JRC TECHNICAL REPORTS

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

TECHNICAL REPORT
Criteria Areas
(Draft) Working Document

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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 addressing[1]:

- 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 institutions. The specific information, views and suggestions arising from questions

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

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. This document, together with the updated EU Ecolabel criteria proposal document, respond to feedback received both at the AHWG meeting and in written form.

For each of the criteria areas the current criteria and the first 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.

Based on the definitions provided by Energy Star 6.0 the revised scope of the EU GPP criteria is proposed to include the following computer sub-categories:

Proposed scope of GPP criteria (first proposal)
• Desktop Computers (incl. Integrated Desktop Computers and Thin Clients) • Notebook Computers (incl. Mobile Thin Clients) • Tablet Computers • Small scale servers • Workstations

These definitions include graphics processing units, peripherals 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. In line with the forthcoming new Implementing Measure for Ecodesign and the revision process for the EU Ecolabel, a display may have dual capability as a display and television.

Stakeholder feedback to date

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 further specific GPP questionnaire stated that in most cases that the proposed scope was generally 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 talks about “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.
- It is not seen that displays sold separately or with a computer 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 GPP criteria.
- Another stakeholders 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.

1.3 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 growth[2]. Figure 1 provides global shipment data for desktop PCs, notebook PCs, and tablets from 2010 to 2012 and also offers a forecast until 2017 [3].

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

[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/

Figure 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[Error! Bookmark not defined.]. 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 DisplaySearch[4], all-in-one (AIO) PCs historically have amounted to no more than 2% of the total desktop display market. A former forecast until 2012 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.

[4] Source: 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

Thin clients

Dickinson[5] 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 IDC[6] 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 Research[7] 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 2 provides an overview of the server market, providing a general overall picture for servers[8]. 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: http://www.misco.co.uk/blog/news/00795/emea-shipments-of-enterprise-thin-clients-rise-9-point-2-percent-in-2012

[6] Source: http://www.idc.com/getdoc.jsp?containerId=235691

[7] Source: 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/

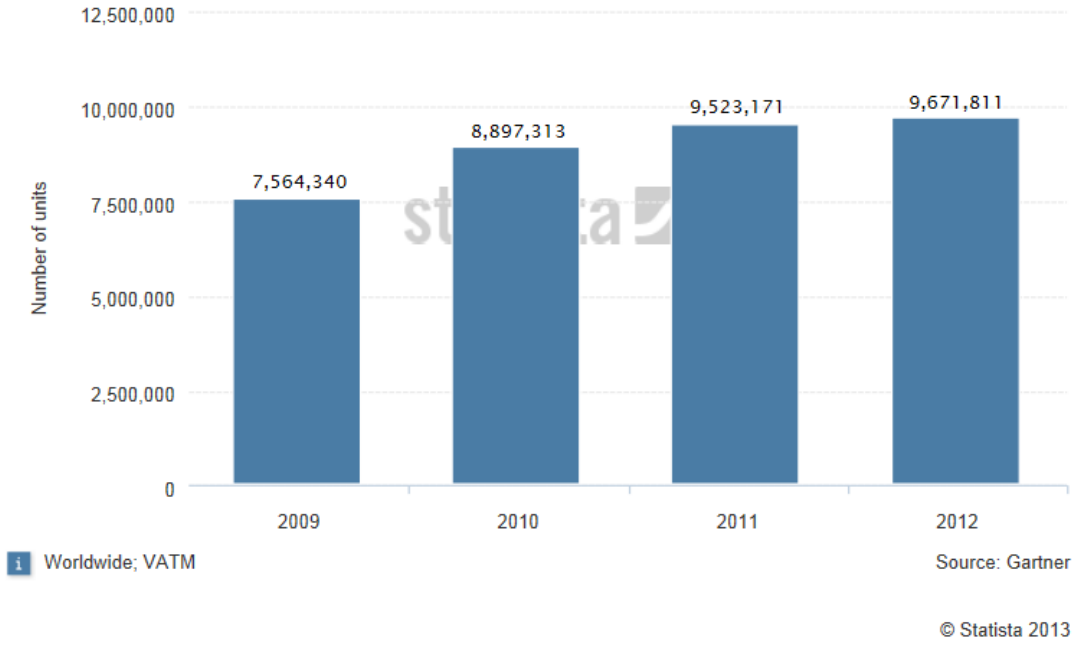

Figure 2: Worldwide server shipments from 2009 to 2012 (Source: Statista)

1.3.2 Computer displays

Figure 3 illustrates the global large-area (9"+) TFT LCD monitor shipments from 2009 to 2011 [9]. 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 iSuppli[10], 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: http://www.nytimes.com/2012/02/08/technology/for-multitaskers-multiple-monitors-improve-office-efficiency.html?pagewanted=all&_r=0

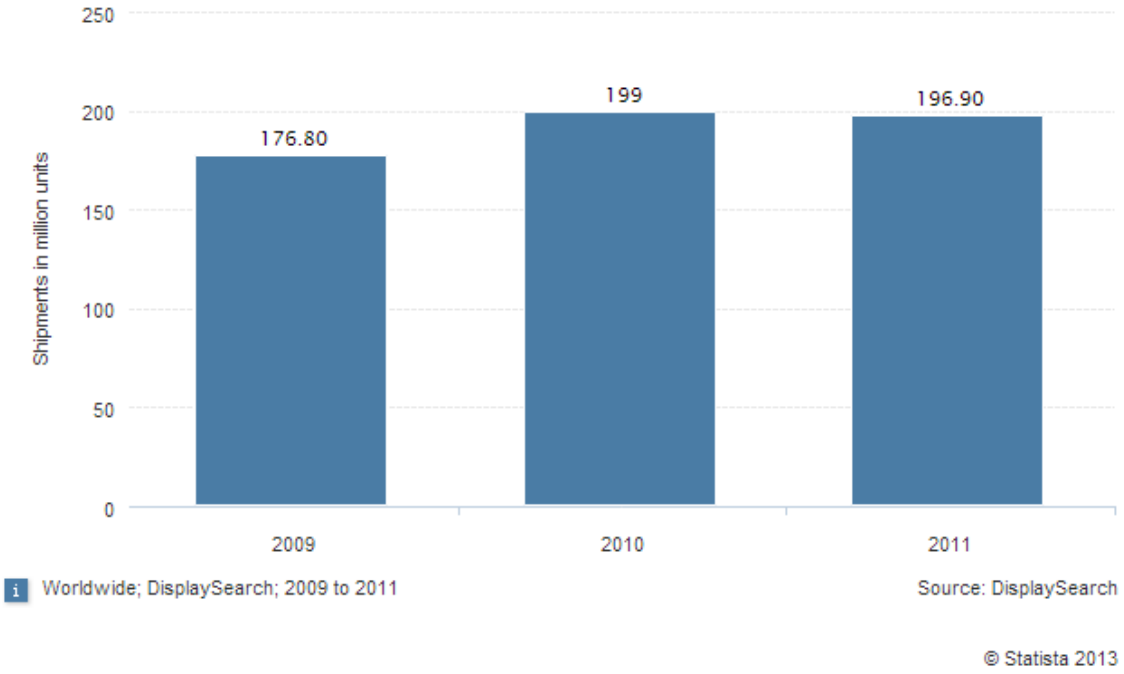

Figure 3: LCD monitors shipments from 2009 to 2011 (Source: Statista)

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**Error! Reference source not found.**)[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: 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 DisplaySearch[12] 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.

Consultation questions
• Is better public procurement data available at Member State, regional or local level? • Are there IT procurement networks or consortiums which could be contacted? • *More information and examples are requested on procurement strategies taken by public authorities*

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.

[12] Source: http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/100610_slim_led_backlit_notebooks_rapidly_gain_market_share.asp

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 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, the transformation of land 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 Criterion 1.1 – Minimum energy performance

Current criteria

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
All products shall meet the latest ENERGY STAR standards for energy performance, available at www.eu-energystar.org. **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.	All products shall meet the latest ENERGY STAR standards for energy performance, available at www.eu-energystar.org. **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.

Computer devices: Background technical discussion and rationale

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.

Table 2: 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 measure under the Ecodesign Directive which are broadly identical to those of Energy Star v5.2. The Tier 1 efficiency requirements use the same benchmarks and TEC-calculation formulas. These Tier 1 requirements will enter 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.

New Energy Star Program Requirements for Computers have been developed (Draft Version 6.0) [13] and are scheduled to take effect in April 2014. These requirements aim to target the top 25% of models currently on the market (Energy Star 2011). Given the greater significance of the manufacturing phase for tablets, and that they are not specifically included within the scope of Energy Star, it is not proposed to have overall energy criteria for tablets.

Allowances for discrete graphics processing units (GPUs):
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.

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 4 and 5 that Energy Star version 6.0 is nearly in line with Ecodesign Tier 2 starting from 1 January 2016 for all product sub-categories G1 to G3, i.e. not exceeding the legal requirements, with some exceptions [14].

[13] See https://energystar.gov/products/specs/node/143
[14] Please note that Energy Star Version 6.0 introduces new definitions of sub-categories, thus the products subsumed are not directly comparable. Nevertheless, the maximum TEC allowances provide an indicative comparison.

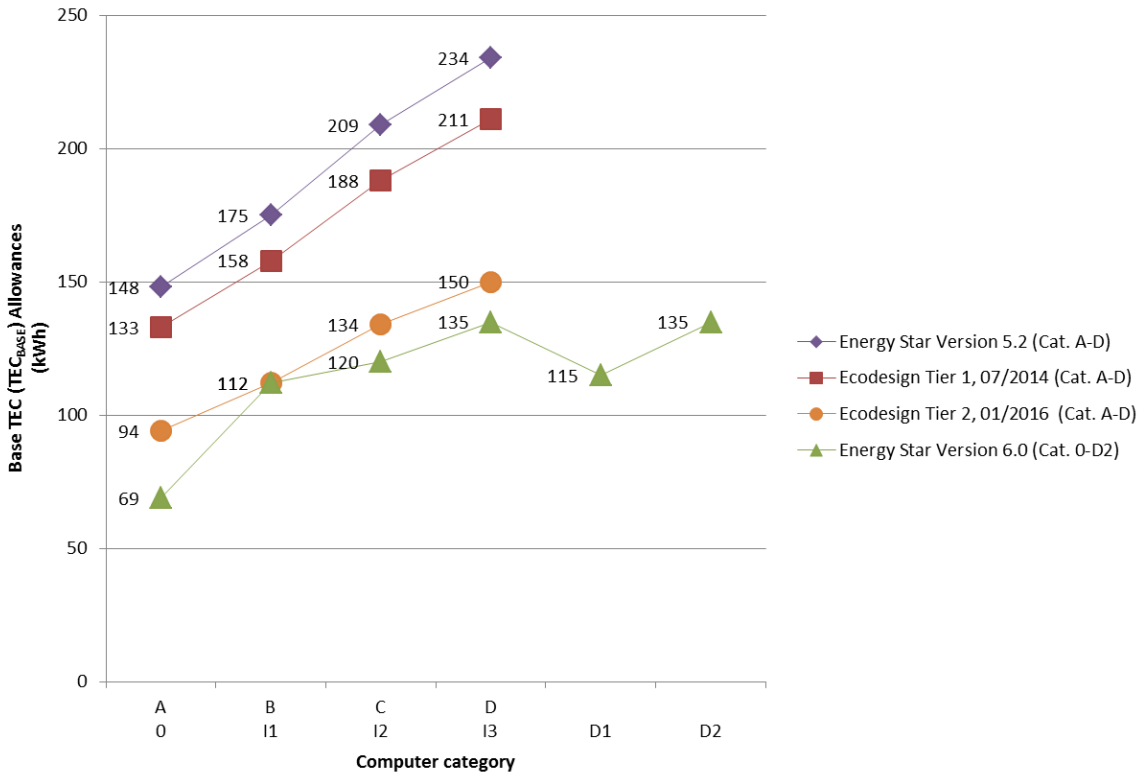

Figure 4: Comparison of TEC_{BASE} Allowances of Energy Star versions 5.2 and 6.0 with Ecodesign Tier 1 and Tier 2 for Desktop and Integrated Desktop Computers

