

Green IT

Rob Bristow - Joint Information Systems
Committee

- Top tips
- The problem
- The opportunity
- Areas of activity
- Some examples
- JISC's plans
- The way ahead

Top Tips to reduce your carbon footprint

1. Assess your carbon footprint
2. Enable PC Powerdown for devices not in use. Move to Thin-Client Devices or more efficient thick-client devices as appropriate
3. Extend life of equipment and procure to Energy Star 5
4. Consolidate and virtualise servers. Get servers out of departments and offices into properly designed data centres. Run them warmer
5. Implement Hot/Cold aisle separation and containment in your data centre. Look at the possibility of direct cooling of racks
6. Install more efficient power supply units (PSU) and uninterruptible power supply systems (UPS)
7. Consolidate printers and enable duplex and monochrome printing by default
8. Reduce travel by maximising the opportunities for remote working and flexible and home working
9. De-duplicate and rationalise data storage
10. Rationalise and simplify IT systems and architecture

Make this part of your strategic planning

The Problem

- Many devices
 - 760,000 PCs
 - 215,000 servers
 - 147,000 networked printers
 - 512,000 Mwh of electricity
 - 275,000 tonnes of CO2
- High costs
 - £116 million + in 2009 (HE & FE in UK)

The Drivers

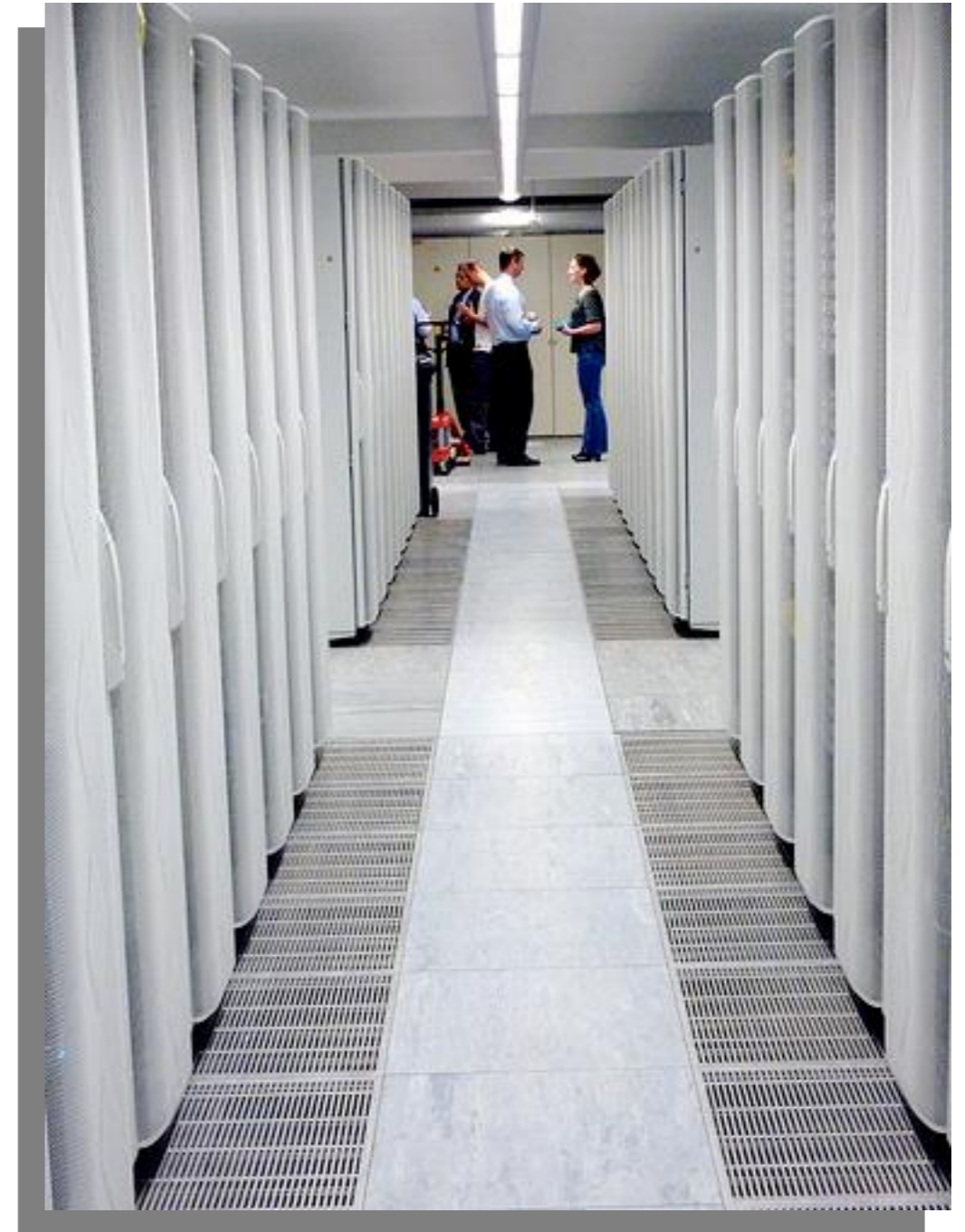
- Rising energy costs and uncertainty of supply
- CRC Energy Efficiency Scheme - 2009
- Reputation
- Regulation
 - Waste Electrical and Electronic Equipment (WEEE)
 - Restriction on Hazardous Substances (RoHS) Directive and UK Regulations
 - Equipment and Energy Using Products (EUP) Directive

