# Not another "green" data centre presentation - or

IT starts from here

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Cable&Wireless

# Objective

To start a train of thought; that perhaps you've not considered previously

- What is the output from the largest DCs? – pica-watts of data
- What is the input? Mega-Watts of power

To prompt self questioning, E.G.

- Why are we in the present position with Datacentre power?
- Why do DC continue to grow in the manner they have?
- Can those working in Datacentre / IT / facilities change this?

# Not covered

Numerous presentations exist by very learned speakers covering:

Datacentre design and maintenance practice.
Site development or equipment improvements

This presentation specifically excludes:

- Moore's law
- Hot/Cold aisle configurations/ Cold containment
- Room conditions
- UPS Engine design,
- Resilience levels Y(N+X)

But will try and challenge conventional thinking

# Define the problem

- Most companies / organisations are dependant on IT processing
- Data processing consumes power
- Bigger faster processors consume more resource
- Power is becoming increasingly more expensive
- $CO_2$ production is proportional to power consumed
- Efficiency requirements are driven by many sources:
  line management, market, Government and peer pressure
- Reliability works against this efficiency

There is no single “magic fix”

# Green data centres

Fact or fantasy?

If the IT processing requires power consumption at anything above domestic density, then without fundamental technology change we are left needing vast electrical supplies to operate IT systems

If as operators we continue to concentrate servers into sites to achieve economies of scale then cooling will continue to be required

So Greener data centres are probably the best outcome without a fundamental technology change.

# Scale of the problem

Finding reliable consumption data is tricky. Most organisations don't keep this data in a ready to use format… yet. New Euro building ratings due March/April 2009

In the US (2006) Environmental Protection Agency[1] quote 61 billion kW/hrs were consumed by servers. Or 1.5% of total US 2006 consumption.

Other DC's: How much does the rest of the world consume? The same? More?

The total is a big number – however it is estimated

1: EPA report to Congress on server and Datacentre energy efficiency Aug 2nd 2007

# Scale of the problem

1kWhr ~ 0.51 kg CO2 or

1000kg ~1960 kW hrs [2]