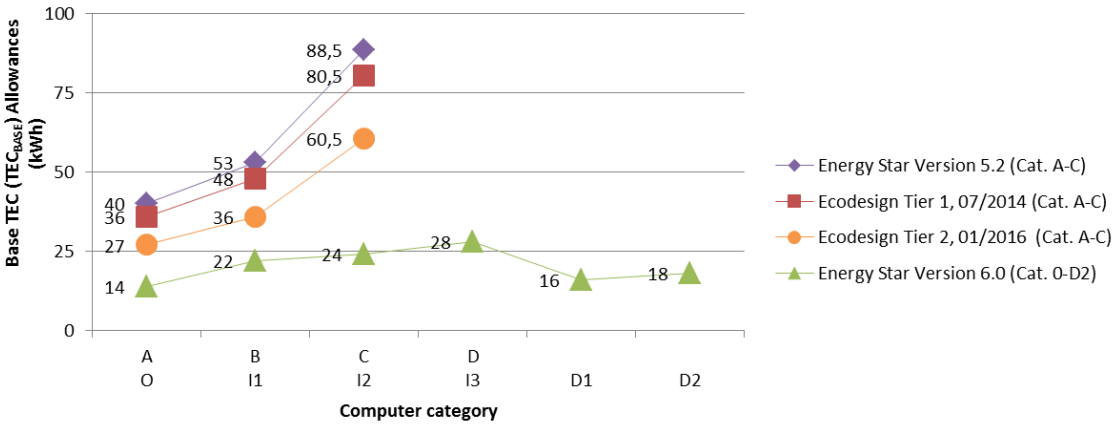

Figure 5: Comparison of TEC_{BASE} Allowances of Energy Star versions 5.2 and 6.0 with Ecodesign Tier 1 and Tier 2 for Notebook Computers

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 include:

1. Setting a maximum for the total amount of allowances to ensure a highly consuming PC with several graphic cards cannot be awarded. This maximum is proposed to be set at 90 W for Desktop PCs and 33 W for Notebook PCs. This would correspond to the allowance for one single G6 allowance in Ecodesign Tier 2016.
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 implemented on some notebook models, such as Apple MacBooks, with the additional benefit of saving battery life.

Figure 6 and Figure 7 provide a comparison of maximum allowances regarding the Typical Energy Consumption for graphics ($TEC_{GRAPHIC}$) of Desktop and Notebook computers within the current and upcoming Energy Star and Ecodesign versions. It can be seen that Energy Star version 6.0 is nearly in line with Ecodesign Tier 1 starting from 1 July 2014 for the product sub-categories G1 to G3, i.e. not exceeding the legal requirements, whereas it is slightly stricter for the categories G4 to G7.

Taking into account that the GPP criteria will probably not be implemented before spring 2015, it is proposed for Comprehensive criteria to already align the allowances for discrete graphics cards to the values of Ecodesign Tier 2 thus preventing GPP tenders from behind legally binding requirements from 1 January 2016.

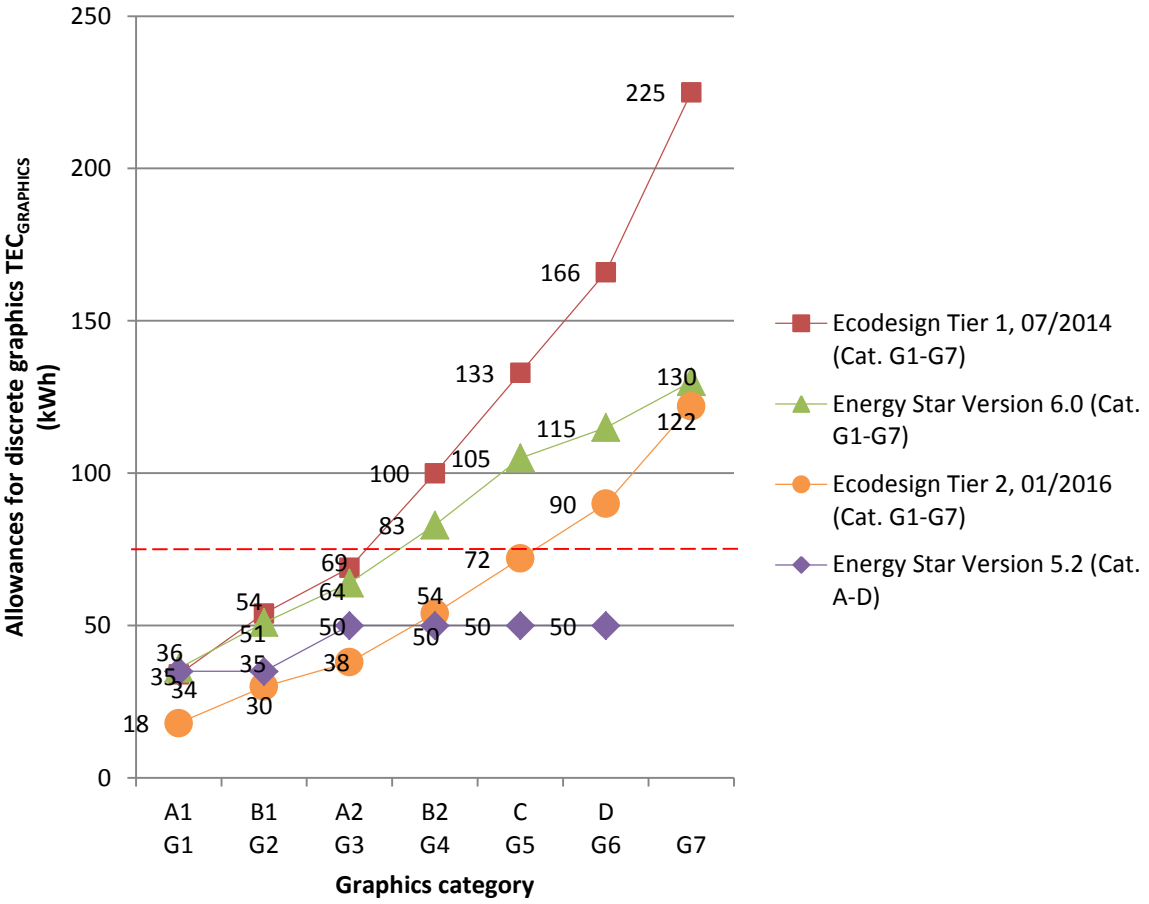

Figure 6: Comparison of $TEC_{GRAPHIC}$ Allowances of Energy Star versions 5.2 and 6.0 with Ecodesign Tier 1 and Tier 2 for Desktop and Integrated Desktop Computers

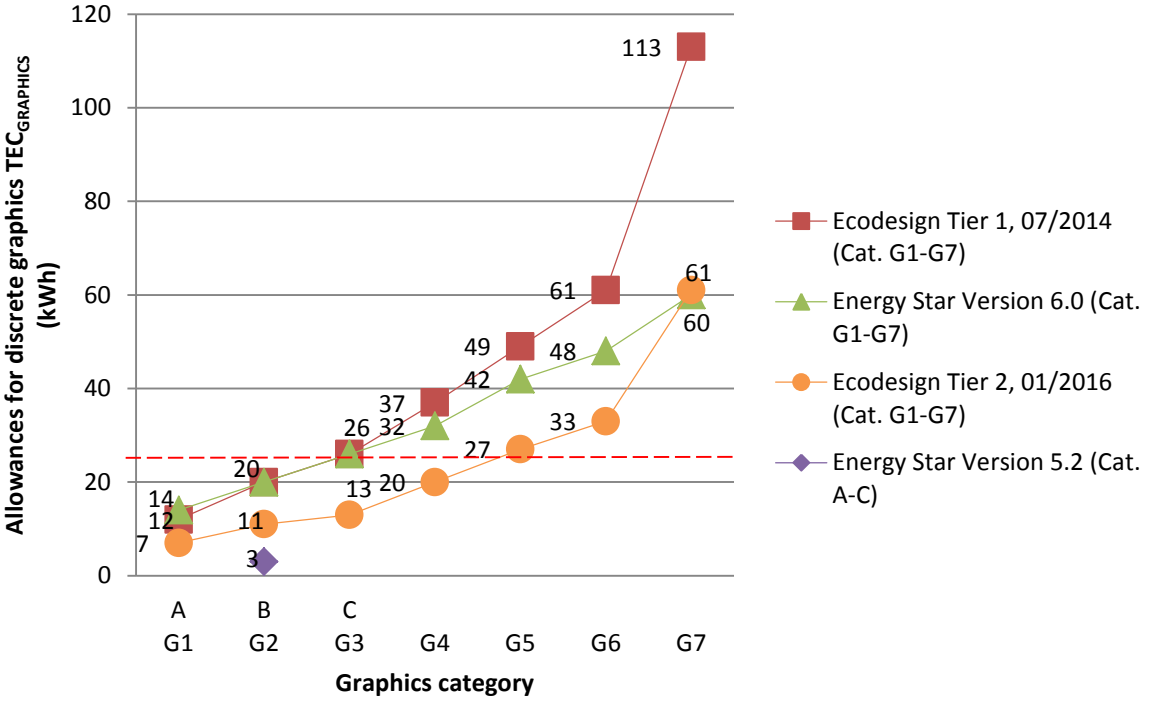

Figure 7: Comparison of $TEC_{GRAPHIC}$ Allowances of Energy Star versions 5.2 and 6.0 with Ecodesign Tier 1 and Tier 2 for Notebook Computers

Taking into account that the GPP criteria would probably not be implemented before spring 2015, it is proposed to already align the allowances for discrete graphics cards in the Comprehensive criteria to the values of Ecodesign Tier 2 thus preventing them falling back behind legally binding requirements from 1 January 2016.

Internal power supplies

Desktop computers are associated with the greatest power consumption of the three main computer products addressed within the Office IT Equipment scope. The power supply unit has a direct influence on the efficiency with which the mains electricity supply is transformed into useful power in the computer.

Internal power supplies are addressed within the Total Energy Consumption calculation for Energy Star. The new criteria whilst being ambitious only correspond to a bronze class under the international label for power supply performance 80plus

[15]. It might therefore be considered to align the minimum requirements for internal power supplies to those of the 80plus-label classes silver, or possibly gold, as research suggests that there are a range of certified power supplies in these classes available in the market (see Table 3).

Table 3: Number of 80plus certified power supplies for 115 and 230 V applications

80plus class / Number of certified models	Standard	Bronze	Silver	Gold	Platinum	Titanium	Total
115 V Internal	1,266	1,625	319	759	200	---	**4,169**
230 V Internal	---	34	104	175	166	8	**468**

However, a simple analysis of the cost and benefit of a silver or gold power supply based on figures provided by an manufacturer suggest that the energy savings would not be significant enough recouped. For example, changing a 300W power supply unit from 80+ bronze to the 80+ gold standard would double the cost from around 3.60 to around 7.20 Euros whilst the 7% performance improvement can be estimated to amount, in the best case, to 2.0 Euro's/annum.

External power supplies have not been considered to be addressed within the criteria because the current Ecodesign requirements are understood to still be the strictest on the market. Moreover, they will be revised in the future further based on a Code-of-Conduct developed by JRC.

Power management

The Ecodesign Regulation 617/2013 for computers and computer servers legally requires from 1 July 2014 that “the computer shall be placed on the market with the display sleep mode set to activate within 10 minutes of user inactivity”. This therefore supercedes the criterion currently specified in a number of ecolabels, including the EU Ecolabel. Energy Star v6.0 will also include additional power management requirements related to network requirements for power management..

