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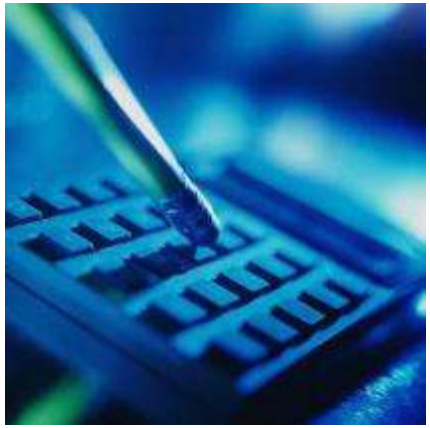
Thin Clients, Clouds and Data Centers



BREAKFAST SESSION

Monday, 1 November 2010

PROGRAMME

8.30am	Registration
9.00am	Presentation
10.15am	Coffee & demonstration
10.30am	Design & case study
11.15am	Q&A
11.30am	Networking & close

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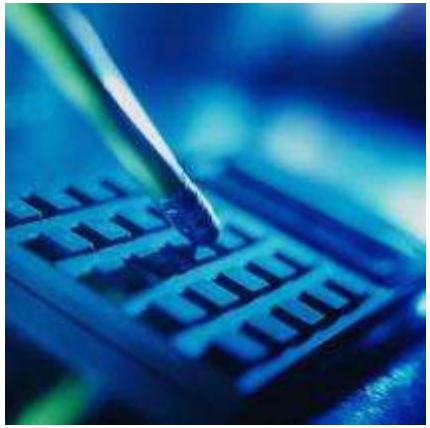

Upcoming Events

4i Forum Launch - December 2010

2011

Predictions & Resolutions

Joint BIFM Event

Joint YEP Event

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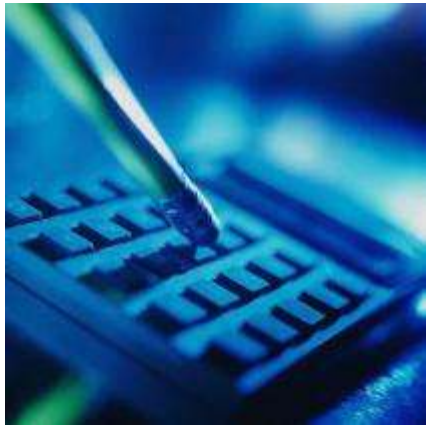

Greg Koplick

Programmes Committee

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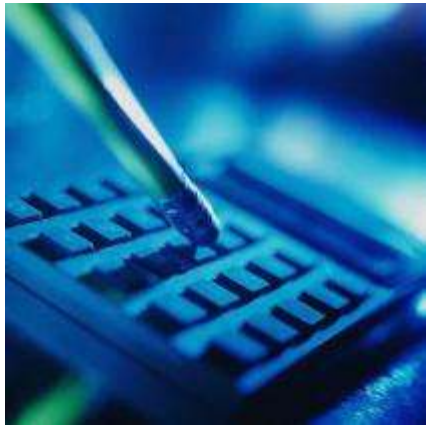
Martin Laws	Moderator. Deloitte
John Starling	Deloitte
Alan Wakeman	Oracle Corporation
Marc Mulhuijzen	Oracle Corporation
Richard Forrest	Deloitte
John Killey	Citi



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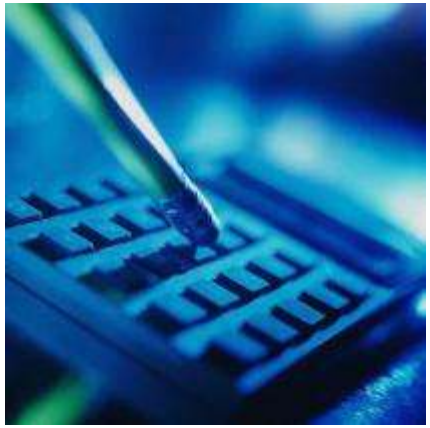

Martin Laws

Partner, Real Estate Solutions

Deloitte

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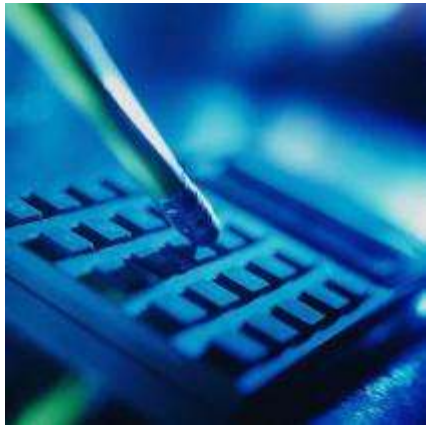

John Starling

Associate Partner, Technology Integration Practice

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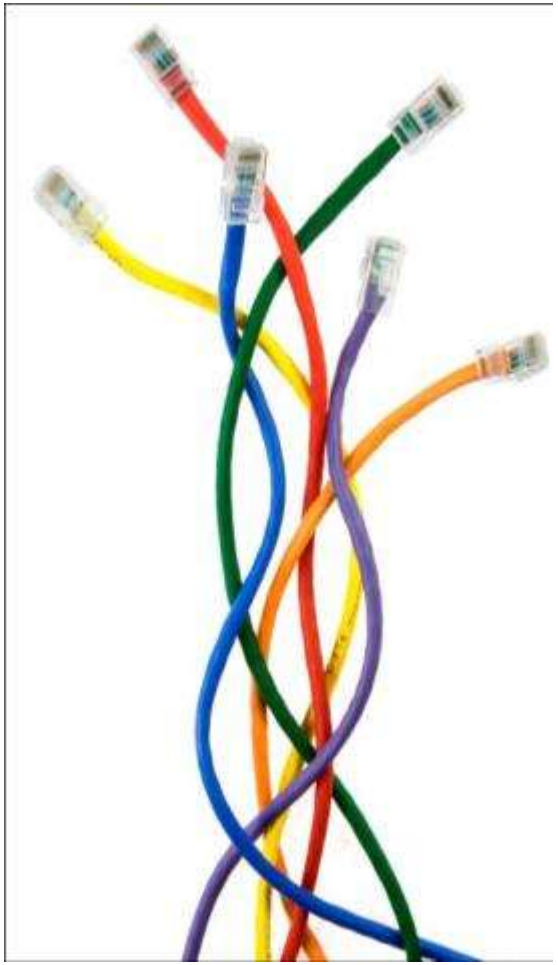
Current and future tends in

Cloud, thin client and web 2.0



Introducing Deloitte

Deloitte is the largest professional services company in the UK. As well as providing advice and services, we conduct and publish technology research across a variety of topics...

John Starling : Associate Partner

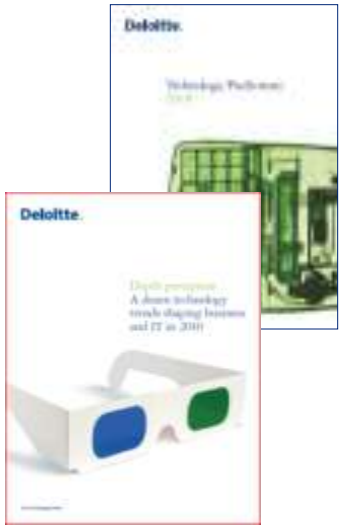
- Fifteen years of IT experience within industry and management consultancy, specialising in the management of IT and Infrastructure Services within Financial Services.
- Leads Deloitte's data centre practice within the UK.
- Also worked in Merrill Lynch, Deutsche Bank and VISA.

Technology Predictions Series

This document gives Deloitte's predictions to emerging technology trends and the technology market. Initially focused on the TMT industry, the predictions are now recognized as relevant to all industries.

UK CIO Depth Perception

Our Depth Perceptions document also covers a range of technology trends, aimed at increasing the CIO 's understanding of hot topics



Hypothesis:

The corporate office is dead.

Cause of death:
Cloud. Mobility. Web 2.0.
Virtualisation.

Cloud Computing

Cloud Computing

Cloud is perhaps the most "hyped" of all technology trends in recent times, and is on the minds of every CIO.

At Deloitte we define Cloud simply as *"the delivery of IT through technologically abstracted and commercially flexible models".*

•'Cloud' can be provided *Internally* or *externally.* Regardless of this, the service needs to be flexibly provided in terms of demand and the cost to the business;

•Many elements of IT can be delivered as 'cloud' services, including individual applications, whole environments (e.g. development/test), storage, email, DESKTOP, etc

•Externally provided Cloud makes commercial sense:

- To reduce capital expense. OPEX and speed to market;
- Where Cloud providers can leverage economies of scale to beat the "in house" cost;
- When demand for services is variable;
- If skills in the area do not exist in house, or where existing IT capacity (space, power or resources) is limited.

Cloud Computing

Why wouldn't our IT managers choose Cloud?

Constraints and Limitations

- Cloud vendors do not have mature services in all areas; the reality is behind the hype!
- Cloud services are inherently "commodity" and therefore less bespoke and functionally sophisticated;
- Cloud services are separate from one another; integration will be lower and interfaces may be challenging to implement; (NOT THE CASE WITH DESKTOP – CLOUD IMPLIES CENTRALISATION OF APPLICATIONS WHICH MAKES IT EASY TO PROVIDE A PERFORMANT, SECURE, FLEXIBLE DESKTOP ENVIRONMENT).
- Concerns around *where* the data is stored and processed can cause significant concern; not all cloud vendors can answer these questions adequately.
- QUITE OFTEN IT'S NOT IN THE INTERESTS OF THE IT DEPARTMENT TO PROMOTE CLOUD.

Implications to Corporate Real Estate

- The need for corporate data centres may reduce.
- Applications will be accessed via the web, increasing mobility and reducing the demand for traditional workstations.

