CTO COUNCIL Green ICT Working Group

Areas for Potential Carbon Reduction

Exteded List of Action 28/10/2008

CTO Council

This is the extended version of the Potential Areas for Carbon Reduction from Appendix B of the Greening Government ICT Strategy: Efficient, Sustainable, Responsible.

This list of initiatives to be implemented within government departments to reduce the impact of their ICT has been created by The Green ICT working group of the CTO Council, with input from many government departments and industry partners. The actions have been distilled from research, case studies and accepted industry best practice. Whilst ICT can assist in reducing impact, at this stage this document focuses on the direct impact of ICT and the way that we implement it.

This is a living document; and will be adapted and any gaps filled as further input is received and as further innovation, products and research becomes available.

We would like to thank you in advance for your personal and Departmental efforts as we begin what we hope will be a significant ICT leadership journey for the UK.

PCs and Laptops

Actions	Rationale	Possible Implementation Methods
Remove active screensavers	A monitor left running with an active screen saver uses the same amount of energy as when the screen is in full use. The PC may also be consuming needless power in sustaining the saver	Communications programme Disable screensaver functionality
Switch monitors to low power mode after 5 minutes of inactivity (no active screensaver)	Prevents a longer period of wasted power May be possible to use the PC standby trigger to automatically switch the monitor to standby at the same time.	Communications programme Centrally set monitor standby and disable individual controls
Shut down PCs after office hours	For the default working day of 8 hours the overnight period lasts 16 hours, so could be wasting up to twice as much energy as consumed during the working day	Put stickers on PCs: Not standby- OFF Please. Communications programme: switch off campaign Shut down PCs remotely after office hours Deploy power management software
Enable active power management on desktops (lop power mode after a defined period of inactivity	Having active power management enabled will more closely match the consumption of energy with use, reducing wasted energy There are products that will enable active power management for all networked devices that have such power management facilities	Communications programme Centrally set standby/hibernation and disable individual controls Deploy power management software
Ensure reduce and re-use of equipment that is no longer required but is still serviceable	Some sources claim that majority of energy in the life of a PC or laptop is consumed in its manufacture, delivery and disposal. By ensuring equipment which is still servicable is re-used you are therefore saving energy which would have been required to dispose of the old product and manufacture a new one.	Mandate parts-based accredited audit trail whether for re-use, resale or recycle Recommend EMAS or ISO 14000 certification to all disposal agents Consider 3rd sector or charitable donation Ensure that suppliers provide breakdown of landfill avoidance Especially with older equipment ensure that reuse is going consume less energy of the lifecycle than manufacture/recycling//disposal Ensure necessary security procedures are carried out prior to re-use/recycling or disposal

If re-use is not possible ensure recycle and disposal is green	PCs and Laptops contain various components, some of which can be recycled, some which can't and some which may be toxic. By recycling where possible and ensuring green disposal if not then the end-of-life environmental impact can be minimised.	Mandate parts-based accredited audit trail whether for recycle or disposal Recommend EMAS or ISO 14000 certification to all disposal agents Ensure suppliers provide breakdown of landfill avoidance Ensure necessary security procedures are carried out prior to re-use/recycling or disposal
Specify low-power consumption CPUs and high-efficiency Power Supply Units (80% conversion or better)	Do not over specify system requirements. The richer the functionality on a device the more mains power is drawn – a high powered machine suitable for high graphic gaming is not needed in a central government office. Power supply units convert mains AC power to the DC power needed by computers. More efficient units minimise the loss of energy from this conversion in the form of heat.	Ensure that power consumption and power supply efficiency are considered during procurment.
Apply Thin Client technology	A Thin client is less complex than a PC and contains fewer components, increasing its life over that of a normal PC and reducing maintenance and support costs and thus energy consumption. However additional energy is required to support the greater bandwidth necessary for connection to its server as well as to run the server and its supporting air-conditioning equipment. Implementation of thin client technology should be balanced against potential increases in server usage.	
Replace CRT Screens with LCD	LCD monitors use on average 50 to 70% less energy in on-mode than conventional CRT (Cathode Ray Tube) monitors. Size of monitor should also be consider as large screen require more power.	Consider this both as part of the refresh cycle and outside it
Apply timer switches to non-networked technology	Not all ICT equipment can be networked and/or automatically shut down or put into standby mode – particularly legacy computers aren't networked. Neither do all such devices have automatic facilities to switch to a standby mode after a re-set time. Timer switches can be used to turn off such equipment automatically outside office hours saving up to 2/3rds of its daily energy consumption if currently left on 24hours a day.	

