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DATA CENTER eureca PROJECT

Public Sector Data Centres
Best Practice Procurement of an Energy Efficient Data Centre (Case Study)

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Best Practice Procurement of an Energy Efficient Data Centre (Case Study)

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4. Best Practice Solutions
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1 About Me

About Me

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Steve Bowes-Phipps

- Over 25 years of operational systems management experience
- Managed data centres for over 20 years
- Worked at the University of Hertfordshire 2007 – 2014
- A member of the Data Centre Alliance Energy Efficiency group, the EU Code of Conduct for Data Centres Best Practices Committee and regular speaker on Data Centre Best Practice

University of Hertfordshire

- UK's leading business-facing university and an exemplar in the sector
- One of the region's largest employers with over 2,650 staff and a turnover of almost £233 million
- A student community of over 27,200 including more than 2,800 students from eighty-five different countries, the University has a global network of over 175,000 alumni
- One of the top 100 universities in the world under 50 years old, according to the new Times Higher Education 100 under 50 rankings 2012
- Sector leader in environmental management - ranked top ten in the People and Planet Green League for each of the last five years

2 Reduction And Re-use of Energy in Institutional Data Centres (RARE-IDC)

Reduction and Re-use of Energy in Institutional Data Centres (RARE-IDC)

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Data Centre Leaders Award Winner 2010

"***Innovation in a Micro-Data Centre***"

Uptime Institute Green Enterprise IT Award™ Winner 2011

"***Innovation in a Smaller Data Centre <1000 sq ft***"

First University ***Participant*** of the EU Code of Conduct for Data Centres 2010

Green ICT Winner of Green Gown Awards 2011

Background to the RARE-IDC project

- Refurbishment of one of two main 75m^2 Data Centres for the University
- Funding had already been allocated in order to overcome several legacy risks
- We shared many issues with other Public Sector institutions
- Sector leader in environmental management – consistently ranked in the top ten of the People and Planet Green League
- Joint Information Systems Committee (JISC) funding brought new constraints and new objectives:
  - "An exemplar of a Green Data Centre for the HE/FE Sector"
  - "A model for other institutions to follow and learn from"
  - "Meet the business need with capacity, resilience and economy for at least ten years"

3 Planning Green Data Centres

Planning for Success

- Build Business Case on return on investment (ROI) – Not Carbon savings
- Base specifications and requirements on best practice standards
- Have a contracted efficiency target
- Seek innovation (‘cutting edge’, not ‘cookie cutter’)
- Hold back a % for results (6 months to a year is normal)
- Put Estates on the project and/or on the Board
- Run everything as a project, no matter how small
- Identify your risks and mitigate them
- Log, track and resolve issues

