Sustainable ICT Procurement in Higher Education

- A Briefing Paper prepared for the Joint Information Services Committee

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Contents

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Introduction

ICT has a surprisingly heavy environmental footprint. A typical European office PC and LCD monitor weighs around 20kg, contains over 27 different materials, and generates 66kg of waste and 1,096kg of CO_2 during its lifetime (IVF 2007). ICT overall accounts for around 2% of global CO_2 equivalent emissions (Gartner Consulting 2007), and around 3% of UK electricity consumption (MTP 2008). The SusteIT report also calculated that ICT use in further and higher education will use over £116m of electricity in 2009, and generate over 500,000 tonnes of CO_2 emissions (James and Hopkinson 2009).

Procuring the right ICT equipment and services can greatly reduce this footprint, through increased energy efficiency and in other ways. This is especially true of devices that are regularly replenished, such as servers and PCs. A number of factors are now requiring or stimulating greater action by universities and colleges in this area, including:

Rising costs of electricity, and therefore ICT usage;

Central Government initiatives, such as Quick Wins;

Sector initiatives to reduce carbon emissions and other environmental impacts; and

The development of new or improved energy and environmental labelling schemes for ICT products.

This paper explores their implications for ICT procurement in universities and colleges. It is based in part on an event, Sustainable ICT Procurement, held at Nottingham Trent University on 2 July 2009.[1]

1. Government Initiatives for Sustainable ICT Procurement

There are a confusing number of UK Government initiatives of relevance to sustainable ICT procurement, including strategic policies, procurement bodies and detailed implementation schemes. The following sections describe: the flexible framework; the EU Energy Services Directive; Quick Wins; Buying Solutions and the Greening Government IT strategy.

1.1 Strategic Government Procurement Policies

The Government's Sustainable Procurement Action Plan (Defra 2007) (which was a response to the Sustainable Procurement Task Force's 2006 'Procuring the Future' report) sets out a flexible, five-stage, framework setting out the actions that public sector organisations should adopt to improve the sustainability of their procurement policies. The five stages consist of: (1) foundation; (2) embed; (3) practice; (4) enhance; and (5) lead. The Task Force identified 10 areas of spend being identified as priorities for action including two of relevance to ICT - pulp, paper & printing and consumables, and office machinery and computers.

By April 2009 all public sector organisations should have reached Level 3 (or above) of the Flexible Framework with leadership (Level 5) in at least one area by December 2009.

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[1] Presentations from that event can be found at www.susteit.org.uk.

The Universities UK Strategic Procurement Group (SPG) is working with AUPO to develop the adoption of the Sustainable Procurement Task Force Report Flexible Framework in institutions. A Best Practice Indicator (BPI) has been agreed, with the launch at a Conference on University Purchasing in September 2009.

1.2 Energy End Use and Services Directive

This European Directive, referred to as the Energy Services Directive, is intended to enhance the cost effective improvement of energy end use efficiency in Member States. Article 5, which was supposed to come into effect in May 2008 in Member States, requires the public sector to fulfil an exemplary role in achieving this. The Directive requires the public sector to take up cost effective energy efficiency improvements that generate the largest savings in the shortest space of time. They must also show leadership by demonstrating and communicating their energy saving actions, and sharing best practice and information. Negotiations on voluntary agreements to meet the requirements of the Directive have taken place with lead bodies across the public sector. These are expected to be signed shortly.

In terms of implementation in the UK, equipment and vehicles purchased in the public sector must as a minimum conform to the energy efficient product specifications detailed in the Buy Sustainable – Quick Wins list (see Section 1.3 below). These specifications also consider the energy efficient consumption of equipment in all modes.

HEFCE has stated it will work with sector bodies to determine the best approach to implementing Article 5, though it is likely that it will adopt Quick Wins as the means to do this (see Section 3.1).

1.3 Quick Wins

The Government's 'Buy Sustainable – Quick Wins' set minimum and best practice procurement standards for office equipment and other products purchased by Central Government (Defra 2009). The "minimum standards" are mandatory for central government and its agencies but the more stringent "best practice" and "class leader" specifications are voluntary and highlight the "higher specification" and "best in class" products in certain areas. Best practice and class leader specifications signal the direction of travel for future product specifications. Anyone can use these specifications during procurement.

As per HEFCE's Sustainable Development Action Plan (see Section 2) the education sector will likely need to follow these standards as part of the implementation of the Energy End Use and Services Directive.

In order to meet the Quick Win standard a product has to comply with the Technical Specifications, but the Award Criteria are optional criteria that purchasers could take into account at award, if they choose to, to further differentiate. The criteria are drawn from existing IEEE international standards[2] which have undergone international consultation, to avoid a plethora of different standards. Defra maintains a database of environmental product data for each product type and have developed a tool to assess which suppliers conform with the requirements (Williams 2009). The office equipment standards were updated in April 2009. Appendix 1 shows the standards for one product, desktop computers.

Although Quick Wins are a UK set of standards Defra view them as a stepping stone to the harmonisation of international standards (Williams 2009). Defra are currently developing a communication strategy on Quick Wins to promote awareness within and outside central government.

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[2] IEEE P1680 Family of Standards for Environmental Assessment of Electronic Products. See http://grouper.ieee.org/groups/1680/.

1.4 Buying Solutions

Buying Solutions, formerly known as OGC Buying Solutions, is the UK government executive agency charged with procurement management.[3] It is an executive agency of the Office of Government Commerce in HM Treasury. They provide a professional procurement service to the public sector to enable organisations to deliver improved value for money in their commercial activities and provide professional support , advising on technical issues, energy saving and environmental improvements. As with the University regional purchasing consortia, Buying Solutions' operations break down into framework agreements, which are a set of pre-tendered contracts with a range of suppliers from which public sector customers can purchase goods and services. A small commission (averaging less than 1%) is collected from the suppliers for each sale they make under the frameworks. Buying Solutions has a number of framework agreements for IT Goods and Services including client devices, IT consumables, software etc. Although the largest of over 40 Professional Buying Organisations (PBO) in the wider public sector, and with a legal remit to trade across the whole of UK public services, it is not generally used by the university sector who tend to rely on the sector purchasing consortia instead.