IT's Environmental Footprint

- Worldwide IT accounts for ~2% Emissions (less than the airlines, in fact)
- UK IT accounts for 3% of electricity generated
- Embedded CO₂ of a PC is same as lifetime usage CO₂
- Typical PC & Monitor generates 66Kg waste and produces 1Tonne of CO₂ through its life

The Problem

- Data centres
- The desktop
- Printing
- Embedded carbon
- Disposal
- Demand!



Picture: Josie Fraser
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The opportunity

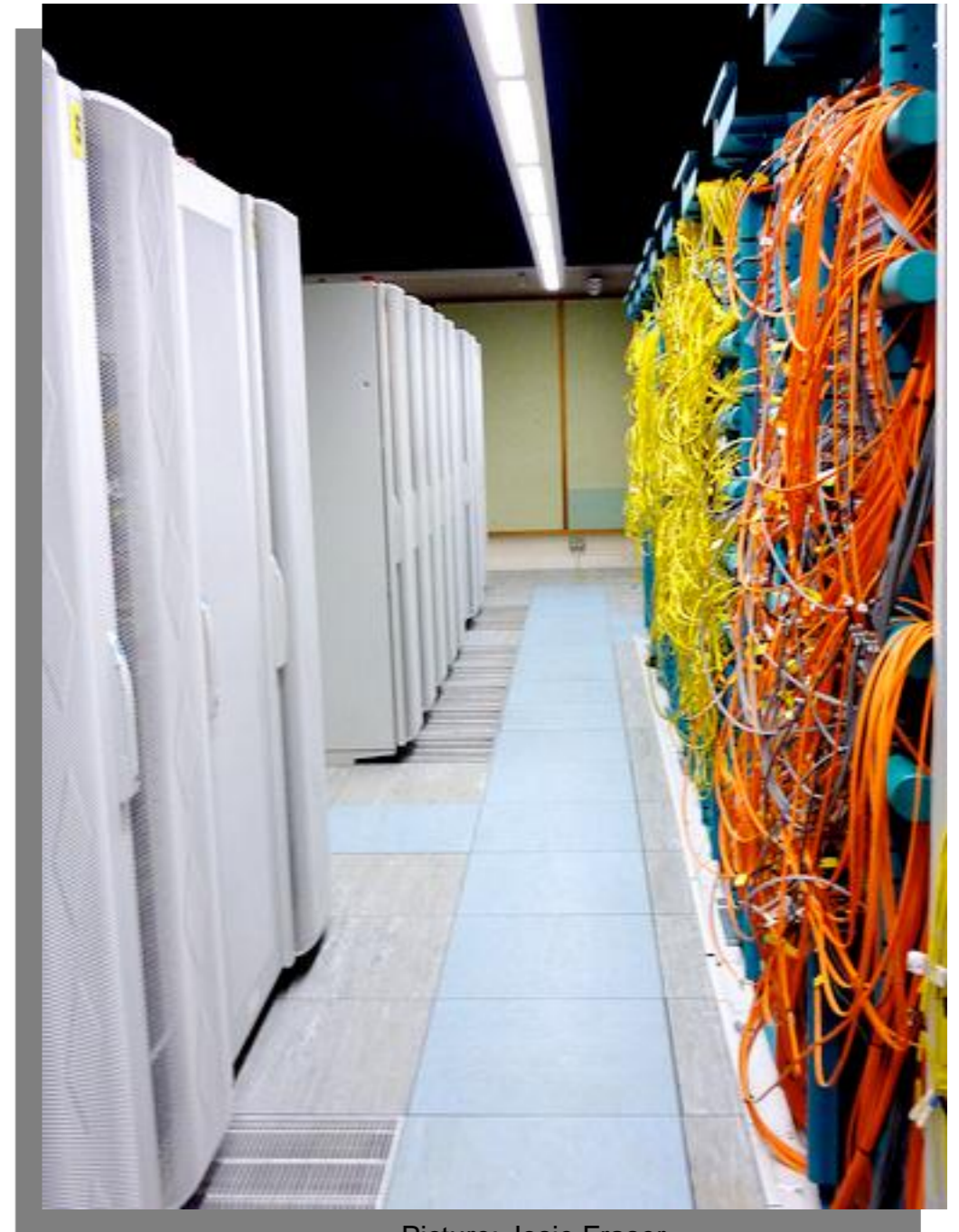
- Smarter systems, buildings and processes
- De-materialisation and dis-aggregation
- HE as exemplar for low-carbon IT
- Green as driver for other efficiency gains