61 billion kilowatt hours

61,000,000,000 x 0.51=

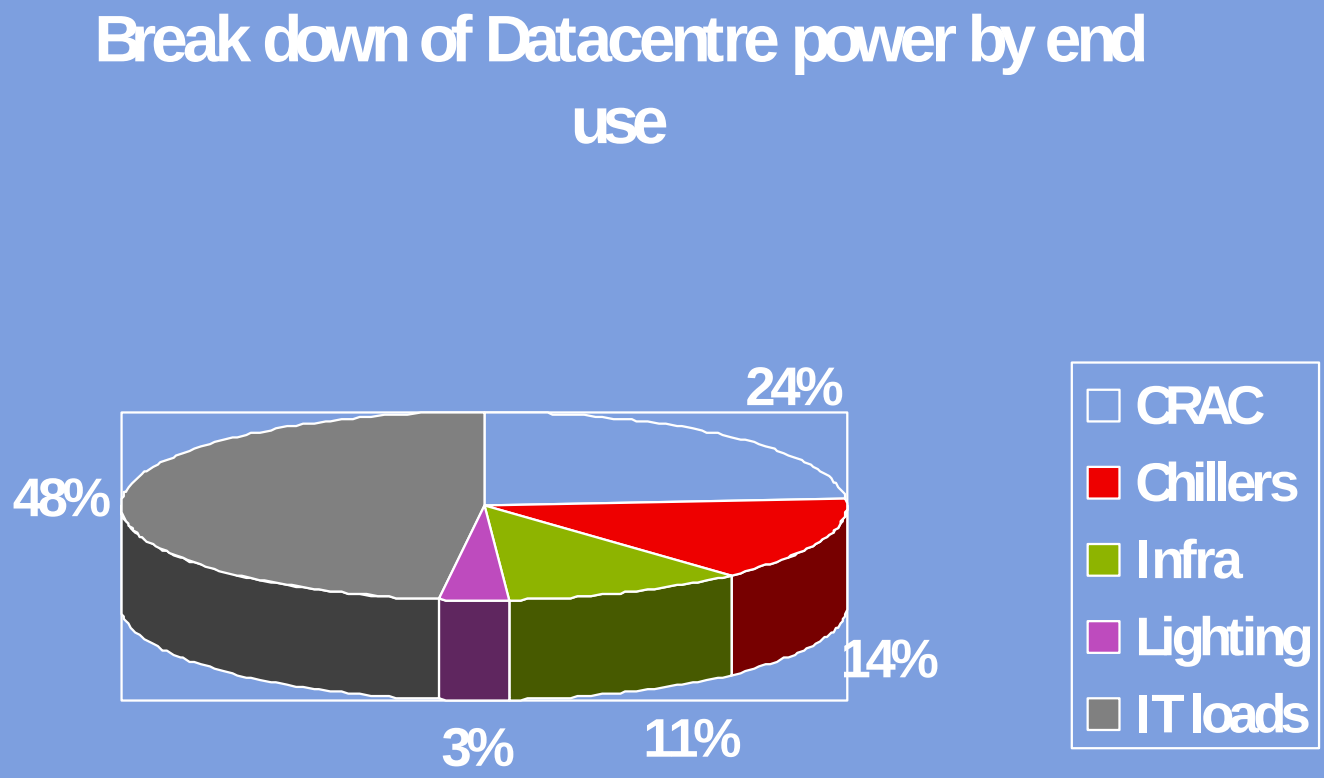
31,110,000,000 kg CO2/ year

Equates to 3,235,440,000 km of urban cycle [3]

2: CO2 to kW hrs from IBM Communications Centre download pdf papers 2008

3: Mini Cooper 1.6 diesel 0.104kg/km - figures from Mini Brochure 2008

# where does the energy go?




Chillers /CRAC units / Infra - How can these loads be influenced?
There are lots of traditional systems – and some new variants

from J.D. Mitchell-Jackson, “ENERGY NEEDS IN AN INTERNET ECONOMY: A CLOSER LOOK AT DATA CENTERS”, UCB Masters Thesis, July 10, 2001.
C/O Intel Corp 2006

# What can be done?

Strategic not tactical; Avoid silo thinking IT / Facilities

Look at the losses (DC  heat loads) – and follow the trail back to their origin.

Look at the IT box - how it work? Where does it use power? (losses)

Reducing loads at the server reduces the scale of everything in the delivery streams.

Use collective or community  buying power to influence products available.

Adjust what is specified / bought – servers have become cheap, but do we buy what is needed or what is sold?

# What, where?

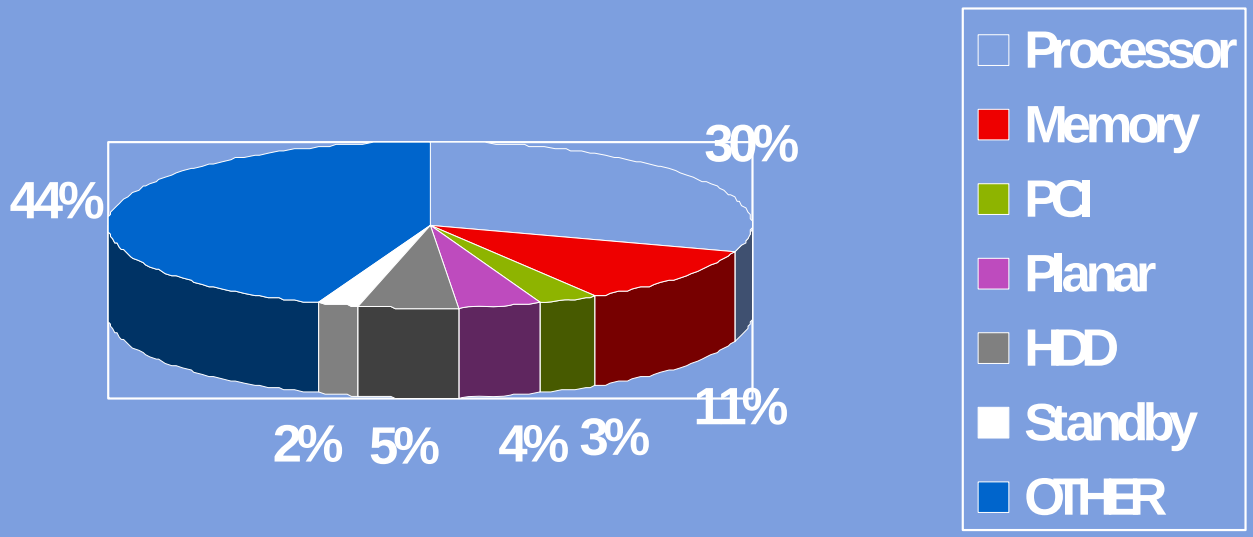
"*Newtonian Physics*"
Cannot create, or destroy energy or matter.

