Cabinet Office

Greening Government ICT

Efficient, Sustainable, Responsible

Making government work better

Why are we 'greening' Government ICT?

Government runs some of the world's largest computer systems. They are an essential element in the delivery of public services, be it helping 6000 people into jobs every day, handling 7.5 million online car tax renewals or storing more than 400 million digital x-rays. Hundreds of thousands of public servants can use their desktop computers to work far more efficiently than we could have dreamed possible as recently as 20 years ago.

But this progress comes with a price. Information and Communication Technology (ICT) is a major user of energy and natural resources. The use and disposal of computers, servers and printers has to happen in a sustainable way and as Britain's largest purchaser of ICT it is up to us to set an example. We have to do our best to ensure that the very systems that improve the lives of millions of people do not also have a negative impact on the environment.

The Greening Government ICT strategy sets out the first steps we can take to reduce our carbon footprint. We are the first government in the world to look at our ICT in this way and we want to see changes taking place immediately. We want to see best green practice throughout government - computers switched off overnight, printers defaulting to duplex, data centres efficiently cooled. The good news is that we are not alone in aiming for these goals. There is already a great deal of activity in departments and within industry and we will be working with our suppliers to ensure that action is taken immediately.

There are many simple steps that can be taken right now to improve the situation. We need to make sure these things happen and happen quickly. By turning off just one computer overnight we can save 235kg of CO_2 in a year. Over the whole estate the potential is enormous – turning off every one of Whitehall's 500,000 computers at night would have the same effect as taking 40,000 cars off the road.

We want our technology to be efficient, we want it to be more sustainable and above all we want to be responsible in the way we use it. This strategy sets out the first steps we are taking to achieve these goals.

TOM WATSON

Minister for Transformational Government

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1 UK Government Position

Her Majesty's Government (HMG) is on a journey to achieve environmental sustainability across its estate. Two years ago as Chancellor, Gordon Brown led the bold shift in objectives required to reflect this in his speech to the UN:

> "Environmental sustainability is not an option – it is a necessity. …We have a compelling and ever more urgent duty of stewardship to take care of the natural environment and resources on which our economic activity and social fabric depends. So the new synthesis we need is that economic growth, social justice and environmental care advance best when they all advance together."
> Gordon Brown, April 2006

UK Government has set a target for the central government office estate to achieve carbon neutrality by 2012. The UK has an overarching target to reduce greenhouse gases by 26% or more by 2020 and by at least 60% by 2050. The current Sustainable Operations on the Government Estate (SOGE) targets were announced by the Prime Minister in 2006. They cover all central government departments and their executive agencies, including buildings and managed land. A summary can be found in Appendix A. In addition to the SOGE targets Government currently has the following sustainable operational commitments:

- departments to source at least 10% of electricity from renewables by 31 March 2008 (Government achieved 28.3%[1]);
- departments to source at least 15% of electricity from Combined Heat and Power (2010).

Government has already identified the need for stronger leadership and is creating a new Director General post of Chief Sustainability Officer (CSO). In addition, all permanent secretaries' objectives now include key performance indicators for achievements against SOGE targets[2].

[1] Sustainable Development in Government 2007, Sustainable Development Commission

[2] http://www.cabinetoffice.gov.uk/reports/~/media/assets/www.cabinetoffice.gov.uk/publications/reports/sustainable_development/govt_response_sdc_180308%20pdf.ashx

2 Green ICT Vision

Government recognises the critical importance of Information and Communication Technology (ICT) both as a large consumer of energy and primary resources and as an enabler for environmental and cultural change.

The Government's vision for ICT in central departments is:

- inline with the existing SOGE targets and SOGE definition for Carbon Neutrality, the energy consumption of Government ICT on the office estate will be Carbon Neutral by 2012. Work is ongoing with Defra to define Carbon Neutrality and how this can be delivered[3];

- by 2020 Government ICT will be carbon neutral across its lifecycle.

[3] These targets will be reviewed in light of the ongoing work in the definition of carbon neutrality. Government ICT refers to standard office ICT and data centres for central departments and their executive agencies

3 The ICT Contribution

Energy consumption on the government estate is not falling as much as had been expected[4], one certain contributor is ICT. ICT is already pervasive in government buildings and across industry via outsourced government contracts. Office equipment is the fastest growing energy user in the business world. The Carbon Trust estimates that it consumes 15% of the total electricity used in offices, expected to rise to 30% by 2020, with around two-thirds of the energy consumed by office equipment being attributed to computers[5].

