encompass multiple components.

Where the damage was the result of an accident the most common causes were being dropped whilst being carried (72%), followed by some kind of liquid spillage (66%) and a fall from a desk or table (55%). Of most significance from the IDC study is the claimed extension of lifespan for a semi-rugged notebook, on average from 2 years 5 months to 3 years 6 months.

Test methods and benchmarks of durability

The terms 'rugged' and 'semi rugged' can be seen as the first attempts to define durability benchmarks for notebooks. Endpoint Technologies (2011) define them with reference to the US Department of Defence's MIL-STD-810G test standards⁶⁷ and

⁶⁵ Squaretrade Inc, *1 in 3 laptops fail over 3 years*, USA, November 16th 2009
http://www.squaretrade.com/html/pdf/SquareTrade_laptop_reliability_1109.pdf

⁶⁶ IDC, *The Business case for ruggedized PC's*, USA, June 2012

⁶⁷ US Department of Defence, *Test method standard MIL-STD 810G*, 31st October 2008

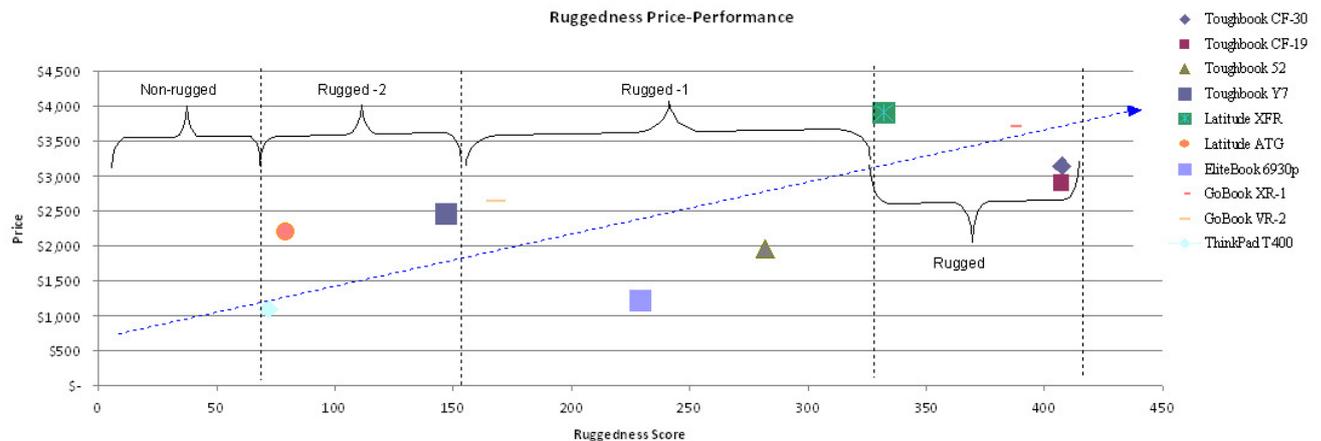
the IP65 (International Protection) standards⁶⁸. The study defines a five point numeric scale which it uses to grade notebook durability. The scale relates to the level of compliance with MIL-STD-810G and the International Protection standards for dust and water ingress, as well as whether compliance has been third party verified.

The lower tiers of the range encompassing 'semi-rugged' and 'business rugged' are likely to be of most relevance to the procurers seeking greater durability, whilst 'rugged' and 'ultra-rugged' can be seen to reflect high cost products specially designed for military and field applications, such as Panasonic's Toughbook, which is the only product to achieve the 'ultra-rugged' category. The tests and their associated performance benchmarks for 'semi-rugged' relate to:

- Drop
- Vibration
- Shock
- Pressure at varying altitudes
- Temperature over a range between -29°C to $+60^{\circ}\text{C}$
- Temperature shock
- Humidity

The price performance of products by Panasonic, GD-Itronix, HP, Dell and Lenovo can be seen in Figure 2.3.2. HP and Lenovo are notable for their products which meet standards 1 and 2 at a lower price point. Commentators suggest that 'business rugged' specifications can attract up to a 50% premium on comparable computing specifications.

⁶⁸ UL, *Environmental ratings for enclosures based on Ingress Protection (IP) Code designations*, <http://www.ul.com/global/eng/pages/offering/services/hazardouslocations/ref/ingress/>



Source: Endpoint Technology Associates (2011)

Figure 2.3.2: Price versus performance of products assessed on the rugged scale

The Endpoint study defines high end specifications for notebooks with a focus on environmental stress. A scoping of test routines applied to mainstream business and consumer notebooks products by the most significant notebooks manufacturers by EU market share reveals a similar set of tests related to specific design improvements. Some additional tests related to everyday functionality are also added, such as the durability of the keyboard and screen lid hinge. The tests applied by each manufacturer are summarised in Table 2.3.5. The findings indicate that comprehensive durability testing, including drop, shock and vibration tests, tend to be carried out for selected business models.

It is understood that, in line with the recommendation of Endpoint Technologies, a number of the manufacturers listed have the tests carried out by testing bodies, thereby ensuring that performance is third party verified. TÜV is an example of a test body carrying out durability and so-called HALT (Highly Accelerated Life Tests) tests. For some manufacturers, such as Asus, the tests are carried out in-house.

Table 2.3.5: Indicative sample of manufacturers' notebook durability tests

Manufacturer	Market segment (% models with testing applied)	Models to which testing is applied	Scope of testing
HP	Consumer range (no models)	<i>No testing claims made for consumer models.</i>	n/a
	Business range (88% models)	250-i2/3/5, 350-i2/3/5, 350-G1,355-G2 series	Internal test specifications: <ul style="list-style-type: none"> • Water spill resistant keyboard
		Probook series 455-G1, 640-G1, 645-G1, 840-G1, 430-G2, 450-G2, 455-G2, 470-G2 Elitebook series 820-G1, 840-G1, 1040-G1, 725-G2, 745-G2, Folio 4010-G1, 8470p	Internal 'total test process' based on MIL-STD-810G standards: <ul style="list-style-type: none"> • Drop, shock, vibration, dust, humidity, altitude, temperature range, temperature shock Additional test specifications: <ul style="list-style-type: none"> • Keyboard strokes (7 year simulation) • Screen/lid open-close (6 year simulation)
Acer	Consumer range (no models)	<i>No testing claims made for consumer models.</i>	n/a
	Business range (14% models)	Travelmate P2, P4, B, Aspire S7	Internal test specifications: <ul style="list-style-type: none"> • Water spill resistant keyboard
		Travelmate P6	Internal test specifications: <ul style="list-style-type: none"> • Drop, shock, vibration, dust, temperature range • Screen/lid open-close • Dust ingress
Lenovo	Lenovo range (no models)	<i>No testing claims made for consumer models.</i>	n/a
	Thinkpad range (56% of models)	11E/T/X/L/W/G series	MIL-STD-810G standards: <ul style="list-style-type: none"> • Drop, shock, vibration, dust, humidity, altitude, temperature range, temperature shock Additional internal test specifications: <ul style="list-style-type: none"> • Screen pressure test • Water spill resistant keyboard

Manufacturer	Market segment (% models with testing applied)	Models to which testing is applied	Scope of testing
			<ul style="list-style-type: none"> Hinge durability
Dell	Consumer range (32% of models)	XPS	n/a
		Inspiron 3000,5000,7000 models	Internal test specification: <ul style="list-style-type: none"> Temperature range Screen lid open/close (25,000 times) Keyboard (10 million key strokes) Trackpad (1 million presses)
	Business range (46% of models)	Latitude series 3000, 5000 models,	MIL-STD-810G standards: <ul style="list-style-type: none"> Shock, vibration, temperature range, temperature shock
		Inspiron series 3000,7000 models	Internal test specification: <ul style="list-style-type: none"> Temperature range Screen lid open/close (25,000 times) Screen lid torsion (25,000 times) Keyboard (10 million key strokes) Trackpad (1 million presses)
Asus	All notebooks (100% of models)	All notebook series	Internal test specifications: <ul style="list-style-type: none"> Drop, shock and vibration tests Temperature range Keyboard strokes simulation Screen pressure test Screen lid open/close (20,000 times)
	Business range (100% of models)	ProB and ProP series	Internal test specification with higher performance for: <ul style="list-style-type: none"> Drop test (+100% increase in drop height) Screen pressure test (+20%) keyboard strokes (+100%)
Toshiba	Consumer range (no models)	<i>No testing claims made for consumer models.</i>	n/a
	Business range (58% models)	Tecra series Portege series	Highly Accelerated Lifetime Test simulating 3 years of use:

Manufacturer	Market segment (% models with testing applied)	Models to which testing is applied	Scope of testing
			<ul style="list-style-type: none"> • Drop, shock and vibration tests • Temperature range • Screen pressure test • Water spill resistant keyboard

Test methods and benchmarks of durability

Stakeholders expressed mixed views on how best to specify the test methods. Some expressed concern that reference should be made to European or International standards such as EN or IEC. Some industry stakeholders are familiar with reference to the US MIL standards and commented that they would prefer that these remained the reference point for verification.

The tests described by MIL 810-G and IP are for the most part reflected by similar test procedures in the IEC 60068 'environmental testing' series and the IEC 60529 'Degrees of protection provided by enclosures' standard. Where possible the proposed test methods have therefore been updated based on an approximation to the equivalent IEC standard. An exact equivalence could not be identified for the water spillage test, so instead reference has been made to the IEC definition of 'acceptable conditions for water ingress'.