Losses occur where energy is changed (transformed) or work is done –

- Transformers
- Rectifiers
- DC/DC voltage change
- Rotating machines etc.

In a DC ~52% is  a facility over-head. The temptation is to focus on this – traditional thinking? However is there a potential loss that's invisible ?

# Inside the Server




Of the 48% facility power used by the IT Box
*"Other"* @ 44% - These are the components required to make the IT box work
Power supplies, cooling fans, Power converters, Losses in transmission etc.
Or only 27% of Facility power gets to the IT processing equipment ~ 73% losses

How many different voltages are used on a motherboard? Why?

Source: Chart - Intel presentation "the Green Datacentre 2007

# On the motherboard

Chip speeds have been increased by putting more transistors on a wafer. Tracks have become physically closer, so voltages have dropped to stop cross over.

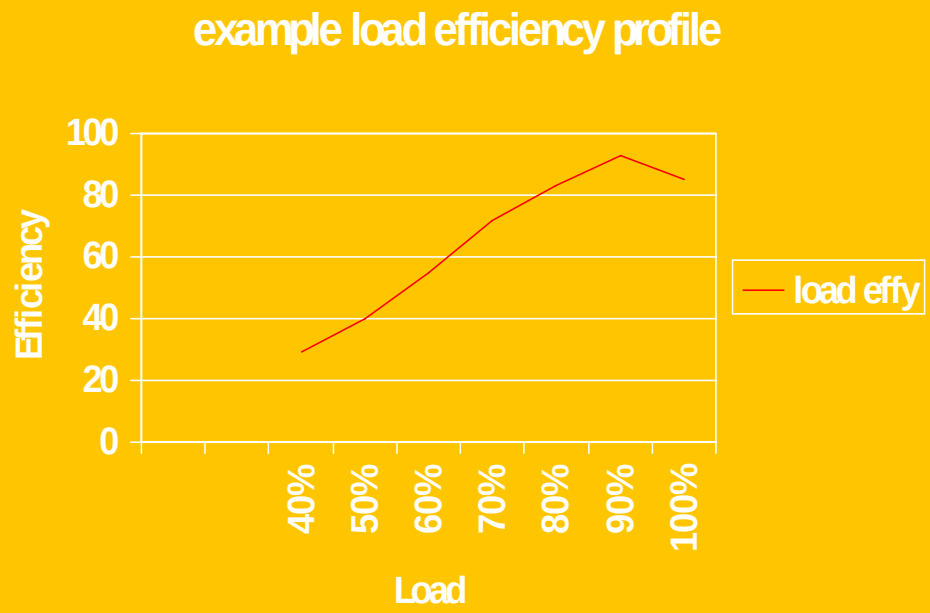
All as customers demand higher processor power.

If we apply school physics $V=IR$ and $W=I^2R$

For a given modern chip processing current (I) is higher. So losses must have increased by a square law.

# Load factor

All IT boxes will have a Power Supply Unit (PSU) with an efficiency. A typical curve will rise with load and dip when run at maximum or overload. The better designed PSU the flatter the curve



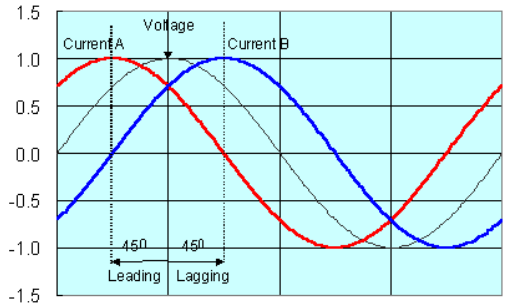

In a modern DC where is the “normal” operating point of these PSUs?