However the Green ICT agenda is not just about energy efficient ICT, ICT can also be used to generate environmental benefits elsewhere in government operations and the UK. It is a key enabler for most Transformational Government programmes and it should play a major part in reducing carbon emissions from other areas of government activity, for example through enabling tele and video conferencing, remote and home working.

Coupled with the cultural change and more energy efficient working practices, the use of ICT can reduce both building occupancy and travel. This has knock-on benefits as government staff take these new behaviours and best practices home to their local communities. Government ICT can act as a powerful enabler for UK citizens and businesses to reduce their carbon emissions. But these changes are likely to require an increase in ICT investments, making it all the more important to ensure that the inherent carbon footprint of new ICT investments is significantly reduced.

[4] www.sd-commision.org.uk/publications/downloads/sdig_report_2007.pdf

[5] Carbon Trust, Technology Overview, Office Equipment – Introducing energy saving opportunities for business

At the ministerial eGovernment conference in Lisbon in 2007 the then Minister for Transformational Government stated.

> "We have a responsibility to set a positive example on the environment, so I am asking our IT leaders to work with industry to find new ways to improve the sustainability of government computer systems."
> Gillian Merron, September 2007

In light of this, The Government's Chief Information Officer (CIO) was asked to work with industry and draw up evidence-based proposals for improving the sustainability of Government ICT used both in-house and in out-sourced contracts with service providers.

This strategy covers Central Government Departments and their Executive Agencies.

4 Green ICT Strategic Objectives

- By January 2009 all departments are to address and consider the impact on carbon emissions of all new ICT purchases, building on existing mandatory "Quick Wins[6]" standards for certain aspects of sustainable ICT purchasing across government.
- The SOGE targets state that Central Government's office estate will be Carbon Neutral by 2012. This will be supported by Government ICT in lowering the power consumption of equipment used, including outsourced contracts and services . ICT will also support the wider sustainability agenda and the SOGE targets, for example reducing emissions through changes in business processes and working practices, minimising transport and reducing waste through minimising paper use.
- By 2020 Government aims to comply with and where possible lead and go beyond global best practice for sustainability across the whole ICT lifecycle. This will cover carbon neutrality and sustainable processes for use of materials, water, accommodation and transport, in the manufacture, use and disposal of ICT.
- Off-setting to be seen as a last resort and only through an accredited scheme in line with Department for Environment Food and Rural Affairs' (Defra's) code of best practice[7].

This will be delivered by:

- extending the Business/IT Strategy to include a green ICT plan that shows how the department will deliver the strategic objectives detailed above;
- implementing as many actions from 'Areas for ICT Carbon Reduction' (Appendix B) as are practicable and necessary to deliver the strategic objectives above and specifically:
    - **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. This should

[6] http://online.ogcbuyingsolutions.gov.uk/bcm/sustainablesolutions/quickwins/

[7] http://www.defra.gov.uk/environment/climatechange/uk/carbonoffset/codeofpractice.htm

occur where such extension will have environmental benefits across the product lifecycle and re-deployment of the equipments is not envisaged;

- reduce the overall **number of PCs and laptops** used by the organisation to reach as close to a 1:1 ratio as possible unless there are exceptional circumstances[8];
- implement a range of **active device power management** actions as detailed in Appendix B to significantly reduce power consumption;
- **reduce the overall number of printers** used by the organisation and replace with multi-function devices where security issues allow and use green printing defaults wherever possible (such as double-sided and multiple pages printing);
- **increase average server capacity** utilisation to achieve a minimum of 50% where possible, as part of a commitment to comply with the forthcoming European Code of Conduct for the operation of Data Centres;

- as well as continuing adherence to the "Quick Wins" criteria[9], 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;
- by December 2009 departments will demonstrate how ICT is helping reduce the carbon footprint across the whole department;
- by January 2010 departments will be ready to report on the progress made towards carbon neutrality;
- achieving these objectives will require close collaboration between departments, the ICT industry, Government CIOs and Government Chief Technology Officers (CTOs). The CIO of Defra has been asked to lead the development of this strategy and to oversee its implementation by the CIO Council.