[15] Plug load solutions, *80Plus certified power supplies and manufacturers*, http://www.plugloadsolutions.com/80pluspowersupplies.aspx

For more details see the EU Ecolabel and GPP Task 4 report "Improvement Potential", section 4.2.1.1 "energy efficiency".

Computer displays: Background technical discussion and rationale

The European Commission is currently preparing a new Ecodesign and Energy Labelling Regulation for Electronic Displays, bringing televisions and displays into one Implementing Measure.

Based on stakeholder feedback the revised EU Ecolabel energy criteria for displays are proposed as being based on the proposed Ecodesign requirements which are derived from an Energy Efficiency Index (EEI). The calculations of have been revised compared to the first proposals from DG ENE as follows in Table 4[16]:

Table 4: Ecodesign: Proposed Calculation of Energy Efficiency Index for Displays (2014)

$EEI = \frac{Pm}{(1.10 * A + 9.11) * 2.10}$	for screen areas where A ≤ 15.9 dm^2
$EEI = \frac{Pm}{(42.66 * \ln(A) - 90.68) * 2.10}$	for screen areas where A > 15.9 dm^2

The calculations distinguish between smaller and larger display sizes. This recognises that displays with smaller screens should have more relaxed requirements due to their low total energy consumption. The logarithmic regression line (compared to the linear lines in the existing Ecodesign and Energy labelling Regulations on televisions) works against larger more energy intensive displays.

The draft version of the Commission Regulation with regard to Ecodesign requirements for electronic displays (not published yet) proposes the tiers for on-mode power demand in Table 5.

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

Table 5: Proposed Ecodesign Requirements and timetable for On-mode power demand (2014)

Tier	Timetable (after publication of the Regulation)	EEI
I	12 months	≤ 0.60
II	36 months	≤ 0.40
III	60 months	≤ 0.20

Note: The EEI of Ecodesign requirements is not directly comparable and adoptable to the EEI values of the Energy Efficiency Label due to different underlying equations.

The accompanying Explanatory Memorandum to the Commission Regulation with regard to Ecodesign requirements for electronic displays (not published yet) reflects these EEI values against a market dataset of 882 models of televisions (794 models) and computer monitors (88 models) made available to consumers in 2012/2013, representing both small and large screen displays.

The following Table 6 provides a market overview from research commissioned in support of the new Regulation. It illustrates the pass/compliance rate of 775 LED display models with the Tier 1 to Tier 3 on-mode power demand requirements laid down in the proposed measure.

Table 6: Percentages of compliant small, large and all screens with regard to the proposed Ecodesign Requirements for On-mode power demand (2014, not yet published)

%	Tier 1	Tier 2	Tier 3
Max EEI	**≤ 0.60**	**≤ 0.40**	**≤ 0.20**
Small	71.12%	18.41%	0%
Large	81.53%	44.98%	0%
Total	**77.81%**	**35.48%**	**0%**

Within the EU Ecolabel it has been proposed to:

- align the Ecolabel requirements at least to the EEI values of Ecodesign Tier 2 as the compliance rate of Tier 1 is already relatively high and would become mandatory within the validity period of the EU Ecolabel;

- to differentiate Ecolabel requirements between small and large displays as the compliance rate of larger displays seems to be higher;
- to include a dynamic approach for taking into consideration future innovations within the four years period of the EU Ecolabel (above data are based on 2012/2013 market data).

Table 7 provide an overview of the calculated EEI values of current computer display models listed by www.topten.eu catalogue[18]. Topten already lists the best products currently available on the market. The following indicative calculations assess if there are any products which would fulfil the proposed requirements today. The overview shows that the proposed requirement for comprehensive criteria of EEI ≤ 0.4 for smaller displays, as well as EEI ≤ 0.3 for larger displays would be supported.

Table 7: Overview of EEI values of computer displays

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11
Screen diagonal [inch]	15	17	19	19	22	22	23	23	24	24	27
Screen area A [dm²]	6,2	7,97	9,95	9,95	13,34	13,34	14,58	14,58	15,88	15,88	20,1
Power demand on-mode P_m [W]	13	16	13	18	12	22	14	22	15	21	20
EEI (Ecodesign)	0,39	0,43	0,31	0,43	0,24	0,44	0,27	0,42	0,27	0,38	0,26
EEI (Energy Label)	0,28	0,29	0,21	0,29	0,15	0,28	0,17	0,26	0,17	0,24	0,19
Energy Label classification	A	A	A	A	A+	A	A+	A	A+	A	A+

Taking this into account the market position it is therefore proposed to follow the same approach for GPP criteria. Lower stringency EEI levels are proposed for core criteria but higher than Ecodesign Tier 1 that would become mandatory whilst the new GPP criteria are still in effect (2015 onwards). The same stringency as the EU Ecolabel is proposed for the Comprehensive criteria.

[17] 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.

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Power management requirements

The Ecodesign Regulation 617/2013 for computers and computer servers legally requires from 1 July 2014 that "the computer shall be placed on the market with the display sleep mode set to activate within 10 minutes of user inactivity". This therefore supercedes the criterion currently specified in a number of ecolabels, including the EU Ecolabel. Energy Star v6.0 will also include additional power management requirements related to network requirements for power management..

For monitors, following the same approach as the revised proposals for the EU Ecolabel criteria for electronic displays, it is proposed to include power management requirements in GPP criteria. The proposal is aligned to the current ecolabel criteria of Blue Angel RAL-UZ 145 for Television Sets from July 2012.

For more details see the EU Ecolabel and GPP for computers Task 4 report "Improvement Potential", section 4.2.1.1 "energy efficiency".and EU Ecolabel and GPP for televisions Task 4 report "Improvement Potential", section 4.2.1.1 "energy efficiency".

Criteria proposal: Major proposed changes (First proposal)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
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. **Verification:** The tenderer shall submit a test report carried out according to the Energy Star v6.0 test methods for the computer models .	**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: • Desktop Computers: 90 W; • Notebook Computers: 33 W. Tablet computers shall be exempted from this requirement.

	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.
A2. Minimum energy performance of displays 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 *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*[19]: (a) For electronic displays with a visible area of the screen ≤ 15.9 dm^2: (i) At the date of adoption of the Decision: EEI ≤ 0.50 (ii) Two years from the date of adoption of the Criteria: EEI ≤ 0.40 (b) For electronic displays with a visible area of the screen > 15.9 dm^2: (i) At the date of adoption of the Decision: EEI ≤ 0.40 (ii) Two years from the date of adoption of the Criteria: EEI ≤ 0.30 **Verification:** 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.	**A2. Minimum energy performance of displays** 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 *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*[20]: (c) For electronic displays with a visible area of the screen ≤ 15.9 dm^2: (iii) At the date of adoption of the Decision: EEI ≤ 0.40 (iv) Two years from the date of adoption of the Criteria: EEI ≤ 0.30 (d) For electronic displays with a visible area of the screen > 15.9 dm^2: (iii) At the date of adoption of the Decision: EEI ≤ 0.30 (iv) Two years from the date of adoption of the Criteria: EEI ≤ 0.20 **Verification:** 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.
AWARD CRITERIA	
A3. Minimum energy performance of computers and displays 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). **Verification:** 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.	**A3. Minimum energy performance of computers and displays** 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). **Verification:** 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.

[19] Not yet published.

[20] Not yet published.

	A4. Display power management Additional points shall be awarded to tenderers who are able to supply displays with the following advanced power management features: (i) *Automatic Brightness Control*: 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) *Other options to be discussed* **Verification:** The tenderer shall submit a test report demonstrating that the on mode power consumption measured according to EN 62087 is met.

Summary rationale for the proposals

Computer devices

- The core criteria for energy savings are proposed to be aligned to the underlying performance requirements of the Energy Star program requirements for computers, version 6.0 which is effective from the 28th April 2014. This is because in some cases they are similar to Tier 1 of Ecodesign. However, for the comprehensive criteria allowances are capped and a dynamic element is introduced, with a link to the *latest version* of Energy Star.
- As tablet PCs (slate computers) are not specifically covered by Energy Star v6.0 (they are expected to be included in the next version of Energy Star) and as this product sub-group does not consume much electricity (an estimate being approximately 4 kWh per year) it is not proposed to set criteria for the energy performance of tablet PCs.
- Requirements for power management such as display sleep mode being activated after 10 minutes of user inactivity will 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. .A dynamic

approach to the energy criteria is to be discussed in the face of a fast developing market and response to performance requirements such as Energy Star.

- 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.

Display devices

- The requirements on power demand in on-mode for computer displays have been aligned to the EEI equations of the proposed revised Ecodesign Regulation.
- Market research in support of the new Regulation together with data from the Topten project have been used to inform the specification of the Core and Comprehensive criteria.
- The Core have been set at an intermediate performance level between the proposed Tiers 1 and 2, although for larger displays it is stricter because the market share is already more than 50%.
- The Comprehensive criteria have been set at the Tier 2 level bearing in the mind the anticipated timescale for publication of the GPP criteria and the new Regulation, with small screens already achieving approximately a 20% market share and for larger screens a stricter EEI value reflecting the already relatively high market share.
- For both Core and Comprehensive and anticipating market and technology learning in response to the new Regulation a dynamic criteria is proposed, with new EEI values proposed after two years.

Consultation questions

- How could the core criteria work given that the latest version of Energy Star is usually targeted at the best 25% of models on the market?
- Is there a significant demand for computers with discrete Graphics Processing Units in public procurement?
- Are automatic brightness controls available for displays and if so is this an appropriate Award Criteria?
- Are there other power management features that should be considered?

2.2 Criteria area 2 – Hazardous substances

Current criteria

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
The background lighting of LCD monitors shall not contain more than 3.5 mg of mercury on average per lamp. **Verification:** 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)	The background lighting of LCD monitors shall not contain more than 3.5 mg of mercury on average per lamp. **Verification:** 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)
	Substances in plastic parts hazardous to health 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: - R45 (may cause cancer). - R46 (may cause heritable genetic damage). - R60 (may impair fertility). - R61 (may cause harm to the unborn child). **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.

Background technical discussion and rationale

A range of hazardous substances are used in the manufacturing of office IT equipment and may be present in the final products. A number of substances formerly used in electrical devices 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 211/65/EU which applies to electronical 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 retardants.

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. The evidence base is summarised in Table 8. This has aimed to identify the main components of the products that should receive attention and the hazardous substances that they may contain. This evidence based has been used to identify three groups of substances:

1. Current hazard benchmarks: *Substances that are currently used or were used until recently in mainstream products*. For each substance the CAS number and, as far as possible, their hazard profile have been identified for comparative purposes.
2. Proposed substitution benchmarks: *Substitutes for hazardous substances currently used in mainstream products that have been implemented, or are proposed for implementation, by leading manufacturers*. For each substance the CAS number and, as far as possible, hazard profile have been identified for comparative purposes.
3. Proposed restrictions: *Substance restrictions that have been identified from manufacturer's own restriction lists or from risk assessment exercises by the European Commission, Member State or Intergovernmental bodies*. Where a restriction is proposed:
   - The specific substances, how they relate to the product and, where appropriate, a concentration limit are identified.
   - The potential to specify analytical testing of component parts to strengthen verification is flagged as well as possible test methods.

The complexity of the supply chain for computers and displays means that care needs to be taken in setting criteria in this area. It is also important to note that manufacturers have developed systems to verify with suppliers the absence of specified substances but they are not generally used to verifying hazard classifications, as called for the by the EU Ecolabel.

There is, however, increasing interest from manufacturers in third party verification of substance hazard profiles so as 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 has been raised that Ecolabels and their use as GPP criteria have led manufacturers to make 'regrettable substitutions' to substances for which there are major data gaps in their hazard profile. Third party certified schemes such as Green Screen are now being used to inform decision-making instead.