The detailed proposed test specifications were determined by cross-referencing test definitions proposed by US market intelligence company Endpoint⁶⁹ with test specifications provided in-confidence by Toshiba and Asus, and the published test procedures of HP and Dell. For a number of tests – namely screen resilience, keyboard lifespan and hinge resilience - standardised methods could not be identified:

⁶⁹ Endpoint Technologies Associated, *Redefining rugged: Assessing the spectrum of durability in the notebook market*, USA, 2008 and 2011

- Screen resilience, which has been updated to with reference to LCD quality tests for Asus, Toshiba, Apple and LG ⁷⁰. The inspection requirements could be further elaborated on in the User Manual based on manufacturer guidelines for LCD units.
- Keyboard lifespan is further specified to ensure that testing is weighted to reflect the most commonly used keys.
- Hinge failure was highlighted by a manufacturer as being a breakage that is particularly costly to repair. A test based on a set number of openings and closures of the screen is therefore proposed, allowing a minimum lifespan for the product to be defined.
- Liquid spillage is generally carried out for hot and cold drinks and either based on an even spillage or a spillage concentrated in specific locations. The lack of standardisation has therefore required some flexibility in how the testing is specified.

Equipment suppliers for such tests can be identified ⁷¹, so the verification has been updated to require that the equipment and setup used for the test is reported. In all cases tests must be carried out by a third party.

For tablets a combination of a screen resilience tests with a drop test is proposed, based on the practices of leading manufacturers such as Microsoft and Fujitsu, as well as warranty providers such as Square Trade ⁷². This was commented as being important to ensure a durable tablet product. The majority of manufacturers are already understood to use toughened glass such as Corning's Gorilla glass and

⁷⁰ AUO B133EW07 V0 *display specification for LED backlight with high color gamut* (Apple specification) and LG Display, *HD TFT specification for approval*, September 2012

⁷¹ See for example Design & Assembly Concepts, <http://www.dac-us.com/testandreliability.html>

⁷² Squaretrade, *New Research Rates Google's New Nexus 7 Tablet a "Medium Risk" 5 Breakability Score, Outscoring the iPad Mini*, August 2013 <http://www.squaretrade.com/press/new-research-rates-google-new-nexus-7-tablet-a-medium-risk-5-breakability-score-outscoring-the-ipad-mini>

Schott's Xensation glass, so there would be limited scope for market differentiation by having a specific performance requirement for the screen glass.

2.3.4.4 Revised criterion proposal (v2)

Core criteria	Comprehensive criteria
AWARD CRITERIA	
	<p>C9: Notebook durability testing</p> <p>Points shall be awarded for products that have passed durability tests carried out according to IEC 60068 or equivalent. <i>The tests applicable shall be specified in the ITT to reflect the conditions of use defined for the product.</i></p> <p>A maximum of x points may be awarded:</p> <ul style="list-style-type: none"> • Accidental drop (x/4 points) • Resistance to shock (x/4 points) • Resistance to vibration (x/4 points) • Screen resilience (x/8 points) • Temperature stress (x/8 points) <p>Functional performance requirements and test specifications are provided in Annex 1 of the criteria document.</p> <p>Verification:</p> <p>The applicant shall provide test reports showing that the model has been tested and has met the functional performance tests. Testing and verification shall be carried out by a third party.</p> <p>Products holding the EU Ecolabel for personal, notebook and tablet computers (Commission Decision 201xx/xxx/EUxx) or another relevant Type 1 Eco-label fulfilling the listed requirements will be deemed to comply.</p>

	<p>C10: Tablet durability testing</p> <p>Points shall be awarded for products that have passed durability tests carried out according to IEC 60068, or equivalent.</p> <p>A maximum of x points may be awarded:</p> <ul style="list-style-type: none"> • Accidental drop (x/2 points): • Screen resilience (x/2 points): <p>Functional performance requirements and test specifications are provided in Annex 1 of the criteria document.</p> <p>Verification:</p> <p>The applicant shall provide test reports showing that the model has been tested and has met the functional performance tests. Testing and verification shall be carried out by a third party.</p> <p>Products holding the EU Ecolabel for personal, notebook and tablet computers (Commission Decision 201xx/xxx/EUxx) or another relevant Type 1 Eco-label fulfilling the listed requirements will be deemed to comply.</p>
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Proposed Annex 1: Notebook and Tablet durability test specifications

Test	Test conditions and performance benchmarks	Test method
Accidental drop <i>(Notebooks and tablets)</i>	<p><i>Specification:</i></p> <p>The notebook or tablet shall be dropped from 76 cm of height onto a surface consisting of a minimum of 30mm of wood over a non-yielding surface. One drop shall be made on the top, bottom, right, left, front and rear side, as well as each corner.</p> <p><i>Functional requirement:</i></p> <p>The notebook or tablet shall be switched off during the test but shall successfully boot up following each test. The casing shall remain integral and the screen undamaged following each test.</p>	IEC 60068 Part 2-31: Ec (Freefall, procedure 1)
Screen resilience <i>(Notebooks and tablets)</i>	<p><i>Specification:</i></p> <p>Two loading tests shall be carried out. A load of 50kg shall be evenly applied to the screen lid (for notebooks) or screen (for tablets) over a minimum area of 176cm. A minimum load of 25kg shall be applied to an area with a diameter of 3cm. The notebook or tablet shall be placed on a flat surface during each test.</p> <p><i>Functional requirement:</i></p> <p>The screen surface and pixels shall be inspected for the absence of lines, spots and cracks after application of each loading.</p>	The test equipment and setup used shall be confirmed by the tenderer.

Resistance to shock	<p><i>Specification:</i></p> <p>A minimum of a 40G peak half-sine wave pulse shall be applied three times for a duration of a minimum of 6 ms to the top, bottom, right, left, front and rear side.</p> <p><i>Functional requirement:</i></p> <p>The notebook shall be switched on and running a software application during the test. It shall continue to function following the test.</p>	IEC 60068 Part 2-27: Ea Part 2-47
Resistance to vibration	<p><i>Specification:</i></p> <p>Randomised sinusoidal vibrations in the frequency 5-250Hz shall be applied for a minimum of 1 sweep cycle per axis to the top, bottom, right, left, front and back axis.</p> <p><i>Functional requirement:</i></p> <p>The notebook shall be switched on and running a software application during the test. It shall continue to function following the test.</p>	IEC 60068 Part 2-6: Fc Part 2-47
Temperature stress	<p><i>Specification:</i></p> <p><i>The notebook shall be subjected to a minimum of four 24 hour exposure cycles in a test chamber. The notebook shall be operational during a cold cycle at -25oC and a dry heat cycle at +40oC. The notebook shall be non-operational during a cold cycle at -50oC and dry heat cycling between +35 and +60oC.</i></p> <p><i>Functional requirement:</i></p> <p><i>The notebook shall be checked that it functions following each of the four exposure cycles.</i></p>	IEC 60068 Part 2-1: Ab/e Part 2-2: B

Summary rationale:

- It is proposed that a basic set of durability tests are specified, reflecting the most common accidents and weakpoints associated with notebooks, as well as those most commonly applied to business products by the leading manufacturers in the EU market.
- *The requirements requested in the ITT are proposed to be specified depending on the required robustness and the nature of the end-use for the notebooks to be procured. So, for example, notebooks to be used in the field might be expected to meet all the tests.*
- However, given a degree of uncertainty associated with the market availability and additional costs associated with durability tested notebooks it is proposed to specify these tests as award criteria, with points then awarded

according to the level of durability offered by the tenderer. A weighting is additionally proposed for the points to be allocated.

- The tests listed for notebooks are proposed to encompass: drop, shock, vibration, screen resilience and temperature stress. For tablets the list is reduced to drop and screen resilience, reflecting the greater inherent robustness of some of the components of a tablet e.g. use of solid state drives.
- To verify the durability tests, reference is proposed to the IEC 60068 standards series. However, it should be recognised that several manufacturers already use the US MIL standards as the basis for testing. In both cases reference to the quoted standards do not provide a clear test routine. The outline test specifications developed for the EU Ecolabel are therefore proposed for inclusion in an Annex.
- Tests specified in the EU Ecolabel for which there was no reference EU or international test method have not been proposed for GPP i.e. screen hinge durability, keyboard lifespan.
- The testing is proposed as being carried out and verified by a third party in order to provide comparability and assurance.

2.5 Criteria area 4 – End-of-life management

2.5.1 Criteria 4.1 – Design for recycling

2.5.1.1 Current criteria

Core criteria	Comprehensive criteria
AWARD CRITERIA	
<p>Additional points will be awarded for ease of disassembly and ease of recycling plastic parts:</p> <ul style="list-style-type: none"> - Connections shall be easy to find, accessible with commonly available tools, and as standardised as possible. - Plastic parts heavier than 25g shall have a permanent marking identifying the material, in conformity with ISO 11469: 2000 or equivalent standard. Excluded from this criterion are extruded plastic materials and the light-guide of flat panel displays. Plastic parts shall be of one polymer or compatible polymers, except for the cover, which shall consist of no more than two types of polymer, which are separable. <p>Verification:</p> <p>A test report shall be submitted with the application detailing the dismantling of the personal computer. It shall include an exploded diagram of the personal computer labelling the main components as well as identifying any hazardous substances in components. It can be in written or audiovisual format. Information regarding hazardous substances shall be provided to the authority in the form of a list of materials identifying material type, quantity used and location.</p>	<p>Additional points will be awarded for ease of disassembly and ease of recycling plastic parts:</p> <ul style="list-style-type: none"> - Connections shall be easy to find, accessible with commonly available tools, and as standardised as possible. - Plastic parts heavier than 25g shall have a permanent marking identifying the material, in conformity with ISO 11469: 2000 or equivalent standard. Excluded from this criterion are extruded plastic materials and the light-guide of flat panel displays. Plastic parts shall be of one polymer or compatible polymers, except for the cover, which shall consist of no more than two types of polymer, which are separable. <p>Verification:</p> <p>A test report shall be submitted with the application detailing the dismantling of the personal computer. It shall include an exploded diagram of the personal computer labelling the main components as well as identifying any hazardous substances in components. It can be in written or audiovisual format. Information regarding hazardous substances shall be provided to the authority in the form of a list of materials identifying material type, quantity used and location.</p>
	<p>Recycled content and recyclability (for PCs, notebooks and monitors) Additional points will be awarded if the external plastic case of the system unit, monitor and keyboard has a post consumer recycled content of not less than 10% by mass.</p> <p>Verification:</p> <p>A declaration by the manufacturer stating the percentage post consumer recycled content.</p>