Device consolidation	Reducing the number of electronic devices an individual has will reduce in-direct energy requirements e.g. less support and maintenance. Move from using PC and laptop, to a laptop with docking station(s), or use a desktop device (Thin Client) and Remote access services on a home or other non-work device connected to the internet to access email.	Consider this both as part of the refresh cycle and outside it
Only buy for the specification you now need	Higher specification systems often means higher power requirements	Purchase only the hardware specification that is required within the next 24 months, if you need more capacity later, migrate the service.
Minimise the full life-cycle energy and material usage	Energy requirements for different systems can vary widely therefore green accreditation can help identify more energy efficient devices Energy and materials required in the manufacture of the products can vary widely so full life-cycle should be considered	Ensure that the use of non-recyclable components (e.g. PVC) is minimised Ensure that equipment does not contain composite plastic components Ensure that equipment is designed to allow re-use of individual components
Extend refresh cycle where appropriate	Energy is required to manufacture, deliver and dispose of PCs and laptops. By extending the refresh cycle over time you will reduce the number of devices required and energy required.S	Extend the lifecycle of all ICT purchases to their natural demise either caused by failure, inability to support the business objectives of the organisation, excessive maintenance costs or excessive carbon footprint and energy consumption, as opposed to frequent automatic refresh and replacement programmes

General Office

Actions	Rationale	Possible Implementation Methods
Apply timer switches to non-networked technology and printers	Some ICT equipment can be networked and/or automatically shut down or put into standby mode – some fax machines, printers and even legacy computers aren't networked. Neither do all such devices have automatic facilities to switch to a standby mode after a re-set time. Timer switches can be used to turn off such equipment automatically outside office hours saving up to 2/3rds of its daily energy consumption if currently left on 24hours a day.	
Set default green printing including duplex and grey scale	By reducing the amount you print you will save paper and energy. Further savings can be made by presetting duplex, booklet and greyscale defaults and using a "Print on collect" facility if provided.	Set duplex printing as default mode Set greyscale as default mode Set booklet printing as default At end of life, replace non-duplex with duplex printers Consider the use of printout optimisation technology (e.g. PrintGreener) Use soft printing to PDF format Install card or code-based print job activation
Optimise power-saving sleep mode on printers	Printers are only active for 263 hours/yr or 12 calendar days; so if on permanently they waste energy 97% of the time. If power saving is already in place - reduce the amount of time before sleep activated.	Enable power-saving sleep mode on printers Put printers on timed power supply (automatically turn off power with manual override for out-of-hours use)
Printer consolidation	Reducing the number of printers and replacing those left with networked multi-function devices (MFDs) e.g. combined printers/copiers, can significantly reduce energy consumption. Fewer printers may also lower maintenance and management costs.	Replace individual printers, copiers, fax machines, scanners with shared multi-function devices Ensure they are capable of duplex printing and have power saving sleep mode

Device consolidation	Reducing the number of electronic devices an individual has will reduce in-direct energy requirements e.g. less support and maintenance. Rather than a mobile phone and a PDA (e.g. Blackberry), use a single integrated device and “follow-me“ services	Applying "follow-me" services allows a single contact number working on an office phone when at a desk and a mobile device when out and about. Look at having a single combined mobile and PDA device rather than individual devices.
Consider VoIP as a replacement for desk-top phones	There is potential to reduce energy requirements by combining voice and data networks	Consider using a headset with computers rather than separate telephones to potentially reduce energy requirements further
Managed shutdown of VOIP ports outside of office hours	For the default working day of 8 hours the overnight period lasts 16 hours, so could be wasting up to twice as much energy as consumed during the working day	
Consolidate video conferencing equipment with desktop devices	Rather than having separate video conferencing equipment consolidating it into desktop devices may reduce energy consumption	
Minimise energy requirements of mobile phones	As mobile phones become more advanced energy requirements are increasing	Do not over specify phones - consider what functions are required Continue to lobby manufaturers for chargers that have zero power draw when not in use and until avaliable specifuy those with low power draw Adopt local renewable charging (e.g. portable solar panel) to charge mobile devices Ensure selected devices have optimal energy efficiency Consider if a new handset is needed or if the old one can be reused
Review and reduce energy consumption of PBX equipment		
Consolidate voice network to minimum required	Minimising the size of the network will reduce the energy requirements	
Consolidate WAN network to minimum required	Minimising the size of the network will reduce the energy requirements	