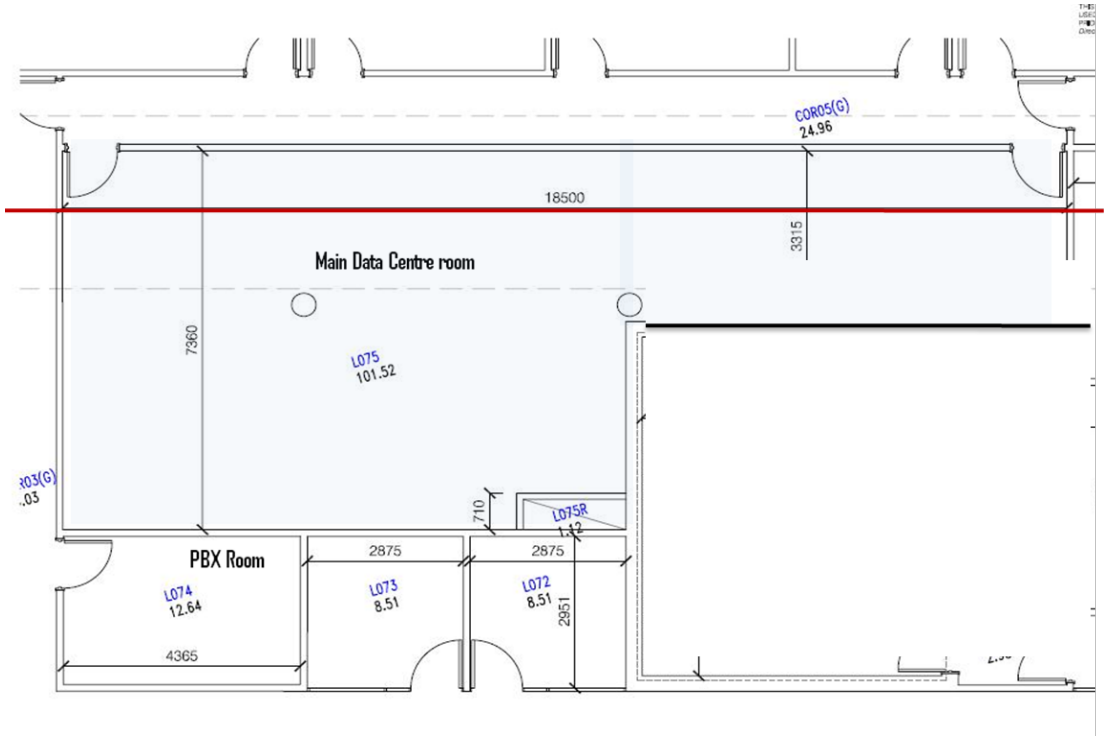
Project Process

- Engaged closely with key stakeholders
- Bolstered our skills in best practices, cutting-edge sustainable technologies and thought leadership on reducing the carbon impact of Data Centres
- Researched a wide variety of sustainable technologies & best practices
- Design & Build Contract
- Pre-Qualification Questionnaire (PQQ) helped to reduce No. of appropriate responses
- The Invitation to Tender (I.T.T)
  - Included Best Practices (EU Code of Conduct for Data Centres)
  - British & International Standards (TIA942, etc.)
  - Would now include reference to EN50600
- Interview with top 4 Suppliers
- M&E Consultant engaged to challenge designs
- Simplification of proposals for Board approval