2.5.1.2 Revised criteria proposal v1(04/2014)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
	<p>H1. Recyclability of plastics and metals</p> <p>The recyclability of the metal or plastic housings used and enclosures shall be verified.</p> <p>Plastic used for housings and enclosures shall consist of a maximum of two polymers and shall not have surface coatings or metal inlays.</p> <p>Verification:</p> <p>Recyclability shall be verified by a declaration from a permitted treatment operation in accordance with Article 23 of Directive 2008/98/EC (the WEEE Directive) that there is an end-market for the materials.</p>
<p>H2. Marking of plastics</p> <p>Plastic parts of greater than 200 grams shall be marked in accordance with ISO 11469 and ISO 1043, sections 1-4, or equivalent. Marking shall not be required where it would impact on the performance or functionality of the plastic part, including screen light guides.</p> <p>Verification:</p> <p>Documentation shall be provided showing conformity to the above mentioned ISO standards, or equivalent. A technical justification shall be provided where marking cannot be applied.</p>	<p>H2. Marking of plastics</p> <p>Plastic parts of greater than 100 grams shall be marked in accordance with ISO 11469 and ISO 1043, sections 1-4, or equivalent. Marking shall not be required where it would impact on the performance or functionality of the plastic part, including screen light guides.</p> <p>Verification:</p> <p>Documentation shall be provided showing conformity to the above mentioned ISO standards, or equivalent. A technical justification shall be provided where marking cannot be applied.</p>
AWARD CRITERIA	
<p>H3. Plastic recycled content</p> <p>Points shall be awarded for post-consumer recycle content incorporated into internal and external housings, casings and structures at or greater than 10% by weight.</p> <p>This criterion shall not be applied to products with metal casings.</p> <p>Verification:</p> <p>The tenderer shall provide documentation verifying traceability for the post-consumer recycled content according to ISO 15343 or equivalent standards or schemes.</p>	<p>H3. Plastic recycled content</p> <p>Points shall be awarded for post-consumer recycle content incorporated into internal and external housings, casings and structures at or greater than 25% by weight.</p> <p>This criterion shall not be applied to products with metal casings.</p> <p>Verification:</p> <p>The tenderer shall provide documentation verifying traceability for the post-consumer recycled content according to ISO 15343 or equivalent standards or schemes.</p>

2.5.1.3 Stakeholder comments on revised criteria proposals v1

Stakeholder feedback and follow-up evidence

Summary of AHWG, GPP AG and written stakeholder feedback

A manufacturer highlighted that a 25g threshold for plastics marking was the state of the art but that 100g could be acceptable for a Core criterion. Manufacturers proposed that the exemption for "light guides" refer instead to "plastic optical components".

Industry stakeholders asked for exemptions for certain surface coatings and expressed their willingness to provide more data. It was noted that additives in plastics are a key factor in recyclability, but that material declarations would be required to verify this. An industry representative commented that it is possible to verify the presence of a flame retardant in recycled resin if it has received a so-called yellow card (UL746D) for fire protection.

Industry stakeholder's views on a criterion encouraging a percentage of recycled material were diverse. The precedent set by the legal case European Court of Justice, Wienstrom ECJ C-448/01 was cited, which raises issues about relating the requirement to the Subject Matter. Another saw the value as being easy to achieve while another saw the limit as very ambitious. Several industry stakeholders felt that recycled content should be measured on average. It does not need to be product specific. This is the standard procedure already with other EU Ecolabelled products, such as with organic cotton.

2.5.1.4 Technical background and rationale for revised criteria v2

Similar to the cluster lifetime extension, the research results of Task 3 and Task 4 revealed that high attention should also be paid to the end-of-life (EoL) management of computers to reduce the overall environmental impacts since secondary resources from recycling can substitute primary production.

The recyclability of plastics and metals

Evidence from pilot studies on recyclability⁷³, dismantling studies such those carried out by JRC-IES⁷⁴ and Fraunhofer IZM (2013)⁷⁵, as well as feedback from recyclers, confirmed the importance of considering the recyclability of plastic components.

Metal foils attached to plastic parts reduce the value of the plastics fraction, and may be passed onto an additional shredding process for separation. Coating and plastics parts attached to bulk plastics parts reduce the value of the plastics fractions PC/ABS, white mixed plastics and black mixed plastics from the perspective of the dismantler. Meaning that mono material plastic housing parts without coatings, inserted metal windings, metal shields attached are better to recycle than composite materials.

Manufacturers may alternatively choose a metal casing, for the purposes of ensuring toughness and durability of the product (e.g. cast aluminium, magnesium oxide) as well as avoiding the need for treatments or additives to provide fire protection.

Two potential approaches to defining and verifying the recyclability of plastics were considered for the EU Ecolabel criteria on recyclability. The first based on a 'recyclability rate' calculation as specified in IEC 62635 and reflecting a hypothetical scenario for EU end-of-life WEEE treatment. The second based on consideration of specific technical issues relating to combinations of plastics, metals and additives. Given that the former may change over time and is not comprehensive enough to address specific technical challenges associated with plastic components, it was decided to adopt the second approach.

⁷³ Peeters.J.R, Vanegas.P, Tange.L, Van Houwelingen.J and J.R.Duflou, *Closed loop recycling of plastics containing Flame Retardants*, Journal of Resources, Conservation and Recycling, 84 (2014) p-35-43

⁷⁴ Ardente, F.; Mathieux, F.: *Integration of resource efficiency and waste management criteria in European product policies – Second phase. Report no 2, Application of the project's method to three product groups*. Joint Research Centre – Institute for Environment and Sustainability, Ispra, 2012

⁷⁵ Fraunhofer IZM, *Disassembly analysis of slates: Design for repair and recycling evaluation*, Final report, August 2013.

The potential to verify the recyclability of plastic enclosures was reviewed against the underlying criterion of the successful US eco-label EPEAT - the IEEE 1680.1 standard for the environmental assessment of computer products⁷⁶ - and cross referenced with studies on dismantling and plastics recycling. This highlighted the importance of focussing on:

- A requirement relating to the avoidance of paints or coatings that are 'incompatible with recycling';
- An optional criterion that plastic enclosures shall not contain moulded-in or glue-on metal unless the metal inserts can be easily removed;
- Plastic combinations with additives such as flame retardants.

A major concern with regards to verification was raised by stakeholders in relation to what constitutes 'compatibility with recycling'. 'Compatible' is defined in EPEAT as being when:

'Paints and coatings on plastic parts are proven to be compatible with recycling processes if they do not significantly impact the physical/mechanical properties of the recycled resin. Significant impact is defined as >25g reduction in notched Izod impact at room temperature as measured using ASTM D256-05 [ISO 180].'

Notable in this definition is the reference to a specific testing method for the physical/mechanical properties of recycled resin. For metal inserts the verification options include a listing of commonly available tools that can be used to remove a metal insert and a statement from a recycling company with electronics recycling expertise confirming that the product design meets the requirements.

Based on the tests carried out by Peeters et al (2014) to determine the recyclability of plastics incorporating flame retardants could also be verified using the same

⁷⁶ IEEE Computer Society, *Standard for Environmental Assessment of personal computer products*, IEEE Std 1680.1-2009, 5th March 2010.

physical/mechanical test according to ISO 180 that is proposed for paints and coatings.

Stakeholders queried whether flame retardants are actually used in computer casings, whereas for monitors they are a legal requirement to meet fire regulations. Feedback from a major computer OEM confirmed that FRs are incorporated into plastic computer casings, even though this is not a regulatory requirement. Moreover, the ENFIRO FP7 study on flame retardants³¹ recommended expanding the recycling of plastics in such a way as to retain the functional value of FR's.

The marking of plastics

Different opinions exist on the industrial value of plastics marked according to ISO 11469 with ISO 1043. Products may be shredded with low grade material recover. According to Köhnlechner (2014)⁷⁷, plastic sorting technologies can increasingly cope with black coloured plastics. Amongst others, sorting based on density separation as well as electrostatic properties of different polymer types can achieve high quality output for ABS and HIPS⁷⁸ – independent from the plastic colour.

On the other hand, feedback from re-processors and dismantlers carrying out initial separation of plastics suggests that it is of value. The codes in ISO 1043-4 identifying flame retardants were highlighted as being particularly important. But it was noted that they do not identify CAS numbers.

The need for exemptions for cases where technical limitations or restrictions result in marking not being feasible was highlighted by industry stakeholders. For example, transparent plastic parts of display units such as PMMA light guides, which are understood to be easy to identify, and printed circuit boards are therefore proposed exempted from this requirement.

⁷⁷ Source: Köhnlechner, R.: Erzeugung sauberer PS- und ABS-Fraktionen aus gemischtem Elektronikschrott. In: Thome-Kozmiensky, K.T.; Goldmann, D.: Recycling und Rohstoffe, Volume 7. Munich, 2014.

⁷⁸ HIPS: High Impact Polystyrene; ABS: Acrylnitril-Butadien-Styrol

In terms of the weight thresholds it was noted by industry stakeholders that 25g represents 'state of the art' but that 100g could be suitable as a core requirement. The UNSP²³ program and the UK Government Buying Standards⁷⁹ set 25g as a weight threshold, with the UN criterion awarding extra points. Excluded from these criteria are extruded plastic materials and the light-guide of flat panel displays. The EPEAT Ecolabel sets a minimum weight threshold of 100g and an optional threshold of 25g.