Mobility

[insert slides on mobility technologies]

- ACCESS :
  - 3G
  - WIRELESS
  - DSL
- REMOTE ACCESS SOFTWARE
  - SECURE GLOBAL DESKTOP
  - THIN CLIENT EMULATION (ORACLE VIRTUAL DESKTOP CLIENT)
  - CITRIX
- DEVICES
  - LAPTOPS WITH WINDOWS OR LINUX
  - MAC
  - THIN CLIENT LAPTOPS

Implications to Corporate Real Estate

- Workers will have the tools to access corporate systems, anytime, anywhere.
- This will further reduce the demand for traditional workstations.

Web 2.0
Collaboration & Social Media

Collaboration, Web 2.0 and Social Computing

To put it simply social computing is about harnessing the power of participation over the network

Web 1.0 *"Interrupt the mass audience"*	**Social Computing or Web 2.0** *"Engage the individual"*
▪ Structured	▪ Flexible
▪ Siloed	▪ Collaborative
▪ One size fits all	▪ Personalised
▪ Passive audience	▪ Communities of engaged users
▪ Top-down only	▪ Top-down, bottom-up & lateral
Power lies with: institutions, platforms, and technology	Power lies with: users, communities, and experiences

LinkedIn · friendster · YouTube · Slashdot · Juice · reddit · digg · facebook · metacafe · twitter · StumbleUpon · WordPress · plaxo · Wikipedia · slideshare · Technorati

AMR Research

"Companies that don't employ wikis or blogs, whether the CIO knows about them or not, are quickly becoming a rarity."

FORRESTER®

"Social computing is not a fad… [it] will impact almost every role, at every kind of company, in all parts of the world."

What are the benefits of social computing?

Implementing a Social Computing programme can bring a number of benefits

Facilitate internal connectivity

- Break down internal barriers and promote collaboration
- Improve employee engagement through multi-user, 2-way communication

Improve customer relations

- Improve understanding of customer needs
- Build stronger relationships with partners and suppliers
- Reinforce brand image and reputation

Share knowledge

- Improve content discovery and reuse
- Use ratings to identify the most useful documents
- Break down historical content silos

Improve collaboration

- Enable collaboration across time zones and locations
- Support teams through shared documents and calendars

Encourage innovation

- Use the wisdom of the cloud to generate and prioritise ideas
- Focus R&D effort on solutions which address user needs

Improve productivity

- Reduce time required to locate information, documents and experts
- Reduce the volume of emails and attachments

Implications to Corporate Real Estate

- Employees will reject traditional working practices and demand a more dynamic, EFFICIENT workplace.

Virtualisation

DESKTOP VIRTUALISATION has emerged as a genuine alternative to the traditional desktop computer

What is it?

- **DESKTOP VIRTUALISATION** – *a STACK of technologies that deliver a user's "desktop" independently from the physical hardware the user interacts with*
- *DV delivers a user's personalised desktop experience – anytime, anywhere, and securely*

What do you need to know?

- DESKTOP VIRTUALISATION is mature, works and is now becoming mainstream

Organisations will be considering DESKTOP VIRTUALISATION as they plan for Windows 7

DESKTOP VIRTUALISATION will challenge the IT organisation, and the CRE (?) needs of the organisation

The case for DESKTOP VIRTUALISATION is cost reduction, efficiency, security, mobility and workspace flexibility

- Whilst capital intensive (?), the case for "doing nothing" is often more expensive

Bottom line

"the traditional desktop model — inherently insecure, inflexible, and hard-to-manage — is a thing of the past ... client virtualization is not just an emerging trend, it's the future of the corporate PC" ***Forrester Research***

Whilst DESKTOP VIRTUALISATION can deliver both TCO and unit reductions, we believe it should be positioned as a platform for enterprise wide cost reduction and business transformation

Enterprise "hidden" costs

- Flexibility
- Disaster Recovery
- People & office moves
- Office space
- Electrical power
- Training & downtime

Example "enterprise" opportunities

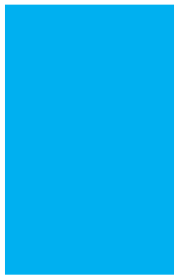
- Increased user mobility and productivity
- ***Rapid and simplified "office" deployment***
- ***Reduce the overall demand for office space and running costs through better space management, utilisation and hot desk concepts***
- Bring Your Own Computer to work
- Manage offshore / remote workers more securely and simply
- ***Simplify the movement of staff around facilities and avoids expensive and disruptive movement of IT equipment***
- ***Reduced requirement for redundant space e.g. Continuity facilities***
- Reduce the cost associated with home or remote users and access
- Overall reduction in total power consumed in supporting desktop computing workload

IT desktop costs

TCO x units

- HW / SW
- IT Ops
- Admin

TCO reductions - 10-15%



Key elements

- Reduced hardware support and maintenance
- Reduced software licensing , e.g. Information security
- Reduced disposal costs
- Reduced IT and IT security operations

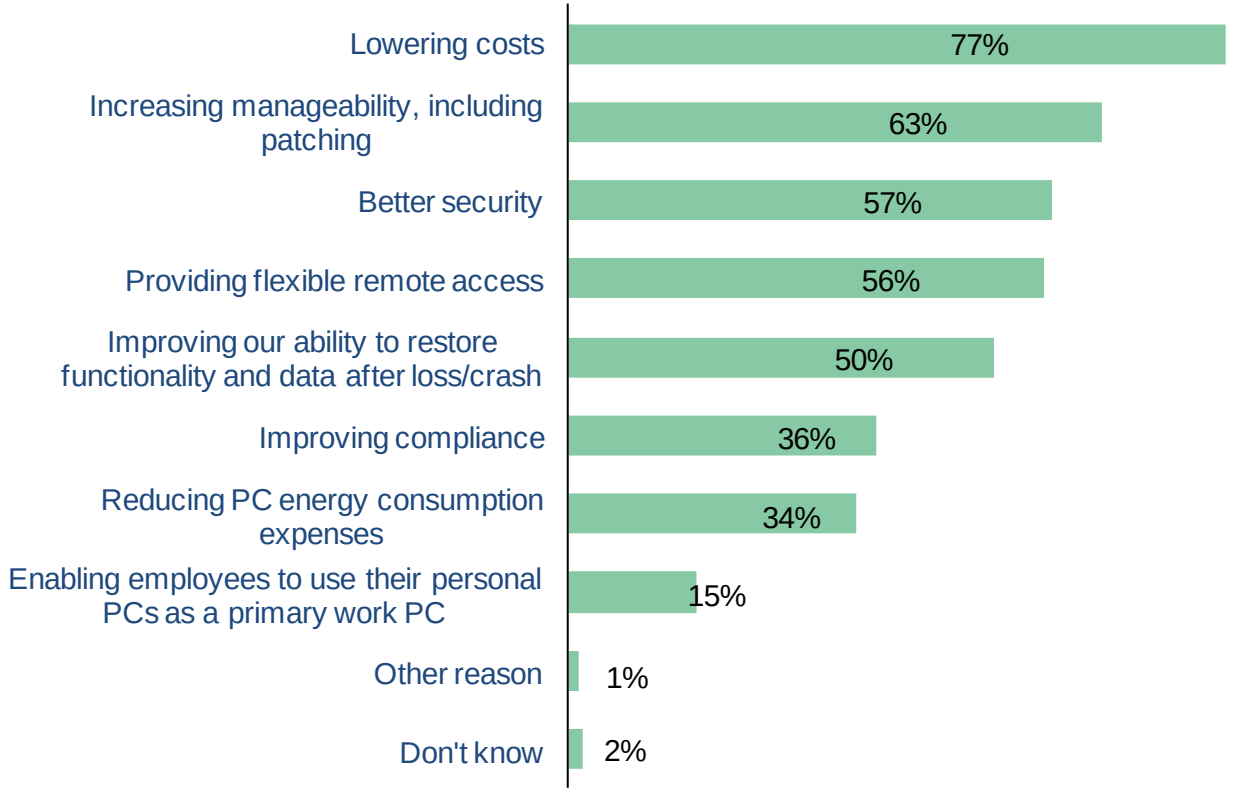
Unit reductions – further 10-15%

Key elements

- Desktop pooling
- Desktop "build on demand"

Market Research : Driving Forces behind alternate desktop delivery technologies

"Which of the following aspects of the traditional client PC environment are driving your firm's interest in alternative(s)?"