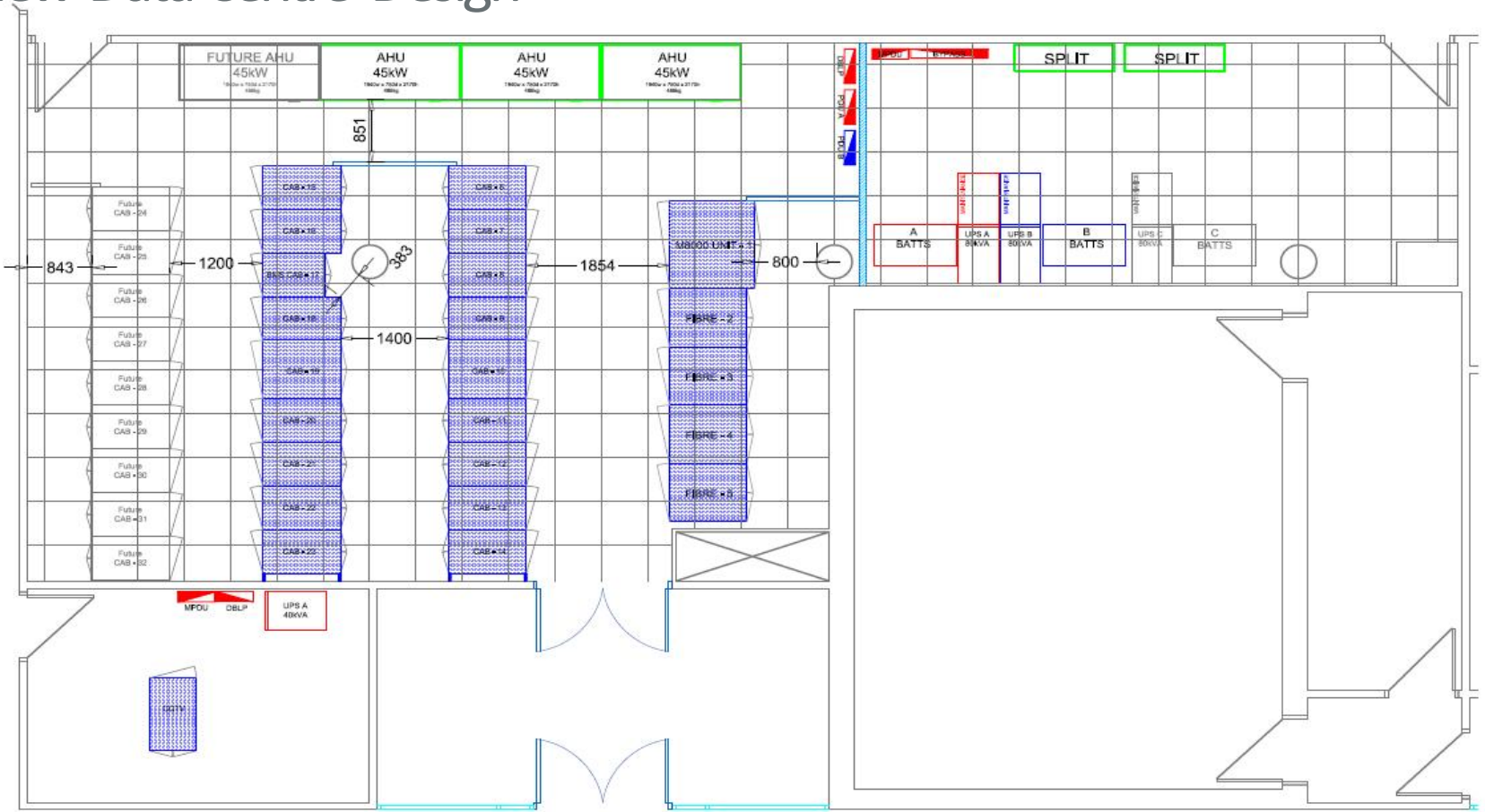
4 Best Practice Solutions

Existing Challenges

- Pillars
- Riser
- Capacity
- Contamination from work areas
- Overhead bulkhead
- Lack of under floor capacity (only 250mm)
- Legacy incorrect (and dangerous) power cabling
- Limited plant space
- Restricted external build space
- “Meet-Me” point for all network cabling
- No external walls
- No segregation of duties



New Data Centre Design



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Room Layout

Practice

- Hot Aisle / Cold Aisle
- Containment
- Blanking panels
- No shelf mounted equipment
- Route cables away from fans
- Raised floor
- Tile grommets
- Position of cold aisle relative to CRAH
- Dust mat

Impact

- Separate hot and cold air streams
- Increase efficiency of CRAH / CRAC
- Reduce / remove “hot spots”
- Improve air circulation / flow
- Prevent fan failure / filter ineffectiveness

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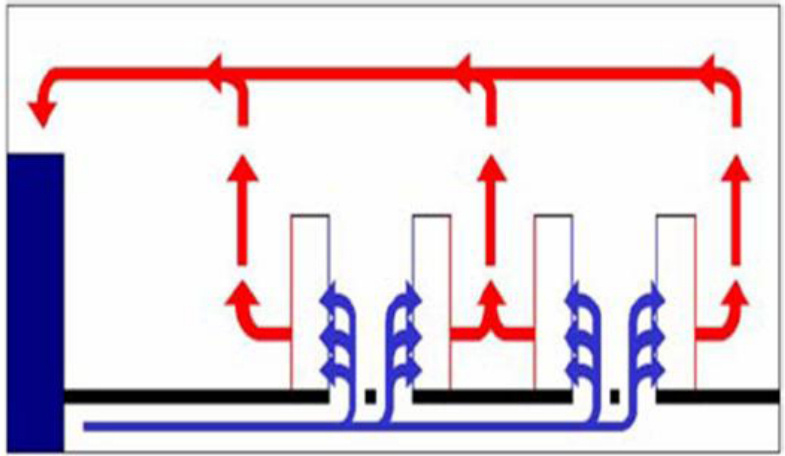
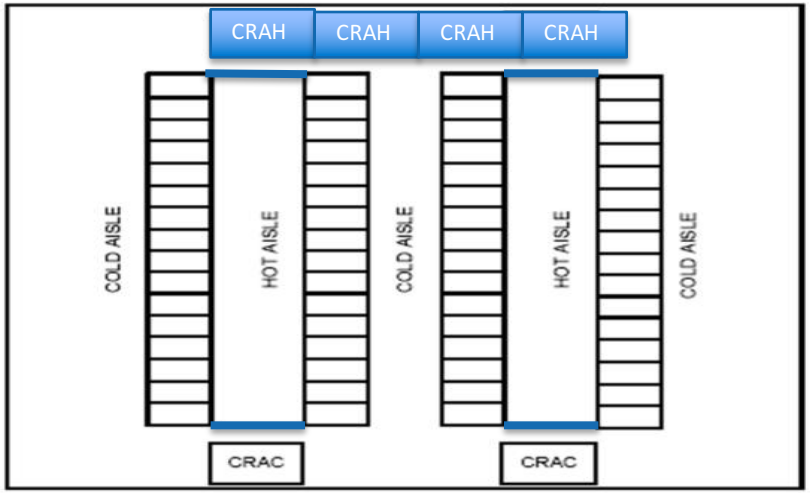
Hot Aisle / Cold Aisle Configurations