Data Centres

- “the physical reality of modern campus CyberInfrastructure (CI) is a complex network of ad hoc and sub-optimal energy environments in departmental facilities”
 - Green Light project - UC - San Diego
<http://greenlight.calit2.net/>
- But demand is growing
 - Processing
 - Storage

Data Centres

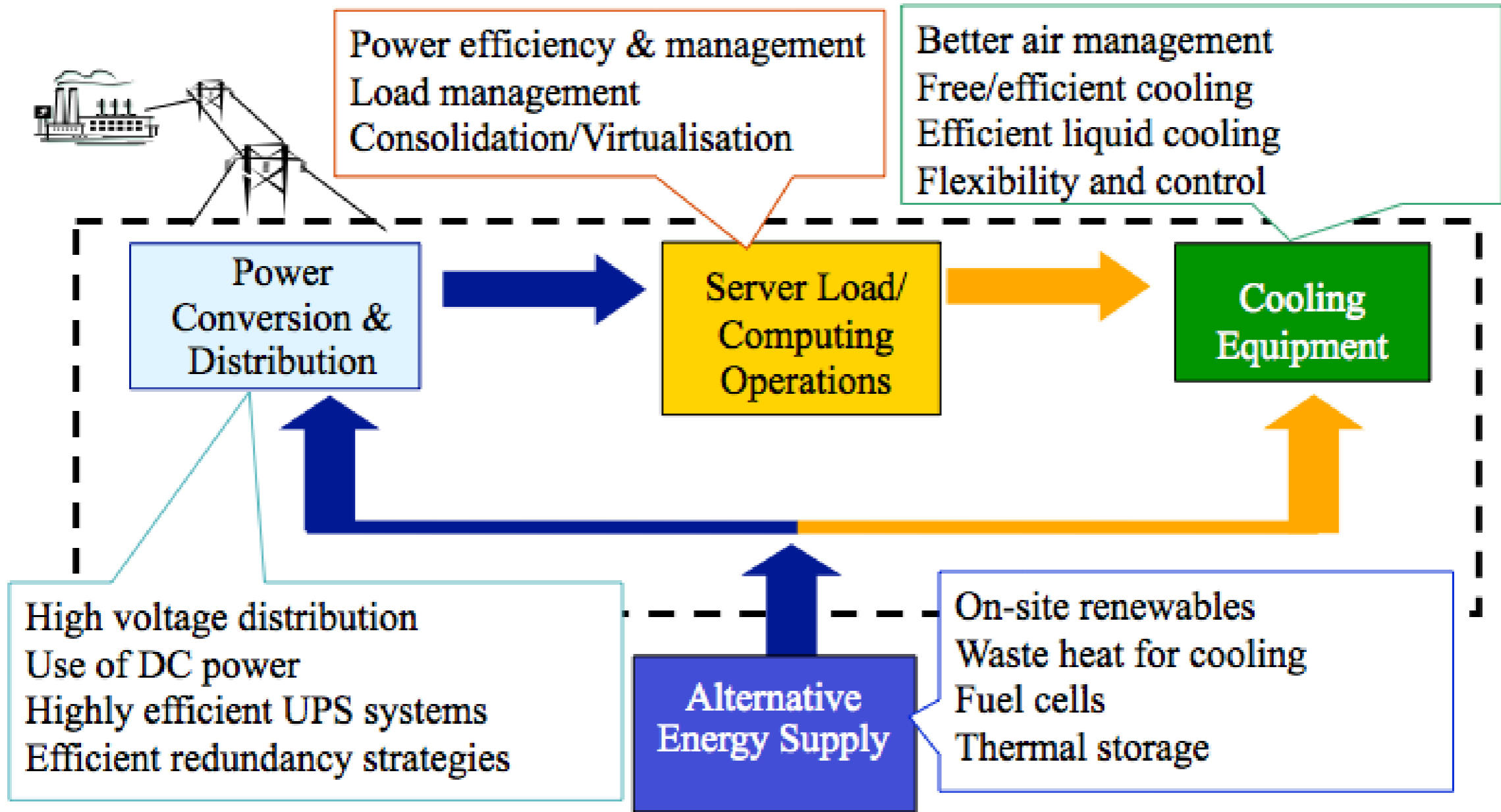
- Data centres consume ~ 1% of global energy
- This consumption doubled between 2000 and 2006
- Huge wastage of energy on cooling and power supply
- What's your PUE? - Up to 1.2 is achievable
- Should you even have one?
- EU Code of Conduct