Use logical (VLAN) rather than physical network isolation		
Only buy for the specification you now need	Higher specification systems often means higher power requirements	Purchase only the hardware specification that is required within the next 24 months, if you need more capacity later, migrate the service.
Ensure reduce and re-use of equipment that is no longer required but is still serviceable	As well as in-use energy is consumed in its manufacture, delivery and disposal. By ensuring equipment which is still serviceable is re-used you are therefore saving energy which would have been required to dispose of the old product and manufacture a new one.	Mandate parts-based accredited audit trail whether for re-use, resale or recycle Recommend EMAS or ISO 14000 certification to all disposal agents Consider 3rd sector or charitable donation Ensure that suppliers provide breakdown of landfill avoidance Especially with older equipment ensure that reuse is going consume less energy of the lifecycle than manufacture/recycling/disposal Ensure necessary security procedures are carried out prior to re-use
If re-use is not possible ensure recycle and disposal is green	Electrical equipment contains various components, some of which can be recycled, some which can't and some which may be toxic. By recycling where possible and ensuring green disposal if not then the end-of-life environmental impact can be minimised.	Mandate parts-based accredited audit trail whether for recycle or disposal Recommend EMAS or ISO 14000 certification to all disposal agents Ensure suppliers provide breakdown of landfill avoidance Ensure necessary security procedures are carried out prior to recycling or disposal
Minimise the full life-cycle energy and material usage	Energy requirements for different systems can vary widely therefore green accreditation can help identify more energy efficient devices Energy and materials required in the manufacture of the products vary widely so full life-cycle should be considered	Look for green accreditation when purchasing new equipment Ensure that the use of non-recyclable components (e.g. PVC) is minimised Ensure that equipment does not contain composite plastic components Ensure that equipment is designed to allow re-use of individual components

Extend refresh cycle where appropriate	Energy is required to manufacture, deliver and dispose of all electrical equipment. By extending the refresh cycle over time you will reduce the number of devices required and energy required.	Extend the lifecycle of all ICT purchases to their natural demise either caused by failure, inability to support the business objectives of the organisation, excessive maintenance costs or excessive carbon footprint and energy consumption, as opposed to frequent automatic refresh and replacement programmes

Data Centres

Actions	Rationale	Possible Implementation Methods
Much of the information in this section of the document builds on the EU Code of Conduct on Data Centres, due for publication in November 2008		
Server Optimisation a. Implement storage virtualisation & capacity management b. Convert existing physical servers to “virtual servers” – partition servers that run in parallel on the same hardware without any interference (e.g. VMware, Xen) c. Turn off servers outside their service level agreement, subject to a phase loading and chiller unit risk assessment (e.g. Cassatt, VMware) d. When designing & provisioning new services, create “virtual servers” instead of procuring physical new servers. d. Implement a multi tiered storage solution, much of the data spinning on disks today is seldom accessed	Assists in identifying unused servers and disks Air-conditioning/cooling equipment typically requires at least the same power as the servers they cool, so reducing servers may save twice the power required to run them Industry practice has been to run a server using only 20% of its capacity A server which is switched on but idle still requires 50-70% of the power it uses when it is running under maximum load, therefore a single server running at 80% load uses considerably less energy than 4 servers each running at 20% load Configure several ‘virtual’ servers onto a single server to increase capacity used. Using a single device in this way not only reduces the hardware and support costs but also decreases the energy requirement	