Example Traditional Layout



RARE-IDC Layout



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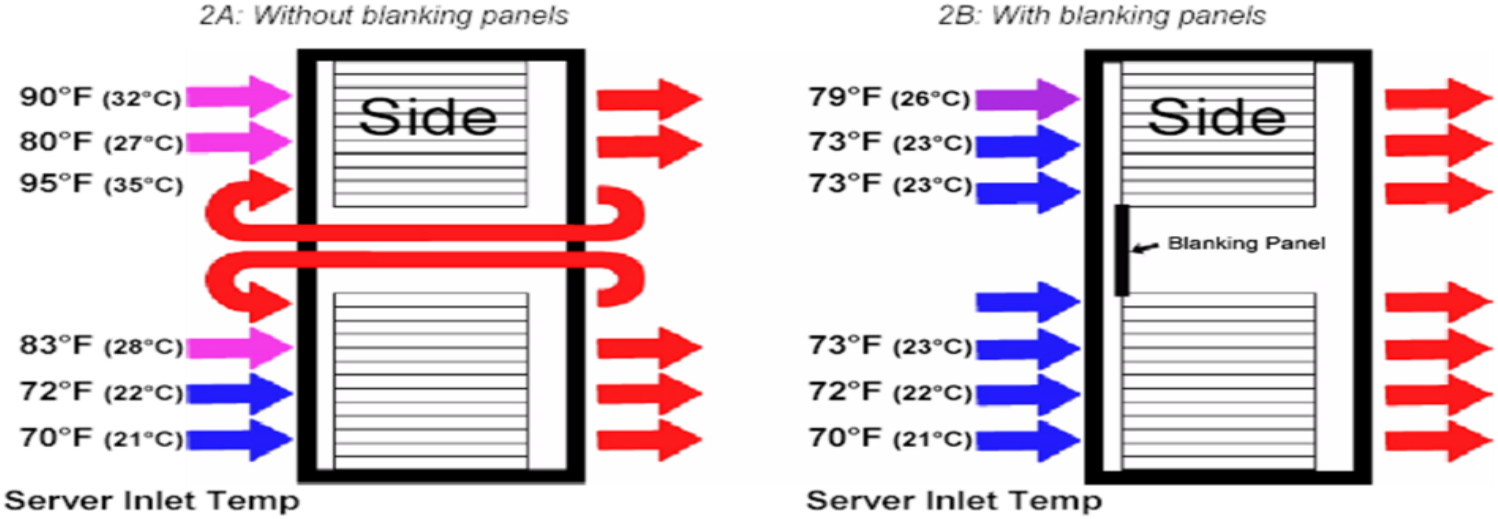
Blanking Panel Effectiveness

- Effect of installation of blanking panel on server air inlet temperature



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Furniture & Fittings

Practice

- T5 Low-energy lighting
- PIR
- Colour of racks
- Provision for additional capacity but don't build it!

Impact

- Reduce lighting requirements
- Reduced facility power cost
- Power and cool only where needed

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Electrical configuration

Practice

- Parallel UPSs
  - On-line Interactive
  - Dual Conversion
- Multiple Power Distribution Boards (PDBs)
- Power Factor
- TNSS Filters
- Phase balancing
- Generator

Impact

- Clean mains supply
- Redundancy of supply
- Stability of supply
- Continuity of supply

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Cooling Effectiveness

Practice

- "free air"
  - Direct Free Air
  - Indirect Free Air
  - Direct Water Free Air
  - Indirect Water Free Air
  - Sorption cooling (absorption / adsorption)
- Variable speed fans
- Humidifiers
- Immersion cooling
- Waste heat recycling

Impact

- Use ambient air to extract cooling
- Don't dump all waste heat into environment
- Reduced cost of cooling
- Reduced operating cost of building
- Transferral of thermal energy

