Energy Efficiency in the Datacentre

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1970's Datacentre

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2010 Datacentre

Not much has really changed

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What is a Datacentre

- **Whether you have half a rack of equipment or a large dedicated room, business processes are relying on IT processes more than ever before.**
- **Data Centers are now mission critical facilities with new challenges and requirements**

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What is a Datacentre

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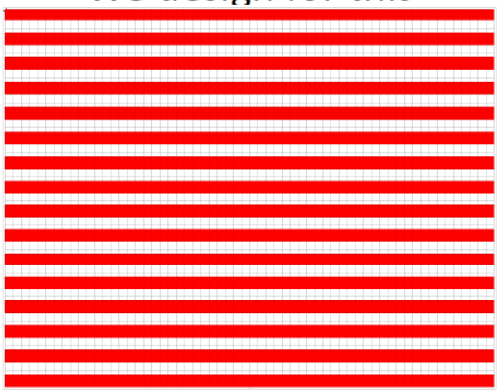
Datacentre Challenges

We design for this



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Datacentre Challenges

When we needed this

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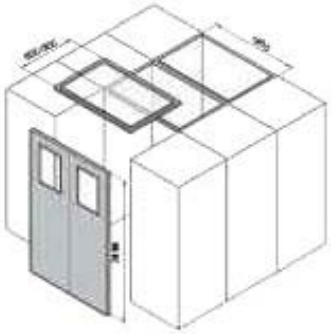
Datacentre Challenges

Or this



Or even this

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Datacentre Challenges

- Rapid pace of IT has given rise to massive challenges
- Power
- Cooling
- Space

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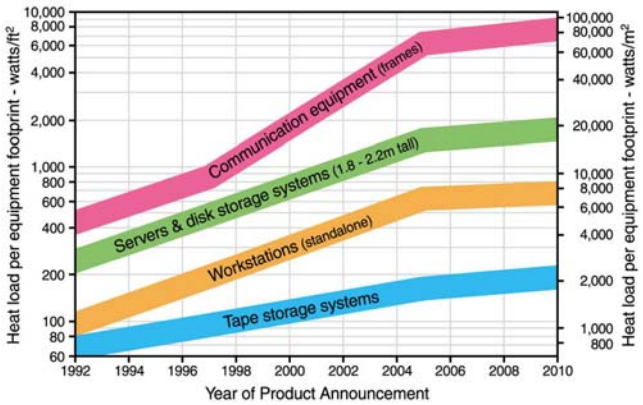
Datacentre Challenges



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Datacentre Challenges

- **Electricity Prices are tipped to rise as much as 60% over the next three years.**
  - *(Independent Pricing and Regulatory Tribunal)*

Many Companies, Institutions and Government Agencies have agreed to be carbon neutral by 2020

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Datacentre Challenges

- **Technology compaction is the major trend impacting rack systems**
  - **Escalating heat densities of rack-mounted equipment**
  - **Increasing number of required power receptacles with redundancy**
  - **Large amounts of power and data cables**
  - **Increasing rack-mounted equipment weight loads**
- **Technology convergence driving a mix of rack-mounted equipment**
  - **IT equipment (servers, storage devices) mounted in same rack with networking equipment (switches, routers)**

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Datacentre Challenges

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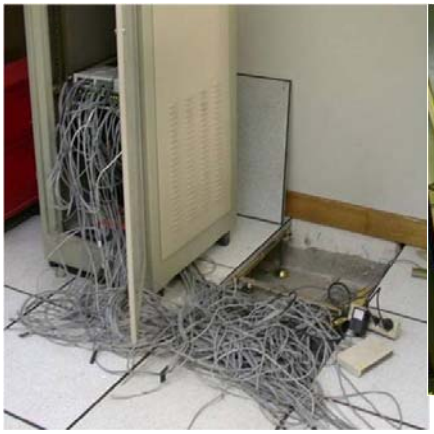
Datacentre Challenges



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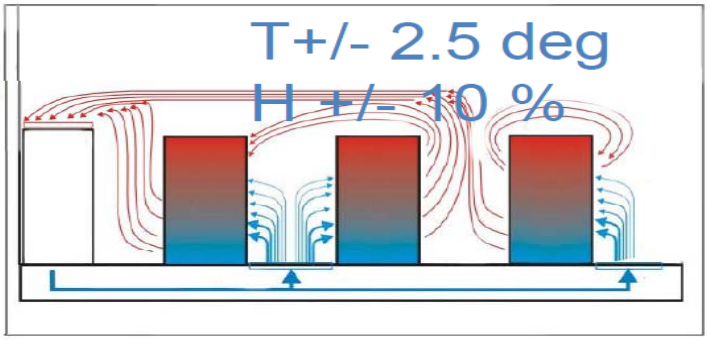
Datacentre Challenges

Some things need to change (and change is coming!!!)