Base: 609 PC decision-makers at North American and European enterprises and SMBs that are interested in any of the previous alternative PC technologies
(multiple responses accepted)

Source: Enterprise and SMB Hardware Survey, North America And Europe, Q3 2009

Summary of Vendors by Solution Elements

	Thin Client	'User' Blade	Protocol	Virtualisation / Hypervisor	Server	Storage	Management Software
Oracle	✓		✓	✓	✓	✓	
HP	✓	✓	✓		✓	✓	
WYSE	✓		✓				✓
VMWare			✓	✓			✓
IBM		✓			✓	✓	✓
Microsoft			✓	✓			✓
Citrix			✓	✓			✓

COMMENTS - Summary of Vendors by Solution Elements

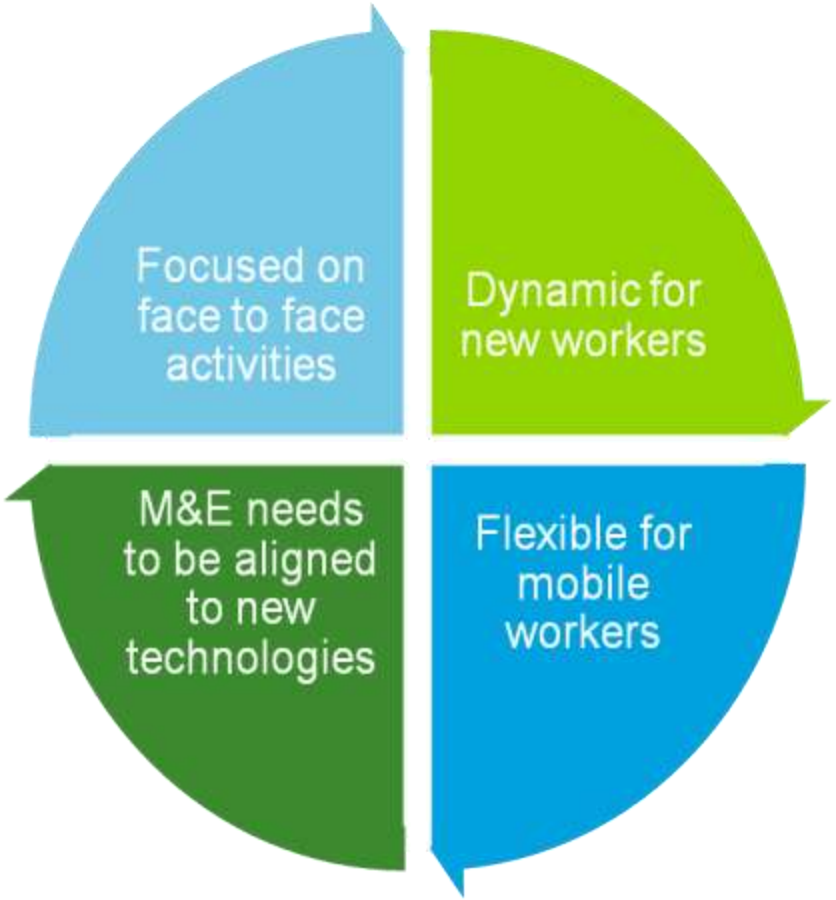
- “USER BLADES” CAN BE DEPLOYED WITH ORACLE VDI – A USER CAN USE A DEDICATED BLADE, SERVER OR PC
- IF WYSE, VMWARE AND OTHERS CAN BE CONSIDERED TO HAVE MANAGEMENT SOFTWARE (ONLY FOR THEIR COMPONENT OF THE OVERALL SOLUTION) THEN SO DOES ORACLE. WE ALSO HAVE ENTERPRISE MANAGER WHICH WILL BE EXTENDED TO MANAGE THE WHOLE ENVIRONMENT.
- ANOTHER IMPORTANT ASPECT IS OFFERING AN OPEN SOLUTION – MANY SOLUTIONS ONLY WORK WITH THEIR OWN TECHNOLOGIES OR A LIMITED RANGE OF TECHNOLOGIES
- DESKTOPS BEYOND WINDOWS – WINDOWS IS THE DEFACTO USER INTERFACE TODAY. MOST OF THE SOLUTIONS LISTED ARE PREDOMINANTLY TIED TO WINDOWS. THE ORACLE SOLUTION SUPPORTS A WIDE RANGE OF CLIENT DEVICES, CLIENT OS, AND APPLICATION-REQUIRED OS AND BROWSERS (3270/5250. VMS, OLD BROWSER ENVIRONMENTS, ETC.

Implications to Corporate Real Estate

- DESKTOP VIRTUALISATION is a key enabling tool for flexible working.
- CRE functions should be part of any strategic workplace optimisation programme decisions that help define business cases that release business benefits

Life after death.

The workplace needs to respond to these changes in IT and ways of working by becoming far more dynamic and flexible.



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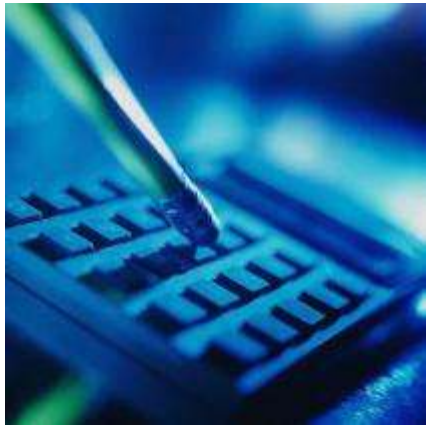

Alan Wakeman

Marc Mulhuijzen

Oracle Corporation

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Desktop Virtualisation

Alan Wakeman
Partner Manager, Oracle Desktop Virtualisation Business Unit, Western EMEA

Market Opportunity & Trends in Virtualisation

Gartner predicts -

- $65.7 billion in Desktop Virtualisation revenue and 49 million users in 2013
- Growth in number Desktops from 500,000 units in 2009 to 49 million units in 2013
- In a down economy Desktop Virtualisation is going to grow at a phenomenal rate due to cost savings

• Virtualisation a reality not just for the Data Centre – the Desktop and x86 is the major growth area for 2010 - 2011

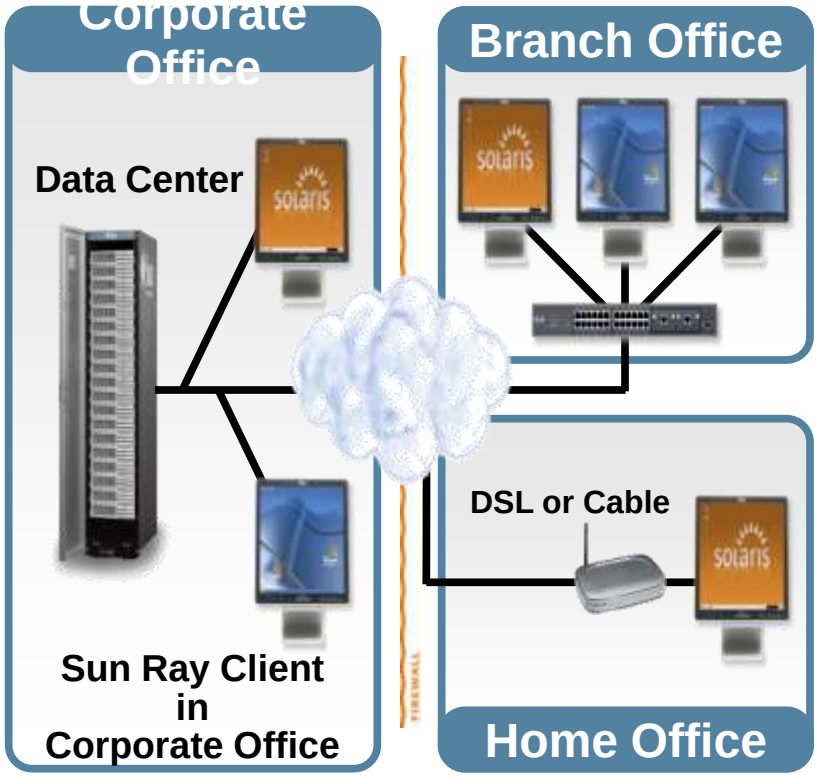
“The IT community must play its part in ensuring sustainable development. That means not only in moving to new, more energy efficient technologies such as thin clients and virtualisation- which have the potential of dramatically reducing energy and other costs , but also using information to allow people and business to operate in more sustainable ways”

John Suffolk, HMG CIO

What is an Ultra Thin Client ?

- No local Operating System
- No local data
- Display and manipulate sensitive data without it ever leaving the server
- Data is never cached
- No hard disk or addressable flash memory
- No intellectual property risk if a client is lost or stolen
- Control USB devices
- No client virus issues
- Nothing to manage

What is Desktop Virtualisation ?



- Desktops run in the Data Centre
- Secure
- Easy to manage
- Can host multiple organisations
- Enables use of dumb and intelligent client devices
- Can utilise :
  - Shared Windows environments
  - Virtualised Applications
  - Complete Virtualised desktops

What is Driving the Need to Change the Traditional Desktop Model?

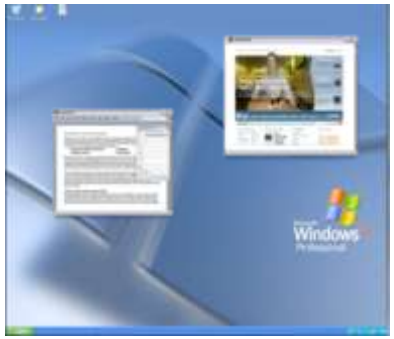
- **Lower costs** – reduce expenses beyond the cost of the physical desktop... and be environmentally friendly
- **Security** – Protect and control access to corporate assets, protect intellectual property and identity information and avoid of catastrophic disaster – Business Continuity, Lost Laptops")
- **End User Mobility** – Enterprise access with no geographical boundaries, without device limitations and with greater convenience and flexibility
- **End User Efficiency** – locations for different tasks, noise-free environment, zero boot time
- **Technology** – Constant change. Technology enhancements and innovation are turning the "Desktop" into a " Network Delivered App"

“So what did Sun achieve …?”

- **OpenWork Participation**
- Flexible location workers
  - 14,803 participants
- Work from Home
  - 12,674 up to 2 days / week
  - 1,760 3-5 days / week
- Flexible Offices
  - 127 location globally
  - 14,800 participants
  - 72% Satisfaction globally
  - 80% Satisfaction U.S.
- Drop In Centres
  - 14 centres, 5000+ users
  - Av. 90 mins. saved per visit

- **Costs Saved / Avoided**
- Real Estate
  - 6600 seats avoided FY05
  - $63.9 million for FY05
  - $319 million over 5 years
- Sun Rays
  - Over 35000 deployed in Sun
  - Over $24 million saved p.a.
- System Admin $15m
- Electricity $2.8m
- Desktop refresh $6.5m
  - Carbon savings
  - 30,000 tons/year
  - No cost moves
  - Easy upgrades

What Is A Traditional Desktop ?