1.5 Greening Government ICT

In 2008 the Government set out their strategy for reducing the environmental impact of their computer systems (Cabinet Office 2008). There are two aims: to make energy consumption of their ICT systems carbon neutral by 2012, and to make them carbon neutral across their lifetime (including manufacture and disposal) by 2020. The strategy asks for immediate action, with simple steps implemented straight away (see Appendix B of the Strategy). For example it recommends specification of low power/high efficiency devices, only buying for the specification you need now, consolidation of devices and extending the refresh cycle of devices.

The Strategy contains a number of recommendations relevant to ICT procurement. For example, as well as continuing adherence to the "Quick Wins" criteria, it recommends by January 2009 all procurement documentation must specify environmental criteria for ICT in line with advice being developed by the OGC Centre of Expertise in Sustainable Procurement. The CESP has not yet developed specific procurement guidance around environmental criteria but generic criteria are available in 'Buy Green and Make a Difference' (OGC 2008).

Progress to date includes:

> Establishment of a Green ICT Delivery group by the CIO Council, with the aims of increasing awareness of best practice, and providing support and advice to departments in its implementation.
>
> A pilot Green ICT Scorecard that benchmarks organisational behaviour, policy, governance, procurement, energy efficiency, labelling and disposals, in both internal and out-sourced structures.
>
> Development of a CIO Green ICT SOGE map that shows where greening ICT can help meet SOGE targets.[4]

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[3] See www.buyingsolutions.gov.uk

[4] Sustainable Operations on the Government Estate (SOGE) are sustainability targets that came into effect in 2007 for all central Government Departments, executive agencies, and to Non-Departmental Public Bodies (NDPBs).

1.6 Procurement Scotland

There are two main procurement bodies for Universities and Colleges in Scotland. Procurement Scotland develops and implements procurement strategies for national 'Category A' commodities on behalf of all Scottish public bodies (Procurement Scotland). These are goods or services that are standard or of a similar nature across the largely common requirements of users in the public sector in Scotland, and include many IT products such as desktops, notebooks, Mutifunctional devices (MFDs) and IT software. A sector procurement body, Advanced Procurement for Universities and Collleges (APUC) procures sector-specific commodities (see section 3.2). APUC does work closely with Procurement Scotland, through a Commodity Forum, on the procurement strategy and specifications for ICT commodities. Procurement Scotland is currently considering consulting on procurement of PC power management software.

2. Energy and Environmental Labels for ICT Products

Sustainable ICT procurement is made much easier when standardised methods are available to assess environmental impacts. For example how to determine whether one PC which uses less power in standby but more in active mode than an equivalent, is more energy efficient? The situation is complicated further when comparing difference environmental impacts. For example a PC can use 10% less power than an equivalent, but contain more toxic compounds, and create greater pollution problems at the manufacturing stage. Reaching an overall judgement as to how green this is – and how it compares with other models – is very difficult. The task is made even more difficult because manufacturer's claims are not always accurate. This is not necessarily for fraudulent reasons, but because test conditions may differ from those in the field, or because they do not know of upstream impacts from production of brought in components. Energy and environmental labelling schemes help to standardise comparison and ensure that like is being compared with like, and provide third party verification of claims.

Appendix 2 discusses, and compares and contrasts, the three energy and environmental labelling schemes which seem to have the best potential for greater adoption within UK further and higher education. The three schemes are:

> Energy Star – originally a US scheme (which has also been adopted as an official European Union (EU) scheme) that covers energy consumption in use;
>
> ECMA Eco-Declaration – a European scheme developed by suppliers which covers energy, but also broader environmental issues such as hazardous substances and the company's environmental policy and management; and
>
> EPEAT – a similar scheme to ECMA which was originally developed in the US but has become international, and applies in all EU countries.

The SusteIT report concluded that Energy Star is proven, easier to use and directly applicable to the EU, and should therefore be used more widely in sector purchasing activities.

Although EPEAT-compliant products are available in the UK, EU Public Procurement Law strictly limits the use of company performance standards in product specifications which may cause problems for public sector organisations wishing to specify it. Discussions currently underway will address how the scheme could be made acceptable for the EU market (Redding 2009).

However both EPEAT and ECMA go beyond current legal standards in the EU and therefore a computer with either EPEAT or ECMA-370 eco-labels will offer more environmental benefits than one with Energy Star alone. Some of these (e.g. corporate environmental performance reporting) may be addressed directly at the procurement stage through environmental questionnaires to the suppliers. EPEAT is the current best option in terms of a more comprehensive eco-label.

3. Sector Responses

ICT procurement in further and higher education is a complex activity. Purchases can be – and are – made by IT departments, by corporate users (schools, departments etc) and by individuals. IT departments themselves can purchase independently, or through the national, inter-regional (i.e. involving two or more consortia) and regional agreements, which are negotiated by the sector's purchasing consortia (see below).

3.1 Funding Councils

In England HEFCE's Strategic Statement and Sustainable Development Action Plan, published for consultation in 2008 and finalised in February 2009 (HEFCE 2009) states:

> *"There is a need to promote a wider understanding of the impact of procurement decisions on sustainable development. We will continue to work with sector bodies to support sustainable procurement, in particular through UUK's Strategic Procurement Group, which provides strategic direction, and the Association of University Procurement Officers' (AUPO's) Sustainable Purchasing Group."*

It contains three main actions on sustainable ICT procurement:

> *"We will continue to support the work of JISC and others to minimise the environmental impact of ICT use and to maximise the contribution that ICT can make to sustainable development more widely.*
>
> *We will work with UUK's Strategic Procurement Group and AUPO's Sustainable Purchasing Group to encourage sustainable procurement.*
>
> *We will work with the Department of Energy and Climate Change, the UUK Strategic Procurement Group and others to determine the best approach to implementing and monitoring the requirements of Article 5 of the EU Energy Services Directive."*

The agreement with the Government regarding implementation of Article 5 in England will be made once the Steering group for the new centre of excellence (see Section 3.3) has been convened (Butcher, Personal Communication 2009). In Wales there were no specific actions against Article 5 at the time of writing however this may be included within a Higher Education Funding Council for Wales (HEFCW) forthcoming review of carbon management in Wales to support the Welsh Assembly Government Climate Change Strategy (Cowburn 2009). It is unclear at the time of writing how the Energy Services Directive is being implemented in other parts of the UK.