Table 8: Main evidence base used to support EU Ecolabel criteria development

Screening	Evidence base
RoHS (recast) Directive	• Relevance of exemptions identified from manufacturer's restriction lists
RoHS ATP	• Oeko-Institut and Austrian EPA reports with recommendations on extended RoHS scope
ECHA Candidate List	• Substances of relevance to the product group using IEC 62474 Declaration List (see colour coded version appended) • ECHA and Member State risk assessments and dossiers (e.g. German BFR - PAHs)
Substitution analysis	• EU ENFIRO study of environment-compatible flame retardants • US EPA Printed Circuit Board and decaBDE evaluations • Green Screen assessments for TV enclosures and plasticisers • COWI and the Danish Technological Institute compilation for plastics
Industry substitutions and restrictions	• OEM chemical restriction lists (with a focus on SG members HP, Samsung, Dell, LG) • International Electronics Manufacturing Initiative (iNEMI) • EFRA and PINFA guides to flame retardant applications in electronic equipment • SubSport Case Story substitution database • OEM product and component specifications

The outcome from the EU Ecolabel screening exercise are two listings. The first is a so-called 'white list' which defines, using EU hazard classifications, which substances can be used (see Table 9). The main focus is on flame retardants and plasticisers (phthalates). These are the two substance groups that have been the main focus for substitution initiatives.

A proposal has been received from three major computer manufacturer that halogen-free components should be a GPP Award Criteria. The following text has been 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 reflects industries progress in moving away from brominated flame retardants, even for Printed Circuit Boards, which even so continue to pose a technical challenge. IEC 61249-2-21 defines a concentration limit of 900ppm for bromine present in the resin of the PCB. This can provide the basis for laboratory testing as a form of verification.

The commonly used brominated FR was Tetrabromobisphenol (TBBPA) CAS No. 79-94-7 which has a harmonised classification of H400 and H410. The substitute for brominated FR's in PCB's is understood to be Dihydrooxaphosphaphenanthrene (DOPO) CAS No 35948-25-5. This does not currently have a harmonised CLP classification but notifications by industry suggest that data gaps exist for Acute Toxicity and CMR hazards. The US EPA generally evaluates it to be a 'low' hazard, but this is largely based on estimates and judgement.

Flame Retardants are also the focus of attention for other components such as casings. Many brominated FR's are now restricted under REACH because of their potential impact upon release to the environment or incineration. The hazard profile

of brominated FR's that are still used, such as Ethane bis (pentabromophenyl) (EBP) CAS No 84852-53-9, is not as yet harmonised at EU level and so the extent to which they may be of comparative concern to structurally related FR's such as Deca BDE (CAS No 1163-19-5) is not yet clear. Moreover, it is understood that for display casings in particular a restriction on brominated FR's would have a significant impact in terms of market selectivity, as many Japanese and Korean manufacturers use them.

Screening of substitutes for the EU Ecolabel has highlighted that the most common substitutes used do not in all cases represent an improvement. It cannot therefore be generalised that halogenated flame retardants are in all cases worse for the environment than non-halogenated. It is therefore important that any evaluation of the hazard profile of a substance is based on the latest scientific evidence.

Table 9. Proposed substances that may be used in the EU Ecolabel as defined by hazards

Substance group	Sub-components	Hazards permitted
1.1 Flame retardants	Printed Circuit Boards	*H412, H413*
	Internal connectors and switches	*H413*
	Plastic enclosures and casings	*H412, H413*
	Recycled plastic in enclosures and casings	*FR's (H412, H413) and their synergists (H351) that are not REACH restricted or identified as Candidate List SVHC's*
1.2 Plasticisers	External cables	*H413*
	Recycled content (all components)	*Substances present in recyclate that that are not REACH restricted or identified as SVHC's*

The second is a so-called ‘black list’ which defines a series of restrictions on the use or concentration of specific substances in the final product (see Table 10). This is a familiar format for manufacturers who generally have more extensive restriction lists which they communicate to suppliers. Taking the example of Dell, verification can often take the form of random analytical testing of components from different

suppliers. The restriction list is still pending stakeholder input and discussion, both in terms of scope and verification.

Table 10. EU Ecolabel draft restrictions of substances in component parts

Substance group	Restriction	Concentration limit	Verification
1. Plasticisers	DEHP, BBP, DBP, DIBP, DMEP, DIPP, DPP, DnPP and DnHP shall not be used in external cables and power packs.	Sum total concentration limit of 0.1%	*Test method to be specified*
	Medium Chained Chlorinated Paraffins (MCCP's) Alkanes C14-17 shall not be used in external cables and power packs.	Sum total concentration limit of 0.1%	*Test method to be specified*
2. Plastic stabilisers	Lead shall not be present in external cables, wires and connecting cords.	Concentration limit of 0.03%.	*IEC 62321-3-1*
3. Plastic colourants	Colourants containing lead, chromium VI and cadmium, including the specific compounds included in the Candidate List, shall not be used.	*Not applicable*	*The potential to specify testing is to be discussed.*
	Pigments and dyes used to colour ABS shall be colour fast.	*Not applicable*	*DIN 53775-3* *A migration rating of 5 is proposed.*
4. Biocides	Biocides intended to provide a hygiene (anti-bacterial) function shall not be added to keyboards and peripherals.		*Self-declaration from component suppliers.*
5. Plastic contaminants	18 listed Polycyclic Aromatic Hydrocarbons (PAHs) shall not be present at or greater than the individual and sum total concentration limits in the external surfaces of: - Notebooks and tablets; - Peripheral keyboards, - Mice, - Stylus and trackpads; - External power cables.	Individual concentrations for the eight REACH restricted PAHs shall be 1 ppm The sum total concentration of the 18 listed PAHs shall not be greater than 10 ppm	*ISO 21461 for rubber parts (to be discussed)* *ZEK 01.4-08 for plastic parts*
6. Metal solder	RoHS exemption 7b for the use of lead solder in small-scale servers shall not be accepted for Ecolabelled computers	*Not applicable*	*Declaration by the manufacture specifying the alternative solder specified.*

7. Electrical contacts	RoHS exemption 8b for the use of cadmium shall not be accepted for Ecolabelled computers	*Not applicable*	*Declaration by the manufacture detailing the alternative contact material specified.*
8. Thermal conductors	Beryllium and its compounds shall not be present in specified parts unless it is in a ceramic form.	Concentration limit 0.1%	*Self-declaration from component suppliers.*
9. External steel parts	Nickel migration from in stainless steel shall be restricted where any external part will be in close contact with the skin.	Migration from metal surfaces of >0.5 ug/cm^2/week	*EN 1811 with detection using GC-ICP-MS*
10. External metallic coatings	Hexavalent chromium shall not be present in metallic coatings applied to parts of a computer.	*To be specified*	*IEC 62321-7-1*
11. Screen glass	Arsenic and its compounds shall not be used in the manufacturing of screen glass	*Concentration limit 0.0010%*	*Verification shall be obtained from the glass manufacturer.*

Criterion proposal (first proposal)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
B1. Mercury in display backlights Mercury shall not be present in LCD backlights at a concentration of greater than 0.1 mg per lamp. **Verification:** 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.	**B1. Mercury in display backlights** LCD backlights shall be mercury free. **Verification:** Tenderers shall demonstrate that an alternative technology is used that does not require mercury.
	B2. Flame retardants in Printed Circuit Boards and casings With reference to the EU Ecolabel hazard list (see Annex 1) where a flame retardant is used then the only hazard classifications they may carry are H412 and H413. **Verification:** 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.
	B3. Plasticisers in external cables With reference to the EU Ecolabel hazard list (see Annex 1) plasticisers used in external cables may only carry the hazard classifications H412 and H413 **Verification:** 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.

AWARD CRITERIA	
	B4. Flame retardants in other components With reference to the EU Ecolabel hazard list (see Annex 1) 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. The flame retardant is used may only carry the hazard classifications H412 and H413. **Verification:** 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.

Summary rationale:

- It is proposed that the mercury content restriction is retained as there may still be some cheaper previous generation backlit displays on the market. The limit value has been lowered in line with feedback from stakeholders.
- For the Compehensive criteria mercury is not permitted, reflecting the market dominance of LED backlit displays. However, a limit value may still be required – subject to feedback from stakeholders.
- It is proposed that the substitution of hazardous flame retardants and plasticisers form the focus for GPP criteria on substances.
- Comprehensive criteria are proposed which would restrict useage to only the best substitutes used by leading manufacturers. This would apply to FR's in the motherboard PCB and external casing and plasticisers in external cables and power packs.
- Award criteria could be set to further encourage substitution with favourable FR's in other components, including internal connectors, CPU's, HDD, Optical drives and power supply units.

- Verification is proposed as being based on third party verification that the FR and plasticisers used are in compliance with the hazards permitted and that there is sufficient confidence in the toxicological data to make a verification. This could include acceptance of assessments where equivalence can be shown, for example using the Green Screen methodology.
- A limited number of further substance restrictions could be selected as technical specifications. It is proposed that these are prioritised and selected once the restriction list for the EU Ecolabel is nearing completion.

Consultation questions
○ Is the focus on flame retardants and plasticisers sufficient? *if not* which other substance groups should be addressed and on what basis? ○ Are trace limits required for LED/OLED mercury content? ○ If verification is based on hazards should we a) define the requirement in terms of hazards that a substance should not be classified with or b) hazards that are permitted? ○ Is third party verification by a toxicologist or hazard specialist a realistic possibility as an alternative to self-declaration? ○ Could assessments for which equivalence can be demonstrated be accepted?

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

Current criteria

Core criteria	**Comprehensive criteria**
TECHNICAL SPECIFICATIONS	
PCs shall be designed so that: - 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. **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.	PCs shall be designed so that: - 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. **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.
Notebooks shall be designed so that the memory is easily accessible and can be changed or upgraded. **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.	Notebooks shall be designed so that the memory is easily accessible and can be changed or upgraded. **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.
The tenderer shall guarantee the availability of spare parts for at least 3 years from the time that production ceases. **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.	The tenderer shall guarantee the availability of spare parts for at least 5 years from the time that production ceases. **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.

Background technical discussion and rationale

Upgradeability and the availability of spare parts feature in the current criteria set and has been 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 repairability of products are major factors to consider.

The nature of the requirements will depend on the form factor 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.

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.

The study 'Disassembly analysis of slates: Design for repair and recycling evaluation' by Fraunhofer IZM (2013)[21] aimed to assess the ease of dismantling tablet products by experimental dismantling of in total 21 different devices. In each case they considered the difficulty and need for special tools, identification of good design examples and suitable product information from manufacturers that would be of value to repairers and refurbishers. However, it is important to note that the practice of

[21] Cf. http://www.izm.fraunhofer.de/content/dam/izm/de/documents/News-Events/News/2013/urn_nbn_de_0011-n-255111-18-1.pdf

glueing components into devices is not necessarily always destructive to the products or components per se.

Extended warrantee periods

Longer guarantees for whole products and, in some cases, for certain components are offered by manufacturers. The availability under warranty of professional repair options to fix problems with devices at cost is also understood to be an important factor in extending product lifespan.

Feedback suggests that longer warrantees are more problematic for batteries because of the different ways in which devices are used. The Type I Ecolabel EPEAT, for example, exempts batteries from such a requirement. This in turn highlights the importance of battery lifetime extension and battery replacement services.

Tablet batteries, and in some cases ultrabook batteries, have been identified as being an issue. They 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 The Nordic Swan Ecolabel criteria state that a replacement battery must be available as an option or a spare part.

An overview of the standard warranties provided by different manufacturers is provided in Table 11. In general this indicates that the defective devices are taken back by manufacturers for repair in the first instance. This arrangement may be more extensive in the case of substantial contracts with public bodies.