Desktop means fixed point of presence - PC

- One desk for user PC access
- Costly and expensive in power, support, real estate
- Lack of true mobility, security, resilience

- **Don't We Really Mean - User's Secure Access to Information**
  - Access to all applications – data and voice
  - Device agnostic – network attached device
  - Session mobility – global access, all devices
  - Secure Access, Anywhere, Anytime, Any Device

Future Desktop

Your desktop isn't a device or a desk
it's where you get work done
in the best location for you
using the right device

Microsoft Windows

Mac OS X, IBM, HP, Linux

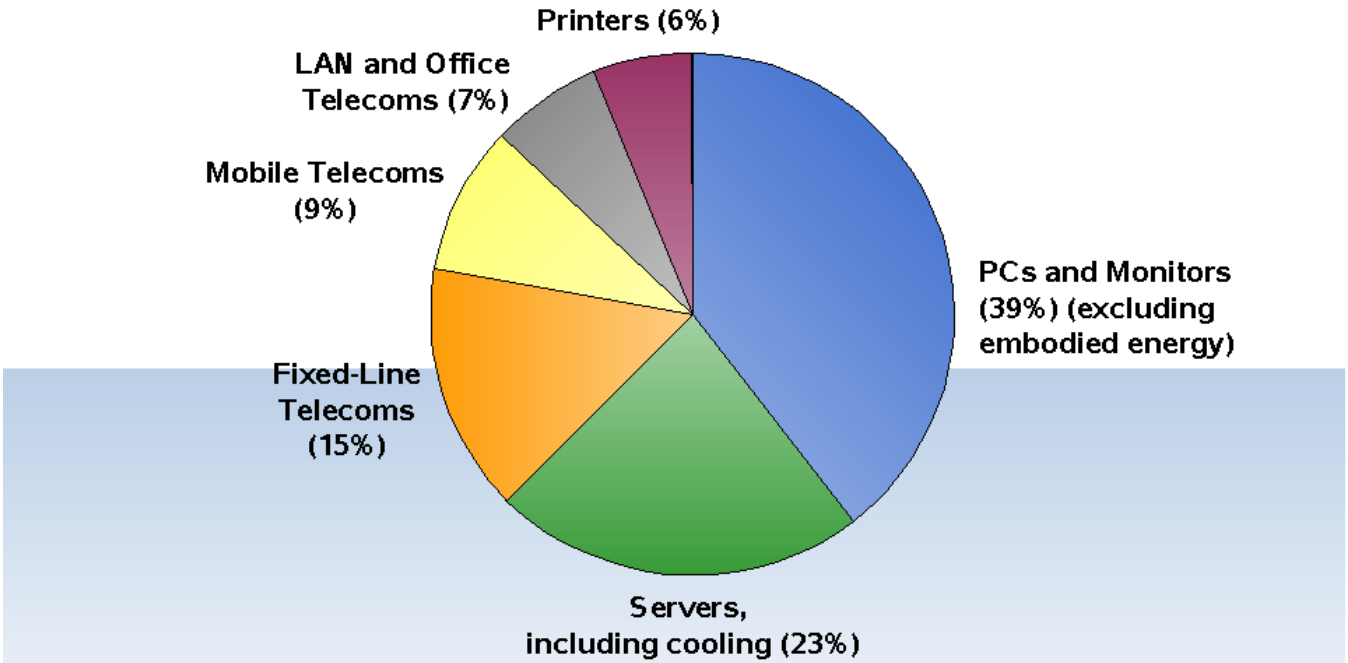
Browser

What Is The Cost Of A Desktop ?

How much does your desktop estate cost ?

- Capex every 3-5 years ?
- Management costs – deployment, updates, fixing ?
- Power costs ?
- Carbon targets ?
- Resilience ?
- Security ?
- Network ?
- Telephony ?
- User demands ?
- Real estate ?
- …

ICT's Global Carbon Dioxide Emissions



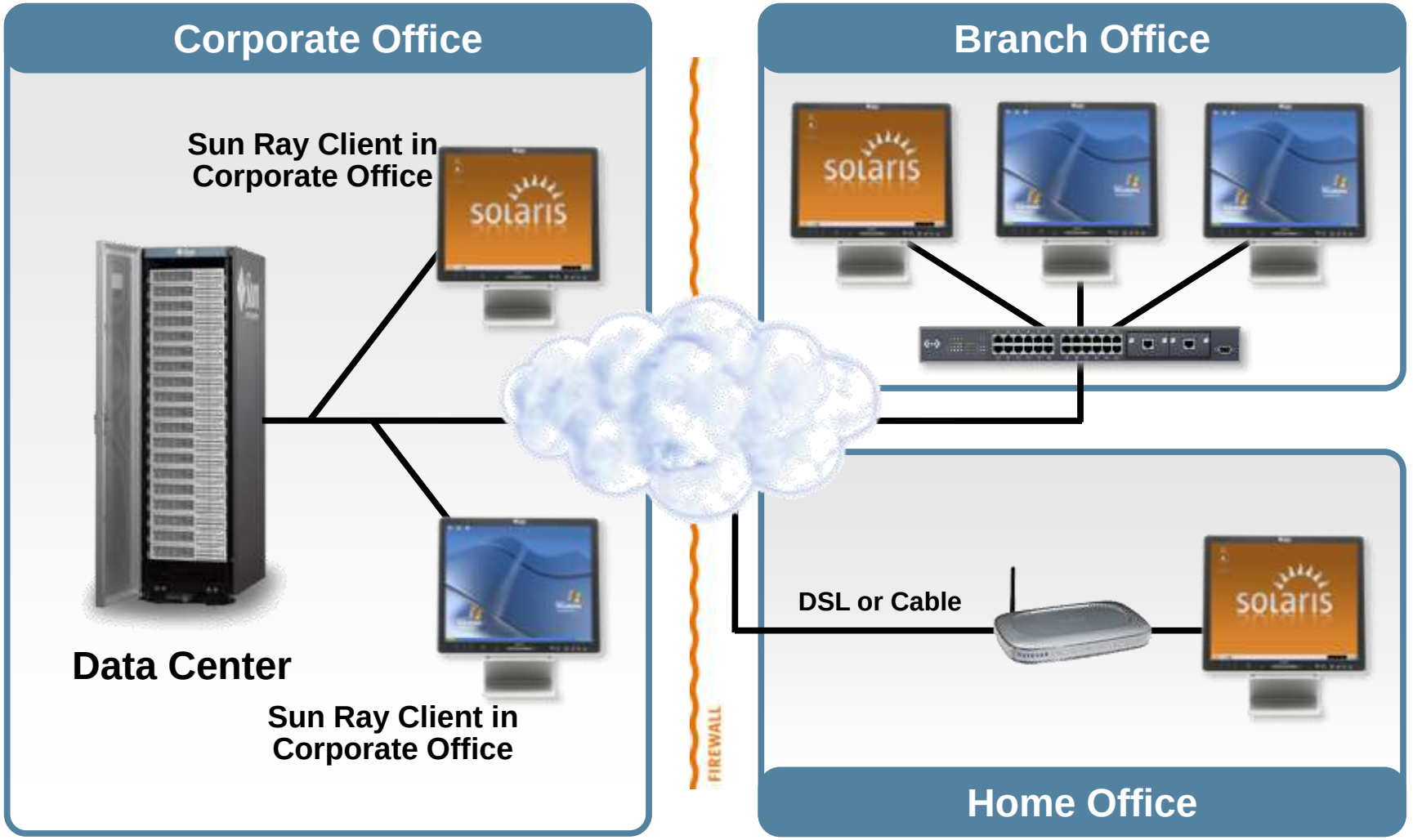
ICT accounts for approximately 2% of global CO_2 emissions.

Source: Gartner

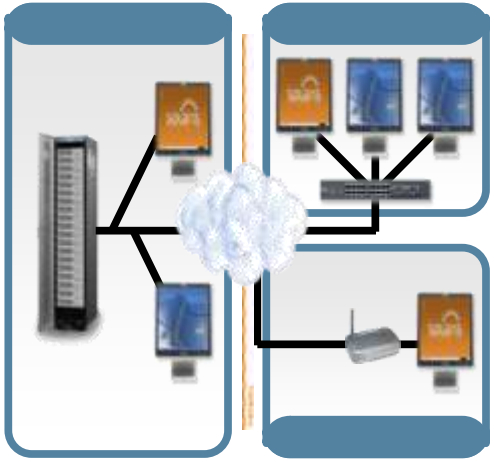
Where Are The Costs ?

- Power/Carbon consumption - client devices, servers and storage
  - PC 40W to 250W
  - Sun Ray 4W
- Management
  - PC replacement in field requires skilled personnel
  - Anyone can replace a Sun Ray as applications and data is held centrally
- Security
  - Business continuity
  - Malware
  - Laptop/local data backup
  - Theft/loss
- User efficiency
  - Always at one desk
  - Desk space
  - Limited mobility
  - Move costs
  - No option for work/life balance

General Desktop Virtualisation Architecture



Architecture Options



- Centralise Management, NOT everything
- Network costs can be high and not robust
- Print and file requirements can be high
- Need for local resilience
- DON'T use VDI except where you need it
  - Shared Windows environment 80 : 20 VDI
- A Thin Client isn't a full PC replacement
  - Majority of client environments can use Thin Clients

Desktop Virtualisation Options

- Choice of Virtualised Desktop Architectures
  - Centralised, regionalised, local
  - Shared Windows environment or full VDI
- No “Big Bang“ migration
  - Sweat PC assets
  - Largest use case is normally the simplest
  - PCs/laptops will always be present for some users
- Integration with other technologies
  - VMware
  - Citrix
  - Brokers
  - PCs, Macs, Linux netbooks, ...
  - Oracle applications – Financials, Peoplesoft, JD Edwards, Siebel, …

Opportunities

- Everybody looking to reduce costs
- Hit Sustainability/CSR targets
- Organisations focussing on their core skills
- Cloud is becoming more accepted
- Everything As A Service being considered
- Traditional Customers become Service Providers
- Huge SMB desktop and applications requirement
- Provide workplaces for different tasks
- Shared Desktop facilities
- Be nimble, open and willing to adapt new technologies rapidly
- Turn IT to benefit, not a cost

Who Is The Enemy ?

