Meeting the Energy Efficiency and Financial Challenges in IT

Liam Newcombe
BCS Data Centre Specialist Group Secretary
Recognising the Problem
Energy and Cost Crisis

- Data Centres: 1.9% of UK grid power
- Power Availability & Cost
- Cooling Capacity
- “90% of business will be impacted by power issues within 5 years” EPA
Recognising the Problem - Business

Business Demand for IT Services

- Rising Demand
- Rising Impact
- Application Design
Environmental Accounting

- Green House Gas Accounting (GHG)
- Kyoto
- EU Emissions Trading Scheme (EU ETS)
- Mandatory Cap & Trade
- Brand Value
- Public Pressure
IT Costs are fundamentally changing

- Demand > Moore’s Law (1)
- Servers cheaper and faster
- Servers using more power
- Power bill > Server Cost
- Data Centre Infrastructure > Server Cost

(1) The Uptime Institute;
The Invisible Crisis in the Data Center
Business Cost & Management Accounting

- Understand the Infrastructure and energy costs of IT systems
- Data Centre capital and power cost is currently “general overhead”
- This must change as costs rise and new costs arrive (Cap and Trade)
- Start carbon accounting now
- Carbon accounting will impact the supply chain

Recognising the Problem – Energy & Business
Communication failures

- CXO
- Business Owner
- IT Architect
- IT Operations
- Mechanical & Electrical
Recognising the Problem - Technology

Server Power vs. Workload

Commodity x86 Power Utilisation by Load

Watts

Load

0% 20% 40% 60% 80% 100%

0 100 200 300 400 500
Recognising the Problem - Technology

Server Power vs. Workload

Commodity x86 Normalised Operations per Watt by Load
Recognising the Problem - Technology

Power Loss Chain

Power Station – Data Centre

90% of Power Station Power
Recognising the Problem - Technology

Power Loss Chain

Data Centre - Equipment

Data Centre 90%

Equipment 40% 25% 35%

36% of Power Station Power
Recognising the Problem - Technology

Power Loss Chain

Data Centre - Servers

- Data Centre: 90% (5% Transmission Losses, 5% Transformer Losses)
- Equipment: 40% (25% Power Infrastructure Losses, 35% IT Equipment)
- Servers: 65% (20% Network Equipment, 15% Storage Equipment)

23% of Power Station Power
Recognising the Problem - Technology

Power Loss Chain - Data Centre – CPU Used

- Transmission Losses
- Transformer Losses
- Data Centre Losses
- Cooling Losses
- Power Infrastructure Losses
- IT Equipment Losses
- Network Equipment Losses
- Storage Equipment Losses
- Servers
- Power Supply
- Other Components
- CPU
- Idle Time Power
- CPU Load Power

1.4% of Power Station Power
Recognising the Problem - Technology

Power Loss Chain – Fossil Fuel – CPU Used

- Fossil Fuel
  - Electricity Generated: 35%
  - Heat Exhausted: 65%
- Data Centre
  - Cooling Losses: 90%
- Equipment
  - IT Equipment: 40%
  - Storage Equipment: 25%
  - Power Infrastructure: 35%
- Servers
  - Network Equipment: 65%
  - Other Components: 20%
  - Servers: 15%
- CPU
  - Power Supply: 30%
  - Other Components: 45%
  - CPU: 25%
- CPU Utilisation
  - Idle Time Power: 20%
  - CPU Load Power: 80%

0.5% of Fossil Fuel Energy
Recognising the Problem - Technology

Data Centre Power Transfer function

• Data Centres use much of their power just being turned on

![Data Centre Power Transfer as Fixed plus Proportional Loads](image-url)
Recognising the Problem - Technology

Data Centre Power Transfer function
• How does this translate into efficiency?

[Image of graph showing Overall Efficiency Functions vs IT Workload]
Green Data Centre = Unreliable?

• This is a myth
• Power or Cooling constrained Data Centres have higher risks
• High Power density gives increased risk
How the Industry is Reacting

Meeting the Energy and Financial Challenges in IT

Creating the IT Profession
Energy Research and Standards

- EPA report to Congress
- ASHRAE
- EU Data Centre Code of Conduct
- UK Mandatory Cap and Trade
- UK Market Transformation Program
- The Green Grid
- Intellect UK
- BCS Carbon Footprint working group
Why is IT equipment so inefficient?