The continued availability of spare parts

Regarding the current criterion on the availability of spare parts general feedback from stakeholders suggests that 3 instead of 5 years is more realistic. Longer product guarantees are preferred as a better indicator of intended minimum first life[22].

Stakeholders have 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 warrantees. 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.

Table 11: Overview of standard warranties provided by different manufacturers

Manu-facturer	Standard warranty				Opening of hardware allowed?
	PCs	Notebooks/ Netbooks	Notebook battery	Monitors	
Acer	• Business PCs: 1-3 years	• Notebooks: 1-2 years • Netbooks: 1 year	6 months	• Professio-nal 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

[22] Source: WRAP GB Report "Electrical and electronic product design: product lifetime"; January 2013; http://www.wrap.org.uk/sites/files/wrap/WRAP%20longer%20product%20lifetimes.pdf

Manu-facturer	Standard warranty				Opening of hardware allowed?
	PCs	Notebooks/ Netbooks	Notebook battery	Monitors	
HP	2 years for certain product series	2 years for certain product series	Excluded from standard warranty	n.a.	Upgrade of hardware not generally forbidden, e.g. RAM, but defects caused by improper repairs or incorrect components not covered by warranty
Lenovo	1-3 years depen-ding 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

The overall upgradeability of products

The upgradeability of computer products 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 motherboard[23].
- 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 faciltate better heat dissipation.[24]

Hardware interfaces

According to PCMag[25], generally, USB is the most widely used standard hardware interface for attaching peripherals (e.g. monitor, mouse, hard drives, keyboard, printer, camera, etc. …) to a computer. There are different types and formats of sockets depending of the devices being host or peripheral. Sockets of hosts (e.g. computers, hubs or chargers) are called “Type A”, and sockets of peripherals are “Type B” (e.g. printer, scanner), “Mini-B” (e.g. digital camera, hub) or Type “Micro-B” (e.g. tablet PCs, smartphones)[26].

Number of USB interfaces: Experiences show that USB interfaces are susceptible to defects; if this happens at the mainboard, it is impossible to repair[27]. Thus,computers generally should have more than one USB port in order to provide substitutes for defect interfaces. For convenience, a larger number of USB ports

[23] 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

[24] www.gamestar.de/hardware/praxis/notebooks/2323984/notebook_tuning_teil_1.html

[25] Cf. http://www.pcmag.com/encyclopedia/term/53531/usb

[26] For illustration of different types of sockets and plugs see for example http://www.conrad.de/ce/de/content/steckertypen_im_ueberblick/Steckertypen-alle-Abbildungen-im-Ueberblick-Conrad-

[27] Source: personal communication to editorial staff of computer magazine c’t.

should be available to connect the different necessary peripherals. The following can be discerned from our initial analysis of products on the market:

- For *Desktop PCs*, four to six USB ports are common; conventional notebooks usually provide three USB ports.
- *Ultrabooks*, being classified as notebooks, generally have less physical interfaces due to their slim and lightweight form factor. However, there are several ultrabooks from different brands on the market providing 3 USB interfaces (e.g. Samsung ATIV Book 7, Lenovo IdeaPads U-series, Asus Zenbook UX302, or Fujitsu Lifebook UH572 Ultrabook)[28]..
- *Tablet PCs* commonly have Micro-B interfaces but they are not recommended as expansion capabilities for tablet PCs because often additional adapters are required and they cannot provide enough power for some peripherals.. To facilitate the use of tablet PCs in a working environment, USB interfaces for accessories and the support for an external display, keyboard and mouse are of importance. USB Type A interfaces are preferable, with devices such as Microsoft Surface, Samsung Galaxy Tab 3 7.0, or Sony Vaio SVT1121B2EW; the Fujitsu Stylistic Q702 hybrid tablet and notebook PC[29].

USB 3.0 is the most current version adopted in 2008. Compared to USB 2.0, USB 3.0 has larger data transfer rates (4.8 GBit/s instead of 480 Mbit/s). Market research company IDC has forecasted that by 2016 all PCs and Notebooks will be equipped with USB 3.0 interfaces. Already many devices in the market already apply at least one USB 3.0 interface.

[28] Further models with 3 USB interfaces, see e.g.: www.onlinekosten.de/computer/ultrabook
[29] Further examples can be found at www.onlinekosten.de/computer/tablet-pc-slate/2

Possible additional interfaces

The potential to connect mobile devices such as Notebook or Tablet PCs to an external monitor, keyboard and mouse is an important function to consider. For displays, this can be realised by different interfaces, e.g. VGA, HDMI, DVI, DisplayPort, Thunderbolt etc. Interfaces for keyboard and mouse could still be PS/2, but today, they are increasingly connected by USB.

For Tablet PCs, e.g. the Nordic Ecolabel additionally requires a storage expansion slot (e.g. a SDHC slot) in addition to the built-in storage. According to Computerworld (2013)[30], some manufacturers per se do not include an expansion slot in their devices referring to the increasing usage of online storage capacities via cloud but, as noted previously, this may not be a functional option for security reasons.

[30] See http://www.computerworld.com/s/article/9241181/Tablet_storage_Do_you_really_need_an_expansion_slot_?pageNumber=1

Proposed revised criteria

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
C1. Warranty period 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. **Verification:** A copy of the warranty or service agreement shall be provided in the tender.	**C1. Warranty period** 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. **Verification:** A copy of the warranty or service agreement shall be provided in the tender.
C2. Continued availability of spare parts The tenderer shall guarantee the availability of spare parts for at least 3 years from the time of purchase. **Verification:** 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.	**C2. Continued availability of spare parts** 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. **Verification:** 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.
C3. Upgradeable and replaceable parts 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): Computers (i) HDD/SSD, (ii) Memory, (iii) Rechargeable battery, Displays (i) Screen assembly and LCD backlight (ii) Power and control circuit boards (iii) Stands Guidance to be provided in an Annex on tools and access to define easily replaceable. **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.	**C3. Upgradeable and replaceable parts** 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): Computers (i) HDD/SSD, (ii) Memory, (iii) Rechargeable battery, (iv) Screen assembly and LCD backlight, (v) Keyboard and mouse pad, and (vi) Cooling fan. Displays (i) Screen assembly and LCD backlight (ii) Power and control circuit boards (iii) Stands Guidance to be provided in an Annex on tools and access to define easily replaceable. **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.

C4. External interfaces The following interfaces and external device connections shall be provided as a minimum: (i) Notebook PCs and Mobile Thin Clients: • Presence of at least 3 USB interfaces, of which at least one USB 3.0. (ii) Tablet PCs: • Presence of at least 1 USB interface. **Verification:** The applicant shall declare the compliance of the product with these requirements to the competent body.	**C4. External interfaces** The following interfaces and external device connections shall be provided as a minimum: (i) Notebook PCs and Mobile Thin Clients: • Presence of at least 3 USB interfaces, of which at least one USB 3.0. • One additional interface for an external monitor (ii) Tablet PCs: • Presence of at least 1 USB 3.0 interface. • Support for external monitor, keyboard and mouse. **Verification:** The applicant shall declare the compliance of the product with these requirements to the competent body.
AWARD CRITERIA	
C5. Continued availability of spare parts The tenderer shall provide a price list for the main component parts (list to 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. **Verification:** The tenderer shall provide a price list for original or backwardly compatible spare parts, including rechargeable batteries (if applicable).	**C5. Continued availability of spare parts** The tenderer shall provide a price list for the main component parts (list to 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. **Verification:** The tenderer shall provide a price list for original or backwardly compatible spare parts, including rechargeable batteries (if applicable).
	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. **Verification:** A copy of the warranty or service agreement shall be provided in the tender.

Summary rationale

- 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.

- The components specified have been listed; for repairs, keyboards, screen, battery and HDD are of relevance, for upgrades HDD/SSD, memory and battery.
- The criteria on availability of spare parts have been improved to add the possibility of being “original or backwardly compatible”.
- The period of five years during which parts shall remain available has been retained as a Comprehensive Technical Specification. For computer products the availability of spare parts for only 3 years would only represent the average lifetime of computers.
- A new Award criterion is proposed inviting manufacturers to offer extended warranties. It is proposed that this explicitly covers the replacement of batteries.
- For desktop and notebook PCs, at least one USB 3.0 interface is required as a Core Technical Specification enabling larger data transfer rates with a lower associated energy demand.
- The required number of interfaces is specified. This includes USB Type A interfaces for Tablets, as market research showed that there are tablets on the market. This, however, is proposed as a Comprehensive Technical specification.
- *A requirement on an additional storage expansion slot for Tablet PCs could be considered based on feedback from stakeholders of how tablets are used in the public sector.*

Consultation questions
• Do the proposals reflect requests made by procurers seeking greater re-assurance? • Is the parts listing sufficient to maintain product performance? • How can lower costs for replacement parts best be incentivised through the tender process?

2.3.2 Criterion 3.2 – Notebook battery quality and lifetime

Background discussion and technical rationale

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 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 61960[31] retaining 60% capacity over 300 cycles. Commentators suggest that 300-500 cycles is the de facto standard for lithium ion batteries[32]. 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 battery[33].

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 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. For 15 inch+ screen desktop replacement notebooks battery life can now extend to an estimated 7-8 hours+ (dependant on hardware combinations). For

[31] Dell (2014) *ErP Lot 3 Technical documentation*, http://www.dell.com/downloads/global/corporate/environ/comply/ErP_Lot_3_Public_Information.pdf
[32] Battery University, *How to prolong lithium based batteries*, http://batteryuniversity.com/learn/article/how_to_prolong_lithium_based_batteries
[33] 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

Ultrabook notebook forms it can extend from an estimated 8-9 hours to up to 16 hours in one example. 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 models[34]. However it is considered that Apple may represent a niche product for public procurers.

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 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 12.

Table 12: 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)

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

[34] Apple, *Determining battery cycle count*, Accessed March 2014, http://support.apple.com/kb/ht1519

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.

Benchmarking and verifying battery performance

Battery life is verified using a range of different software packages and test routines. Consumer magazines and websites use a combination of the two, with some having developed their own bespoke routines, making comparability difficult. Tests include, for example, a wireless web browsing protocol[35] and a HD movie playback[36]. OEM's tend to make reference to business software such as Powermark[37] or Mobilemark[38] which simulate real-life scenarios and power demands. Limited information could be found at this stage to judge the relative merits of these benchmark tools.

In terms of battery cycles 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.

[35] Laptop Magazine, *Laptops with the longest battery life*, 31st March 2014, http://blog.laptopmag.com/all-day-strong-longest-lasting-notebooks

[36] Which? *How we test laptops*, http://www.which.co.uk/technology/computing/guides/how-we-test-laptops/

[37] Futuremark, *Powermark software*, https://www.futuremark.com/benchmarks/powermark

[38] BAPCo, *Mobilemark 2012*, http://bapco.com/products/mobilemark-2012

First criterion proposal

Core criteria	Comprehensive criteria
AWARD CRITERIA	
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. **Verification:** The tenderer shall provide test reports showing the batteries performance in the areas chosen: (i) Battery life shall be verified and benchmarked using Mobilemark software or an equivalent tool (see Annex x for minimum software requirements *– to be defined*). (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).	**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. 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. **Verification:** The tenderer shall provide test reports showing the batteries performance in the areas chosen: (i) Battery life shall be verified and benchmarked using Mobilemark software or an equivalent tool (see Annex x for minimum software requirements *– to be defined*).. (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).