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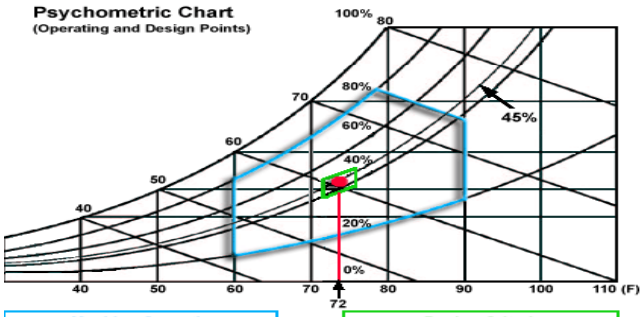
Datacentre Challenges



Machine Operating	
Temperature	16-32° C 60-90° F
Humidity	20-80 %
Max Wet Bulb	22° C 73° F

Design Criteria	
Temperature	22° C (72° F)
Rel Humidity	45 %
A/C Controls	+/- 1° C (2° F) +/- 5 % RH

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Standards

- **ASHRAE**
  - *(American Society of Heating, Refrigeration & Airconditioning Engineers)*
  - New Standard 90.1 is going to include Datacentres
  - *Standard requires, with some exceptions that all Datacentre cooling systems – namely each system that has a fan shall include an air or water economiser (essentially ASHRAE is advocating "free cooling" systems)*
  - *Standard also requires prevention of mixing hot and cold air streams and heating and cooling of the same airstream (Containment is then a must!)*

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PUE

- PUE
  - Power Usage Effectiveness
    - At the simple level, PUE is computed by dividing total facility power by IT equipment power.
    - "Playing the PUE Game"

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PUE

- **PUE is only one measurement of data center efficiency and not always the most meaningful. It only compares *relative* energy use. An *absolute* metric, such as performance per watt, provides data that's more useful for comparing one Datacentre to another.**

- ***(performance per watt)***
- **The rate of computation that can be delivered by a computer for every watt of power consumed.**

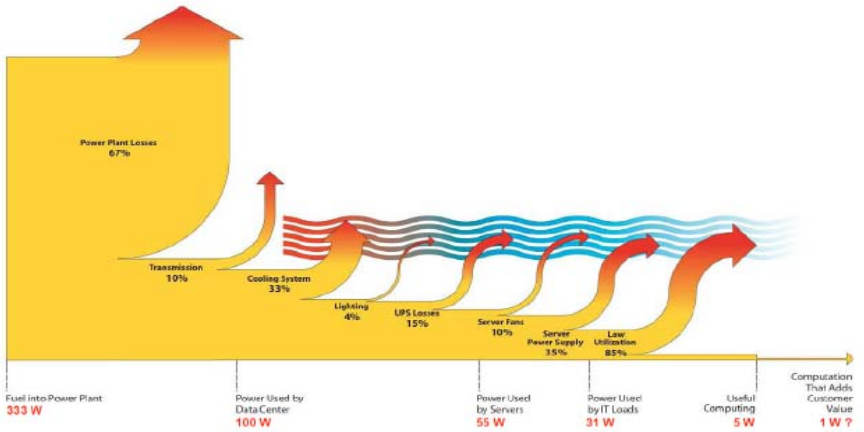
Compute Power Efficiency (CPE)

- **Introducing Compute Power Efficiency (CPE)**
  While PUE captures Datacentre efficiency, there still needs to be a way to capture how efficiently the Datacentre power is used for computation. To capture the computational efficiency, a new metric is introduced called Compute Power Efficiency (CPE). CPE is defined as:

CPE = IT Equipment Utilization / PUE
= (IT Equipment Utilization * IT Equipment Power)/ Total Facility Power

- **This metric provides a view of what percentage of the total facility power is actually used for computation. It connects IT hardware efficiency with the Datacentre infrastructure efficiency. The metric may be applied to an individual server or an entire Datacentre, provided a weighted average utilization may be determined. In many Datacentres, enterprise server utilization is typically 20% or less. This means that for a typical, well-managed Datacentre with a PUE of 2.0, the CPE is 10% or 1W for every 10W of utility power is actually used for computing. Datacentres with a PUE of 3.0 have a CPE of 6.7%**

Compute Power Efficiency



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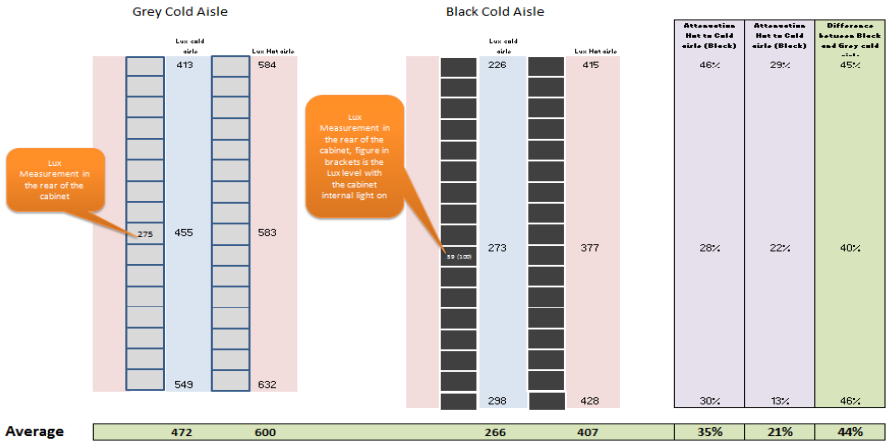
Black Racks vs Light Racks