[8] Exceptional circumstances to include Health and Safety concerns, formal on-call arrangements, business continuity arrangements, security requirements and accessibility or special needs circumstances such as caring duties

[9] http://online.ogcbuyingsolutions.gov.uk/bcm/sustainablesolutions/quickwins/

The approach is to:

- create awareness of the impact ICT has on Departmental carbon emissions amongst Government Ministers, Permanent Secretaries, other senior officials and the ICT industry. Increase staff awareness of the impact ICT can have and encourage them to think of different ways of working;
- work with departments and industry to research and identify more radical proposals to go beyond the easy changes, including the development of longer term low carbon solutions e.g. servers, data centres, more efficient hardware and software, and more sustainable energy supply arrangements;
- understand the resources required, costs of implementation and the issues which need to be addressed if more radical proposals are to be introduced;
- increase awareness of the importance of manufacture and design for ease of re-use and recycle at end of life. Specifically scarce resources, fragmentary mixed metals and toxic materials;
- task Finance Directors (FDs) to assure the environmental consequences of procurements are fully evaluated;
- ensure CIOs demonstrate Leadership, sign a sustainable ICT charter with industry providers (e.g., Ministry of Defence, Defence Equipment and Support (MOD DE&S) model available for adaptation), intercept current procurement exercises (e.g. tenders) to validate against their CIO Action Plans, review existing ICT contracts and amend where possible and report achievements back into the CIO Council via the Ministry of Defence (MOD) chaired Green ICT Delivery group.

5 Progress to date

A Green ICT Delivery group has been established by the CIO Council to increase awareness of best practice for improving green ICT and to provide support and advice to departments in its implementation.

A Green ICT Scorecard that benchmarks organisational behaviour, policy, governance, procurement, energy efficiency, labelling and disposals, in both internal and out-source structures is being piloted. This is one of a number of tools available for use, and a list of those available will be produced.

A CIO Green ICT SOGE map that shows where greening ICT can help meet SOGE targets has been developed.

A list of immediate steps has been developed to encourage the early implementation of some simple but high impact actions (Appendix B). Examples of areas where immediate savings can be made include:

- running a long life asset campaign to increase lifespan where appropriate;
- turning off PC's overnight, at weekends and during holiday periods;
- ensuring that all printers are either purchased with automatic duplexing functionality or default to duplex and grey scale to reduce the amount of maintenance and transport required and electricity, paper and toner used;
- removing active screen savers and utilising power management functionality to put monitors in low power modes after specified periods of inactivity to reduce energy consumption of the equipment;
- ensuring peripheral equipment is switched off overnight;
- putting PCs into low power modes after specified periods of inactivity;
- re-using or re-distributing legacy ICT and related goods to ensure assets are fully utilised for their whole life via a credible, traceable provider.

When developing the business case to support action plans departments should consider the funding and resource requirements and look for self-funding opportunities and other possibilities

including the Partnership for Renewables[10] and The Salix Fund[11]. Departments should also consider opportunities for sharing ICT services with other departments which may have the potential to increase energy savings.

Recognising that new lessons, practices and technologies will continue to appear, the CIO Council will evolve the toolkits and list of actions and provide repositories of best practice and evidence to ensure they continue to reflect current best practice.

Progress against this overall HMG action plan will be reported in the Transformational Government Annual Report and Departments will need to report progress against SOGE targets in the usual way.

This is a continuous programme of activity. Further work will:

- address more complex options in the light of more detailed research, including identifying the pros and cons of different approaches;
- identify Green ICT standards and measurement criteria for discussion and agreement with CIOs and the European Commission;
- embed Green best practices and environmental impact assessments into mainstream departmental and industry operational supply chains and reflect these in departmental procurement standards;
- encourage the use of ICT to help reduce energy consumption in other parts of the organisation e.g. reducing occupancy, minimising travel and ending the need to print documents;
- assess the environmental impact of delivery, support and project development of ICT services.

[10] http://www.carbontrust.co.uk/enterprises/enterprises/pfr.htm

[11] http://www.salixfinance.co.uk/home.html

6 Risks and mitigations

There are a number of risks which need to be considered to ensure the vision is met:

- people not taking the targets seriously – the CIO Council will ensure there is accountability within departments through independent reporting;
- the effort of measurement exceeding the value of what is being done – the CIO Council will work with relevant parties including industry provides to adopt and adapt suitable measurement metrics which can easily be implemented by departments, particularly addressing the challenges faced by smaller departments;
- the cultural change required not happening – the CIO Council will work with departments to ensure that staff embrace the challenge and are involved in the process wherever possible, identifying opportunities for awareness raising and sharing lessons learnt;
- sustainability requirements not being given enough consideration pre procurement leading to un-necessary additional environmental impact - the CIO Council will ensure there is proper engagement with industry jointly with the department of Business, Enterprise and Regulatory Reform (BERR) and will work with other relevant parties to produce criteria to help access the environmental impact of bids;
- new technologies and innovation making current best practice redundant – the list of actions for departments will remain under review by the Green ICT delivery Group on behalf of the CIO Council;
- lack of benchmark data resulting in good progress not being properly recorded and acknowledged – the CIO Council will continue to work with suppliers, departmental colleagues and industry experts to establish a robust baseline to enable an accurate record of progress to be produced;
- operational requirements taking precedence over environmental concerns – the CIO Council will work closely with departments to make sustainable ICT business as usual over the long term.