HEFCE has recently published its consultation on carbon reduction target and strategy for higher education in England (HEFCE 2009b). The consultation suggests a 2020 carbon reduction target of 50% against 1990 levels; and a 100 per cent reduction against 1990 levels by 2050, which in practice will be achieved with contributions from carbon trading and offsetting.

In terms of procurement, the consultation suggests that a significant proportion, possibly half, of the sector's total carbon emissions comes from the usage of third party-generated goods and services procured by the sector. Therefore, this is an area where significant carbon reductions may be possible. In the main these reductions will be achieved by influencing suppliers to deliver against more exacting CO_2 specifications (HEFCE 2009b). It is therefore highly likely that procurement will be expected to play a major role in reducing carbon emissions from universities in future, and HEFCE's funding of a new centre of excellence (see Section 3.3) is a reflection of this importance.

In Wales, in addition to working with JISC, UUK, and AUPO, HEFCW funds and supports the work of the Higher Education Purchasing Consortium Wales to improve sustainable procurement in the area of ICT. HEFCW also require all higher education institutions to utilise the Sustainable Procurement Assessment Framework to embed sustainability within all areas of procurement. This provides a systematic approach to developing sustainability and requires six monthly progress report to be made (Cowburn 2009).

3.2 Procurement Agreements

A large proportion of bulk purchases of ICT equipment within universities are done under the auspices of national, inter-regional or regional procurement agreements. Universities can either award contracts directly where the terms laid down in the framework agreements are sufficiently precise, or add further requirements and hold a mini-competition between the suppliers who are party to the agreement.

The national agreements are negotiated and managed by collaborative working parties, which include ones on Computer and Stationery Supplies, Photocopiers, and Waste Electrical and Electronic Equipment (WEEE) disposal contracts. There are also a number of regional purchasing consortia[5] which have various commodity groups (e.g. desktop PCs, printers & peripherals, photocopier paper) with representatives from their member institution on these groups. This established infrastructure, and the aggregated buying power it creates, gives considerable potential for more proactive procurement actions to support sustainable ICT. The national agreements generally last for 4 years and some ICT agreements have recently been updated.

Table 1: Date for refresh of the main agreements (Toplass and Briggs 2009)

National agreement	**Date of next update**
Desktops and notebooks	2013
Networking Equipment	2013
Printers	2011
Servers and Storage	2011
Apple	2011
Toners	2011

[5] The consortia are the Southern Universities Purchasing Consortium (SUPC); London Universities Purchasing Consortium (LUPC); North East Universities Purchasing Consortium (NEUPC); North West Universities Purchasing Consortium (NWUPC); Advanced Procurement Universities and Colleges (APUC) (formerly Procurement Scotland and Northern Ireland (Proc-SNI)); Higher Education Purchasing Consortium, Wales (HEPCW); Welsh Further Education Purchasing Consortium (WFEPC).

The main *raison d'etre* of the agreements is to use the consortia's purchasing power to negotiate lower prices and/or additional benefits from suppliers. They also enable individual universities to ensure that they are complying with EU Procurement Directives.[6] However, the converse of this is that institutions working within the agreement cannot substantially change its basic terms and specifications – which would include adding significantly new environmental or social requirements to any purchases. Many of the national agreements contain sustainability criteria which have been developed by the working parties.

The SusteIT report noted that many of their interviewees felt that the inclusion of environmental and social issues in current agreements is limited and ad-hoc. It also found considerable uncertainty amongst university procurement staff about relevant sustainability issues, and how these could be taken into account within procurement specifications. One exception is the North Eastern Universities Purchasing Consortium (NEUPC) agreement for Audio Visual (AV) equipment requires all suppliers to complete an environmental questionnaire, which accounts for 5–10% of the total points used to assess the bid. The energy consumption and carbon emissions associated with the operation of AV equipment in different modes (e.g. active, standby), is also required. The National Desktop and Notebook Agreement, which commenced in August 2009 led by the London Universities Purchasing Consortium (LUPC), had similar requirements whereby 5% of the total marks were dedicated to the environmental response from each bidder within the main tender across a section of 18 questions. The coordinating body for the regional purchasing consortia, the English National Purchasing Consortium (ENPC), is also developing a common checklist of environmental questions to include in ICT tender documents.

ICT procurement in further education is more fragmented, in part because purchases are lower in value than for most higher education institutions. A National Audit Office (2006) report found that ICT purchases accounted for an average £291.000 per annum, or 4.4% of average college budgets in England, It also found that ICT was one of the areas where colleges had least knowledge of purchasing costs, with only 16% of respondents to a survey able to provide information on their spending. One of the report's recommendations was that colleges should develop more external collaboration for procurement, and sustainable ICT is clearly one area where they could work more closely with higher education procurement agencies.

3.3 Centre of Excellence

A new Centre of Excellence for Sustainable Procurement for the sector is to be established in 2009 (Toplass and Briggs 2009). Funded by HEFCE for the next 4 years it will be led by the NEUPC in partnership with the Association of University Procurement Officers (AUPO) with two full time staff based at Leeds. The Centre intends to be the central repository of information on sustainable procurement for the Higher Education sector and will work closely with the various regional consortia to embed sustainability in the framework agreements and standards procedures, policies and practices. The Centre will: build capacity in sustainable procurement; develop capability in influencing supply chains; address process issues; develop measurement and monitoring tools; and communicate a full understanding of CO_2 emissions, and other environmental impacts, in the specification, production, delivery, utilisation and disposal of goods and services purchased by the HE sector. Key Performance Indicators for the Centre include changes in the supply chain, capacity building and communication. It will produce an Action Plan before the end of the year (Toplass and Briggs 2009).

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[6] Procurement Directive 2004/18/EC and Consolidated Directive 2004/18/EC, requires bids above a certain threshold to be published in the OJEU.

4. Discussion

The following issues were discussed at the event, or in subsequent email exchanges:

ICT-procurement linkages – many actions to reduce environmental impacts require better communication and understanding between the two functions. It is also important to include Estates in major ICT-related capital spend. One important role for procurement staff is introducing a more strategic view of IT procurement, which goes beyond energy efficient equipment to consider approaches that actually use less of it, such as thin client and virtualisation.