- Us
  - The “traditional“ way we think
  - Educating everyone
  - Sun and Microsoft – resolved a long time ago !
- IT Department
- Inflexible procurement
  - Use refresh/upgrade budgets
  - Change focus from capex to opex
- Service providers
  - Migrate from high revenue PC deployments
  - Adopt lower cost deployments
  - Deliver more As A Service
- Big Bang“ migrations
- Focus on large use cases
- HR – flexible workforce

Case Studies

- Global Bank
  - Reduced number of Data Centres
- Government Agency
  - Reduced annual power costs by £174,000
  - Reduced management costs by £9m over 7 years
  - Hit carbon targets
- Call Centre
  - Improved efficiency by 23%
- Education
  - Students more attentive
  - Achieved better results
  - BSF build larger schools
- Government Agencies now delivering everything as a service

Oracle's Building Blocks

- End to end technology stack
- Sun Ray – Ultra Thin Client, no OS, low power consumption
- Sun Ray OEMs – Sun Rays for specific uses
- Secure Global Desktop – access Windows, Linux, UNIX, VMS, mainframe applications from anywhere with any client
- Virtual Desktop Client – Sun Ray emulator, extend life of PCs
- Sun Ray Software – access and device management, Windows, Linux and UNIX access
- Oracle VDI Software – broker, management interface, integration points, hypervisor and integration to hardware
- Servers
- Open Storage

For More Information

www.oracle.com/virtualization

Talk to me :

Alan.Wakeman@Oracle.com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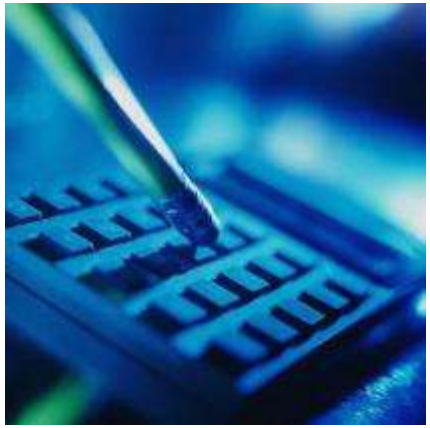

Richard Forrest

Senior Manager, Technology Integration Practice

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Meeting the Business Demand

Richard Forrest

Audit . Tax . Consulting . Corporate Finance .

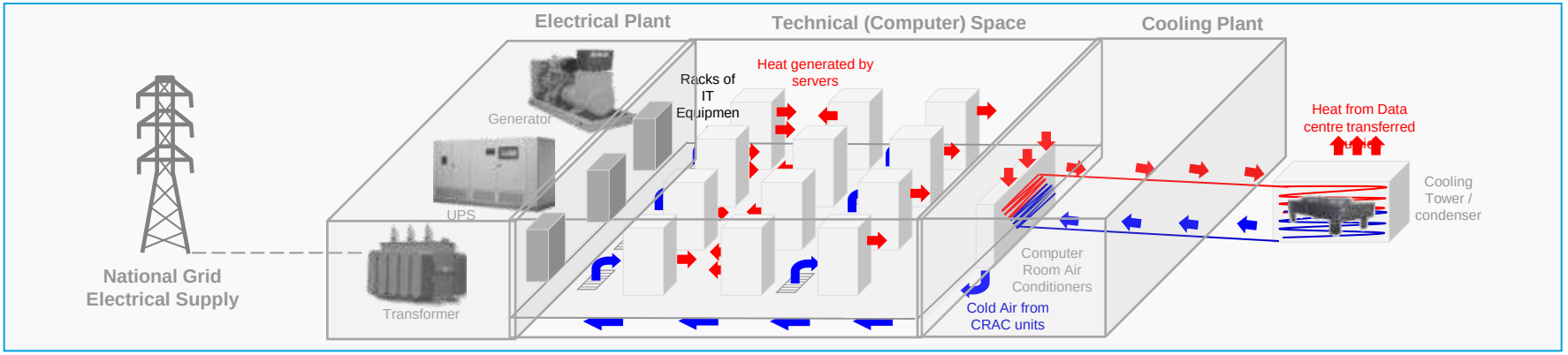
The Data Centre

"Data Centre"

- A facility that hosts IT equipment that delivers business applications, data storage, external connectivity, remote access, telephony services and - potentially - virtualised desktop services
- Distinct from a data room or 'CER' that might provide network and printing services to support an office floor, but be engineered to a level of resilience commensurate with that floor

- **Remote working and virtual desktop technology for many provides release of dependency on office buildings and reduces the need to provide office continuity and disaster recovery seats**
- **However, the IT infrastructure that enables that flexibility and business continuity remains almost exclusively locked in a data centres**

Key Features of a Data Centre



Highly Available Systems

- Sufficient gird power, ideally from 2 distribution points
- N+1 (or better) power and cooling systems
- Backup generation, uninterruptable power supply, fuel storage

Purpose Built Facility

- Raised floors, high loading
- Smoke detection & fire suppressants
- Sufficient space to house plant

Secure

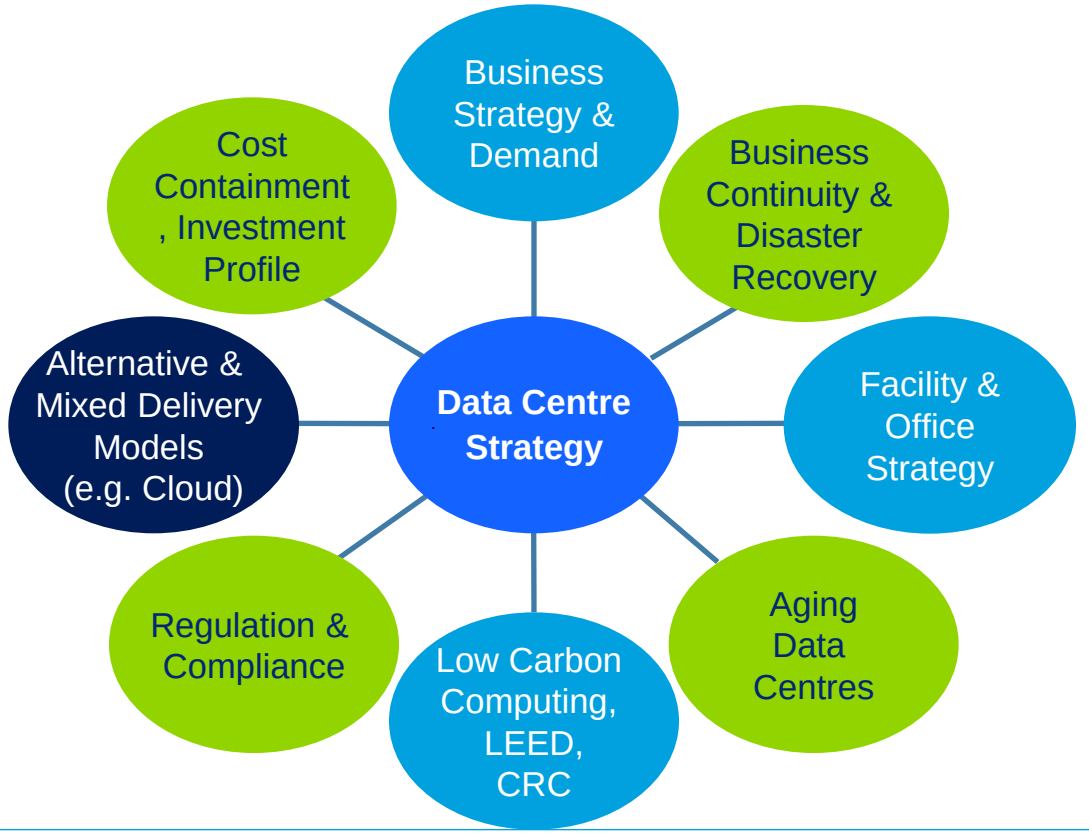
- Building – blast / ram protection
- Operation – CCTV , swipe/ biometrics
- Mostly unbranded and increasingly ‘dark’ sites, with few staff on-site

Low Risk Location

- Environment risk (e.g. flood, terrorism)
- Transport proximate
- Network connectivity

Do I Need a Data Centre at All?

Data Centre Strategic Drivers



Put it in 'The Cloud'?

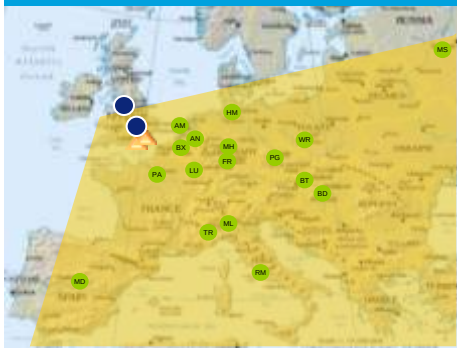
- Cloud suitable for certain services e.g: office applications for small company, rapid prototyping, low-cost compute
- Not going to replace corporate data centre in near future due to security, interoperability, and data protection constraints but should start to contain growth
- Adoption depends on contracting and operating model, just like any other outsourcing arrangement

Where Do We Need Data Centres?