Minimum requirements for plastic recycled content

A number of computer and display manufacturers have sought to increase the recycled content of their products. Evidence from leading notebook manufacturers such as Dell⁸⁰, Lenovo⁸¹ and Asus⁸² is that high levels of recycled content can be achieved in casings. The Label TCO certified edge (version 1.2 for displays) now requires a minimum content for post-consumer plastics of 65 % for larger plastic parts. The TCO database currently contains 89 products with 45 certifications compliant with this specification (date: 27.03.2014).

Specifying plastics with a recycled content is, however, understood from industry stakeholders to pose a specific problem for GPP. This is because there is not an analytical method to verify that the product contains recycled material. The sourcing of recyclate in the required volume and quality is understood to be a challenge for

⁷⁹ UK Government Buying Standards, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/341537/GBS_spec-monitors.pdf

⁸⁰ Dell, *Closed loop recycled content*, <http://www.dell.com/learn/us/en/uscorp1/corp-comm/closed-loop-recycled-content>

⁸¹ Lenovo, *Post consumer and post industrial recycled content*, http://www.lenovo.com/social_responsibility/us/en/materials.html

⁸² Green Electronics Council, *ASUS: Taiwan's Environmental Pioneer in EPEAT* <http://greenelectronicscouncil.org/asus-taiwans-environmental-pioneer-epeat/>

manufacturers because of limited supply, which means that an average recycled content is more feasible, but is more difficult to verify.

2.5.1.5 Revised criterion proposal (v2)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
	<p>D1(a) Recyclability of plastics casings, enclosures and bezels</p> <p>Parts shall not contain moulded-in or glued-on metal inserts unless they can be removed with commonly available tools. Disassembly instructions shall show how to remove them.</p> <p>Verification:</p> <p>The tenderer shall detail the tools required to remove any plastic parts containing metal inserts. Visual evidence shall be provided to support compliance.</p>
	<p>D1(b) Recyclability of plastic casings, enclosures and bezels</p> <p>The presence of the following treatments and additives shall not significantly impact upon the recyclability of the plastic when tested according to ISO 180⁸³ or equivalent:</p> <ul style="list-style-type: none"> - Paints and coatings - Flame retardants and their synergists <p>Verification:</p> <p>The tenderer shall provide valid mechanical/physical test reports carried out according to ISO 180 or equivalent. Third party test reports obtained from plastics recyclers, resin manufacturers or independent pilot tests shall be accepted.</p>

⁸³ For the purposes of this criterion a significant impact is defined as a >25% reduction in the notched izod impact of a recycled resin as measured using ISO 180.

<p>D2. Marking of plastic casings, enclosures and bezels</p> <p>Plastic parts with a mass greater than 100 grams shall be marked in accordance with ISO 11469 and ISO 1043-1, or equivalent.</p> <p>Printed wiring boards, extruded plastics and plastics in the display unit of monitors are exempted.</p> <p>Verification:</p> <p>The tenderer shall identify the plastic parts by their weight, their polymer composition, and their ISO 11469 and ISO 1043, or equivalent, markings. The dimension and position of the marking shall be visually illustrated.</p>	<p>D2. Marking of plastic casings, enclosures and bezels</p> <p>Plastic parts with a mass greater than 25 grams for tablet computers and 100 grams for computers and monitors shall be marked in accordance with ISO 11469 and ISO 1043, sections 1 and 4, or equivalent.</p> <p>Printed wiring boards, extruded plastics and plastics in the display unit of monitors are exempted.</p> <p>Verification:</p> <p>The tenderer shall identify the plastic parts by their weight, their polymer composition, and their ISO 11469 and ISO 1043, or equivalent, markings. The dimension and position of the marking shall be visually illustrated.</p>
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Summary rationale:

- It is proposed to retain criteria on material selection, recyclability and marking in order to recognise that certain combinations of polymers, coatings, metal inlays and alloys may present recycling problems and that the marking will facilitate the sorting activities. Moreover, this overall approach is in line with other GPP schemes and successful electronics eco-labels.
- It is proposed to focus the recyclability requirements on metal insets, coatings and flame retardants, as these were identified as specific barriers to recycling. The verification has been updated to be more specific based on either tooling and dismantling instructions or test results for polymer resins.
- As plastics marking is widely established in practice, it is proposed as a requirement with the exception of where technical limitations or restrictions result in marking not being feasible. In addition, for a comprehensive level, it is proposed that ISO 1043-4 marking is also required in order to identify flame retardants incorporated into the plastics requiring fire protection.
- The weight thresholds for marking have been updated to reflect minimum practice of 100g in the EPEAT Ecolabel (core requirement) and best practice in public procurement of 25g.
- Due to the difficulties in assurance level of the verification clause for the recycled content it is proposed to omit the requirement on minimum recycled

content. Moreover, LCA evidence does not suggest it is a significant environmental hot spot.

2.5.2 Criterion 4.2 – Design for dismantling

2.5.2.1 First criteria proposal v1 (04/2014)

Core criteria	Comprehensive criteria
AWARD CRITERIA	
<p>I1. Dismantling potential of devices</p> <p>Points shall be awarded for time efficient manual disassembly and extraction of the following listed components from devices:</p> <p>All products</p> <p>(i) Printed Circuit Boards relating to computing functions >10 cm²</p> <p>Stationary computer products</p> <p>(ii) Internal Power Supply Unit (iii) HDD drives</p> <p>Portable computer products</p> <p>(iv) Rechargeable battery</p> <p>Displays (including integrated units)</p> <p>(v) Printed Circuit Boards >10 cm² (vi) Thin Film Transistor unit and film conductors in display unit >100 cm²</p> <p>Extraction shall be possible using widely used commercially available tools (i.e. pliers, screw-drivers, cutters and hammers as defined by ISO 5742, ISO 1174, ISO 15601, or equivalent).</p> <p>The time required to extract display components shall not exceed the following:</p> <ol style="list-style-type: none"> a) 220 seconds for screen sizes smaller than 25 inches; b) 320 seconds for screen sizes greater than or equal to 25 inches and smaller than 40 inches; c) 480 seconds for screen sizes greater than or equal to 40 inches and smaller than 55 inches. <p>For stationary computers and notebooks the threshold shall be 600 seconds.</p>	<p>I1. Dismantling potential of devices</p> <p>Points shall be awarded for time efficient manual disassembly and extraction of the following listed components from devices:</p> <p>All products</p> <p>(i) Printed Circuit Boards relating to computing functions >10 cm²</p> <p>Stationary computer products</p> <p>(ii) Internal Power Supply Unit (iii) HDD drives</p> <p>Portable computer products</p> <p>(iv) Rechargeable battery (v) HDD drive</p> <p>Displays (including integrated units)</p> <p>(vi) Printed Circuit Boards >10 cm² (vii) Thin Film Transistor unit and film conductors in display unit >100 cm² (viii) Polymethyl Methacrylate (PMMA) film light guide (screen size >15 inches)</p> <p>Extraction shall be possible using widely used commercially available tools (i.e. pliers, screw-drivers, cutters and hammers as defined by ISO 5742, ISO 1174, ISO 15601, or equivalent).</p> <p>The time required to extract display components shall not exceed the following:</p> <ol style="list-style-type: none"> a) 220 seconds for screen sizes smaller than 25 inches; b) 320 seconds for screen sizes greater than or equal to 25 inches and smaller than 40 inches; c) 480 seconds for screen sizes greater than or equal to 40 inches and smaller than 55 inches.

<p>Verification: The tenderer shall provide a 'test dismantling report' detailing the dismantling sequence, the reported timings and the tools needed for the disassembly.</p> <p>The disassembly sequence shall be provided for verification by either:</p> <ul style="list-style-type: none"> (i) A third party, testing body. (ii) A specialised recycling firm that is a permitted treatment operation in accordance with Article 23 of Directive 2008/98/EC. <p>The report may be submitted either in writing or in digital format, supported by photos, drawings and/or videos.</p>	<p>For stationary computers and notebooks the threshold shall be 600 seconds.</p> <p>Verification: The tenderer shall provide a 'test dismantling report' detailing the dismantling sequence, the reported timings and the tools needed for the disassembly.</p> <p>The disassembly sequence shall be provided for verification by either:</p> <ul style="list-style-type: none"> (i) A third party, testing body. (ii) A specialised recycling firm that is a permitted treatment operation in accordance with Article 23 of Directive 2008/98/EC. <p>The report may be submitted either in writing or in digital format, supported by photos, drawings and/or videos.</p>
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2.5.2.2 Stakeholder comments on the first criteria proposal

Summary of AHWG, GPP AG and written stakeholder feedback
<p>For computers an industry representative questioned whether the criteria were realistic given that notebooks are at the moment not pre-processed by manual dismantling.</p> <p>A Member State voiced concern as to whether the criterion was right for the product group. Although separation can be very manual, the market is driven by the value of the components and materials and industry is developing many different innovative ways of extracting parts that are of value. This is very difficult to reflect in a criterion.</p> <p>For monitors some stakeholders did not see the added value of timed dismantling since there are a lot of facts that will affect the time that are out of the control of the manufacturer. A manufacturer saw the proposal on time threshold as very ambitious and disagreed with third party verification since it will mean to send to destruction a high number of TVs. A Member State saw added value on having the time threshold because it makes a bigger difference than the minimum legal requirements under the WEEE directive. Another stakeholder also supported the added value of having a time threshold.</p> <p>Industry stakeholders noted that at present there is no standardised method for timed dismantling, making comparison between bids difficult, but that they understood that,</p>

following on from the work for Ecodesign, a mandate has been sent to CENELEC.