Reinventing wheels? – One participant wondered why the sector could not make greater use of existing sustainable procurement mechanisms, such as those of Buying Solutions and Quick Wins, rather than spending time developing criteria for procurement agreements. As expertise was limited, there was a danger that the criteria may be undemanding or unrealistic. Others argued that the existing models were themselves undemanding, and that sector procurement agreements provided a means of driving greater improvement.

Whole Life Costing (WLC) – also known as Total Cost of Ownership (TCO). As ICT-related energy consumption and, to a lesser degree, end-of-life management is a growing proportion of whole life costs, a thorough analysis will usually be helpful to environmental improvement. It can also pick up secondary costs, which may be incurred as a result of a decision or purchase (e.g. existing cooling or power facilities may be inadequate, and need to be upgraded), even if it is undertaken for purely financial reasons. However, the SusteIT survey found that only 17% of respondents conducted a detailed WLC when purchasing ICT equipment (James and Hopkinson, 2008). A more standardised, sector-wide, approach would be helpful. There is an existing tool, initially developed by the Joint Procurement Strategy Steering Group (JPSSG), which has been found useful by some institutions. However, it does not appear to be widely used in a way which highlights energy and environment-related costs. Discussions at past HEEPI workshops suggest that one reason is that some people have found the tool overly complex to use for relatively simple equipment purchases.

Carbon accounting - conventional WLC deals only with financial data. However, the potential for more direct consideration of the carbon costs of ownership is also emerging with the development of new standards for carbon accounting such as PAS 2050 (British Standards Institute 2008). Gathering data on the carbon impacts of ICT use is relatively straightforward (and can be assisted, for example, by use of the SusteIT footprinting tool). More problematic is gathering data on the carbon impacts of purchased equipment, as this in turn depends upon first tier suppliers gathering information from many other downstream organisations in generally complex supply chains. EPEAT may help with this, but it remains to be seen how quickly such data might be available to assist procurement within universities and colleges.

Simple energy ratings – it was noted that Energy Star 5 makes this easier, by making it possible to calculate lifetime total energy consumption (TEC) information. This could be the basis of a simple A-G rating system, as used in building energy certificates. An NGO, UK CEED, is currently working on such a scheme.

Supplier bias? – A view was expressed that small, innovative, suppliers could not easily get onto sector procurement agreements as these were inevitably geared to large volume suppliers. No conclusions were reached, although it was noted it is difficult for any sector procurements to exclude the main vendors of equipment.

Enabling aspects of ICT - A recent study (Climate Group, 2008) has argued that greater take-up of many ICT applications could reduce global CO_2 equivalent emissions in 2020 by 15%, creating $946 billion of cost savings in the process, and avoid approximately 5 tonnes of CO_2 emissions through applications for every tonne created by the production, use and disposal of ICT equipment, ICT can achieve this by: improving building energy management; substituting face-to-face learning sessions or meetings with virtual equivalents; enabling people to reduce commuting and other work-related journeys by 'teleworking' at home, or other remote locations, and; replacing paper documents with electronic ones, which can be read on screen.

Responsibility for lifetime energy costs – there is a dislocation between the purchaser of ICT equipment (often the IT department or individual academic departments) and the savings in terms of reduced energy costs, which is typically captured by estates. Energy savings often come at some cost to the ICT department in the form of higher initial costs (for highly energy efficient equipment). reduced performance (e.g. lower energy CPUs) and additional management time (e.g. for virtualisation). These additional costs will come out of the ICT department budget – while they rarely see the benefits in terms of additional budget, providing little incentive for whole life costing decisions.

Joint procurement – Several areas were identified where this might be useful as a means of reducing prices and/or gaining better technical information from suppliers, e.g. power management software, power consumption of equipment.

Remanufacturing/reuse - A further way to extend the useful life of IT products and reduce the life cycle impacts (especially those associated with manufacturing) is to upgrade existing devices, procure remanufactured or refurbished devices or to ensure the reuse of equipment at the end of its useful life (through donation to charities such as Computeraid - see case studies on www.susteit.org.uk). Currently photocopiers appear to be the only remanufactured ICT device available in the UK (Centre for ReManufacturing and Reuse).

5. Conclusions

The SusteIT report concluded that:

> *"There are a plethora of guidance, consortia and different standards and the procurement field is quite fragmented ….. There is a certain degree of reinventing the wheel both within the consortia and within universities. It is not clear that the university framework agreements are providing universities with the option of the most sustainable ICT equipment on the market as there is a need to provide universities with preferred, often large, suppliers. There is also a need to find room for innovation and support smaller suppliers who may provide a more sustainable alternative. One of the most difficult issues for HE in terms of sustainable ICT procurement is the decentralised university culture which means that procurement decisions are being taken by a large number of different players including IT Departments, academic departments as well as central procurement departments. Also the responsibility for lifetime energy costs – one of the main drivers of low energy ICT devices – is disconnected from responsibility for first costs ((James and Hopkinson 2009)."*

Although some progress has been made since this was written, in late 2008, it remains the case that there is much to be done.

Appendix 1 - 'Quick Wins' Standards for Desktop Computers

Source: Defra, updated 2009

	Minimum Mandatory	Best Practice	Class Leader
Technical Specification	(a) The product meets the performance requirements of ENERGY STAR (b) Parts that have to be treated separately are easily separable (c) Plastic materials in covers/housing have no surface coatings that are incompatible with recycling or reuse, including metal coatings (d) Plastic parts >100 g consist of one material or of easily separable materials. (e) Plastic parts >25 g have material codes according to ISO 11469 referring to ISO 1043. (f) Plastic parts are free from metal inlays or have inlays that can be removed with commonly available tools. (g) Labels are easily separable. (This requirement does not apply to safety/regulatory labels). (h) Upgrading of components can be done (e.g. with processor, memory, cards or drives) (i) Upgrading can be done using commonly available tools (j) Spare parts are available after end of production for 5 years Appropriate means of proof include a declaration from the manufacturer (k) All cover/housing plastic parts >25 g are halogen free (l) Plastic parts >25 g are free from flame retardant substances/preparations above 0.1% classified as R45/46, R50/51/53 and R60/61 (67/548/EEC) (m) Product does not contain batteries defined as hazardous according to 91/157/EEC (n) Product plastic packaging does not contain chlorine (o) User and product documentation do not contain chlorine bleached paper	As for minimum mandatory technical specification plus: (u) and (v) from the minimum mandatory award criteria	As for best practice plus: (w) All printed circuit boards (without components) >25g are halogen free (x) User and product documentation contain recycled paper
Award Criteria	(p) Servicing of products is available after end of production for 5 years (q) Electrical cable insulation material of power cables are halogen free (including PVC) (r) Electrical cable insulation material of signal cables are halogen free (including PVC) (s) All printed circuit boards (without components) >25 g are halogen free (t) Maximum A-weighted sound power level of <4.0 LWAd (B) in the idle operating mode (u) Maximum A-weighted sound power level of < 4.5 LWAd (B) when accessing a hard-disk drive (v) User and product documentation contain recycled paper	As for minimum mandatory award criteria minus criteria (u) and (v)	