Summary rationale:

- Given uncertainty related to price and availability it is proposed to introduce a minimum technical specification and a more ambitious award criteria linking both battery life and cycle endurance.
- Points could be awarded for additional battery life and endurance cycles over and above 7-8 hours and 500 cycles (with 70% capacity retention) respectively. Cycle endurance is proposed to be weighted higher than battery life.
- Battery life is an important factor in some decisions to purchase notebooks and so it is proposed to encourage improvement upon a minimum threshold for a good quality battery. This would reflect the performance of desktop replacements rather than ultrabooks, which are niche consumer products.
- Verification of battery life is potentially problematic due to the range of different methodologies used by manufacturers. The most comprehensive reference

point is considered to be professional testing software but further input is required from stakeholders and the underlying specifications for the software may need to be defined.

- 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, but the minimum battery life shall be achieved.
- IEC 61960 is considered to represent an international reference point for the comparable verification of a batteries cycle endurance . It shall be possible to verify either cells or packs. The accelerated test option offers a lower cost of verification.

Consultation questions
• Is the approach using Award Criteria appropriate or should there be a Technical Specification? • Is the approach to verification of battery life workable?

2.3.3 Criterion 3.3 – Disk drive reliability and durability

Background technical rationale

Hard disk drives (HDD) are one of the computer components where according to WRAP (2011) [39] 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 HDD[40], specify the reliability of HDD using metrics such as 'Mean Time Between Failures' and 'Operating Shock'.

Summary of findings from a manufacturer enquiry

As a starting point a follow-up enquiry was made to OEM's with a view to gathering more information On drive quality and physical specifications to imrove their durability

[39] See http://www.wrap.org.uk/sites/files/wrap/Laptop%20case%20study%20AG.pdf

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

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 13.

Table 13: 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: • 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.

Stationary drive durability and reliability

A leading HDD manufacturer highlights that new HDD models tend to be designed and specified based on detailed analysis of previous models and accelerated life testing[41]. Parameters such as Mean Time Between Failure (MTBF) are therefore extrapolated from design and prototype testing and modelling. Seagate recommend the use of Annual Failure Rate as a clearer indication of the probability of a HDD failing during its lifespan[42]. The AFR is calculated as follows:

AFR = 1 – exp(– Annual Operating Hours / MTBF)

So a MTBF of 1,600,000 hours represents an AFR of 0.55% for any one HDD within the production line for that model. Bit error rates are also highlighted as a metric[43] although they are only considered relevant, and at a higher benchmark, for servers because this error will only reveal itself after extended operating times.

A recently published study by US Company Backblaze, an on-line storage provider, indicates the possible range in HDD performance[44]. The study analysed 27,000 HDD from Seagate, Hitachi and Western Digital. 47% of the drives registered an AFR of between 0.9% and 3.2%. The best 20% of the HDD gave a performance of 0.9%. The survey results have, however, been subject to criticism by industry specialists[45]. For example, the results represent 24 hour operation at servers, so features such as power up and power down, which may be of value to a consumer, may have exerted greater wear on the HDD used. The results also combine enterprise drives and

[41] HGST, *HGST and hard disk drive reliability*, Whitepaper, November 2007.

[42] 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/

[43] Newman, H, *How to choose a hard drive*, 27th February 2014, http://www.enterprisestorageforum.com/storage-management/how-to-choose-a-hard-drive-1.html

[44] Backblaze, *What hard drive should I buy?,* January 21st 2014 http://blog.backblaze.com/2014/01/21/what-hard-drive-should-i-buy/

[45] Newman, H, *Selecting disc drive: How not to do research*, Enterprise Storage Forum, 29th January 2014, http://www.enterprisestorageforum.com/storage-hardware/selecting-a-disk-drive-how-not-to-do-research-1.html

consumer drives (the majority of the sample), and are heavily skewed by a number of Seagate HDD models that have acknowledged problems.

A study by Google in 2007 of server HDD of a sample of over 100,000 server drives[46] also refers to Annualised Failure Rate (AFR) as a headline parameter. The study quotes a number of other studies with significant HDD samples sets in which AFR ranged from 1.9% to 6.0%.

Notebook drive protection features

Free-fall sensors are either fitted externally or internally to a HDD and detect a sudden motion associated with a fall. This then sends a signal to retract the magnetic head of the HDD so that it cannot physically damage the media's surface, thereby protecting the data.

Sensors can have a varying degree of response time, which will give different levels of protection depending on the height of the fall. A white paper by Dell from 2008 suggests that this can vary between 500 milliseconds and 150 milliseconds[47]. This represents the difference between protection from a fall of 122 cm and 12.5 cm, with the latter protecting against a notebook being dropped whilst being carried or from a desk.

A cross-check of specifications for free-fall sensor response in the portable HDD of four major manufacturers – Seagate, Western Digital, HGST and Toshiba – suggests a performance range of 150 – 300 milliseconds. In the worst case this would still protect against a drop whilst being carried by hand.

The use of physical damping to protect against vibration and shock has also been identified as a design feature. It is understood from commentators on semi-rugged

[46] Pinheiro.P,Weber.W-D and L,Barroso. *Failure trends in a large disk drive population*, Proceedings of the 5th USENIX Conference on File and Storage Technologies, February 2007.

[47] Dell, *Dell raises the bar in shock-resistant hard drives*, February 2008. www.dell.com/innovation

specifications that HDD are generally placed near the base of a notebook but to protect them better it is required to mount them on dampers or for the HDD housing itself to be insulated[48]. *The effectiveness of the former would need to be checked by a drop test of the notebook itself (see section 2.3.4)* whilst *the latter may be reflected in the tolerance of the HDD quoted in the manufacturers specifications*.

A cross-check of specifications for the shock tolerance of notebook HDD of four major manufacturers – Seagate, Western Digital, HGST and Toshiba – suggests a performance range of 300-400 (operational) and 900-1,000 (non-operational) G force. The verification procedure was not detailed by manufacturers. IEC 62131 is understood to provide a test method for vibration and shock applied to electro technical equipment..

First criterion proposal

Core criteria	**Comprehensive criteria**
TECHNICAL SPECIFICATIONS	
E1. Stationary computer drives 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%. 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. **Verification:** 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.	**E1. Stationary computer drives** 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%. 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. **Verification:** 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.
E2. Notebook computer drives The primary data storage drive used in notebooks shall be designed to withstand a shock of 400 G (operating) and 1000 G (non-operating). ***Verification:*** 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.	**E2. Notebook computer drives** The primary data storage drive used in notebooks shall be designed to withstand a shock of 400 G (operating) and 1000 G (non-operating). ***Verification:*** 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.

[48] Notebook review, *Rugged laptops: Essential to business and home?* http://www.notebookreview.com/news/rugged-laptops-essential-to-business-and-home/2/

AWARD CRITERIA	
	E3. Notebook computer drives Additional points shall be awarded if notebook primary data storage drives meet one of the following specifications: (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. ***Verification:*** 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.

Summary rationale:

- It is proposed that a technical specification is used to set a minimum requirement for HDD performance and shock resistance, and that additional protection measures for notebooks are requested as award criteria where deemed appropriate to their likely pattern of usage.
- For stationary HDD it is proposed to set a criteria in which consumer products are required to meet an Annual Failure Rate (AFR) benchmark and that servers meet an AFR and an error rate benchmark. Further input is requested based on manufacturer's qualification requirements.
- The shock resistance verification method IEC 62131 appears to be a relevant option but feedback is required from HDD manufacturers.
- The Comprehensive criteria for notebook drives is proposed to include two options which reflect choices that can be made, at variable cost, to provide increased protection to the drive itself or the data in the event of an incident.
- The two notebook HDD options are proposed are a free-fall sensor and SSD. The former is a physical feature the presence of which would need to be verified. SSD would eliminate moving parts, but comes at a higher cost than HDD technology, hence its award and optional status.

Consultation questions
• Have we chosen the best way of measuring/comparing shock resistance for HDD? *If not, can you suggest other methods?* • Do the AFR and bit failure rates correspond with market leading performance?

2.3.4 Criterion 3.4 – Notebook durability testing

Background discussion and rationale

The preliminary technical background for this criteria revision summarised research by UK organisation WRAP which identified common components that may fail in computers. Accordingly proposals have therefore been made for disk drives and batteries. A key factor to consider beyond the resilience of individual components is, however, the real-life conditions and stresses that a product may be subjected to.

With notebooks computers set to shortly become the most common form factor for computers in the market the conditions to which computers are used have changed 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. In this respect we have looked 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'.

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 Preliminary report in October 2013[49]. The study highlighted a hardware failure rate of 20.4% and accidental damage of 10.6%. It was also highlighted a significant variation in reliability between leading brands, ranging from 15.6% to 25.6%.

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

Market analysts IDC, sponsored by Panasonic, who manufacture the leading 'Rugged' notebook[50], 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 where 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 standards[51] and the IP65 (International Protection) standards[52]. 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

[50] IDC, *The Business case for ruggedized PC's*, USA, June 2012

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

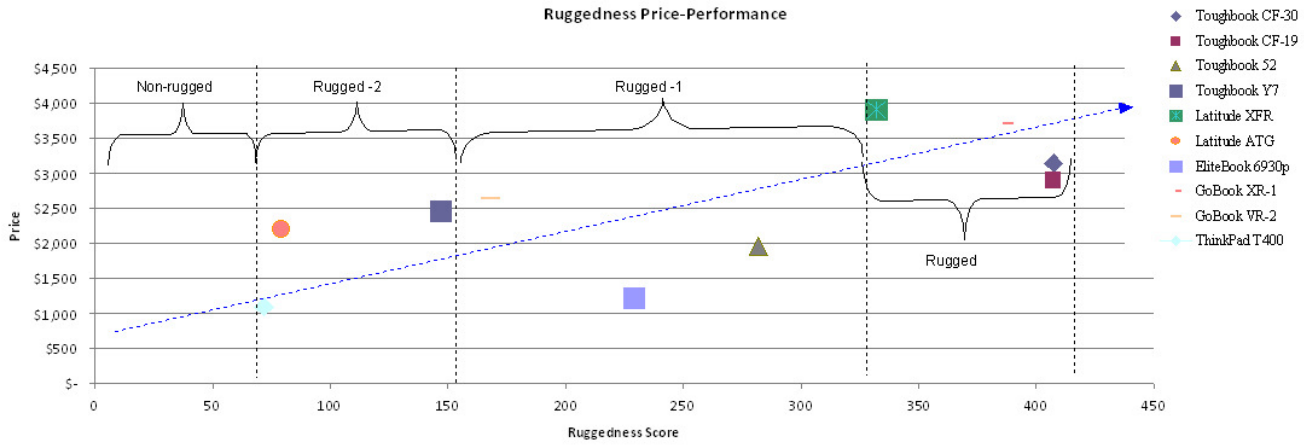
[52] UL, *Environmental ratings for enclosures based on Ingress Protection (IP) Code designations*, http://www.ul.com/global/eng/pages/offerings/services/hazardouslocations/ref/ingress/

‘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^{o}C to +60^{o}C
- Temperature shock
- Humidity

The price:performance of products by Panasonic, GD-Itronix, HP, Dell and Lenovo can be seen in Figure 8. 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.



Source: Endpoint Technology Associates (2011)

Figure 8: 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 14.