Picture: Josie Fraser
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Energy Efficiency Measures

Adapted from US EPA original



JISC EU Code of Conduct for Data Centres

aims to: “inform and stimulate data centre managers to reduce energy consumption in a cost-effective manner without hampering the mission critical function of data centres”

- From comms cabinets to bespoke facilities
- Vendors & Participants (Data centre operators & end-users)
- Released November 2008
- Best practices and guidelines (not mandatory)
- Agreement to adopt recommended measures
- Commitment to report performance data

JISC EU C of C for Data Centres - Expected Practices 1

- Group Involvement - Cross functional team
- Grid and Virtualisation - no new single use boxes
- Select efficient software - get the vendors to think about this
- Environmental
 - Raise operating temperature (up to 27^o)
 - Increase humidity range
 - Review temperature points for air or chilled water systems

JISC EU C of C for Data Centres - Expected Practices 2

- New IT Equipment -
 - Include Performance per Watt of IT Devices in tendering process
- Power Provisioning
 - Provision for actual need - not PSU or nameplate rating
- Cooling
 - Containment, variable speed fans, rack air-flow management
- Utilisation
 - only provision for 18 months into the future

Data Centres - Changes

- Virtualise
- Hot and cold aisle separation and containment
- Run the Data Centre hotter - ASHRE limits have been increased
- More efficient PSUs and USPs
- Go multi-core and use the GPU
- DC power?

The Desktop

- Powerdown - This should have been done by now
- Extend it out to staff PCs
- Wake-on-LAN solutions available
- Extend life
- Procure to Energy Star 5 and EPEAT Gold if possible
- Examine case for Thin-Client

Power Management States

ACPI Global State	ACPI Sleep State	Energy Star Category	Common Terminology	Definition	Relative Energy Saving
G0 – Active		Idle?		CPU executing tasks.	Baseline
G1 – Sleeping	S-1	Idle?	Seldom used in current devices	The CPU is not executing tasks but, as with all other components, remains powered.	Negligible
	S-2		Standby (but seldom used in current devices)	The CPU is not being powered, but RAM and other components are.	Negligible
	S-3	Sleep	Standby in Windows; Sleep in Mac; also Suspend to RAM	Similar to S2, but with fewer components powered.	Low
	S-4		Hibernation in Windows, Safe Sleep in Mac; also Suspend to Disk	No power to CPU or RAM, with all content saved to non-volatile memory such as a hard drive. (No operating system restart required).	Medium
G2 – Soft Off	S-5	Standby	Shut Down	Power to only a very few components so that wake events can be triggered, e.g. from a LAN, followed by an operating system restart.	High
G3 – Mechanical Off				No components powered and device fully switched off. Can only be reawakened by restoring power and starting the operating system	Very high

ACPI Sleep States (adapted from NRDC 2005)

Thin Client

- Plus

- Kit lasts longer
- Easy to consolidate and virtualise
- Lower Energy consumption in use and reduced need for cooling
- Less weight and bulk to transport - less waste
- Reduced support costs

- Minus

- Load at server
- Many devices on 24/7
- Video/3-D Graphics not handled well
- New thick-client solutions can match the thin-client claims
- Important to match to users' needs

Cost and Carbon Comparison Tool: Thick vs Thin Clients - Thick Clients Vendors' Data