Appendix 2 – Energy and Environmental Labelling of ICT Equipment

Table 7 compares and contrasts the three main labelling schemes – Energy Star, ECHEMA and EPEAT. It is based on part on an analysis of existing, established sustainable product standards, databases for energy saving products and product lists (ERM 2008).

A1 Energy Star

This is the most developed labelling scheme, but only addresses energy consumption in use. It was developed in the US, but is now – at least as far as ICT is concerned – a joint activity between the US Environmental Protection Agency and the European Commission. Energy Star is a voluntary eco-label which is based on a minimum performance of energy in use. Once a product has qualified for the eco-label it is entered onto a web-based database which is easily searchable. The Energy Star database lists the most energy efficient models, within the group of Energy Star qualified office equipment. It has specifications for computers; displays; imaging equipment, and monitors. The first specification for servers is also under development. The specifications are reviewed periodically, typically every 2-3 years, and standards tightened based on technological and market conditions. While compliance is voluntary the US-EPA tests a random number each year for verification.

The table below summarises the status of the main performance specifications for office equipment – some of which have been updated recently.

Table 3: Status of Energy Star Specifications for Office Equipment (EU Energy Star 2009)

Category	**Includes**	**Most recent specification**	**Date in effect**
Computing equipment	computers, workstations, games consoles and laptops	Version 5 (October 2009)	**1 July 2009**
Displays	Monitors (LCD, LED, CRT) and plasma display panels	Version 5 (March 2009)	**October 30, 2009** for displays under 30 inches viewable diagonal screen size **January 30, 2010**, for displays between 30 and 60 inches, inclusive.
Imaging Equipment	copiers, fax machines, multi-functional devices (MFDs), printers, scanners, digital duplicator, mailing machine	Version 1.1 (October 2008)	**1 July 2009**
Servers	Computer server, blade system, blade chassis	Version 1 Final Draft (March 2009)	To be decided

Energy Star 5.0 for Computers

Because it is an EU scheme, Energy Star rated devices are readily available in the UK. For example in mid-June 2009 there were 874 desktop, 1323 notebooks/tablets and 1179 MFD models listed in the EU database conforming to the existing version 4.0 specifications for computing equipment (EU Energy Star website). However as a newer and more stringent version of Energy Star (version 5) came into effect on 1 July, the numbers are expected to drop back dramatically and then gradually increase as manufacturers improve their products. Note that Quick Wins, EPEAT and ECMA-370 require conformity with the latest Energy Star standards.

The new performance requirements and methodology are detailed in the box below and tables 4-6.

Energy Star 5 raises the bar for energy performance significantly – based on the top 25% performing products on the market.

New Requirements of Energy Star 5.0 for Computers

This introduces a Typical Energy Consumption (TEC): A method of testing and comparing the energy performance of computers, which focuses on the typical electricity consumed by a product while in normal operation during a representative period of time. For desktops and notebooks, the key criterion of the TEC approach is a value for typical annual electricity use, measured in kilowatt-hours (kWh), using measurements of average operational mode power levels scaled by an assumed typical usage model (duty cycle). For all computers, requirements are based on a TEC power value calculated from operational mode power levels, maximum power, and an assumed duty cycle (see Tables 6 and 7) based on the following formulae for desktops and notebooks (E_{TEC}) and workstations (P_{TEC}):

$$\mathbf{E_{TEC} = (8760/1000) * (P_{of} * T_{off} + P_{sleep} * T_{sleep} + P_{idle} * T_{idle})}$$

$$\mathbf{P_{TEC} = 0.35*P_{off} + 0.10*P_{sleep} + 0.55*P_{idle}}$$

where Px are power values in Watts, all Tx are time values in % of year, and E_{TEC} is annual energy consumption in kWh, based on mode weightings shown in Table 8 below.

Table 4: Final Energy Star V. 5.0: TEC Requirement – Desktops, Notebooks and Workstations (Energy Star 2008) (see Table 4 below for definitions of categories).

	Desktops and Integrated Computers (kWh)	**Notebook Computers (kWh)**	**Workstations**
E_{TEC} (kWh)	Cat A ≤ 148.0 Cat B ≤ 175.0 Cat C ≤ 209.0 Cat D ≤ 234.0	Cat A ≤ 40.0 Cat A ≤ 53.0 Cat A ≤ 88.5	n/a
P_{TEC} (kWh)	n/a	n/a	≤0.28*(P_{max}+(#HDD*5)]

Table 5: Final Energy Star V. 5.0 categories for Desktops and Notebooks (Energy Star 2008)

	Category			
	A	**B**	**C**	**D**
Desktops				
- Physical cores	<2	2	>2	≥4
- System memory	< 2GB	≥ 2GB	≥ 2GB and/or discrete GPU	≥ 2GB and/or discrete GPU with Frame Buffer Width > 128-bit
Notebooks				
- Physical cores			>2	
-System memory	Not meeting definition of B or C	Discrete GPU	>2GB and discrete GPU with a Frame Buffer Width > 128-bit	n/a

Table 6: Final Energy Star V 5.0: Operational Mode Weighting – Desktops and Notebooks (Energy Star 2008)

	Desktop		**Laptop**	
	Conventional	Proxying (a)	Conventional	Proxying (a)
T_{off}	55%	40%	60%	45%
T_{sleep}	5%	30%	10%	30%
T_{idle}	40%	30%	30%	25%

(a) Proxying refers to a computer than maintains Full Network Connectivity as defined by Energy Star.