Table 14: Indicative sample of manufacturers' durability tests

Manufacturer	Durability tests and methods	Models to which they are applied
HP[53]	MIL-STD-810G standards: • Drop, shock, vibration, dust, humidity, altitude, temperature range, temperature shock Additional internal test specifications: • Keyboard strokes (7 year simulation) • Screen/lid open-close (6 year simulation)	HP Elitebook All business models
Asus[54]	Internal test specifications: • Drop, shock and vibration tests • Temperature range • Keyboard strokes simulation • Screen pressure test	All models. Commercial models achieve higher performance
Toshiba[55]	Internal test specifications: • Drop, shock and vibration tests • Temperature range • Screen pressure test	Portege and Tecra models
Lenovo[56]	MIL-STD-810G standards: • Drop, shock, vibration, dust, humidity, altitude, temperature range, temperature shock	Lenovo x131e/140e (student models) L/T/W Thinkpad models
Dell[57]	MIL-STD-810G standards: • Drop, shock, vibration, dust, humidity, altitude, temperature range, temperature shock Additional test specifications: • IEC 60529 dust ingress • Keyboard spill test	Selected Latitude models Selected Latitude models

[53] Hewlett Packard (2012) *Testing the business ruggedness and reliability of HP Elitebook notebook PC's*, Technical white paper

[54] Asus, *Product guide: August – September 2013*

[55] Toshiba, *Easyguard protection*, Accessed March 2014, https://www.toshiba.co.uk/innovation/generic/easyguard_protection/

[56] Lenovo, *Thinkpad laptops and ultrabooks*, http://shop.lenovo.com/us/en/laptops/thinkpad/

[57] Dell, *Latitude 6420u ultrabook summary of environmental testing*, October 2012, http://partnerdirect.dell.com/sites/channel/Documents/Dell-Latitude-6430u-Ultrabook-Environmental-Testing-Product-Guide.pdf

Manufacturer	Durability tests and methods	Models to which they are applied
Acer[58]	Unspecified internal standards: • Drop, shock, vibration, dust, humidity, altitude, temperature range, temperature shock • Screen/lid open-close	Business models

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

Durable models and design features

In the process of identifying the test routines of the EU's leading manufacturers a series of related design improvements were also identified. These features can include more robust single components as well as focus on the layout and junctions between components in order to, for example, better absorb impacts[59]. These, together with the products ranges or models in which they are incorporated, are summarised in Table 15. They are grouped according to the common accidents and reasons for failure identified by IDC (2011).

Based on feedback from selected manufacturers it is also understood that a combination of durability tests and improved design specifications can provide the confidence to give 2 or 3 year warranties with new products.

[58] Acer, *Built to last:ready for business*, Accessed March 2014, http://www.acer.com/professional-products/en_GB/index_legacy.html

[59] Notebook Review, *Rugged laptops: Essential to business and home?* 25th May 2010, http://www.notebookreview.com/news/rugged-laptops-essential-to-business-and-home/

Table 15: Sample of product design features specified for improved durability

Durability factor	Design feature	Product ranges
Accidental drop	• Strengthened case, e.g. magnesium alloy, carbon fibre • Shock and vibration absorbent internal enclosure lining	• Lenovo T series • Dell Inspiron • HP Elitebook • Toshiba Portege and Tecra
	• HDD redesign of location and incorporation of shock protection dampers • HDD accelerometer to retract magnetic head in the case of a sudden fall	• Acer business models • Toshiba Portege and Tecra • Asus B-Series • Lenovo X131/140e
	• Solid State Drive (SSD) instead of HDD to eliminate moving parts	• Toshiba Portege and Tecra • Apple Macbook Pro and Air • Dell Latitude models
Liquid spillage	• Spill resistant keyboard with elimination of possible drainage points	• HP Elitebook • Toshiba Portege and Tecra • Asus B-Series • Lenovo Thinkpads and X131/140e
Screen breakage	• Pressure absorbent casing • Screen reinforcement, e.g, glass fibre, toughened glass	• Asus all models • HP Elitebook • Dell Latitude
Keyboard lifespan	• Durable keyboard specifications	• Apple Macbook Pro • HP Elitebook • Asus all models • Dell Inspiron

First criterion proposal

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
	F1. Notebook durability: Drop test 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. The notebook shall be non-operational during the test but shall function following the test. **Verification:** 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.
	F2. Notebook durability: Water ingress 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 seconds, inverted on its side for 45 seconds and then tested after 2 minutes. The notebook shall be operational during and after the test. **Verification:** 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.
AWARD CRITERIA	
	F3. Notebook durability: Screen resistance 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. **Verification:** 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. *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.*

	F4. Notebook durability: Keyboard lifespan The applicant shall submit the notebook model for durability testing. This shall consist of a 10 million random keystrokes simulation for *(to be specified)* product samples. The keys to then be inspected for their integrity. **Verification:** 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. *No formal test method exists as a reference: stakeholder input is required.*

Summary rationale:

- It is proposed that a basic set of durability tests are provided to procurers to use, 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 of 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 afforded by the tenderer. Additional guidance is therefore proposed to be drafted to support decision-making.
- The test routine is proposed to encompass: Drop, Water ingress protection (to protect from spillages), a screen pressure test to guarantee screen robustness and an accelerated life test for keyboards. A separate screen durability specifications was also proposed by stakeholders, particularly for tablets where the screen is exposed. Further feedback is required on this proposal.
- To verify the durability tests the initial references for the methods are the US MIL-STD-810G, IP (International Protection) and IEC 60529 standards. Subject to further investigation, the EN 60068 series may be suitable to substitute the US MIL standard and IP standards. The number of samples of models to be

tested and the inspection routines for integrity of the product following testing are to be detailed further.

- The testing is proposed as being carried out and verified by a third party in order to provide comparability and assurance.
- The screen pressure test and accelerated life test for keyboards may both require bespoke testing routines and benchmarks to be established based on further input and discussions with manufacturers and testing bodies.

Consultation questions
• Are the range of test methods and the split between technical specifications and award criteria appropriate? • Should there be any differentiation in terms of the end-use for the device? *If so, what would you propose?* • Are there standardised test methods or reference points for the keyboard and screen pressure tests? • Are there tougher screen specifications that could be included for tablets?

2.3.5 Criterion 3.5 – Data deletion

Background technical discussion and rationale

Second hand usage of IT equipment can prolong the overall lifetime of computers. However, a barrier to IT devices from the public sector being given over for second hand usage is is the need for confidential data deletion from 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.

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.

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 €7.

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 Repairability.

Data deletion standards that provide a high level of assurance

Complete deletion of data without allowing any data recovery, is only possible by multiple overwriting algorithms of the drive with different bit patterns. Several standards have been defined for those software based approaches, for example[60]:

- 5220.22-M-Standard by the US Ministry of Defence, AFSSI-5020 by the US Air Force (3-times overwriting; first: zero; second: one value; third: random character);
- VSITR-Standard of the German Federal Office for Information Security (BSI) (7-times overwriting; first: random bit pattern; 2nd to 6th: reversed bit pattern, i.e.

[60] Sources: BITKOM (2008): "Leitfaden zum sicheren Datenlöschen"; Version 2.0; www.bitkom.org/files/documents/Leitfaden_Sicheres_Datenloeschen_Version_2-0_vom_300508.pdf; http://pcsupport.about.com/od/toolsofthetrade/tp/free-data-destruction-software.htm

zero is replaced by one and one is replaced by zero; 7th: overwriting by fixed '01010101' pattern)

- Bruce-Schneier algorithm (7-times overwriting; first: zero; second: one; 3rd to 7th: random character);
- Peter-Gutmann algorithm (35-times overwriting, random character).

Software for effectively wiping data from the Hard Disk Drive can be approved by Government security agencies. This is understood to occur at a national level e.g. in UK, software can be approved by CESG (Communications-Electronics Security Group).

On the other hand, irretrievable data sanitisation can be achieved by physically destroying storage media using one of the following methods:

- Shredding;
- Degausser (demagnetisation);
- Thermally destruction.

BITKOM (2008) recommends that for highly sensitive data, generally physical destruction is preferred. In this case the data deletion should be documented in a tamper-proof report.

First criterion proposal

Core criteria	Comprehensive criteria
AWARD CRITERIA	
	G1. Secure computer sanitisation, re-use and recycling Tenderers shall be invited, either in separate or combined ITT's, to offer: (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. The re-use service shall be in full accordance with the contracting authorities security requirements for data

	protection and sanitisation. 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. **Verification:** 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. Performance shall be monitored during the contract period against the re-use and recycling rates estimated in the tender.

Summary rationale:

- Data sanitisation of drives is an important step in facilitating the re-use of computers used in the public sector.
- Given the varying levels of security and pre-approval that may be required it is proposed that an Award criterion is considered to encourage innovation in maximising the potential for re-use of computers, either by sanitising drives or removing them for recycling.
- A number of options using different combinations of contractors could be encouraged so as to find cost effective solutions geared to the level of data security required.

Consultation questions
• Does the proposal provide sufficient flexibility to adapt to different procurement routes? • How might it be improved in order to reflect experience and best practices?

2.4 Criteria area 4 – End-of-life management

2.4.1 Criteria 4.1 – Design for recycling

Current criteria

Core criteria	Comprehensive criteria
AWARD CRITERIA	
Additional points will be awarded for ease of disassembly and ease of recycling plastic parts: - 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. **Verification:** 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.	Additional points will be awarded for ease of disassembly and ease of recycling plastic parts: - 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. **Verification:** 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.
	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. **Verification:** A declaration by the manufacturer stating the percentage post consumer recycled content.

Background technical discussion and rationale

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.

Recyclability of plastics and metals

The study 'Disassembly analysis of slates: Design for repair and recycling evaluation' by Fraunhofer IZM (2013)[61] indicates on the basis of an interview with a recycling company that 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.

WRAP research[62] on separation techniques showed that factors such as pigment selection can interfere with automated separation processes (e.g. use of certain black pigments prevents recognition by infrared sorters). Equally, if the parts are to be separated manually, the speed with which the plastic can be removed and separated is vital.

Manufacturers may 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. Metal casings may not necessarily, however, be readily recyclable. The alloy and coatings used may present problems for smelting.

The marking of plastics

Different opinions exist on the industrial value of plastics marked according to ISO 11469. Products may be shredded with low grade material recover. On the other hand feedback from re-processors and dismantlers carrying out initial separation of

[61] Cf. http://www.izm.fraunhofer.de/content/dam/izm/de/documents/News-Events/News/2013/urn_nbn_de_0011-n-255111-18-1.pdf

[62] Cf. http://www.wrap.org.uk/content/separation-mixed-weee-plastics-0

plastics suggests that it is of value. It has been noted by stakeholders that ISO 1043 is of value but only refers to flame retardant classes. It would therefore be important to also mark CAS numbers.

According to Köhnlechner (2014)[63], 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 HIPS[64] – independent from the plastic colour.

Plastic recycled content

Specifying plastics with a recycled content is understood from industry stakeholders to be a problem for GPP. This is because there is not an analytical method to verify that the product contains recycled material. The availability of post-consumer recycled content and the presence of hazardous substances in recyclates are also problematic. A number of computer and display manufacturers have sought to increase the recycled content of their products.

In the case of the latter the polymer must be treated the same as virgin material, although recent research suggests that there is an increasing focus on the potential to recycle plastics with FR's incorporate, potentially giving the recyclate a fire protection rating [65].

It is also understood that sourcing recyclate in the required volume and quality can be difficult for manufacturers because of limited supply. Besides availability, there may also be other technical obstacles. If plastics constitute the outside layer of a computer or other product (laminated or not), stringent appearance requirements may require highly consistent raw materials, which may exclude recycled materials.

[63] 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.

[64] HIPS: High Impact Polystyrene; ABS: Acrylnitril-Butadien-Styrol

An example of a traceability system for recycled content was provided by the Belgian Competent Body. The QA-CER system is a third party verified quality management system developed by a Belgian certification body and the Flemish Plastics Centre[66]. The system is based on ISO 9001, as well the EN standards EN 15347 relating to the characterisation of waste polymers[67] and EN 15343 relating to the traceability of waste polymers[68]. The standard EN 15343 is of particular interest as an underlying reference for QA-CER as it described a system for tracing polymer waste flows recognising that a system for analytical testing to verify recycled content does not exist.

The Label TCO certified edge (version 1.2 for displays) 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).

First criterion proposal

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
	H1. Recyclability of plastics and metals The recyclability of the metal or plastic housings used and enclosures shall be verified. Plastic used for housings and enclosures shall consist of a maximum of two polymers and shall not have surface coatings or metal inlays. **Verification:** 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.