It was additionally commented that shredding with some selective metal and plastic recovery followed by incineration is currently the most common treatment for handling monitor waste. This position was also supported by a manufacturer.

An industry representative voiced concern that, in general, if manual disassembly was being promoted, this would require cheap labour which could result in greater e-waste exports.

2.5.2.3 *Technical background and rationale for revised criteria proposal v2*

Reflecting the approach proposed in the draft revision of the Ecodesign Implementing Measure for Televisions (and Displays) EC/642/2009⁸⁴, the potential to time the dismantling and extraction of specific computer and display components of economic and environmental value has been developed into a criteria proposal for the EU Ecolabel for displays. A streamlined version is therefore proposed for GPP in order to promote improved end-of-life management of electrical waste.

The time and complexity of disassembling an IT product at the end of its life is a proxy for the cost effectiveness of extracting components that are valuable from both a life cycle and resource efficiency perspective. It is economically viable to spend tens of minutes to repair a computer, but not more than few minutes for dismantling. It is considered that this will remain the case even if dismantling is, in the future, carried out robotically⁸⁵.

⁸⁴ European Commission, Integration of resource efficiency and waste management criteria in European product policies: Application of the project's methods to three product groups, JRC-IES, November 2012

⁸⁵ R. Knoth, M. Hoffmann, B. Kopacek, P. Kopacek, and C. Lembacher, *Intelligent disassembly of electronic equipment with a flexible semi-automatic disassembly cell*, Austrian Society for Systems Engineering and Automation.

Valuable critical metals and raw materials present in IT equipment

The EU Raw Materials Initiative working group has identified and listed the Critical Raw Materials⁸⁶. Of direct relevance to Green Public Procurement is the recommendation made in the 2010 report that policy actions are undertaken to 'make recycling of raw materials-containing products more efficient' including 'mobilising end of life products with critical raw materials for proper collection'. A specific recommendation is also made that:

'...overall material efficiency of critical raw materials should be achieved by...minimising raw material losses into residues from where they cannot be economically-recovered.'

It can be seen from the Bills of Materials for products that CRMs (Critical Raw Materials) are concentrated in a small number of main components, primarily the motherboard, batteries, HDD, optical drives and LED backlights. Sub-components can then be identified that would require extraction in order to recover the CRMs – for example, capacitors containing tantalum, magnets containing neodymium, LED cells containing gallium.

Table 2.5.1: Indicative occurrence of high value metals and CRMs in an indicative notebook computer

Metal	Content per notebook (mg)	LCA hot spot	EU CRM	Occurrence in the notebook
Cobalt	65,000		✓	Lithium ion batteries
Neodymium	2,100		✓	HDD motors and accelerators (70%) Loudspeakers (30%)
Tantalum	1,700		✓	Motherboards capacitors (90%) Other PCB capacitors (10%)
Silver	440	✓		Motherboard (57%) Other PCB's (43%)

⁸⁶ European Commission, *Critical raw materials for the EU*, Report of the Ad Hoc Working Group on defining critical raw materials, DG Enterprise and Industry, 30th July 2010

Praseodymium	270		✓	HDD accelerators (53%) Loudspeakers (47%)
Gold	100	✓		Motherboard (54%) Other PCB's (46%)
Dysprosium	60		✓	HDD accelerators
Indium	40		✓	Display and LED Backlights
Palladium	40		✓	Motherboard (64%) Other PCB's (36%)
Platinum	4		✓	HDD platters
Rare Earths ^a	2.48		✓	LED backlights
Gallium	1.6		✓	LED backlights

Notes:

a) Yttrium, gadolinium, cerium, europium

Table 2.5.2: Indicative occurrence of high value metals and CRMs in an indicative desktop computer (without display)

Metal	Content per desktop (mg)	LCA hot spot	EU CRM	Occurrence in the notebook
Steel	6,737.50	✓		Chassis and enclosure
Plastics	1,579.55			Enclosure, cables, peripherals
Aluminium	550.21	✓		Chassis, capacitors, HDD platters
Copper	413.225	✓		Circuitry, cables, capacitors
Zinc	25.94			-
Tin	19.57	✓		Solder
Antimony	18.58		✓	Solder, flame retardants
Nickel	12.70	✓		Metal plating
Neodymium	5.87		✓	HDD motors and accelerators Loudspeakers
Silver	1.70			Motherboard and other PCB's
Gold	0.26	✓		Motherboard and other PCB's
Palladium	0.12		✓	Motherboard and other PCB's
Chromium	0.02			Coatings
Ceramics & others	366.04			Heat sinks, power supply units and capacitors

Table 2.5.3: Indicative occurrence of high value metals and CRMs in electronic displays

Metal	Content per LCD computer display (LED backlit) [mg]	LCA hot spot	EU CRM	Occurrence in the product
Silver	520	✓		PCB and contacts (100%)
Indium	82		✓	Internal coating on display (100%)
Gold	200	✓		PCB and contacts (100%)
Yttrium	3.20		✓	Background illumination (100%)
Palladium	40	✓	✓	PCB and contacts (100%)
Europium	0.06		✓	Background illumination (100%)
Cerium	0.2		✓	Background illumination (100%)
Gallium	3.30		✓	Background illumination (100%)
Gadolinium	1.50		✓	Background illumination (100%)

The market potential for dismantling and CRM recovery

Whilst it is possible to identify components and sub-components for selective extraction, it is not guaranteed that their extraction is currently economically or technically feasible. The collection of WEEE in Europe has grown rapidly since the introduction of the WEEE Directive in 2003, and this is set to increase further as the recast WEEE Directive is transposed at a European level.

Treatment centres tend to be a mixture of large processing centres handling a wide range of different types of WEEE and niche operators concentrating on a few or even single streams. Centres may consist of a combination of manual dismantling and sorting of components with bulk shredding and detoxification (e.g. mercury removal

from LCD screens)⁸⁷. Selected components may then be sent to specialist smelters (e.g. PCBs) or be subject to automatic or manual separation (e.g. plastics).

The main plastics fraction (e.g. PC/ABS casing), steel and aluminium chassis, alloy casings (painted or unpainted), rechargeable lithium ion batteries, capacitors with a diameter larger than 2.5 cm, external power cables and printed circuit board's larger than 10 cm² are generally extracted and passed on to the relevant markets for materials recycling.

From a resource point of view, leading actors in the specialist metals and CRM market claim that some manual pre-treatment, including complete removal of PCBs and other components such as HDDs, followed by subsequent recovery of the precious metals would enable a significantly more efficient recovery of various metals and CRMs, including REEs (Rare Earth Elements)⁸⁸. Taking silver, gold and palladium as examples the recovery rate could be increased in selected scenarios from 12-26% to 90%.

The market position with regards to specific component parts of computers and displays is briefly summarised below:

- Plastic casings: Despite the prevalence of shredding, the recent REWARD/EFRA pilot study highlights the importance of plastics marking and the provision of information about the FRs used as being important to facilitate recovery and recycling⁸⁹.
- Printed Circuit Boards (PCBs): The main economic aim of recovering PCBs is to recover the copper, gold, silver and palladium. However, other critical

⁸⁷ Meskers.C.E.M and C.Hagelüken, *The impact of different pre-processing routes on the metal recovery from PC's*, Conference paper *Resource management and technology for material and energy efficiency*, EMPA Materials Science and Technology, September 2009.

⁸⁸ C. Hagelüken and C. E. M. Meskers, *Complex life cycles of precious and special metals*, Chapter 10 from *Linkages of Sustainability* (2010) Strüngmann Forum Report, Edited by Thomas E. Graedel and Ester van der Voet.

⁸⁹ EFRA (2013) *Recycling of plastics from LCD television sets*

metals such as tantalum in capacitors are lost in this process – so-called ‘dissipative losses’.

- LCD/LED display units: Display organic components (liquid crystals, polarisation filters, resins) are generally shredded and may then be incinerated. The indium contained in the displays is generally lost through dissipation⁹⁰. Germany is understood to be considering storage of dismantled display units for recycling at a later date. Several mobile pilot plants are being developed to recover metals like copper, manganese, zinc, yttrium, indium from WEEE by hydrometallurgical processes.
- LED backlights: The CRMs rare earth metals used in the manufacture of LED backlight units are related to doping and luminescence. They can include indium, gallium, cerium, europium, yttrium and gadolinium.
- PMMA display light guide: The plastic light guides within an LCD display constitute a large proportion of the plastic used in a TFT display. It is readily identified however, without prior manual separation, it may be dispersed among other shredded fractions.
- Hard Disk Drives (HDDs): HDD contain Rare Earth Metals such as neodymium from magnets. Larger 3.5 inch HDD formats used in desktop computers, servers and datacentres are of interest in terms of the quantity of materials for recovery. Their physical design can, however, hamper recovery. Industry initiatives to recover REEs from HDD’s are being developed by Hitachi amongst others.
- Lithium ion batteries: Lithium ion batteries are addressed by the collection requirements under the Batteries Directive 2006/66/EC but it is understood

⁹⁰ See Oeko Institut (2012)

that their recovery rate is currently low, with a recent report claiming as low as 5%⁹¹.

Some industry stakeholders suggested that portable computers are not yet commonly recovered for recycling. The manual dismantling of desktop computers and monitors, with the selective extraction of some key components, is already commonplace. Feedback from the market is that few notebooks are currently reaching recycling facilities. Various possible reasons can be cited - second-hand market and repairing, storage at the consumer's home/work, shipment outside EU - and therefore recycling by manual dismantling is not well established yet.

Setting a time threshold for the extraction of key components

A JRC-IES draft report on material efficiency for EU Ecolabel criteria⁹² provides an analysis of studies in the literature on the dismantling of electronic displays.