	Thick Clients (Generic)	Very PC GreenPC BE & LG 22" LCD	Very PC Fulwood & LG 22" LCD	Very PC Treeton II & LG 22" LCD	Very PC Treeton II XS & LG 22" LCD	Very PC BC & LG 22" LCD	Very PC Atom & LG 22" LCD	Own data
Replacement cycle (years)		INCLUDING SCREEN	INCLUDING SCREEN	INCLUDING SCREEN	INCLUDING SCREEN	INCLUDING SCREEN	INCLUDING SCREEN	INCLUDING SCREEN
	4	4	4	4	4	4	4	1
Capital Costs (£)		INCLUDING SCREEN	INCLUDING SCREEN	INCLUDING SCREEN	INCLUDING SCREEN	INCLUDING SCREEN	INCLUDING SCREEN	INCLUDING SCREEN
Client purchase price per client (incl. VAT)	595.73	484	920	553	586	494	386	1
Energy Costs (£)								
Power of client in active/idle mode (Watts)	79	37.97	17.399	26.536	26.536	31.76	28.34	1
Power of client in standby mode (Watts)	4	1.502	0.876	2.532	2.532	2.051	2.016	1
Power of monitor in active/standby mode (Watts)	35	19	19	19	19	19	19	1
Power of monitor in standby mode (Watts)	2	1	1	1	1	1	1	1
Space utilisation (m2)								
Average space per client (m2)	3	3	3	3	3	3	3	1

Cost and Carbon Comparison Tool: Thick vs Thin Clients - Thin Clients Vendors' Data

	Sun	Wyse	Chip PC	Own data	Clever thing
Replacement Cycle					
Replacement cycle (years)	8	12	10	1	1
Replacement cycle for thin client server	4	4	4	1	1

Numbers of Devices (#)					
Integrated monitor?	Yes	Yes	No	No	No
No. thin clients per Thin Client server	240	240	240	3	1

Capital Costs (£)					
Client purchase price per client (incl. VAT)	265	227	105	3	1
Thin client server purchase price	3,600		5,800	3	1

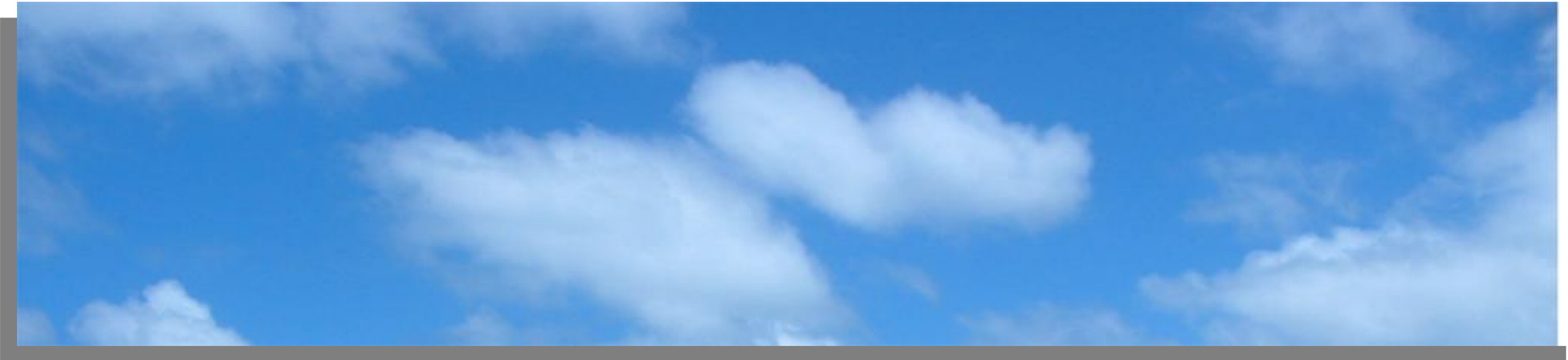
Operational Costs (£)					
Licence costs					
Annual client and server licence costs (per client)	19.00		15.00	3.00	1.00
Energy Costs					
Power of client in active/idle mode (Watts)	28	6	3	3	1