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Environment

Practice

- Dust free
- Dry bulb inlet temp of 25-26oC
- Relative humidity of target 50% +/- 20%
- Turn off unused servers / consolidation / virtualisation
- “Lights Out” – lighting only where needed and when needed
- Separate UPS plant area

Impact

- Reduced fan/filter failure
- Reduced cost of facility
- Reduced cost of cooling
- Cooling appropriate to equipment

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Virtualisation and Consolidation

- Turned off old servers
- Consolidated & virtualised existing services
- Reduced physical footprint
- Reduced energy (and hence, Carbon) footprint
- All new apps evaluated against virtualised environment by default
- Server utilisation rates moved from 4% -> 25% (average)
- Over 3 years saved approximately £340,000 in Capital costs & £36,000/yr Operating Expenses

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Four "M"s of Data Centre Management

Practice

- Meter
- Monitor
- Maintain
- Manage

Impact

- Understand your Data Centre "profile"
- Reduced cost of cooling
- Improved reliability of components and infrastructure
- Early and easier diagnosis of issues leading to speedier resolutions

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Change Management (ITIL)

- The Data Centre cannot be considered a constant
- Change can wreak untold damage on efficiency and effectiveness
- Plan for change and understand the impact

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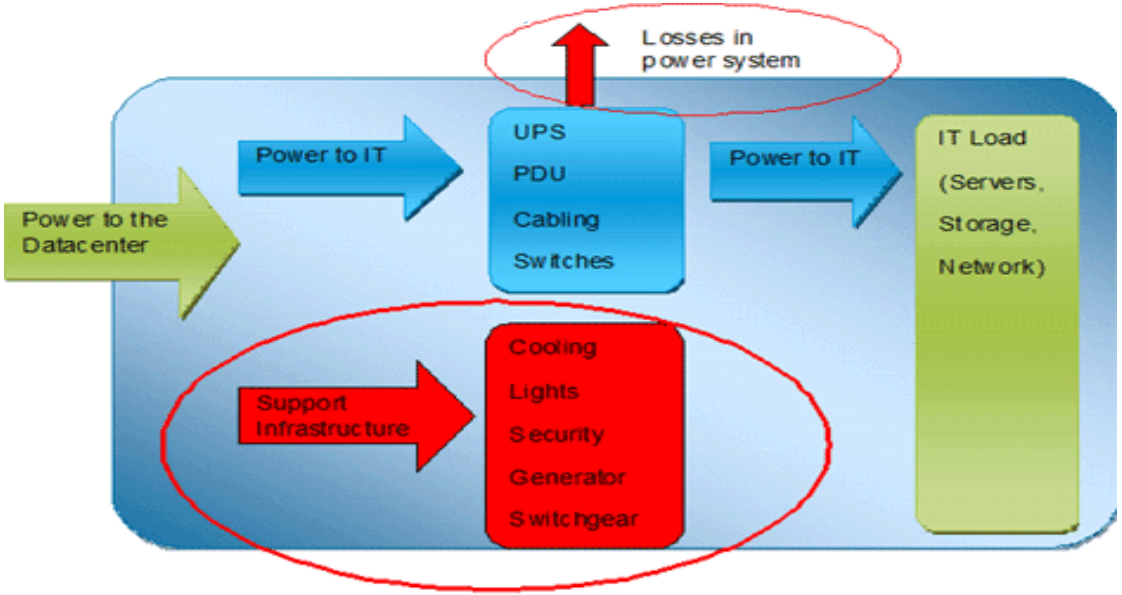
5 Measuring Success

Results

Energy Consumed Per Hour	Before:	After:
Total IT Load	120kW	120kW
Total Facility Load	264kW	146kW
Electricity used per Year	2,312,640KWh	1,282,464kWh
Annual Carbon Footprint	1,394 Tons	773 Tons

Reduction in	CO2 Emissions	Equivalent to
1 Year	621 Tons	117 Fewer Cars
5 Years	3,106 Tons	586 Fewer Cars
10 Years	6,212 Tons	1,172 Fewer Cars