Unfortunately, these studies generally refer to the full disassembly of the displays (without a detail of the dismantling of the above mentioned key parts) and results are presented as aggregated average result over a large number of devices.

In order to cope with this data gap, the study performed a survey of recyclers in Europe and visits were made to five facilities (two in Italy, one in UK, one in Belgium and one in Spain). The time for dismantling was found to be one of the most relevant parameter driving the treatments at the recycling facilities. In fact, the recyclers try to get a balance between the costs for disassembly (mainly the labour costs) and the potential revenues from a more accurate separation of components.

⁹¹ ENDS Europe, *Low recycling rates for lithium batteries criticised*, 14th February 2013

⁹² JRC - IES (2014 draft). Analysis of material efficiency for EU Ecolabel criteria: the example of two product groups. Environmental Footprint and Material efficiency support for product policy (Not published yet)

A previous JRC-IES report on benefits and impacts/costs of options for different potential material efficiency requirements for Electronic displays⁹³ provided data collected from the treatment of waste displays and the dismantling of around 70 waste displays in a Italian recycler. Based on this data, they show the percentage of displays of different sizes with a time for dismantling PCB (larger than 10 cm²), PMMA and TFT panels below certain thresholds. It is observed that around 50% of the displays smaller than 25'' have a time for extraction lower than 250 seconds. It is also observed that around 50% of the displays with a size between 25'' and 40'' have a time for extraction lower than 470 seconds.

The first JRC- IES (2014 draft) report⁹² gathered additional data about the time for dismantling for electronic displays from two other relevant EU studies. The results from these studies were used to check the robustness of the results obtained by JRC-IES and also to enlarge the experimental sample to aid in the definition of thresholds for the time for dismantling electronic displays. The final results (related to the entire data sample) are subdivided in three size ranges (S < 25''; 25'' ≤ S < 40''; 40'' ≤ S ≤ 55''). The thresholds met by 30% of displays are presented in Table 2.5.4 .

Table 2.5.4:Time for dismantling target components (s). (Source JRC-IES (2014 draft) report)

Size	S < 25''	25'' ≤ S < 40''	40'' ≤ S ≤ 55''
Threshold of the time for dismantling [s]	260	340	400

With regards to computer products, no similar analysis has yet been undertaken. However, in order to set an award criterion for GPP it is desirable to establish a threshold so that tenders can be clearly differentiated and decisions do not have to be made based on very small time margins, or within the range of uncertainty for

⁹³ JRC-IES (2013). Report on benefits and impacts/costs of options for different potential material efficiency requirements for Electronic displays. Integration of resource efficiency and waste management criteria in European product policies - Second phase, Joint Research Centre - Institute for Environment and Sustainability of the European Commission.

comparable extraction sequences. As a starting point a conservative figure has therefore been selected from a disassembly exercise carried out for a potential EU Ecolabel applicant with support from the Fraunhofer IZM and Tricom⁹⁴.

Defining the test method for timed dismantling

Industry stakeholders commented that there is currently no standardised method for timed dismantling. The potential for variability in the results could be significant between, for example, a manufacturer's careful dismantling in a lab and a more destructive dismantling in a recycling plant. It is important to note that the data analysed by JRC-IES relates to destructive dismantling so it is therefore proposed that in all bids, assessment and verification be based on the timing of dismantling in a recycling plant to improve comparability.

A mandate has now been submitted to CENELEC to develop a standard method to support the requirements proposed for inclusion in the revised Ecodesign Regulation for Displays. The timing for this process is likely to extend beyond the programme for adoption of the new EU Ecolabel and GPP criteria for computers. Therefore, an interim method would need to be specified for the GPP criterion. Reference is therefore proposed to an outline developed by JRC-IES⁹⁵ of what could be contained within such a standard. Outline steps for the method are for example described in Box 1.

⁹⁴ Iameco, *Iameco 2 - Low Carbon, Resource Efficiency and Long Life in PC Design*, http://iameco.com/wp-content/uploads/2013/10/iameco_2_-_Final_Technical_Report_FINAL.pdf

⁹⁵ Joint Research Centre – Institute for Environment and Sustainability - “Analysis of dismantleability” - draft 2014

Box 1: Outline steps for the measurement of the time for the extraction of certain target parts in IT products

<p>Terms and definitions</p> <ul style="list-style-type: none"> • <i>Target parts:</i> Parts and/or components that are targeted for the extraction process. <p>Operating conditions for the extraction</p> <ul style="list-style-type: none"> • <i>Extraction sequence to be followed:</i> The extraction sequence to be followed has to be set out prior to the measurement. The sequence shall be documented and provided to the third party carrying out the extraction. • <i>Tools for extraction:</i> The extraction operations should be performed using manual or power-driven standard tools. <p>Extraction time measurement</p> <ul style="list-style-type: none"> • <i>Measurement sample:</i> The sample of EEE to be used for the measurement shall be undamaged. • <i>Measurement:</i> The extraction time measurement consists of the measurement with an instrument of the time elapsed between the starting of the first operation listed in the extraction sequence documentation and the end of the last one. <p>Recording of the test conditions</p> <ul style="list-style-type: none"> • <i>Recording media:</i> Photos shall be taken and a video recorded of the extraction of the components. The video and photos shall include a time code and enable clear identification of the extraction sequence.
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2.5.2.4 Revised criterion proposal (v2)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATION	
	<p>D3. Monitor dismantling potential</p> <p>Points shall be awarded for the time efficient manual dismantling and extraction of the following components from monitors:</p> <ul style="list-style-type: none"> (i) Printed Circuit Boards >10 cm² (ii) Thin Film Transistor unit and film conductors in display unit >100 cm² (iii) LED backlight units <p>Extraction shall be possible using widely used commercially available tools (i.e. pliers, screw-drivers, cutters and hammers as defined by ISO 5742, ISO 1174, ISO 15601, or equivalent).</p> <p>The time required to extract the key components shall not exceed the following thresholds:</p> <ul style="list-style-type: none"> a) 400 seconds for screen sizes smaller than 25 inches; b) 500 seconds for screen sizes greater than or equal to 25 inches and smaller than 40 inches; c) 600 seconds for screen sizes greater than or equal to 40 inches and smaller than 55 inches.

	<p>Verification:</p> <p>The tenderer shall provide a 'dismantling test report' recording and providing a detailed description of the dismantling sequence, extraction steps and timing for the target parts and components.</p> <p>The disassembly test shall be carried out by a specialised recycling firm that is a permitted treatment operation in accordance with Article 23 of the Waste Framework Directive.</p> <p>See Annex 2 for the timed dismantling method to be used.</p>
AWARD CRITERIA	
	<p>D4. Computer dismantling potential</p> <p>Points shall be awarded for the time efficient manual dismantling and extraction of the following components from computers (<i>excluding tablets, subnotebooks and two-in-one notebooks</i>):</p> <p>All products</p> <ul style="list-style-type: none"> (i) Printed Wiring Boards relating to computing functions >10 cm² <p>Stationary computer products e.g. desktops</p> <ul style="list-style-type: none"> (ii) Internal Power Supply Unit (iii) HDD drives <p>Portable computer products e.g. notebooks</p> <ul style="list-style-type: none"> (iv) Rechargeable battery (v) HDD and optical drives (excluding SSD) <p>Extraction shall be possible using widely used commercially available tools (i.e. pliers, screw-drivers, cutters and hammers as defined by ISO 5742, ISO 1174, ISO 15601, or equivalent).</p> <p>The maximum time threshold required to extract the key components shall not exceed 600 seconds. Additional points shall be awarded in proportion to reduction the time required to extract the components relevant to the product. A maximum of x points shall be awarded:</p> <ul style="list-style-type: none"> (i) over 60% lower: x points (ii) 31-60% lower: 0.6x points (iii) 10-30% lower: 0.3x points <p>Verification:</p> <p>The tenderer shall provide a 'dismantling test report' recording and providing a detailed description of the dismantling sequence and extraction steps for the target parts and components that are relevant to the product.</p> <p>The disassembly test shall be carried out by a specialised recycling firm that is a permitted treatment</p>

	<p>operation in accordance with Article 23 of the Waste Framework Directive.</p> <p>See Annex 2 for the timed dismantling method to be used.</p>
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Proposed Annex 2: Protocol for the dismantling test

<p>(a) Terms and definitions</p> <ul style="list-style-type: none"> (i) Target parts and components: Parts and/or components that are targeted for the extraction process. (ii) Disassembly step: An operation that finishes with the removal of a part or with a change of tool. <p>(b) Operating conditions for the extraction</p> <ul style="list-style-type: none"> (i) Personnel: The test shall be carried out by one person. (ii) Test sample: The sample product to be used for the test shall be undamaged. (iii) Tools for extraction: The extraction operations shall be performed using manual or power-driven standard commercially available tools (i.e. pliers, screw-drivers, cutters and hammers as defined by ISO 5742, ISO 1174, ISO 15601). (iv) Extraction sequence: The extraction sequence shall be documented and, where the test is to be carried out by a third party, information provided to those carrying out the extraction. The sequence shall be defined as a series of steps that shall be followed by the third party. (v) Measurement: The extraction time measurement consists of the measurement with an instrument of the time elapsed between the starting of the first step listed in the extraction sequence documentation and the end of the last one. <p>(c) Recording of the test conditions and steps</p> <ul style="list-style-type: none"> (i) Documentation of steps: The individual steps in the extraction sequence shall be documented and the tools associated with each step shall be specified. (ii) Recording media: Photos shall be taken and a video recorded of the extraction of the components with a time code displayed recording the elapsed time during the recording. The video and photos shall enable clear identification of the steps in the extraction sequence.
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Summary rationale for the criteria proposal

- The criterion is proposed to be retained because of its environmental and economic significance for different types of IT equipment.
- The criterion reflects proposals by the Commission for introduction into the Ecodesign implementing measure for Displays requirements to measure and report on product dismantling times from an estimated 2016/17 onwards, being considered based on background studies by JRC-IES an important proxy for economic first stage manual dismantling.