- Historically equipment was selected based only on price : performance
- Redundant Components
- Vendors responded to this demand through the entire chain
- Manufacturing and Disposal ~75%
Many new products and services from vendors in all parts of IT and M&E

- Products are pitched within their own layer and compared within that layer
- Lack of generally accepted metrics and models to compare equipment
- Vendors creating their own, proprietary metrics to present their equipment in best light
- Near impossible for IT user to effectively compare servers / UPS etc in their scenario
But Virtualisation (insert name of current high margin product) will save us!

- No it won't, virtualisation is a one shot deal with diminishing return
- Same applies to many other ‘savior’ technologies
- High power density ‘solutions’ such as blades just move the problem around
New breed of equipment based on energy efficiency now that there is market demand

- New servers present new challenges as well as solutions
- Power demands will still rise
- Propose target to increase performance without increasing power demand of servers
- IT equipment labeling

Creating the IT Profession
Metrics, how do I choose equipment?

- Sun SWAP
- SPECPower & Energy Star
- What about Data Centre Infrastructure?
- Broader measurement and analysis tools and standards
Meeting the Energy and Financial Challenges in IT

Required Changes in our Industry
New breed of Data Centre designs and equipment

- Fresh air cooling
- DG & CHP, absorptive chillers
- High efficiency UPS etc
- Fully enclosed air flow
Choosing a Design Reliability

Data Centre specification excessive
‘best practice’, ‘best you can afford’
not based on requirements

Data Centre specification
dominated by 5% most critical systems,
overkill for the other 95%
### Achieving Real Reliability

Multiple Tier2/3 sites can reduce cost and improve availability

<table>
<thead>
<tr>
<th>Tier</th>
<th>Redundancy</th>
<th>Annual Downtime</th>
<th>Single Site Availability</th>
<th>Dual Site Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N</td>
<td>28.8</td>
<td>99.7%</td>
<td>99.999%</td>
</tr>
<tr>
<td>2</td>
<td>N+1</td>
<td>22</td>
<td>99.75%</td>
<td>99.999%</td>
</tr>
<tr>
<td>3</td>
<td>N+1 / N+2</td>
<td>1.6</td>
<td>99.98%</td>
<td>99.99999%</td>
</tr>
<tr>
<td>4</td>
<td>2(N+1)</td>
<td>0.4</td>
<td>99.995%</td>
<td>99.9999998%</td>
</tr>
</tbody>
</table>
There is an optimum reliability for any service defined by minimum overall cost.

**Minimise Overall Business Cost**

- **Reliability:**
  - 99.000%
  - 99.700%
  - 99.900%
  - 99.970%
  - 99.990%
  - 99.997%
  - 99.999%

- **Cost:**
  - £1,000
  - £10,000
  - £100,000
  - £1,000,000
  - £10,000,000
  - £100,000,000

- **Required Changes - Process**
Problems with Design Reliability

High Design Reliability can be an illusion

- 10% Hardware
- 40%-80% Human error

Failures Happen, Accept this and Design for it

- Fault tolerance
- Fault containment
- Maximum independence
- Not more monolithic hardware
DCSG energy and cost models for IT equipment and data centres

- What does a model need to include?
  - IT workloads
  - Server models
  - Data Centre Infrastructure Models
DCSG energy and cost models for IT equipment and data centres

- Open Source, public review, no need for multiple models, unbiased
- What can a model tell you?
  - Efficiency of existing equipment
  - Efficiency of proposed new equipment
  - Benefits of virtualisation
  - Impacts of data centre operational process
What has our analysis told us about Date Centres?

- DC / M&E costs dominate IT equipment costs
What has our analysis told us about DC Operations?

• Data Centres are not individual components, they are complex systems, view them as such
• Component Improvements can be masked
• Consider Merging your IT and M&E groups now
What has our analysis told us about DC Operations?

• There is considerable capacity locked up in your current data centre
• Stop nameplate provisioning
• Retrofit with airflow control, blanking plates and contained hot / cold aisle
What has our analysis told us about DC Operations?

- Buy servers by Performance / Watt not Performance / £
- One-App per server - buy the lowest power servers
- Build lower Tier data centres and achieve reliability at the systems / network level
- Build modular data centres to keep the utilisation levels high
- Crop Rotate your data centre to sweep out the disused equipment
What has our analysis told us about Data Centres?

• Green is Good Business
Thank you
Find out more
http://dcsbg.bcs.org