Consolidation Options - Partial

Multi Hub

Continental



- Trend to consolidate a service into fewer, larger data centres continues, bounded by data protection legislation (Europe, US)
- Large corporates continue to drive demand for wholesale and retail data centre services and self-build sites in and around major cities.
- M25 'ring' city locations remain highly popular due to:
  - Lower / alternative risk profile
  - Manageable network latency from city offices, financial exchanges and internet POPs
  - Availability of power (or the ability to produce it)
- Continuing separation of data centres from users
- It increasingly difficult to incorporate data centres into office buildings, just locating the required M&E equipment can be impossible

In specific cases data centre location provides specific business advantage:

- Ability to perform a business process offshore, managing tax exposure (e.g. Jersey / Guernsey)
- trade as close to a financial exchange as possible, or
- provide internet content as close as possible to a top level internet point of presence

- Whilst offshoring of IT staff has been a major change factor in IT development and support, **there is very limited case for moving IT equipment offshore** due to poor utility and legal situation, with limited cost reduction

Delivering High Availability Of IT Services

Whilst tendering for retail / wholesale space, organisations typically demand for the highest facility specification available ...

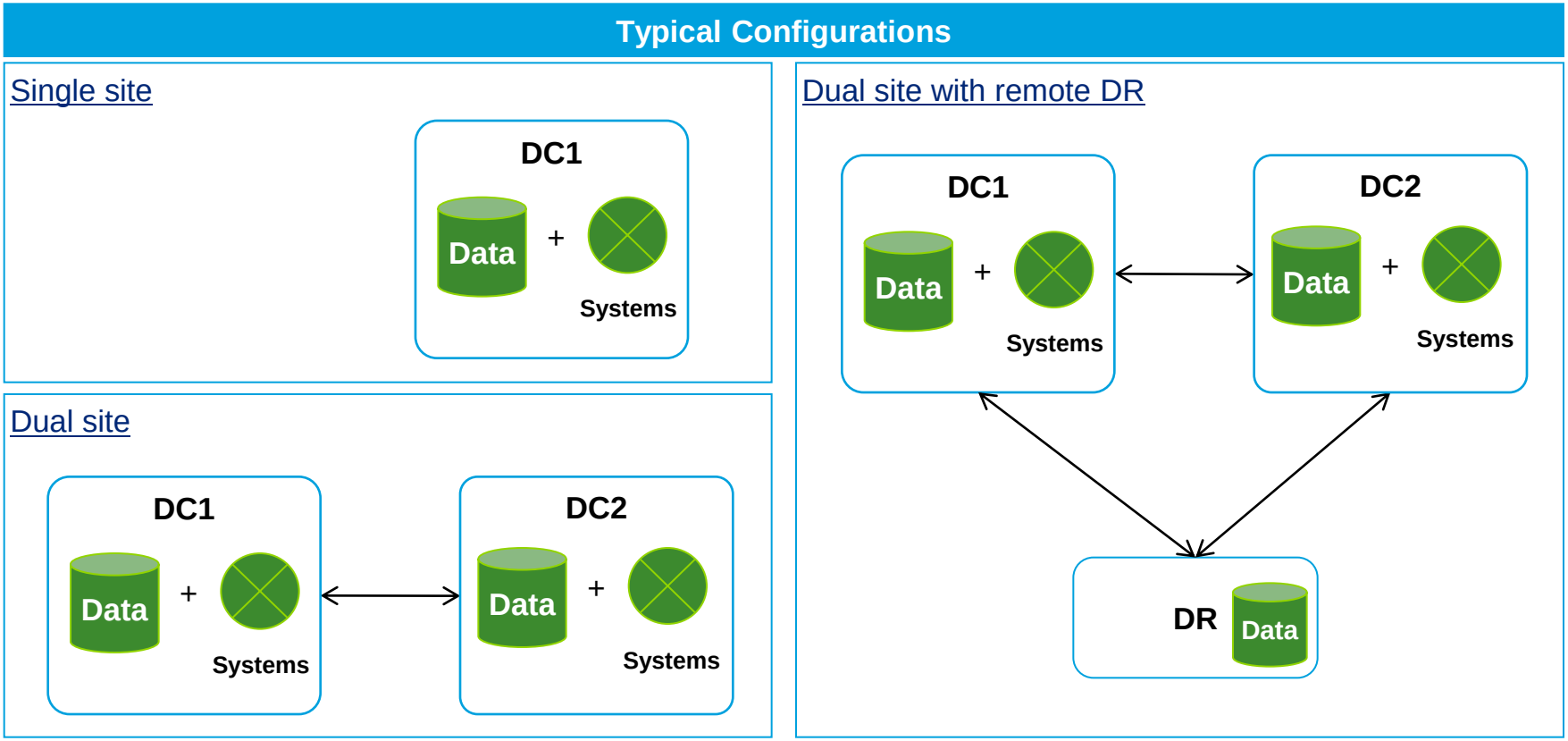
Uptime Institute 'Tier' Classification for Data Centre Facilities	
I	Basic - Single path for power and cooling distribution, no redundant components - 99.671% availability (29 hr downtime)
II	Redundant components - Single path for power and cooling distribution, redundant components - 99.741% availability (22 hr downtime)
III	Concurrently maintainable - Multiple power and cooling distribution paths, but only one path active redundant components, concurrently maintainable - 99.982% availability. (1.6 hr downtime)
IV	Fault tolerant - Multiple active power and cooling distribution paths, redundant components, fault tolerant - 99.995% availability (0.4 hr downtime)

"40% Extra Cost"

Delivering High Availability Of IT Services

... when in reality highly available IT services need to be optimally delivered from a suitably resilient service at the various layers of:

- **data centre**: there are no perfect risk free locations
- **IT infrastructure**: servers will always fail, storage, database systems should handle this transparently
- **applications** : should operate regardless of single infrastructure device or service failure

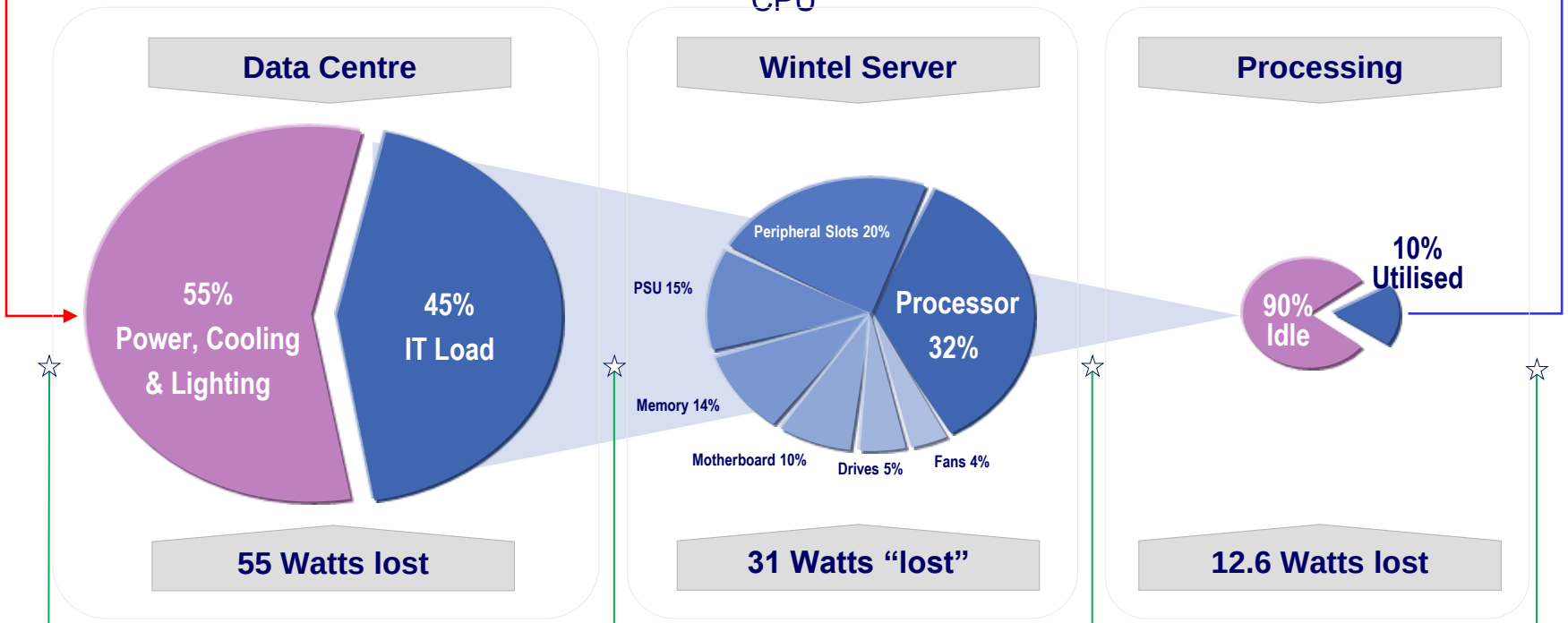


Power Efficiency in the Data Centre (Worst Case Example)

100 Watts Supplied

"For every 100 watts of power supplied to the data centre, only 1.4 watts are used for productive computation by a CPU"*

1.4 Watts used for computation



* "EPA Report to Congress on Server and Data Centre Energy Efficiency, August 2007

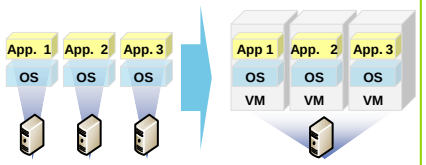
- **PUE : Power Usage Effectiveness** : the number of Watts required to be delivered to a data centre to deliver 1 Watt to an IT load
- PUE : Total Facility Power % Power Provided at IT Equipment
- Range from 2.5 (poor) to 1.2 (excellent)

- **Latest Consolidated Servers** providing for far greater levels of efficiency
- E.g. IBM claim 2010 Power Series 7 servers can perform up to '4x throughput' for similar Power 6 server in 2007

- **Rationalisation, Consolidation, Virtualisation, Thin Provisioning**
- Other platforms can be very utilised – e.g. Retailer consolidated P series load at 90%+ utilisation