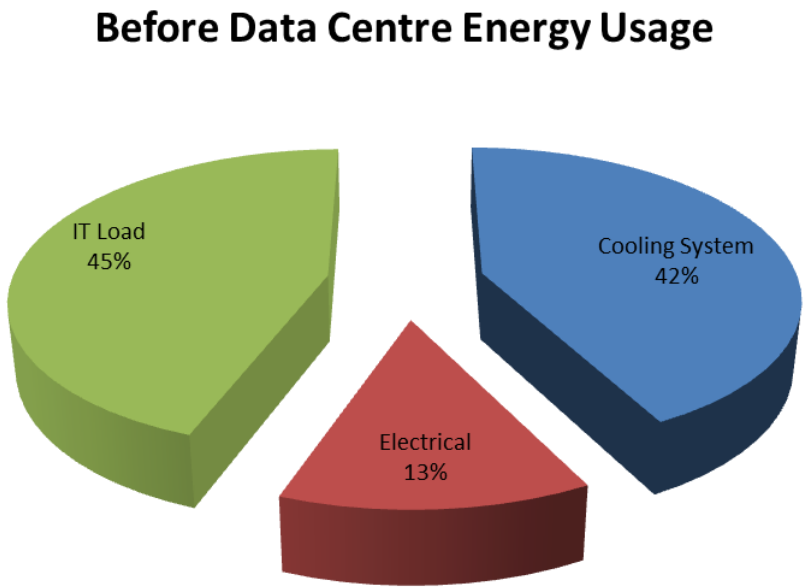
Power Usage Effectiveness



$$PUE = \frac{Total\ Facility\ Power}{IT\ Equipment\ Power}$$

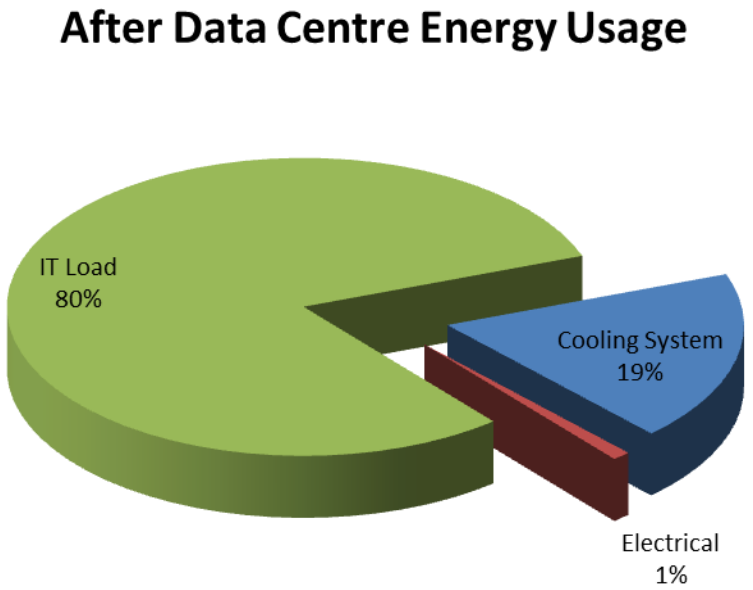
Original Energy Breakdown

- Power Usage Effectiveness (PUE) approximated at 2.2
- IT Load at 45%
- Cooling System taking up 42% of total
- Power
- Electrical usage significant at 13%



Energy Use Post-Project

- PUE down to $1.19_{L2,MD}$ – $1.33_{L2,MD}$
  Target = 1.22
  Actual = $1.25_{L2,MD}$
- IT Load increased from 45% to 80%
- Cooling usage decreased from 42% to 19%
- Facility electrical usage decreased from 13% to 1% (UPS losses, lighting, etc.)



Successful Outcomes

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- Capability of project to act as an exemplar to the wider market in relation to the issues of the smaller data centre
  - **The first University** in Europe to achieve compliance against the EU Code of Conduct for Data Centres
  - Our pathfinder project enables others to follow our success and apply the lessons we've learned along the way
  - **Refurbishment** not new Build
  - **Re-use** of some Equipment
  - **"Free Air" Cooling** for 86% of the year (based on local weather conditions)
  - Increase in capacity of 69% & a **55% reduction in the carbon footprint** of the Data Centre
  - Operational cost savings of **£186,000 per annum** (inc Carbon cost £12/Tonne CO2)
  - Using a contained Hot Aisle configuration, **waste heat is recycled** into the building's hot water supply
  - Worked with **JISC** to further EU-wide knowledge-sharing through the e-infranet project
  - Still disseminating **Best Practice** through the EU-funded EURECA project

Thank You

Blogs: http://blogs.herts.ac.uk/rare-idc/
http://blogs.herts.ac.uk/carbs/

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