Printing

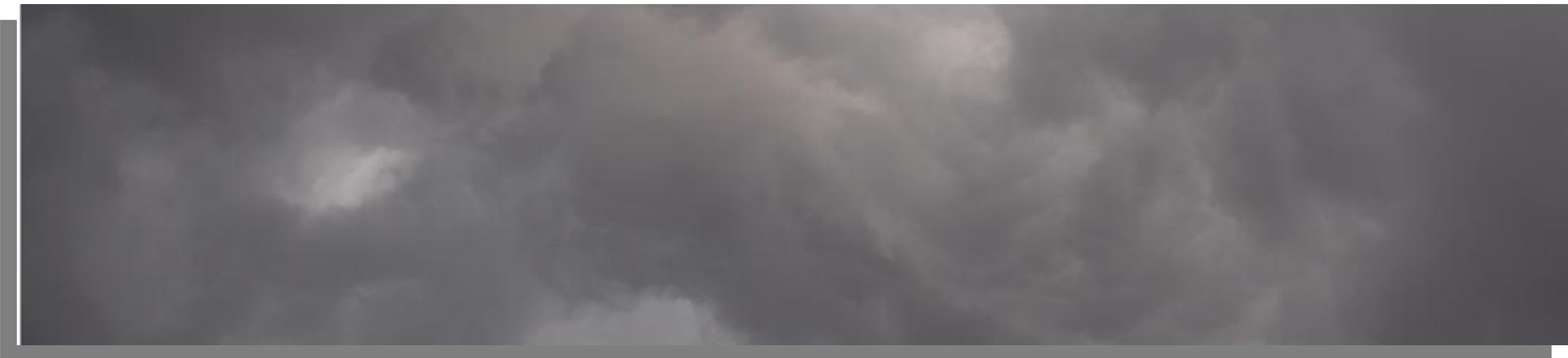
- (Staff) printing is out of control
- HE Sector consumes over 21,000 tonnes of paper per year
- Accounts for 10-16% of ICT-related electricity use
- Most of the energy associated with printing comes from making the paper
- Form a cross functional team and get buy-in from users
- Consolidate printing to MFDs
- Enable “Pull” printing
- Enable duplex and monochrome printing by default
- Enable quick switch to low power mode

- UK Government's Quick Wins
- Centre of Excellence
- Standards
 - Energy Star
 - ECMA Eco-Declaration
 - EPEAT
- Sustainability not yet embedded in procurement practices
- Need for strategic view of procurement and estates involvement

The Cloud



Or



?

The Cloud

- “Not everything will move into the cloud, but the cloud will move into everything” - Nicholas Carr
- JISC - three studies
 - Cloud for Research
 - Technical Review of the Cloud
 - Environmental and Organisational Implications of the Cloud for HE and FE
 - Reports in May 2010

Queen Margaret University

- Thin clients everywhere
- New build
- Key driver was avoiding AC
- Good IT/Estates cooperation
- Reduced support overhead by 2 FTEs



Cardiff University

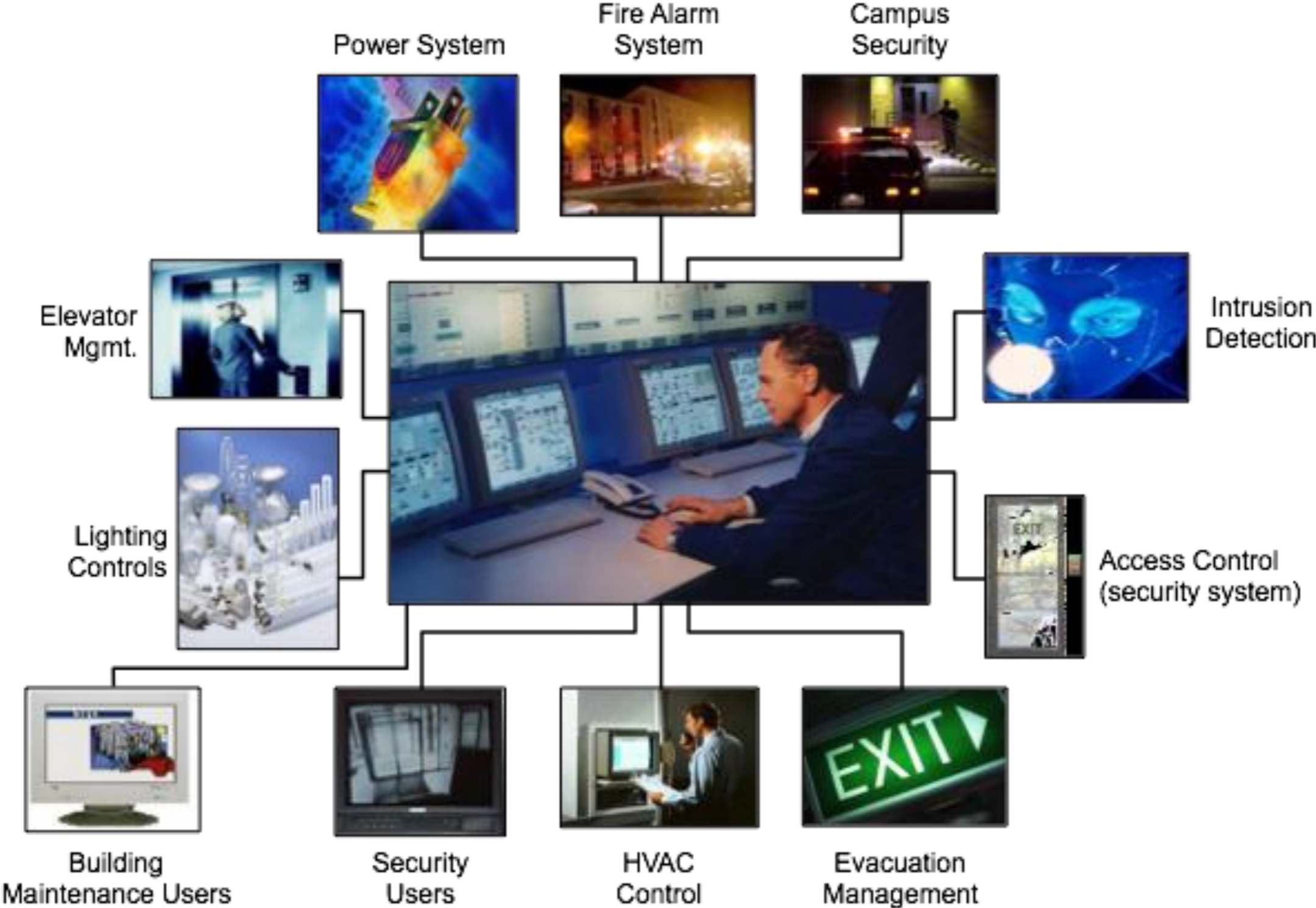
- Low power servers
- Chilled water cooling
- Efficient layout
- Efficient UPS
- 30% support overload