Energy Star for Other Products

The principles are similar for other products:

> Imaging: Energy Star 5 for imaging equipment also uses a Total Energy Consumption (TEC) approach which varies by category of device (printers, MFDs etc) and also by printing speed (images per minute) and colour (Energy Star 2008b).
>
> Displays: Energy Star for displays requires a maximum On Mode power consumption, power management requirements and Automatic Brightness Control as a default.

The products which meet the criteria are listed in a database on the energy star website.

A2 ECMA Eco-Declaration

The European Computer Manufacturers Association (ECMA) – which includes many suppliers from Asia and North America who manufacture in Europe – has developed ECMA-370. This is intended to be a global scheme, but is focusing on EU implementation in the first instance. The scheme specifies environmental attributes and measurement methods for ICT and CE products according to known regulations, standards, guidelines and currently accepted practices. It can be applied to finished products, or subassemblies, components, accessories and/or optional parts. It addresses company programs and product related attributes, not the manufacturing processes and logistic aspects. Supplier compliance is monitored by a mandatory third party verification. The 3rd edition of ECMA was released in December 2008 (ECMA website). The ECMA-370 scheme is still in its early stages and it is difficult to find lists of models that have

been certified as compliant, or examples of organisations which are using it in procurement. However, this is likely to change with time.

A3 EPEAT

The Electronic Product Environmental Assessment Tool (EPEAT) was originally developed by over 120 stakeholders convened with support from the US Environmental Protection Agency, through a consensus process managed by a non-profit group, the Zero Waste Alliance. The EPEAT standard is formalized as Standard 1680 of the Institute of Electrical and Electronic Engineers (IEEE), and the system is managed by a non-profit organization, the Green Electronics Council (2008). It is used to assess laptop and desktop computers, and monitors, in terms of 51 performance criteria (23 required, and 28 optional), which cover environmental design, manufacture, end-of-life management and corporate performance (see Table 9). IEEE/EPEAT standards for imaging equipment and televisions are currently under development, with UK government staff involved as stakeholder participants. Standards development is also planned for servers and mobile devices in upcoming years (O'Brien, Personal Communication 2009).

EPEAT has three tiers of environmental performance – Bronze, Silver and Gold – which are determined by the number of optional credits achieved above the 2 required performance criteria. Manufacturer's self-certify, but these are subject to spot checks by the Green Electronics Council. As with Energy Star the criteria are periodically refreshed to drive continuous improvement. Originally the criteria were based on the IEEE 1680 Standard (IEEE website); in future, the 1680 criteria which address the management of the product registry will serve as an 'umbrella' standard for all products, with additional IEEE standards for different products. Through active engagement with international stakeholders, currently including government representatives from the UK and China, as well as international manufacturer and advocate representation, the aim is to align the standards with the global market to enable its use worldwide (O'Brien, Personal Communication 2009).

As EPEAT was a requirement of US Government contracts it quickly became a market standard. In mid-June 2009 there were 145 desktops and 484 notebooks listed in the EPEAT scheme, from 30 manufacturers. Of these, 97 desktops, and 188 laptops, were gold rated, reaching the highest standard. According to the Green Electronics Council, EPEAT-qualified products accounted for about 22% of worldwide notebook and desktop sales in 2007, up from 10% of all units in 2006 when the first EPEAT-rate products began hitting the market (US Green Electronics Council 2008).

Organisations currently using EPEAT include the US Federal Government (~ $60B in EPEAT purchasing); the Canadian Federal Government; dozens of US cities, states and provinces and a number of private sector firms (O'Brien 2008). The UK offices of the Lehman Brothers financial services firm specified a minimum EPEAT silver rating for its computer purchases of 7,764 desktops and 14,532 monitors in 2007, and estimated that this would save over 11,000 MWh of energy and £1.14 million in costs – and also that, if all purchases were of EPEAT gold products, this would increase to over 13,000 MWh of energy and over £1.3 million in costs (O'Brien 2008). (Whole life cost savings and environmental benefits can be estimated through a lifecycle environmental benefits calculator).

Although EPEAT-compliant products are available in the UK, there are clauses in the EU Public Procurement Law which may cause problems for public sector organisations wishing to specify it – in that they strictly limit the use of company performance standards in product specifications. Discussions currently underway as part of the IEEE standards development processes will address how the criteria might be adjusted to ensure the standard is acceptable for the EU market and aligned with the Energy

Using Products (EuP) Directive (Redding 2009). However, this will not involve a regional variant – EPEAT organisers are determined that there will always be a single standard.

In summer 2009 the EPEAT registry will be expanded to explicitly apply to 40 countries - including all EU and EFTA countries, Japan, China, Taiwan, Brazil, Mexico, Australia and New Zealand, as well as the US and Canada (O'Brien 2009). This expansion will make it easier to identify products by geographic region, since all products will be registered on a country-specific basis, using local model numbers and names as used by the companies in their own marketing. More importantly, the expansion will enhance the opportunity for smaller regional businesses to register their products in EPEAT and know that they will appear based on the geographic region where they are sold. This is expected to bring additional producers into the system, including smaller UK and EU-based manufacturers. In addition, many of the large global firms will be registering products specifically in EU countries (ibid).

Table 7: Selected EPEAT gold desktop and notebook models which are sold in the UK (EPEAT website)

Desktop EPEAT gold model examples	Notebook EPEAT gold model examples
DELL OptiPlex 740 Energy Smart MT	DELL Latitude D630
HP Compaq dc7800 Ultra-slim Desktop PC	HP Compaq 2710p Notebook PC
Apple Mac Pro, Two 2.8GHz Quad-Core Xeon processor	Apple 15-inch MacBook Pro, 2.4GHz (MB470LL)
Lenovo ThinkCentre M57 Desktop	Toshiba Portege R500 - PPR50U

A4 Comparison of ECMA and EPEAT

A key issue for these two schemes is the extent to which they reflect the true life cycle impacts of a PC. For example while EPEAT has credits for eliminating toxic substances such as lead, mercury and cadmium there are few credits for reducing pollution during the production stage – possibly because most of these occur in the materials extraction phase which computer manufacturers have little control over. There are also a number of credits in EPEAT which play a relatively minor part in the overall life cycle impacts of a computer but which perhaps have a large "feel good" factor, such as the emphasis on packaging. Many of the benefits associated with EPEAT also derive from other standards such as Energy Star or the Reduction of Hazardous Substances (RoHS) Directive – which is a legal standard for computers sold in the EU (although not in the US). There are also no energy conservation credits in EPEAT relating to energy use during manufacture. Many of the EPEAT standards relating to design for end of life will also be driven in the EU by the WEEE Directive.