- A technical specification is proposed for monitors based on the evidence analysed in order to set a similar criterion for the EU Ecolabel for display products. The selectivity of these thresholds reflects the results from several EU dismantling studies.
- For computers there is no similar evidence base to set selective thresholds. Instead, an award criterion is proposed that encourages the market to bring forward devices that can be quickly and efficiently dismantled manually.
- Points would be awarded for improvements on a conservative minimum time threshold. The threshold has been set based on analysis by Fraunhofer IZM and Tricom for a potential EU Ecolabel applicant.
- Components for extraction have been identified based on LCA hot spots, CRM/REE occurrence and the current/projected market potential for their recycling. Some distinction has been made between components in stationary and portable products, as well as displays.
- The tenderer would need to specify a dismantling sequence for the device and this would then be dismantled and timed by a recycling company, so as to ensure comparability based on more destructive testing. Verification by a 'real-life' option in a WEEE treatment facility mirrors a similar verification option for dismantling criteria 4.1.1.3, 4.3.1.5, 4.3.1.7 and 4.3.2.1 in the EPEAT standard for computers (IEEE 1680.1).

2.5.4 Criterion 4.3 – End of life management

2.5.4.1 Criteria proposal v1 (04/2014)

Core criteria	Comprehensive criteria
AWARD CRITERIA	
	<p>G1. Secure computer sanitisation, re-use and recycling</p> <p>Tenderers shall be invited, either in separate or combined ITT's, to offer:</p> <ul style="list-style-type: none"> (i) a collection service that maximises the re-use of computers and their displays at the end of their useful operation, (ii) the recycling of components such as HDD or SSD, as well as displays, at the end of their useful life. <p>The re-use service shall be in full accordance with the contracting authorities security requirements for data protection and sanitisation.</p> <p>Points shall be awarded according to the proportion of computers that, following a cost effective process of sanitisation, can be successfully re-used and/or drives that can be recycled.</p> <p>Verification:</p> <p>The tenderer shall provide details of the software they will use to meet the required security protocol levels and the proposed re-use and/or recycling options. The end market for recycled products or components shall be confirmed.</p> <p>Performance shall be monitored during the contract period against the re-use and recycling rates estimated in the tender.</p>

2.5.4.2 Stakeholder comments on criteria proposal v1

Summary of AHWG, GPP AG and written stakeholder feedback
<p>It was queried as to who was the audience for the ITT – a service company, a manufacturer or a third sector/charity organisation. The wording as it is written at the moment could be problematic and verification was seen as being difficult.</p> <p>An example was given of computers being refurbished/remanufactured for resale by manufacturers. Moreover, a leasing arrangement may be better than purchase as it</p>

would create a closed loop. It was commented that, based on evidence from a study in the US ⁹⁶ there is no general rule that, leasing is always better for the environment, as it depends on the product and the specific conditions.

Another manufacturer considered it important that the criterion was flexible, allowing intermediates to bid and leaving it open to the market. A manufacturer highlighted that re-use should be encouraged by the criterion. A Member State asked that it be clarified that computers would be re-used at the end of their service life for the public authority i.e. that they then have the possibility for an extended life. An example was given of a public authority letting a specific contract to a charity to take its computers with an obligation to upgrade and resell a certain percentage and dispose of the rest with a WEEE facility. PAS 141 in the UK should be reviewed as it may provide a model as it provides a protocol for the preparation of electronic products for re-use.

It was felt to be important to understand how the ITT would specify the software to be used for sanitisation. Some customers do not support HDD shredding.

With regards to verification it was felt by one Member State that it would be difficult for tenderers to bid with a predicted re-use/recycling rate. Moreover, the procurer may not be able to monitor performance of such a contract.

2.5.4.3 *Technical background and rationale for revised criteria v2*

Second hand usage of IT equipment can prolong the overall lifetime of computers and displays. However, a barrier to IT devices from the public sector being given over for second hand usage is the need for confidential data deletion from computer drives. This issue has been identified by a number of Member States as being a barrier and has been investigated further in order to identify practical opportunities to work around the problem.

⁹⁶ Agrawal et al, *Is Leasing Greener than Selling?* Management Science, INFORMS (USA), 28th October 2011, p.523-533

There are a wide variety of methods that allow a user to restore a computer to factory settings. However, in some cases the data can still be recovered. Some Government departments such as Defence have strict technical requirements to ensure that this cannot occur. Advanced software exists which writes random patterns to the HDD but it is costly.

Authorities in the Netherlands have investigated the issue in order to find ways of maximising the re-use of government IT equipment. They have identified that there tend to be several levels of confidentiality defined by Government Departments. In the example cases investigated, there were four levels and in 95% of these the level of confidentiality required was at the lowest level. At this level the cost of erasing data becomes cheaper, with approximately €36/computer cited but with the computer then only having a value of €7⁹⁷.

Another option is to remove the HDD for recycling, thus potentially still allowing for the computer to be re-used. HDD are not understood to command significant price for recycling but in the future, companies such as Rhodia and Hitachi are investigating how to process them in order to extract valuable components such as the magnetic heads which are made from Critical Raw Materials such as neodymium. This requires that HDD or SSD can be easily removed whilst still allowing for re-use of the computer. Such an upgrade is proposed under the Criterion C3 on Upgradeability and Reparability.

Different routes to extend product lifespan

Stakeholders commented that the criterion needs to be clearer in terms of what type of tenderers it would attract and what types of services. In order to do this it is necessary to make a distinction between a contractual arrangement with the original

⁹⁷ Personal communication with Joan Prummel, Category manager waste and resources, Netherlands Enterprise Agency.

supplier to take back the products at the end of their service life – for example, HP⁹⁸ or Dell⁹⁹ who remanufacture their own brand products and/or certify proper treatment of collected equipment - or a contractual arrangement with a third party to re-use or recycle products at the end of their service life – for example, Recover-E in the Netherlands¹⁰⁰.

Products may be resold following basic checks, remanufactured/upgraded for resale or sent for recycling. In the case of resale, data wiping services may need to be provided according to the specifications of the public authority and in some Member States voluntary standards have been established for the quality of product testing to give customers reassurance – for example, the PAS 141 standard in the UK¹⁰¹.

The Netherlands government is aiming at ensuring that products are treated and recycled properly at the end of their life following further re-use cycles¹⁰². They have been piloting contracts with contractors that maintain ownership of IT equipment during a number of re-use cycles so that they can guarantee that the opportunities for recycling are maximised. These pilots have also highlighted the need to consider the energy balance of re-use versus recycling, i.e., does it save more energy to re-use an old product or to recycle it?

Addressing input received related to end-of-life management

Some of the most significant potential environmental impacts associated with the informal recycling and improper treatment of WEEE exported from the EU were

⁹⁸ Hewlett Packard, *HP's hardware return and recycling programme*, <http://www8.hp.com/uk/en/hp-information/environment/hardware.html>

⁹⁹ Dell, *Asset recovery and recycling services*, <http://www.dell.com/learn/uk/en/ukcorp1/asset-resale-recycling-services>

¹⁰⁰ Recover-E, <http://recover-e.nl/>

¹⁰¹ WRAP, *Re-use protocols for electrical products*, <http://www.wrap.org.uk/content/re-use-protocols-electrical-products>

¹⁰² Personal communication with Joan Prummel, Category manager waste and resources, Netherlands Enterprise Agency.

highlighted in section 2.2.4. This is a particular concern for public authorities seeking to ensure that equipment that reaches the end of its service life is disposed of to the standards required under EU legislation.

European Environment Agency estimate that 16-38% of the EU's WEEE waste (between 550,000 and 1,300,000 tonnes) was exported in 2008¹⁰³. Moreover, whilst illegal WEEE shipments are classified as hazardous waste under the Basel Convention and are the subject of controls under the recast WEEE Directive, the EEA highlight that there are no restrictions on the export of goods for re-use, for which the end of life phase may not comply with expected EU norms for WEEE disposal.

The EU LIFE funded WEEElabex project¹⁰⁴ is an example of a collaboration with industry to create a certification scheme for proper treatment according to WEEE requirements. Projects such as this have now been superseded by the development of the EN 50625 series which, informed by approach developed by WEEElabex, defines WEEE collection logistics and treatment requirements.

The UK PAS141 standard also makes reference to the certification of legitimate export of WEEE for re-use. It is therefore proposed that guidance is given that when IT equipment reaches its end of life that treatment is, as a minimum, carried out according to the requirements of the EU WEEE Directive Annex VII, but with reference to EN 50625-1 as a standard or equivalent certification schemes.

2.5.4.4 Revised criterion proposal (v2)

For the IT Equipment to be replaced, it is now proposed that public authorities have a separate contractual arrangement that guarantees the collection, upgrade and resale or donation of the used IT Equipment (or its recycling and safe disposal if it is not reusable).

¹⁰³ European Environment Agency, *Movements of waste across the EU's internal and external borders*, Report No 7/2012

¹⁰⁴ WEEElabex, <http://www.weeelabex.org/>

These services are typically performed by social enterprises or charities, and given the low value of such a contract (with the possible exception of very large public organisations or departments), such an arrangement will likely not fall under the scope of the EU Public Procurement Directives. However, a tendering procedure should be considered to ensure that the contractor fulfils requirements on data protection, extension of the products' service life and, when applicable, recycling activities.