Managing Demand within the Envelope (Space, Power, Cooling)

Current focus is on 'Managing within the Data Centre Envelope' which has to a certain extent contained the demand for new data centre space and reduced the amount of data centre build and construction through:

Application Rationalisation	• **Retirement of unused applications and services** • Recent migration project 88 from 340 'applications' recorded were decommissioned (26%!)
Server Virtualisation	• **Using hardware or software services that split a physical server into several logical servers each running a distinct instances of an operating system.** For applicable application types, reduction of physical servers between 4 - 8 to 1 achieved and more if 'over-subscription ' is used • Target 50% of servers to be 'virtual' - now eminently achievable 
Server Consolidation	• **Reducing the number of servers through scaling applications** to utilise the latest server technology • e.g. recent re-platforming project , replaced end of life (3 year old) blade servers with new ones in a scalable compute environment, halved the number of servers required
Storage Thin Provisioning	• Most people have space free on their network drives, and applications are typically assigned multiple storage areas, each with substantial headroom • Using latest generation storage management software, to spoof operating systems that space is available, but actually **maintain free storage capacity in an aggregated form**, allocated automatically only when actually requires – allows **much less spare capacity to be maintained unused**
Network Virtualisation	• New build data centers now using highly configurable network switches that **allows soft re-assignment o ports and migration between vlans** reducing the amount of 'unusable slots' because of wrong network provisioning for a given application requirement
DC Facility Improvements	• Well planned tactical upgrades of existing facilities to be able to utilise latest technology, i**n-rack cooling , hot and cold Isle containment** raising typical power per rack from 3kW to 7kW+

Making the Best use of New Facilities as Economy Grows Again

- This industry has spent many millions to build data centres to handle the high density compute blade farms launched 8 years ago
- However, these are not necessarily being utilised efficiently
- Example - Bank that built new dc, consolidated the environment by 42%, saved 25k tonnes of Co2 but are now considering a £10m space expansion although they are well in the bounds of power and cooling – just not using the DC efficiently enough

- **Challenges and opportunities**
  - Limited relationship between IT and in house property / facility group
  - Typically poor capacity management on both sides with limited instrumentation
  - Inability to properly project capacity projections and impact of IT and facility initiatives to meet the capacity requirement in order to justify the investment
  - IT capital purchase decisions that do not take into account the data centre impact : too often the business sees the cost of adding capacity to an application as the ‘tin cost’ (as little as £2,000) or have charging mechanisms (or managed services contracts) that don’t benefit from handing unused capacity back

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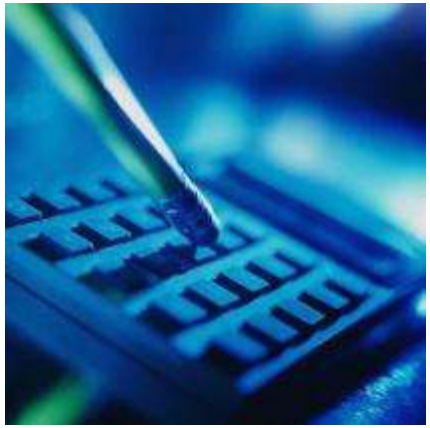

John Killey

Head of Reality Services, EMEA

Citi

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Building a “Green” Data Centre

Challenges, Solutions and Compromises

The Challenge

To deliver a "state of the art" data centre providing 100,000 SF white space with a design load of 1000 W/m^2 (scaleable to 1500 W/m^2), inside 24 months (site time 12 months).

To ensure the data centre achieves the following key design requirements of:

- Reliability
- Performance
- Cost optimisation
- Energy efficiency
- Minimising the environmental impact

To achieve greater than Tier IV reliability (> 99.995% availability).

To be recognised as providing a facility that minimises its environmental impact throughout its life.

citi

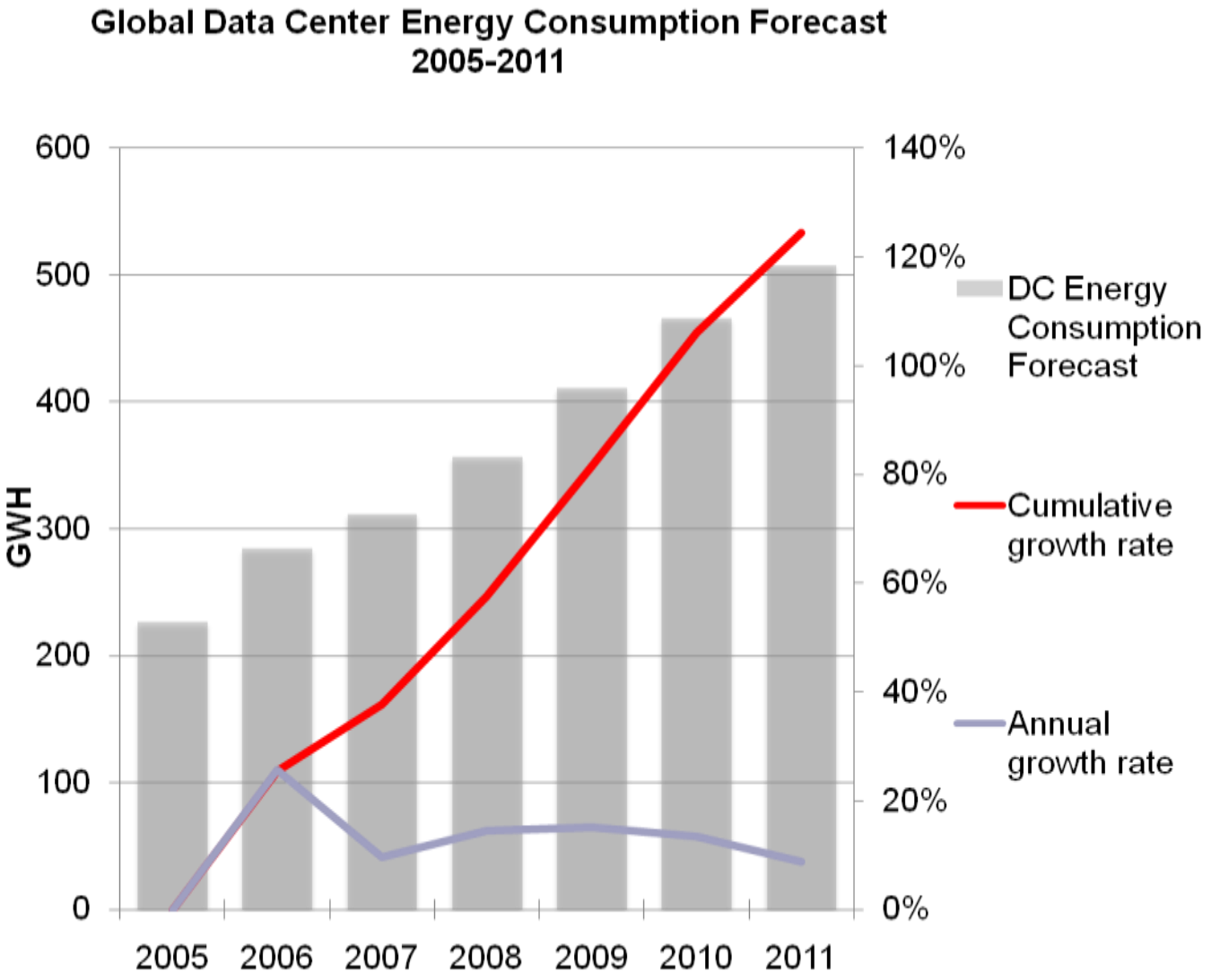
The Challenge

Driven by Citi's global environmental commitment:

and by our commitment to reduce our absolute greenhouse gas emissions by 10% from our 2005 baseline by 2011.

With more than 85 million SF of Real Estate this equates to over 130,000 tonnes of CO_2.

The Challenge



Actual data 2005-2007

The Approach

To embed sustainability into all of the projects core activities.

To consider sustainability in all design decisions and its interaction with reliability, performance and cost.

To incorporate sustainability into the procurement process.

To ensure early engagement of all stakeholders.

To foster close co-operation between stakeholders

To utilise LEED Accreditation to support and recognise the integrated sustainable design and construction approach (achieving a minimum Silver rating).

To obtain ISO14001 once in operation for continuous environmental performance improvement.

Why LEED and ISO 14001?

LEED (Leadership in Energy and Environmental Design) an accepted benchmark for a buildings energy and environmental impact during:

- Design
- Construction
- Operation

Provides an immediate tool for measuring and comparing the environmental impact performance.

Promotes a whole building approach to sustainability looking at 5 key areas of human and environmental health:

- Sustainable site development
- Water savings
- Energy Efficiency
- Material selection
- Indoor environmental quality

ISO14001 promotes continuous environmental improvement.

At Concept Design

	Projected	Maximum
Sustainable Sites	6 points	14 points
Water Efficiency	4 points	5 points
Energy & Atmosphere	4 points	17 points
Materials & Resources	6 points	13 points
Indoor Environmental Quality	14 points	15 points
Innovation & Design process	2 points	5 points
Project totals (pre-certification estimate)	**36 points**	**69 points**

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52+ point

The Solution – Through Procurement

Key Procurement Considerations

Senior management commitment from:

- Client
- Designers
- Contractors

Environmental requirements embodied in:

- Consultant Briefing Documentation
- Design Documentation
- Procurement Documentation

and formed part of contract documentation and selection criteria

Collaboration was key during construction and commissioning phase

The Solution - Through Design Decisions

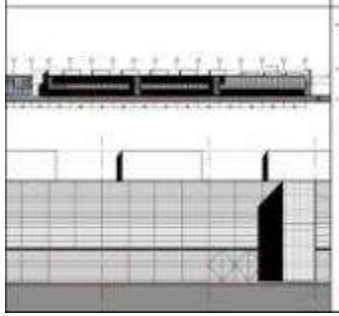
Along with performance, cost and reliability, sustainability was an equal design consideration for:

- site selection
- for systems and materials selection.
- for construction process and management.
- on going operation

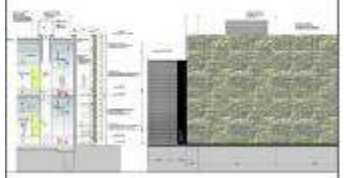
and resulted in:

- Use of low environmental impact materials.
- Consideration of embodied energy of construction materials and their benefit as environmental modifiers.
- Minimisation and reuse of excavated materials on site.
- Minimisation of site waste and maximisation of on-site recycling.
- Water efficiency and rainwater salvage.
- Site planting, “garden zones” & the vegetation of external facades.