- IT as opportunity
- Move to e-Procurement
- Saved 240,000 pieces of paper a year
- £40,000 in postal costs
- Less paper to store
- Leveraged existing e-Business Suite (Oracle)



Ave Maria University



The JISC Greening ICT Programme - 1

- **Suste-IT Study**
 - Thorough examination of all aspects of Green ICt in the sector
- **Institutional Innovation Projects**
 - Wake-on-LAN
 - Location Independent Working
 - Server Virtualisation
 - Reduction of Energy use in computing intensive areas
- **Studies looking at the Cloud and Information management**

The JISC Greening ICT Programme - 2

- Building Capacity
 - Extend the SFC funded work to the rest of the UK
- Growing the Knowledge Base
- Developing Exemplars/Demonstrators
 - Small scale projects starting in 2010, bigger exemplars to follow. Maybe a rapid innovation call at some point
- Strengthening Sustainable Procurement
 - Working with procurement consortia

Real life Carbon Footprint

University of Sheffield

Category	Total Kwh/y	Proportion	Total CO ₂ kg/y
HPC	1,208,617	14%	649,052
Servers	1,520,736	18%	816,666
PCs	4,164,477	48%	2,236,408
Networks	687,362	8%	369,127
Telephony	202,356	2%	108,669
Imaging/Printing	835,659	10%	448,765
AV	61,598	1%	33,080
Total	8,680,805		4,661,767
Total FTE Students 2005/6	20,029		
ICT Energy & Carbon per student	433		233

Real Life Carbon Footprint

Scottish FE Colleges (4)

Category	Total Kwh/y	Proportion	Total CO ₂ kg/y
HPC	15,768	1%	88,468
Servers	812,730	30%	436,452
PCs	1,147,862	42%	616,425
Networks	295,386	11%	158,634
Telephony	29,244	1%	15,705
Imaging/Printing	248,961	9%	133,697
AV	179,095	7%	96,178
Total	2,729,046		1,545,559

Angus College Sustainable ICT

- Experience with footprinting exercise
- What we got out of it
- Action plan
- Current progress

John Clayton



Footprinting Results - ICT

	Lowestoft College	City College Norwich	Angus College
Total Electricity (kWh)	453,714 (100%)	1,241,700 (100%)	491,096 (100%)
PCs and monitors	197,402 (44%)	510,896 (41%)	239,069 (49%)
Servers	135,999 (30%)	226,665 (18%)	110,613 (23%)
Imaging	42,171 (9%)	236,901 (19%)	51,979 (11%)
Networks	68,538 (15%)	156,629 (13%)	49,485 (10%)
AV/Telephony	9,604 (2%)	110,609 (9%)	39,950 (17%)



Footprinting Results - ICT

	Angus College		
	kWh/y	Cost	CO ₂ kg/y
Total	491,096 (100%)	£54,021	263,728
PCs and monitors	239,069 (49%)	£26,298	128,395
Servers	110,613 (23%)	£12,167	59,401
Imaging	51,979 (11%)	£5,718	27,914
Networks	49,485 (10%)	£5,443	26,575
AV/Telephony	39,950 (17%)	£4,394	21,453