The ECMA-370 credits are more comprehensive with 71 credits of which 53 are mandatory (ECMA 2007). As with EPEAT energy consumption only covers energy in use, though there are more credits for material and substance content and the list of restricted hazardous substances is wider.

Table 8: Pros and Cons of EPEAT, ECMA-370 and Energy Star eco-labels (based on ERM 2008).

Pros and Cons	**EPEAT**	**ECMA-370**	**Energy Star**
Robustness and credibility	Incorporates Energy Star. Self-declaration, with spot checks.	Unclear how many organisations have implemented standard. Implementation controlled via third party	Follows principles of due process, openness and consensus. Verification?
Coverage of life cycle environmental issues	Somewhat limited	Greater coverage though not comprehensive	Very limited - Energy in use only
Availability of information	Accessible	Less accessible	Accessible
Potential benefits	Reduction in energy bills, PR benefits and health and wellbeing benefits	Continuity across the globe. Covers majority of priority areas of spend.	Reduction in energy bills. Benefits easily measured using tool on the web
Ease of use	Fairly difficult to review as full criteria must be purchased. Standard mildly complicated.	Fairly complicated and prescriptive. Difficult to monitor consistency with each organisation using its own 3rd party accreditation	Extremely easy for consumers to access.
Applicability to the UK	Limited to main suppliers because US scheme – may exclude a number of EU suppliers	Greater coverage because EU scheme	Very applicable

Table 9: EPEAT criteria (paraphrased) for desktop personal computers, notebook personal computers and personal computer monitors (US Green Electronics Council, undated)

Category	Criteria	Criteria
	Required	**Optional**
4.1 Reduction/elimination of environmentally sensitive materials	4.1.1.1 Compliance with provisions of EU RoHS Directive	4.1.2.1 Elimination of intentionally added cadmium
	4.1.3.1 Reporting on amount of mercury used in light sources	4.1.3.2 Low threshold for amount of mercury used in light sources
		4.1.3.3 Elimination of intentionally added mercury in light sources
		4.1.4.1 Elimination of intentionally added lead in certain applications
		4.1.5 Elimination of intentionally added hexavalent chromium
	4.1.6.1 Elimination of intentionally added Short Chain Chlorinated Paraffin flame retardants and plasticizers in certain applications	4.1.6.2 Large plastic parts free of certain flame retardants classified under EU Directive 67/548/EEC
		4.1.7.1 Batteries free of lead, cadmium and mercury
		4.1.8 Polyvinyl chloride and chlorinated plastics
4.2 Materials Selection	4.2.1.1 Declaration of postconsumer recycled plastic content	4.2.1.2 Minimum content of postconsumer recycled plastic
		4.2.1.2 higher content of postconsumer recycled plastic
	4.2.2.1 Declaration of renewable/biobased plastic material content	4.2.2.2 Minimum content of renewable/biobased plastic material
	4.2.3.1 Declaration of product weight	
4.3 Design for end of life	4.3.1.1 Identification of materials with special handling needs	4.3.1.6 Reduced number of plastic material types
	4.3.1.2 Elimination of paints of coatings that are not compatible with recycling or reuse	4.3.1.7 Molded/glued in metal eliminated or removable

	4.3.1.3 Easy disassembly of external enclosure	4.3.1.8 Minimum 65% reusable/recyclable
	4.3.1.4 Marking of plastic components	4.3.1.9 Minimum 90% reusable/recyclable
	4.3.1.5 Identification and removal of components containing hazardous materials	
		4.3.2.1 Manual separation of plastics
		4.3.2.2 Marking of plastics
4.4. Product longevity/life cycle extension	4.4.1.1 Availability of additional 3 year warranty or service agreement	
	4.4.2.1 Upgradeable with common tools	4.4.2.2 Modular design
		4.4.3.1 Availability of replacement parts
4.5 Energy conservation	4.5.1.1 Energy Star	4.5.1.2 Early adoption of new Energy Star specification
		4.5.2.1 Renewable energy accessory available
		4.5.2.2 Renewable energy accessory standard
4.6 End of life management	4.6.1 Provision of product take back service	4.6.1.2 Auditing of recycling services
	4.6.2.1 Provision of a rechargeable battery take back service	
4.7 Corporate performance	4.7.1.1 Demonstration of corporate environmental policy consistent with ISO 14001	
	4.7.2.1 Self certified environmental management system for design and manufacturing facilities	4.7.2.2 Third party certified environmental management system for design and manufacturing facilities
	4.7.3.1 Corporate report consistent with Performance Track or Global Reporting Initiative	4.7.3.2 Corporate report based on Global Reporting Initiative
4.8 Packaging	4.8.1.1 Reduction/elimination of intentionally added toxics in packaging	
	4.8.2.1 Separable packing materials	4.8.2.2 Packaging 90% recyclable and plastics labelled
	4.8.3.1 Declaration of recycled content	4.8.3.2 Minimum postconsumer content guidelines
		4.8.4.1 provision of take back program for packaging
		4.8.5.1 documentation of reusable packaging

References

British Standards Institute, 2008. Publically Available Specification (PAS) 2050. [Online] Available at: http://www.bsi-global.com/en/Standards-and-Publications/How-we-can-help-you/Professional-Standards-Service/PAS-2050/ [Accessed 26 August 2009].

Cabinet Office, 2008. Greening Government ICT. The Strategy. [Online] Available at: http://www.cabinetoffice.gov.uk/cio/greening_government_ict.aspx [Accessed 30 July 2009].

Centre for Remanufacturing and Reuse (CRR) website. Available at: http://www.remanufacturing.org.uk/reuse-repair-recycle.lasso[accessed 18 September 2009].

Climate Group, 2008. *Smart 2020 – Enabling the Low Carbon Economy in the Information Age*. Global eSustainability Initiative. www.theclimategroup.org/assets/resources/publications/Smart2020Report.pdf [Accessed 1 August 2009].

Cowburn, C., 2009. Personal Communication between Chris Cowburn, HEFCW and Lisa Hopkinson, 26 August 2009.