7 Appendices

- Appendix A – Summary of SOGE Targets & Sustainable Procurement Action Plan
- Appendix B –Areas for ICT Carbon Reduction

Appendix A - Summary of SOGE Targets & Sustainable Procurement Action Plan

PRIORITY AREA	TARGETS
CLIMATE CHANGE & ENERGY	**CARBON EMISSIONS FROM OFFICES** • Reverse the current upward trend in carbon emissions by April 2007. • Reduce carbon emissions by 12.5% by 2010/11, relative to 1999/2000 levels. • Reduce carbon emissions by 30% by 2020, relative to 1999/2000 levels.
	CARBON EMISSIONS FROM ROAD VEHICLES • Reduce carbon emissions from road vehicles used for Government administrative operations by 15% by 2010/11, relative to 2005/2006 levels.
	CARBON NEUTRAL • Central Government's office estate to be carbon neutral by 2012.
	ENERGY EFFICIENCY • Departments to increase their energy efficiency per m2 by 15% by 2010, relative to 1999/2000 levels. • Departments to increase their energy efficiency per m2 by 30% by 2020, relative to 1999/2000 levels.
SUSTAINABLE CONSUMPTION & PRODUCTION	**WASTE ARISINGS** • Departments to reduce their waste arisings (excluding products being sent for reuse) by 5% by 2010, relative to 2004/2005 levels. • Departments to reduce their waste arisings (excluding products being sent for reuse) by 25% by 2020, relative to 2004/2005 levels.
	RECYCLING • Departments to increase their recycling figures to 40% of their waste arisings by 2010. • Departments to increase their recycling figures to 75% of their waste arisings by 2020.
NATURAL RESOURCE PROTECTION	**BIODIVERSITY** • Departments to meet or exceed the aim of having 95% of Sites of Special Scientific Interest (SSSI's) in sole

	ownership or control in target condition by 2010.
	WATER CONSUMPTION • Reduce water consumption by 25% on the office and non-office estate by 2020, relative to 2004/2005 levels. • Reduce water consumption to an average of 3m3 per person/year for all new office builds or major office refurbishments.

GOVERNMENT TO MANDATE

- Departments to adopt The Carbon Trust's Carbon Management Programme.
- The application of BRE's Environmental Assessment Method (BREEAM) excellent standards or equivalent, to all new builds/major refurbishments
- Accepted element from the Sustainable Procurement Task Force National Action Plan, (as set out below).
- OGC's Property Benchmarking Scheme – aimed at improving the efficiency and effectiveness of corporate estate management.
- Departments to work towards an accredited certified environmental management system (EMS) i.e. ISO 14001 or EMAS[12].
- Data collection and reporting – identification of core data to be reported against the new targets.
- All Departments to encourage staff to take an active role in volunteering in the community.
- All Departments to conduct sustainability appraisals of office relocations.

UK GOVERNMENT SUSTAINABLE PROCUREMENT ACTION PLAN

Leadership and Accountability

- Permanent Secretaries are accountable for their department's overall progress and for ensuring, from 2007-08 onwards, key staff in their departments have performance objectives and incentives that drive the implementation of this plan, linked to performance objectives for delivering efficiency savings.

Budgeting and Accounting Practice

- Where responsibility for capital and revenue budgets is divided between different

[12] This does not mean departments must replace their existing EMS. Departments can decide whether to implement an accredited certified EMS for their whole estate, or in selected buildings only.

organisations sponsoring Departments will review budgeting arrangements and performance frameworks to ensure any barriers to choosing sustainable solutions are resolved. In addition, where Departments believe an upfront cost constraint prevents them from choosing the most sustainable option, they may raise this with the Treasury.

Building Capacity

- Departments to set out the actions they are taking to ensure procurement practice helps to achieve their sustainable operations targets in their departmental Sustainable Development Action Plans.
- Government encourages organisations to make full use of the Task Force flexible framework where it helps improve procurement practice and achieve sustainability targets while OGC are developing a new detailed procurement framework.