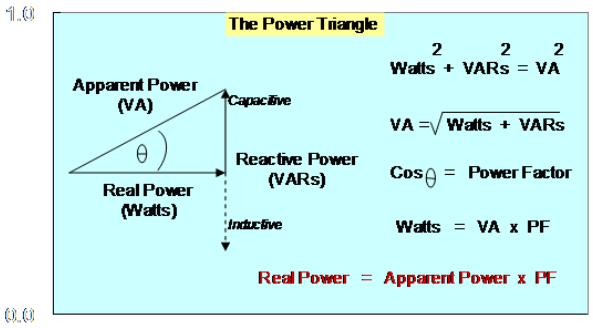
Best case: Server 90-95% loaded
PSU: 45-47% loaded

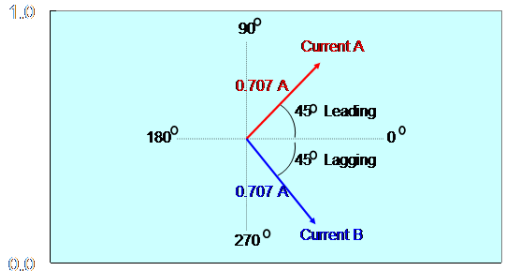
Worst case: Server 10% loaded
PSU 30-40% loaded

When is peak efficiency reached – For a small % of the year, when the server has a PSU failed or one UPS feed is lost

# Power factor



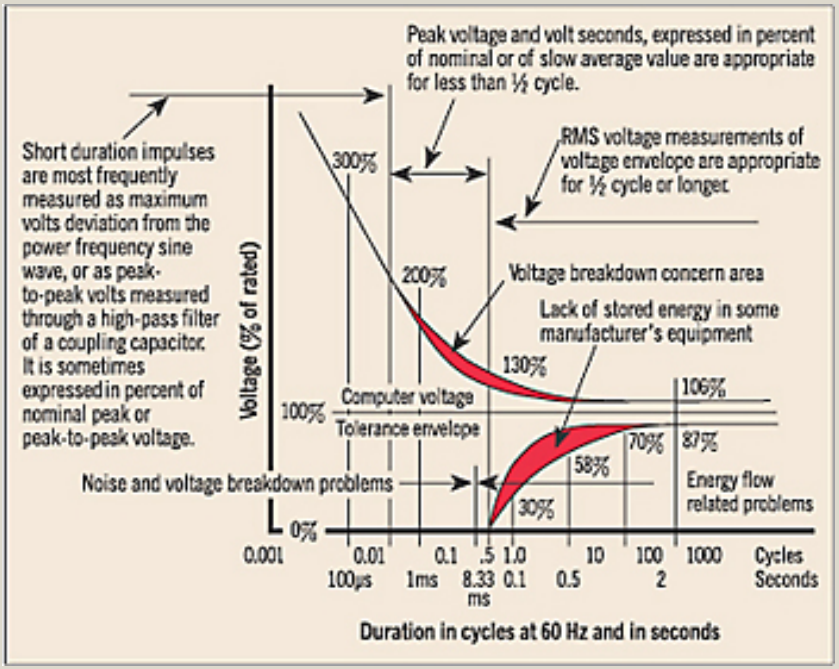




www.the-power-factor-site.com

# Power factor

Leading Power Factor can be experienced as manufacturers seek to comply with CBEMA performance curves. Capacitors are added to PSUs




At low loads these capacitors can make the loads on a UPS system capacitive.

Capacitive loads de-rate most UPS systems making them less efficient.