ICT represents 29% of total electricity



Salient Points

- Very useful exercise – tool easy to use
- Areas of priority – PCs and Servers, then Networks and Imaging
- Savings already made:
 - - power-efficient PCs/monitors - £1,400 p.a.
 - - automated switching off - £7,200 p.a.
 - - printing controls - £400



Provisional Action Plan

- Procurement decisions to include power use over lifetime
- Continue/speed up PC/monitor replacement
- - was 145W now 58W
- Refine and extend automatic shutdown for PCs
- Thin client?



Provisional Action Plan

- Purchase energy efficient servers
- Retire old servers
- Server virtualisation
- Review temperature control in server room
- Switch off lighting



Provisional Action Plan

- Disconnect old/unused network points
- Printing – variety of approaches



Potential Savings

	kWh/y	Cost	CO ₂ kg/y
Total	174,000	£19,140	93438
PCs and monitors	119,000	£13,090	63903
Servers	40,000	£4,400	21480
Imaging	10,000	£1,100	5370
Networks	5,000	£550	2685

This represents a saving of 35%



Current progress

	kWh/y	Cost	CO ₂ kg/y
Total	174,000 31,000	£19,140 £3,370	93,438 16,570
PCs and monitors	119,000 24,000	£13,090 £2,600	63,903 12,800
Servers	40,000 7,000	£4,400 £770	21,480 3,760
Imaging	10,000	£1,100	5,370
Networks	5,000	£550	2685



The Green Gowns Awards

- Run by the Environmental Association of Universities and Colleges (EAUC)
- Posh dinner and kudos
- Make an entry
- Deadline for stage 1 applications - 19th Feb 2010
- See :
http://www.eauc.org.uk/green_gown_awards

Getting stuck-in

- Carbon Footprinting and Reduction Project
- Follows on from SFC funded work in Scotland
- Will run in two regions initially
- Establish baseline CO₂ using Suste-IT tool
- Mutual support and some targeted consultancy
- Will focus on providing that



SustelT ICT Footprinting Tool © SustelT 2009



INSTRUCTIONS
Type in the blue areas below - nominal figures only have been entered.

Areas in yellow are default figures which can be altered if data specific to the institution is available.

NOTES
The letters in brackets correspond to explanations in the User Guide and the worksheet "Assumptions" on how the default assumptions were derived.

MENU

Server Rooms	Number of 1U servers	Watts per server (c)	Overhead	Total kW hours per year
Central servers	1	300		2,628
Departmental servers	1	300		2,628
Storage & other server equipment (d)			0.15	788
Server/equipment sub-total				6,044
Server cooling & power supply overhead (e)			0.5	3,022
Server sub-total				9,067

HPC
PCs and monitors
Networks
Phones
Imaging
AV

Totals and analysis

Links

- <http://www.jisc.ac.uk/whatwedo/programmes/greeningict.aspx> - JISC's Greening ICT Programme
- http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative_data_centers.htm - EU C of C
- <http://www.susteit.org.uk/publications/index.php> - for:
 - Suste-IT main report and summaries
 - Best practice reviews for Data Centres, Personal Computing, Printing, Procurement
 - A number of papers written by Grid Computing Now! for the Suste-IT project. Subjects covered include the EU Code of Conduct for Data Centres, Data Centre Cooling and Virtualisation
- <http://www.susteit.org.uk/cases/index.php> - for 20 case studies drawn from UK HE and FE highlighting good practice and innovative solutions
- <http://greenict.jiscinvolve.org/> - JISC's Green ICT Blog
- #greenict - Tag in use on Twitter et al
- <http://www.eauc.org.uk/home> - The Environmental Association of Universities and Colleges (EAUC)
- <http://www.defra.gov.uk/sustainable/government/what/priority/consumption-production/quickWins/index.htm> - Buy Sustainable - Quick Wins

Summary

1. Assess your carbon footprint
2. Enable PC Powerdown for devices not in use. Move to Thin-Client Devices or more efficient thick-client devices as appropriate
3. Extend life of equipment and procure to Energy Star 5
4. Consolidate and virtualise servers. Get servers out of departments and offices into properly designed data centres. Run them warmer
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- Rob Bristow
 - Programme Manager (Green ICT)
 - r.bristow@jisc.ac.uk
 - 07825 823 282
 - Twitter: robbristow