Raising Standards

- Departments/OGC to take action in respect of central Government contracts to meet updated and extended mandatory standards[13].
    - existing contracts will be updated as soon as is practical;
    - new contracts will be required to meet these standards;
    - steps will be taken to remove offers that fall below these standards from framework agreements within 12 months (where permissible under existing contract terms);
    - Departments will make use of pan-Government collaborative contacts in key areas to achieve compliance.

- New Government contacts, where relevant, will include appropriate requirements for suppliers and sub-contractors to provide products and services that comply with agreed mandatory standards and assist in the delivery of departmental sustainable operations targets.

- From 1 April 2009 only timber and timber products originating either from independently verified legal sustainable sources or from a licensed FLEGT partner will be demanded for use on the Government estate – appropriate documentation

[13] Formerly known as 'Quick-wins 03 and 06'

will be required to prove it. From 1 April 2015, only legal and sustainable timber would be demanded.

- OGC will help Departments achieve their sustainable operations targets through supporting the development of pan-Government procurement of goods and services required to meet the sustainable operations targets.

Market Engagement and Capturing Innovation

- OGC and Government departments will work together to strengthen their strategic engagement with key sectors to ensure key suppliers have plans in place to lower their carbon footprint and that of their supply-chains.

EXISTING SUSTAINABLE OPERATIONAL COMMITMENTS (to continue until completion)

- Departments to source at least 10% of electricity from renewables (31 March 2008).
- Departments to source at least 15% of electricity from Combined Heat and Power (2010).

The above sustainable operational targets to apply from the reporting period April 2006 – March 2007.

Appendix B - Areas for ICT Carbon Reduction

A further list of areas for ICT carbon reduction can be found at www.cio.gov.uk

NB: The following list of actions has been distilled from research, case studies and accepted industry best practice. An indication is given of the qualitative factors to be assessed before embarking on each, but no quantifications of energy reduction are given, as what can be saved will be highly dependent on circumstances.
This list and the extended list will be adapted as further input is received, and as further innovation, products and research become available.

Actions	Rationale
PCs & Laptops	
1. 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 screensaver
2. Switch monitors to standby 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.
3. 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
4. Enable active power management on desktops (standby / hibernate 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
5. Ensure re-use of equipment that is no longer required but is still serviceable. If re-use is not possible recycle or ensure green disposal.	• The majority of energy in the life of a PC or laptop is consumed in its manufacture, delivery and disposal. • Extending its use or seeking its re-use elsewhere will save energy and materials (manufacturing stage) as well as purchase and disposal costs. • Ensuring necessary security procedures are carried out prior to re-use, recycling or disposal.
6. 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.

7. 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.
Other office ICT Equipment	
8. Apply timer switches to non-networked technology and printers	• Not all ICT equipment can be networked and/or automatically shut down or put into standby mode – typically 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.
9. 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.
10. 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.
11. 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.

12. 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 to laptop or Thin Client and remote access services on a home or other non-work device connected to the internet to access email. • Rather than a mobile phone and a PDA(e.g. Blackberry), use a single integrated device and "follow-me" services • Rather than having separate video conferencing equipment consolidating it into desktop devices may reduce energy consumption
Data Centres	
13. 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 c. Turn off servers outside their service level agreement, subject to a phase loading and chiller unit risk assessment d. When designing & provisioning new services, create "virtual servers" instead of procuring physical new servers. e. 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.

14. 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[14]. • Over 50% of the power associated with the data centre is used for cooling the ICT equipment[15].
15. 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.[16]
16. Specify low-power consumption, low voltage servers high-efficiency Power Supply Units (80% conversion or better)	• 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.
17. Ensure re-use of equipment that is no longer required but is still serviceable	• Energy is required to manufacture, distribute and recycle equipment as well as to use it • Extending its use or seeking its re-use elsewhere will save energy as well as purchase and disposal costs.
18. 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[17].

14 http://h20219.www2.hp.com/services/library/GetPage.aspx?pageid=437510&statusid=0&audienceid=0&ccid=225&langid=121

15 http://h20219.www2.hp.com/services/library/GetPage.aspx?pageid=437510&statusid=0&audienceid=0&ccid=225&langid=121

16 High Tech: Low Carbon – The role of technology in tackling climate change, Intellect February 2008

17 http://thehotaisle.com/?p=10