Equipment manufacturers can also provide for the remanufacturing of old products to certified quality standards, as well as certification of proper treatment under WEEE legislation, so such a tendering procedure could be run in parallel with a procedure for the purchasing of new equipment in order to encourage potential suppliers of new equipment to also bid.

As was already highlighted, data sanitisation is likely to be an important consideration. In many cases it is understood that this would be carried out by the contracting authority itself to comply with its security rules, however, internal reviews by some Member States have highlighted that the same level of security may not always be required across all department. As such, for some contracts data sanitisation may be considered within the scope of such a separate ITT.

Revised criteria proposal v2: End of life management

Core criteria	Comprehensive criteria
SUBJECT MATTER	
Procurement of end-of-life management services for Office IT Equipment	
TECHNICAL SPECIFICATION	
<p>D5. Secure computer sanitisation, re-use and recycling</p> <p>Tenderers shall provide a re-use and recycling service for Office IT equipment that has reached the end of its service life.</p> <p>The tenderer shall demonstrate how they will extend the service life of the equipment by sanitising data storage (<i>Unless carried out in-house. The requirements to be specified by the contracting authority</i>), servicing and then supplying it for re-use in the EU.</p> <p><i>Depending on an assessment of the condition of the equipment, the contracting authority may define a minimum re-use target to be met (e.g. 50% of provided equipment).</i></p> <p>Equipment that is not possible to re-use shall be delivered to permitted recycling facilities¹ so it is recycled in full compliance with the requirements in Annex VII of the WEEE Directive.</p> <p>Equipment dating back to prior to Energy Star v4.0 for notebooks and v5.0 for stationary computers and monitors shall be recycled unless it can be refurbished to meet, as a minimum, these requirements.</p> <p>Verification:</p> <p>The tenderer shall provide details of the arrangements for collection of the equipment, as well as the re-use and recycling routes to be used. This shall include the details of all certified WEEE handler(s)² to be used.</p>	<p>D5. Secure computer sanitisation, re-use and recycling</p> <p>Tenderers shall provide a re-use and recycling service for Office IT equipment that has reached the end of its service life.</p> <p>The tenderer shall demonstrate how they will extend the service life of the equipment by sanitising data storage (<i>Unless carried out in-house. The requirements to be specified by the contracting authority</i>), servicing and then supplying it for re-use in the EU.</p> <p><i>Depending on an assessment of the condition of the equipment, the contracting authority may define a minimum re-use target to be met (e.g. 70% of provided equipment).</i></p> <p>Equipment that is not possible to re-use shall be delivered to permitted recycling facilities so it is recycled in full compliance with the requirements in Annex VII of the WEEE Directive.</p> <p>Equipment dating back to prior to Energy Star v4.0 for notebooks and v5.0 for stationary computers and monitors shall be recycled unless it can be refurbished to meet, as a minimum, these requirements.</p> <p>.</p> <p>Verification:</p> <p>The tenderer shall provide details of the arrangements for the collection of the equipment, as well as re-use and recycling routes. This shall include the details of all certified WEEE handler(s)² to be used.</p>
AWARD CRITERIA	
<p>D6. Improvement in the re-use targets</p> <p>Points shall be awarded to tenderers offering higher levels of re-use.</p> <p>Verification:</p> <p>The tenderer shall provide details of how the additional level of re-use will be achieved</p>	<p>D6. Improvement in the re-use targets, recycling upgrading levels and equipment tracking</p> <p>Points shall be awarded to tenderers offering higher levels of re-use.</p> <p>Points shall be awarded to tenderers offering equipment servicing according to PAS141 (UK) or equivalent standards.</p> <p>To qualify for additional points, equipment that is not possible to re-use shall be dismantled and recycled in full compliance with EN 50625-1 or equivalent</p> <p>The tenderer shall additionally be awarded points for operating a tracking system with a unique identifier for</p>

	<p>each item of equipment from the Contracting Authority. The destination for equipment shall be reported to the Contracting Authority and verified using the tracking system.</p> <p>Verification:</p> <p>The tenderer shall provide details of how the additional level of re-use will be achieved and (if applicable) the proposed tracking system to be used. Appropriate documentation to demonstrate compliance with the PAS 141 (UK) standard or equivalent and the EN 50625-1 standard on treatment or equivalent shall be provided.</p>
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CONTRACT PERFORMANCE CLAUSES

<p>D7. Reporting on equipment status and destination</p> <p>The successful tenderer shall provide a report on the status of the equipment collected one year after collection. The report shall:</p> <ul style="list-style-type: none"> - Identify the proportion of items re-used or recycled; - Provide certificates verifying the proper treatment according to the WEEE Directive of the equipment that could not be re-used. 	<p>D7. Reporting on equipment status and destination</p> <p>The successful tenderer shall provide a report on the status of the equipment collected one year after collection. The report shall:</p> <ul style="list-style-type: none"> - Identify the proportion of items re-used or recycled; - Provide certificates verifying the proper treatment according to the WEE Directive of equipment that could not be re-used. - <i>The location or end-destination of the equipment (in case a tracking system is used)</i>
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¹ If the public authority is aware that there are no recycling facilities within a reasonable radius then it may be more appropriate to ask for the equipment to be delivered at an official WEEE collection point.

² WEEE handlers shall be permitted in compliance with Article 23 of Directive 2008/98/EC.

Summary rationale for criteria proposal:

- When purchasing new IT Equipment, the public authority will likely want to dispose of its used equipment. Typically, however, at least a part of this equipment can still be used for an additional period of time by other users. From an environmental point of view and in line with the waste hierarchy, priority should be given to the extension of products' useful life over its recycling and disposal.
- Opportunities to extend IT equipment lifespan through its re-use may be best achieved through the distribution of serviced and upgraded IT equipment by specialist third parties. Therefore, a separate contract is proposed to procure

end-of-life management services independent of the contract to supply new equipment with a requirement to extend the service life of the equipment and to guarantee proper treatment upon the end of life.

- Data sanitisation of drives is an important step in facilitating the re-use of computers used in the public sector; however, this is subject to very specific requirements to be set by the individual contracting authority as this is often carried out in-house.
- At a comprehensive level, standards for the servicing, upgrading and placing on the market of re-used equipment are suggested to encourage best practices.
- At a core level, recycling treatment is proposed to be defined according to Annex VII of the WEEE Directive. At a comprehensive level, the EN 50625-1 standard is proposed in order to promote state-of-the art recycling as this approach may be mandated to form the basis for an EN standard in the future.
- Energy performance cut-offs defined in terms of Energy Star are proposed in order to reflect the need to consider the energy saving balance between re-using and recycling.
- Contract performance clauses should be used in order to monitor execution of contracts

2.7 Criteria area 5 – Further criteria

2.7.1 Criterion 5.1 – Ergonomics

2.7.1.1 Background technical discussion and rationale (04/2014)

Currently, fitness for use is not addressed as a criterion within the GPP criteria set. Ergonomics is an area of potential interest for public procurement because of the need to ensure that working environments are healthy and productive. Workplace claims for problems such as eye and repetitive strain (related to display and keyboards) are also understood to be issues for employers. This could potentially lead to early retirement of displays if they are not suitable for workers.

The well-established electronics label TCO is the main ecolabel addressing ergonomics in its criteria. TCO Certified 2012 for Desktops, Notebooks, All-in-One PCs and Tablet PCs as well as TCO Certified Displays contain criteria regarding both visual ergonomics (image detail, luminance, luminance contrast, reflection and screen colour) and workload ergonomics (inter alia vertical tilt and vertical height for AiO-PCs). These are summarised in Table 2.7.1. The Nordic Swan ecolabel aligns to TCO Displays and Notebooks criteria with regard to ergonomics and includes some own requirements for tablet PCs.

Table 2.7.1: Ergonomic criteria of the TCO ecolabel

Visual ergonomics		Workload ergonomics
Image detail characteristics	<ul style="list-style-type: none"> • Native display resolution requirement 	Vertical tilt
Luminance characteristics	<ul style="list-style-type: none"> • Luminance level • Luminance uniformity • Black level • Luminance uniformity – angular dependence • Greyscale gamma curve 	Vertical height
Luminance contrast characters	<ul style="list-style-type: none"> • Luminance contrast – characters • Luminance contrast – angular dependence 	
Reflection characteristics	<ul style="list-style-type: none"> • Front frame gloss 	
Screen colour characteristics	<ul style="list-style-type: none"> • Correlated colour temperature, CCT, variation • Colour uniformity • RGB settings • Colour uniformity – angular dependence • Colour greyscale linearity 	

The German Ecolabel Blue Angel for Computer Monitors (RAL UZ 78c, edition January 2012)¹⁰⁵ includes a criterion based on ISO 9241, a multi-part standard covering ergonomics of human-computer interaction. In particular, DIN EN ISO 9241-307 establishes test methods for the analysis of a variety of visual display technologies, tasks and environments.

2.7.1.2 First proposal (04/2014)

Following stakeholder feedback, for EU Ecolabel it was proposed not to introduce new ergonomics requirements aligned with the label TCO Certified Displays. However, stakeholder feedback was sought on whether a selection of sub-criteria from either the TCO Certified Displays criteria set or EN ISO 9241-307 would be appropriate for GPP.

2.7.1.3 Summary of stakeholder feedback and proposed next steps

The main points arising from the 2nd AHWG meeting was that 1) quality should only be addressed when there is a clear trade-off with environmentally relevant issues and that 2) the cost of proposed test procedure was considered to be too high. Overall, limited additional feedback was received in order to clarify whether there is a clear trade-off with environmentally relevant issues of visual ergonomics. It is therefore proposed not to include a new criterion on the ergonomics of monitors for GPP.

¹⁰⁵ Cf. http://www.blauer-engel.de/en/products_brands/search_products/produkttyp.php?id=619

Draft document