CBEMA curve derived by the Computer Business Equipment Manufactures Association

# Conclusions

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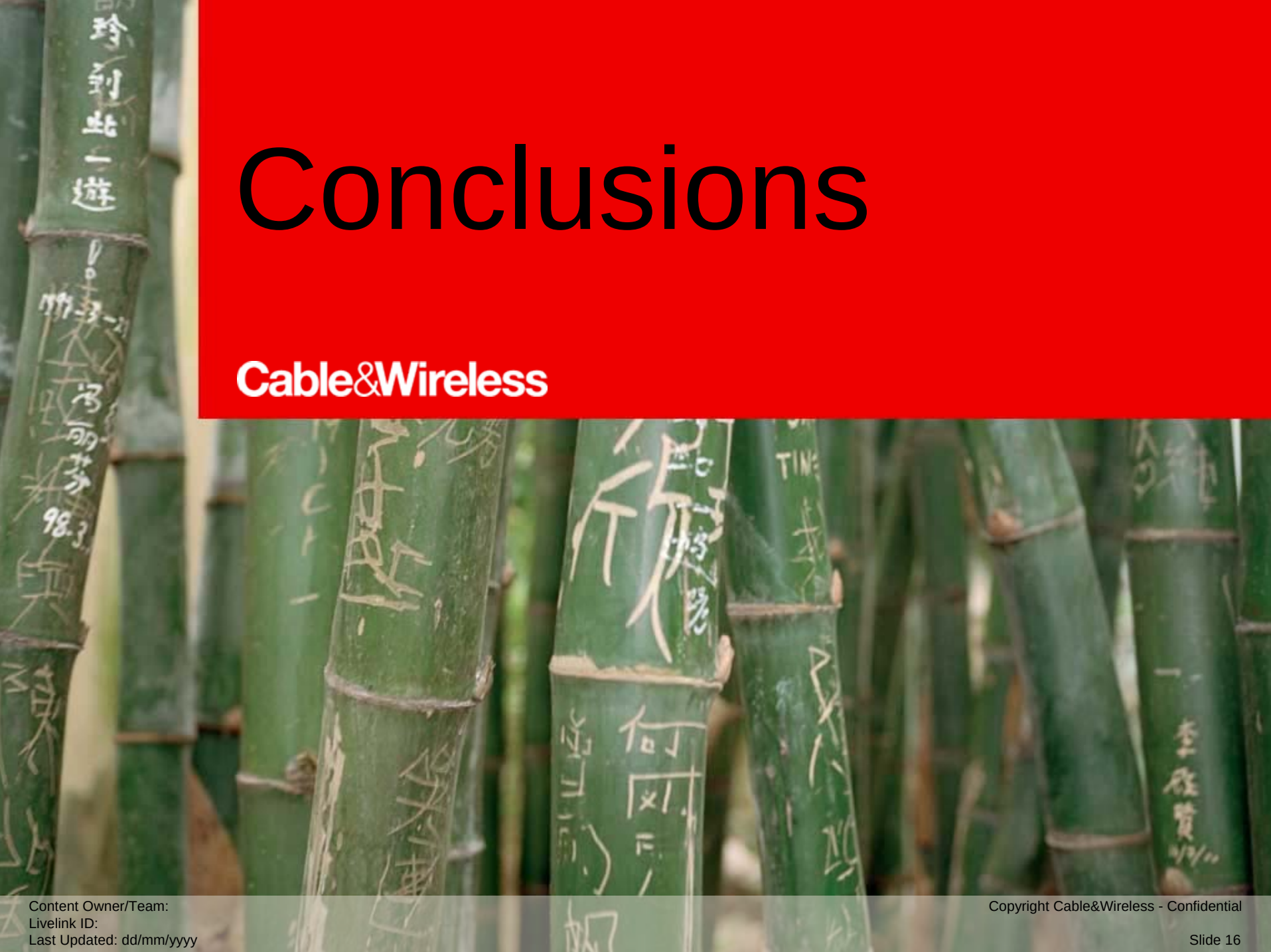

# Conclusions

As operators: IT professionals need to understand where DC energy is used. – this will influence behaviours, to make the IT equipment and site match one another. Avoiding silo decisions.

Turning servers off that are not working and making those that run, do so at peak efficiency is clearly an advantage.

IT need to look at server /storage /monitoring deployment – over spec-ing adversely influences power draw and site demands

Facilities need modular build to cope with IT load changes. Spec needs to cope with Leading PF.

Vendors / manufactures need to understand the impact of the boxes sold on DC infrastructure.

# Not another “green” data centre presentation

So for a truly Green Datacentre select your colours carefully

British Standard colours – BS 381C and BS 4800
Greens are defined as “RAL 60XX”

RAL 6002 leaf green

RAL 6010 grass green

RAL 6012 black green

RAL 6016 turquoise green

RAL 6019 pastel green

Specify this with your Architect carefully :o)

# THANK YOU

## Questions?

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