[66] QA-CER, *QA-CER certification of the quality management system for recycling and production companies*, Version 1, January 2013

[67] CEN, *Recycled plastics – characterisation of plastics wastes*, EN 15347, December 2007.

[68] CEN, *Plastics recycling traceability and assessment of conformity and recycled content*, EN 15343, December 2007.

H2. Marking of plastics Plastic parts of greater than 200 grams shall be marked in accordance with ISO 11469 and ISO 1043, sections 1-4. Marking shall not be required where it would impact on the performance or functionality of the plastic part, including screen light guides. **Verification:** Documentation shall be provided showing conformity to the above mentioned ISO standards. A technical justification shall be provided where marking cannot be applied.	**H2. Marking of plastics** Plastic parts of greater than 100 grams shall be marked in accordance with ISO 11469 and ISO 1043, sections 1-4. Marking shall not be required where it would impact on the performance or functionality of the plastic part, including screen light guides. **Verification:** Documentation shall be provided showing conformity to the above mentioned ISO standards. A technical justification shall be provided where marking cannot be applied.
AWARD CRITERIA	
H3. Plastic recycled content Points shall be awarded for post-consumer recyclate content incorporated into internal and external housings, casings and structures at or greater than 10% by weight. This criteria shall not be applied to products with metal casings. **Verification:** The tenderer shall provide documentation verifying traceability for the post-consumer recycled content according to ISO 15343 or equivalent standards or schemes.	**H3. Plastic recycled content** Points shall be awarded for post-consumer recyclate content incorporated into internal and external housings, casings and structures at or greater than25% by weight. This criteria shall not be applied to products with metal casings. **Verification:** The tenderer shall provide documentation verifying traceability for the post-consumer recycled content according to ISO 15343 or equivalent standards or schemes.

Summary rationale:

- It is understood for housings and casings certain combinations of polymers, coatings, metal inlays and alloys may present recycling problems. It is proposed that the applicants verify the recyclability of their material choice. *Further information is, however, required from stakeholders in this area.*
- It is proposed that the current requirement on recycled content is retained as an Award criteria and that it shall to both internal and external plastic parts and structural elements. The example of TCO Certified Edge Displays shows that there are a certain number of products able to fulfil this criterion although there are still practical problems faced by even front runner manufacturers in consistently meeting a higher requirement.
- Verification of recycled content is proposed as being based on of the traceability standard EN 15343. Third party verification is to be requested. It is to be discussed further with manufacturers whether the information currently collected

to verify recycled content claims is sufficient to enable verification according to EN 15343.

- 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 it is proposed that ISO 1043-4 marking is also required in order to identify flame retardants incorporated into the plastics requiring fire protection.

Consultation questions
• Is third party verification of recyclability feasible? • How is recycled content currently verified by manufacturers? • Is analytical testing a possibility for verification where the recyclate has achieved a fire protection rating? • Is there experience with the use of and/or legality of EN 15343 for recycled plastic verification?

2.4.2 Criterion 4.2 – Design for dismantling

Technical background discussion and rationale:

As described in the Task 4 technical report, multi-stage dismantling is an important means to improve material recovery of, in particular, precious and critical metals, thus reducing the overall impacts of computer products. This can be facilitated by appropriate design.

Reflecting the approach proposed in the draft revision of the Ecodesign Implementing Measure for Televisions (and Displays) EC/642/2009[69] the potential to specify computer and display components of value in terms of metals, rare earth elements and Critical Raw Materials identified at an EU level, has been developed into a criteria proposal for the EU Ecolabel and a streamlined version could also be explored for GPP given Member State in interest in the management of electrical waste.

[69] 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

Identifying critical metals and raw materials

The EU Raw Materials Initiative working group has identified and listed the Critical Raw Materials from a geo-political and economic point of view[70]. 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.'*

Indicative Bills of Materials (BOM's) for notebook and desktop computers and displays are identified in Tables 16-18 based on analysis by Oeko-Institut[71].

It can be seen from the BOM that CRM's 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 then require extraction in order to recover the CRM's – for example, capacitors containing tantalum, magnets containing neodymium, LED cells containing gallium.

[70] 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

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

Table 16: Indicative occurrence of high value metals and CRM's 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%)
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 17: Indicative occurrence of high value metals and CRM's 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 18: Indicative occurrence of high value metals and CRM's 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 does not follow 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)[72]. Selected components may then be sent to specialist smelters (e.g. PCB's) or be subject to automatic or manual separation (e.g. plastics).

[72] Meskers.C.E.M and C.Hageluken, *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.

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 cm^2 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 HDD's, followed by subsequent recovery of the precious metals would enable a significantly more efficient recovery of various metals, CRM's and REE's[73]. 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 FR's used as being important to facilitate recovery and recycling[74].
- Printed Circuit Boards (PCB's): The main economic aim of recovering PCB's is to recover the copper, gold, silver and palladium. However, other critical 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

[73] 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.
[74] EFRA (2013) *Recycling of plastics from LCD television sets*

dissipation[75]. 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 CRM's and 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 (HDD's): 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 REE's 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 that their recovery rate is currently low, with a recent report claiming as low as 5%[76].

Setting a time threshold for the extraction of key components

During 2013 JRC-IES carried out further analysis of electronic displays to provide scientific support to help assess the benefits of the extraction of key components from electronic displays. Further analysis was carried out including a literature review of related studies, measurement of the time for the dismantling of electronic displays

[75] See Oeko Institut (2012)

[76] ENDS Europe, *Low recycling rates for lithium batteries criticised*, 14th February 2013

carried out at an Italian electronic equipment waste recycling plant and identification and assessment of suitable thresholds for the time taken to extract key components.

JRC-IES's 2012 analysis together with the new analysis refers to electronic displays (TVs and monitor) with Liquid Crystal Display (LCD) currently at their end of life (EoL) that have been designed in the past 5-8 years. According to manufacturing associations, modern displays have a significant lower mass and also their design for dismantling purposes has been improved.

The analysis has enabled the identification of several possible thresholds for the total time taken to extract key components, differentiated according to different sizes of screens. The analysis focused on two types of key components in displays: Printed Circuit Boards (PCB) and Thin Film Transistor (TFT) units, for which there are common steps.

With regards to computer products no similar analysis has yet been undertaken. However, in order to set an award criteria for GPP it would be 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, which may be within the range of uncertainty for 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 Tricom [77].

Establishing a comparable test method for timed dismantling

Reference is proposed to analysis and discussion led by JRC-IES to develop a standardised method for the measurement of the timing of dismantling. The timing for this process is likely to extend beyond the programme for adoption of the new EU Ecolabel criteria for computers.

[77] 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

In the interim an extraction method to ensure comparability would therefore need to be outlined in the User Manual based on the work to date by JRC-IES[78]. Outline steps for the method are for example described in Box 1.

Box 1: Outline steps for the measurement of the time for the extraction of certain target parts in electronic displays

Terms and definitions

- *Target parts:* Parts and/or components that are targeted for the extraction process.

Operating conditions for the extraction

- *Extraction sequence to be followed:* 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.
- *Tools for extraction:* The extraction operations should be performed using manual or power-driven standard tools.

Extraction time measurement

- *Measurement sample:* The sample of EEE to be used for the measurement shall be undamaged.
- *Measurement:* 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.

[78] Joint Research Centre – Institute for Environment and Sustainability - "Analysis of dismantleability" - draft 2014

First criterion proposal

Core criteria	Comprehensive criteria
AWARD CRITERIA	
I1. Dismantling potential of devices Points shall be awarded for time efficient manual disassembly and extraction of the following listed components from devices: **All products** (i) Printed Circuit Boards relating to computing functions >10 cm² **Stationary computer products** (ii) Internal Power Supply Unit (iii) HDD drives **Portable computer products** (iv) Rechargeable battery **Displays (including integrated units)** (v) Printed Circuit Boards >10 cm² (vi) Thin Film Transistor unit and film conductors in display unit >100 cm^2 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). The time required to extract display components shall not exceed the following: 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. For stationary computers and notebooks the threshold shall be 600 seconds. **Verification:** The tenderer shall provide a 'test dismantling report' detailing the dismantling sequence, the reported timings and the tools needed for the disassembly. The disassembly sequence shall be provided for verification by either: (i) A third party, testing body. (ii) A specialised recycling firm that is a permitted treatment operation in	**I1. Dismantling potential of devices** Points shall be awarded for time efficient manual disassembly and extraction of the following listed components from devices: **All products** (i) Printed Circuit Boards relating to computing functions >10 cm² **Stationary computer products** (ii) Internal Power Supply Unit (iii) HDD drives **Portable computer products** (iv) Rechargeable battery (v) HDD drive **Displays (including integrated units)** (vi) Printed Circuit Boards >10 cm² (vii) Thin Film Transistor unit and film conductors in display unit >100 cm^2 (viii) Polymethyl Methacrylate (PMMA) film light guide (screen size >15 inches) 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). The time required to extract display components shall not exceed the following: 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. For stationary computers and notebooks the threshold shall be 600 seconds. **Verification:** The tenderer shall provide a 'test dismantling report' detailing the dismantling sequence, the reported timings and the tools needed for the disassembly. The disassembly sequence shall be provided for

accordance with Article 23 of Directive 2008/98/EC. The report may be submitted either in writing or in digital format, supported by photos, drawings and/or videos.	verification by either: (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. The report may be submitted either in writing or in digital format, supported by photos, drawings and/or videos.

Summary rationale for the proposed changes:

- It is proposed that an Award criteria is introduced that encourages the market to bring forward devices that can be quickly and efficiently dismantled manually.
- Components have been identified based LCA hot spots, CRM/REE occurrence and the market potential for 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 third party – either a testing body or a recycling company.
- A requirement on measuring the dismantling time reflects proposals by the Commission for introduction into Ecodesign requirements for electronic products from an estimated 2016/17 onwards, being an important proxy for economic first stage manual dismantling.
- The display timing has been determined from dismantling exercises carried out in the field by JRC-IES. A conservative threshold for computers has been set based on analysis by Fraunhofer IZM and Tricom for a potential EU Ecolabel applicant. However, further input is required from manufacturers to set an award threshold for computers.
- 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).

Consultation questions
• Does the proposal raise any issues/concerns from a procurement perspective? • Can stakeholders provide any comparative data for the computer time threshold?

2.5 Criteria area 5 – Further criteria

2.5.1 Criterion 5.1 – Ergonomics

Background technical discussion and rationale

Currently, fitness for use is not addressed as a criteria 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 work load ergonomics (inter alia vertical tilt and vertical height for AiO-PCs). These are summarised in Table 19. The Nordic Swan ecolabel aligns to TCO Displays and Notebooks criteria with regard to ergonomics and includes some own requirements for tablet PCs.

Table 19: Ergonomic criteria of the TCO ecolabel

Visual ergonomics		**Workload ergonomics**
Image detail characteristics	• Native display resolution requirement	Vertical tilt
Luminance characteristics	• Luminance level • Luminance uniformity • Black level • Luminance uniformity – angular dependence • Greyscale gamma curve	Vertical height
Luminance contrast characters	• Luminance contrast – characters • Luminance contrast – angular dependence	
Reflection characteristics	• Front frame gloss	
Screen colour characteristics	• 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)[79] 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.

Following stakeholder feedback, for EU Ecolabel it is proposed not to introduce a new ergonomics requirements aligned with the label TCO Certified Displays. However, stakeholder feedback is 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.

Consultation questions
• Are ergonomics criteria set in the public procurement of Office IT Equipment? • If so, what are the main criteria are what criteria or test methods are referred to? • Of the criteria in TCO or ISO 9241-307 which would be the most relevant to specifying a high quality, ergonomic display or keyboard?

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