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Increasing Efficiency

- **Modularity wherever possible**
  - *("Pay as you grow" approach)*
  - *Room/space*
  - *Power – UPS, Distribution*
  - *Cooling*
  - *Virtualisation*

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Increasing Efficiency

- **Power**
  - UPS Efficiency – High efficiency coupled with scalability
  - Monitor everything from transformer to equipment – you can't improve it if you can't monitor it

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Increasing Efficiency

- **Cooling**
  - This is where the majority of gains can be made in efficiency and overall costs.
    - *(many Datacentres are overcooled averaging 2.6 times the amount needed for their server load – but still suffer from hotspots – The Uptime Institute)*
    - Simple solutions like blanking panels, sealing up holes in raised floors, stopping aircons from fighting

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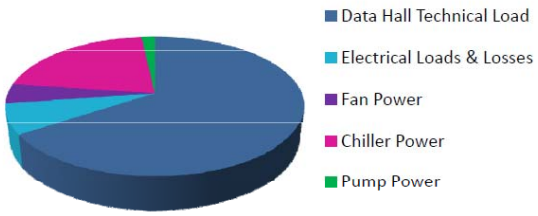
Increasing Efficiency

Data Centre Energy Usage



- The largest portion of parasitic load is the power used for cooling and as such provides the greatest opportunity to save energy

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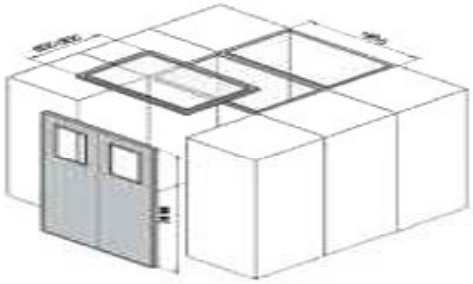
Increasing Efficiency

- **Cooling**
  - Separation of Hot and Cold Air



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Increasing Efficiency

  - Bring Air handlers as close to load as possible ie next to Enclosure

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Run your cooling higher than old ASHRAE standard – look at rated inlet temp of system (*you will be surpised)*

Operating Temp – 10 – 43 deg
Relative Humidity – 18-80%
(common 1RU Server Brand)

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Increasing Efficiency

- **Cooling cont-**
- **Utilise systems with high inlet water temps so "Free cooling" becomes a real option, 15-20 deg water is optimal**

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Increasing efficiency

- Look to utilise Co-gen or Tri-gen systems such as Gas Micro Turbines

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Increasing Efficiency

- Gas can be run during the day, run on mains power at night (off-peak tarrif)
- Use heat from Turbines combined with absorption chiller to run cooling
- Use with economisers for increased efficiencies

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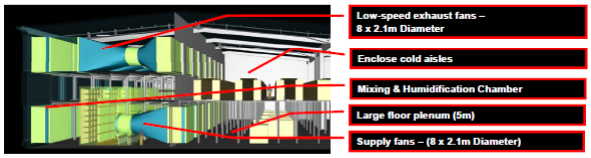
Increasing Efficiency

One Design Solution

- Mix and temper the air on a scale that has not been done before



Coutesy DCD – Patrick Fogerty NDY

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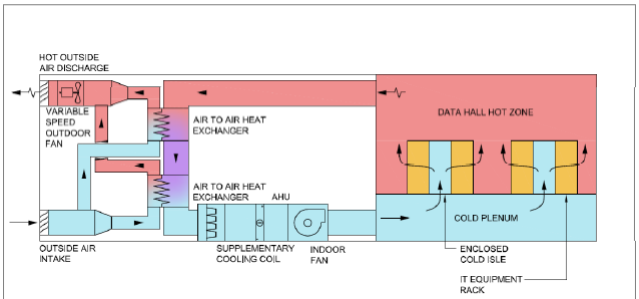
Increasing Efficiency



INDIRECT OUTSIDE AIR COOLING FOR DATA HALL FACILITIES

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Increasing Efficiency

HP (EDS) - Wynyard

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Summary

- **Modular is King across all aspects of Datacentre – increases redundancy, lowers costs, increases Efficiency**
- **Measure – PUE, CPE – Can't change what you don't know**
- **Separate Hot from Cold**
- **Utilise "Free Cooling" where possible**

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Thank you

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