Identify servers and data disks in the data centre that are running but not providing any services and decommission	A server which is switched on but idle still uses 50-70% of the power used when running at maximum load.	
Specify low-power consumption servers with high-efficiency Power Supply Units (80% conversion or better) e.g. Energy star 1.0 Tier 1	Do not over specify system requirements The higher the specification the more mains power is drawn Power Supply Units convert mains AC power to the DC power needed by computers. More efficient units minimise the loss of energy from this conversion in the form of heat	
Consider Blade technology	Research shows that blade servers, networking, storage etc. may require less power than previous generations of rack servers and may require less heat so require less cooling.	Review whether the target data centre environment was designed for and is suitable to cope with high power density systems prior to purchase, reducing physical size will not address power or cooling capacity issues Ensure appropriate expertise is sought.
Power down internal disks after a defined period of inactivity or use MAID array systems.	Powering down after specific periods of inactivity will more closely match the consumption of energy with use, reducing wasted energy	When selecting storage hardware evaluate the energy efficiency in terms of the performance or storage volume delivered per Watt between options. Evaluate both the in use power draw and the peak power of the storage device as both impact per device cost and energy consumption through provisioning.
Only buy for the specification you now need	Higher specification systems often means higher power requirements	Purchase only the hardware specification that is required within the next 24 months, if you need more capacity later, migrate the service.
Carry out a data centre audit	Identifies mismatches between the current physical layout and the layout that would maximise the effectiveness of cooling from air conditioning units Up to a 20% reduction in cooling could be achieved	Improve airflow by creating physically separated cold-air / hot-air aisles (chilled air passes through equipment from cold aisle to hot aisle). Note that blanking plates and floor seals should be fitted first. Identify high power equipment and group these together to allow for controlled cooling

Fit blanking plates and seals	Installation of blanking plates where there is no equipment to reduce cold air passing through gaps in the rack. This also reduces air heated by one device being ingested by another device, increasing intake temperature and reducing efficiency.	If equipment has been removed from a hot/cold aisle environment, gaps may have been left that allow hot air enter the cold aisle. This can be rectified with blanking plates.
Reduce cooling in the data centre to appropriate levels and increase the ambient room temperature	Research has shown that increasing temperatures in data centres does not lead to a higher failure rate as was previously thought. Over 50% of the power associated with the data centre is used for cooling the ICT equipment.	Agter blanking plates and seals have een fitted, review and if practical increase the working humidity range of the data floor within the updated ASHRAE Recommended range for Class 1 Data Centers, 18-27C and 5.5C dew point up to 15C dew point & 60% RH, as approved by ASHRAE TC 9.9 at the Salt Lake City summer meeting, June 23rd, 2008. to decrease the humidity control loads within the facility
Install variable speed fans and link speed of movement to actual heat conditions in the data centre (to reduce cooling in off-peak periods)	The power load on the machines varies throughout the day therefore the amount of heat produced also varies. Most data centres are set to provide cooling for maximum load - therefore additional unnecessary cooling is often provided.	
Evaluate the use of Fresh Air or econimised cooling as the preferred cooling technology for the facility where physical constraints permit	Rather than using air conditioning the temperature of the air outside may be such that this are could be used.	
Evaluate water cooling (instead of air cooling) systems	As the thermal conductivity of water is approximately 25 times that of air allowing a much faster transfer of heat and therefore less energy may be required to cool the data centre.	
Provision power and cooling (M&E) in a modular fashion, only commissioning the sections of data centre with equipment fitted	Cooling the whole data centre unnecessarily causes energy to be wasted	Optimise the facility for the partial load it will experience for most of operational time rather than max load. e.g. sequence chillers, operate cooling towers with shared load for increased heat exchange area

Minimise the full life-cycle energy and material usage	Energy requirements for different systems can vary widely therefore green accreditation can help identify more energy efficient devices Energy and materials required in the manufacture of the products vary widely so full life-cycle should be considered	Look for green accreditation when purchasing new equipment Ensure that the use of non-recyclable components (e.g. PVC) is minimised Ensure that equipment does not contain composite plastic components Ensure that equipment is designed to allow re-use of individual components
Reduce and re-use equipment that is no longer required but is still serviceable	As well as in-use energy is consumed in its manufacture, delivery and disposal	Mandate parts-based accredited audit trail whether for re-use, resale or recycle Recommend EMAS or ISO 14000 certification to all disposal agents Consider 3rd sector or charitable donation where appropriate Ensure that suppliers provide breakdown of landfill avoidance Especially with older equipment ensure that reuse is going consume less energy of the lifecycle than manufacture/recycling//disposal
If re-use is not possible ensure recycle and disposal is green		Mandate parts-based accredited audit trail whether for recycle or disposal Recommend EMAS or ISO 14000 certification to all disposal agents Ensure suppliers provide breakdown of landfill avoidance
Extend tech refresh cycle where appropriate	As well as in-use energy is consumed in its manufacture, delivery and disposal	
Ensure that equipment can be serviced (e.g. disks, RAM)	servicing and assessing equipment rather than replacing it could minimise energy consumption through manufacture and disposal.	
Remove un-necessary or duplicated data/information	The more data stored the more equipment and therefore power is required	