Department for Environment, Food & Rural Affairs (Defra), 2009. Buy Sustainable – Quick Wins. [Online] Available at: http://www.defra.gov.uk/sustainable/government/what/priority/consumption-production/quickWins/index.htm [Accessed 10 June 2009].

Department for Environment, Food & Rural Affairs (Defra), 2007. UK Government Sustainable Procurement Action Plan. Incorporating the Government response to the report of the Sustainable Procurement Task Force [Online] Available at: http://www.defra.gov.uk/corporate/finance/procurement/policy.htm [Accessed 25 August 2009].

ECMA, 2007. Environmental criteria comparison between TED – The Eco Declaration, ECMA-370 for Personal Computers and TCO, Blue Angel, EU Flower, Nordic Swan, US EPEAT. Version 1. 2007 [Online] Available at: http://www.hp.com/hpinfo/globalcitizenship/environment/pdf/iteco_comp_pcs.pdf [Accessed 14 October 2008].

ECMA website. [Online] Available at: http://www.ecma-international.org/publications/standards/Ecma-370.htm [Accessed 16 June 2009].

EPEAT website. [Online] Available at: http://www.epeat.net/ [Accessed: 12 June 2009].

ERM, 2008. Mapping and analysis of sustainable product standards. Final report for Defra. March 2008. [Online] Available at: http://www.defra.gov.uk/environment/consumerprod/pdf/MTP-ProductAssessmentStandards.pdf [Accessed 3 October 2008].

EU Energy Star website. Available at: http://www.eu-energystar.org/en/ [Accessed 12 June 2009].

EU Energy Star 2009a. EU-Energy Star Website, Development of Specifications webpage. [Online] Available at: http://www.eu-energystar.org/en/253.shtml#general [Accessed 30 June 2009].

EU Energy Star 2009b. Energy Star Program Requirements for Computer Servers. Final Draft. April 2009. [Online] Available at: http://www.eu-energystar.org/en/253.shtml#Servers [Accessed 30 June 2009].

EU Energy Star 2009c. Energy Star Program Requirements for Displays. March 2009. [Online] Available at: http://www.eu-energystar.org/en/253.shtml#displays [Accessed 30 June 2009].

EU Energy Star 2008a. Energy Star Program Requirements for Computers. Version 5.0. November 2008. [Online] Available at: http://www.eu-energystar.org/en/253.shtml#computers [Accessed 30 June 2009].

EU Energy Star 2008b. Energy Star Program Requirements for Imaging Equipment. Version 1.1. October 2008. [Online] Available at: http://www.eu-energystar.org/en/253.shtml#imagingequipment [Accessed 30 June 2009].

Gartner Consulting 2007. http://www.gartner.com/it/page.jsp?id=503867

HEFCE 2009b. Consultation on carbon reduction target and strategy for higher education in England. July 2009. [Online] Available at: http://www.hefce.ac.uk/pubs/hefce/2009/09_27/ [Accessed 30 July 2009].

HEFCE 2009a. Updated Strategic Statement and Sustainable Development Action Plan. February 2009. [Online] Available at: http://www.hefce.ac.uk/pubs/hefce/2009/09_03/09_03.doc [Accessed 12 June 2009].

IEEE website. [Online] available at: http://www.ieee.org/portal/site [Accessed 9 July 2009].

IVF Industrial Research and Development Corporation, 2007. Lot 3: Personal Computers (desktops and laptops) and Computer Monitors. Final Report (Task 1-8). Preparatory studies for Eco-design Requirements of EuPs. Report for the European Commission, August 2007. [Online] Available at: http://extra.ivf.se/ecocomputer/downloads/Eup%20Lot%203%20Final%20Report%20070913%20published.pdf [Accessed 15 May 2008].

Market Transformation Programme (MTP), 2008. *Policy Analysis and Projections 2006/08*. [Online]. Available at: http://www.mtprog.com/ReferenceLibrary/10_07_08%20PA&P%2008%20v1.pdf [Accessed 30 November 2008].

National Audit Office (NAO), 2006. Improving procurement in further education colleges in England. Report by the Comptroller and Auditor General | HC 1632 Session 2005-2006 | 25 October 2006. [Online]. Available at: http://www.nao.org.uk/publications/nao_reports/05-06/05061632.pdf [Accessed 23 June 2008].

O'Brien S, 2009. Personal Communication between Sarah O'Brien, EPEAT Outreach and Communications Manager and Lisa Hopkinson, 6 August 2009.

Office of Government Commerce (OGC), 2008. Buy Green and Make a Difference. Pamphlet on how to address environmental issues in public procurement. [Online] Available at: http://www.ogc.gov.uk/news_2008_8474.asp [Accessed 25 August 2009].

Procurement Scotland website. Available at: http://www.scotland.gov.uk/Topics/Government/Procurement/npcoe [Accessed 18 September 2009].

Redding S, 2009. Greening Government ICT and EPEAT – an overview. Presentation at event on Sustainable ICT Procurement, Nottingham Trent University, 2 July 2009. [Online] Available at: www.susteit.org.uk [Accessed 8 July 2009].

Sustainable Procurement Task Force, 2006. Procuring the Future. Sustainable Procurement National Action Plan: Recommendations from the Sustainable Procurement Task Force [Online] Available at: http://www.defra.gov.uk/sustainable/government/publications/procurement-action-plan/ [Accessed 12 June 2009].

Toplass S, and Briggs M, 2009. Sustainable Procurement HUB enabling 'green' IT. Presentation at event on Sustainable ICT Procurement, Nottingham Trent University, 2 July 2009. [Online] Available at: www.susteit.org.uk [Accessed 8 July 2009].

US Green Electronics Council, 2008. Environmental Benefits of 2007 EPEAT Purchasing. May 2008. [Online] Available at: http://www.epeat.net/Docs/EnvironmentalBenefits2007.pdf [Accessed: 29 October 2008].

US Green Electronics Council, undated. EPEAT criteria [Online] Available at: http://www.greenelectronicscouncil.org/epeat/criteria.htm [Accessed 3 October 2008].

Williams K, 2009. Buy Sustainable Quick Wins and Sustainable ICT Procurement. Presentation at event on Sustainable ICT Procurement, Nottingham Trent University, 2 July 2009. [Online] Available at: www.susteit.org.uk [Accessed 8 July 2009].