The Solution - Through Design Decisions

OPTION 3: CLAD	1.1 PLANNING	1.2 AESTHETICS	1.3 PRECEDENTS	1.4 CONSTRUCTION	1.5 MAINTENANCE	1.6 OPERATIONAL ENERGY IMPACT	1.7 EMBODIED CO_2	1.8 COSTS
	- Design Development of façades after receiving planning approval. - Substitution of plans - if applicable. - Consultations with local authorities to clarify further proceedings. Risk: low	- Dilution of holistic vision. - Satisfying façade design almost impossible because of high percentage of louvred areas.		+ Prefabricated elements - easy and fast to erect. + Easy construction sequencing. + High Future Flexibility	+ Easy replacement - Cleaning of panels every ~ 5 years.	+ Allows plant deck to breathe.	- Steel beams and columns as main structure (Level 1). - Aluminium panels. Cradle to Gate: 117.634 t CO_2 Cradle to Recycling: 24.954 t CO_2	5,100,000 $

PROPOSED SCHEME	1.1 PLANNING	1.2 AESTHETICS	1.3 PRECEDENTS	1.4 CONSTRUCTION	1.5 MAINTENANCE	1.6 OPERATIONAL ENERGY IMPACT	1.7 EMBODIED CO_2	1.8 COSTS
	+ Planning approval very likely. Risk: none	+ Holistic functional response for envelope.		+ Prefabricated elements - easy and fast to erect. + Glass curtain wall and louvres are installed by one company. > Less parties involved	- Periodical cleaning of glass façade. - Cleaning of louvres every 5 years.	+ Minimal heat gain. + Enables low energy chilled beams to be used for space cooling. + Some summer glare control.	- Glass curtain wall on all facades. - Aluminium mullions. - Steel structure for louvres. - Aluminium substructure. - Aluminium louvres. Cradle to Gate: 11.518 t CO_2 Cradle to Recycling: 10.678 t CO_2	1,500,000 $

GREEN WALLS + GREEN ROOF	1.1 PLANNING	1.2 AESTHETICS	1.3 PRECEDENTS	1.4 CONSTRUCTION	1.5 MAINTENANCE	1.6 OPERATIONAL ENERGY IMPACT	1.7 EMBODIED CO_2	1.8 COSTS
PROPOSED SCHEME: ECOLOGICAL MODULAR GREEN WALL (SEDUM SYSTEM) 	+ Planning Approval very likely. Planning risk: none	+ Clean green box that keeps the given shape.		+ Façade system with plant box elements - reasonably easy and fast to erect.	+ No / low maintenance to plantings. - Automatic water irrigation system necessary. - Irrigation system requires inspection twice a year.	+ All positive effects from + day 1. + Thermal buffering effect. + Minimizes heat gain to space.	+ Converts CO_2 to O_2 + Provides wider biodiversity to surrounding environment due to various plantings. - Steel beams and columns as main structure. - Aluminium substructure. - Stainless steel boxes. 9.728 t CO_2 -3.000 t CO_2 6.728 t CO_2	400,000 $

The Solution - Through Design Decisions

Green Roof and Green Wall – Supporting sustainability, performance, reliability and cost efficiency by:

- Creating biodiversity lost in the construction
- Increasing roof life/reliability – waterproof membrane life increased to 40 years
- Reducing rain water run off with reduced construction, sewer/storage costs
- Benefiting the ecology through rainwater attenuation and re-use
- Converts CO_2 to O_2.

The Solution - Through Design Decisions

Materials Selection – Supporting sustainability, performance, reliability and cost efficiency by:

- External shading (brise soleil) constructed from zero maintenance timber from sustainable sources with 1/3 less embodied CO_2 over Aluminium
- External aluminium panel screening with high recycled content
- High use of locally extracted/produced building materials to reduce cost and transportation CO_2 emissions.

The Solution - Through Design Decisions

Systems selections – Supporting sustainability, performance, reliability and cost efficiency by:

Water Systems

- Reverse Osmosis water treatment plant incorporating blow down Recycling
- Higher reliability with reduced water– saving 11.6MM US galls p.a./ €217m p.a.
- Reduces environmental impact through lower chemical and CO_2 emissions
- Capturing up to 90% of rainwater for reuse on site.

Cooling systems

- High internal air temperature.
  - CRAC supply: 20˚C (5-7˚C higher than a typical data centre)
  - CRAC return: 27-29˚C (5-7˚C higher than a typical data centre)
- High chilled water temperature.
  - Flow: 10˚C (3˚C higher than a typical data centre)
  - Return: 18˚C (6˚C higher than a typical data centre)

The Solution - Through Design Decisions

Cooling systems

- 2 coil CRAC's linked to 3 stage free cooling system providing free and pre cooling for 8,183hrs per annum (93% of the time).
- Provides 8,486 MWhr of free cooling per annum.
- 2 coils provide a 2N cooling system at the CRAC (> Tier IV stds.)
- Free cooling increases 3N system redundancy in winter period (> Tier IV stds))

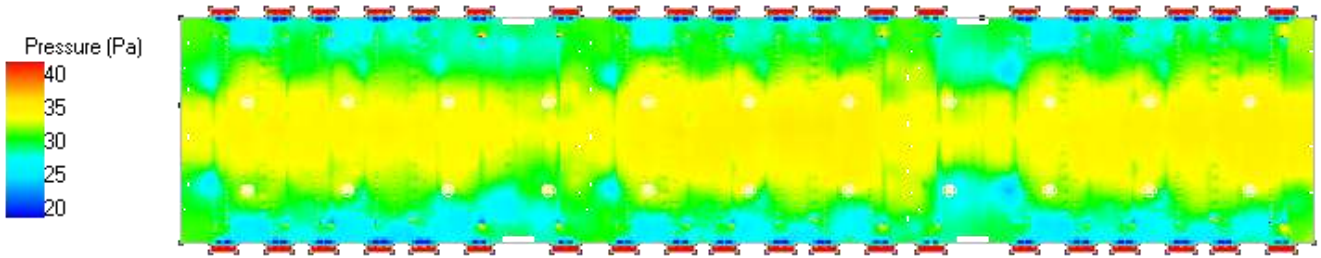
Electrical systems

- MV DRUPS – Increased efficiency, lower copper costs, higher reliability
- Elimination of lead acid batteries – Increased reliability, reduced environment risk
- Reduced plant space – reduced cost and lower construction impact
- Greater than Tier IV reliability with lower plant costs.

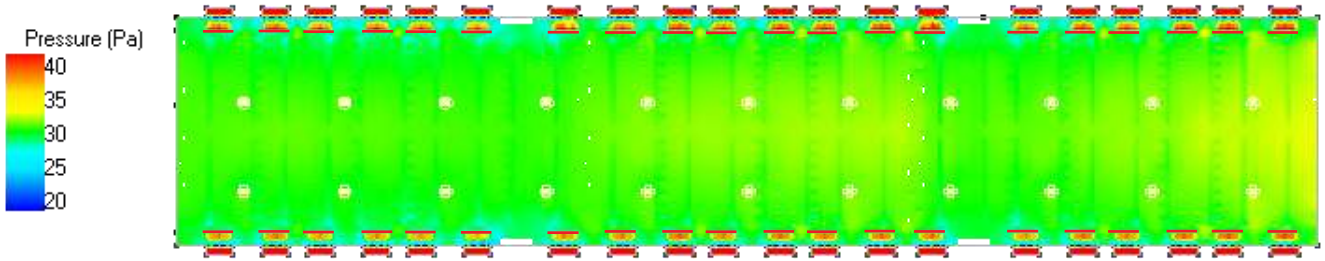
The Solution - Through Design Decisions

Raised Floor Air Management Systems

- Perforated baffles in front of CRAC convert velocity into an even static pressure – reduced fan power, reduced electricity, reduced cost.
- High velocity jets and recirculation under the active floor area are eliminated – improved cooling performance.
- Variable speed drive fans automatically maintain the even pressure in the event of CRAC failure. – increased reliability, reduced energy reduced cost.



- Typical pressure distribution under a raised floor

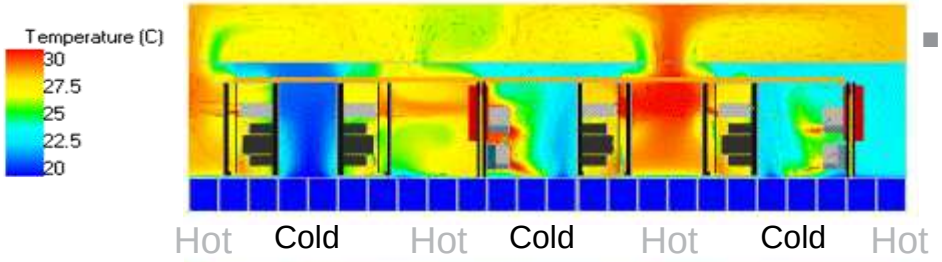


- New Citigroup Data Centre

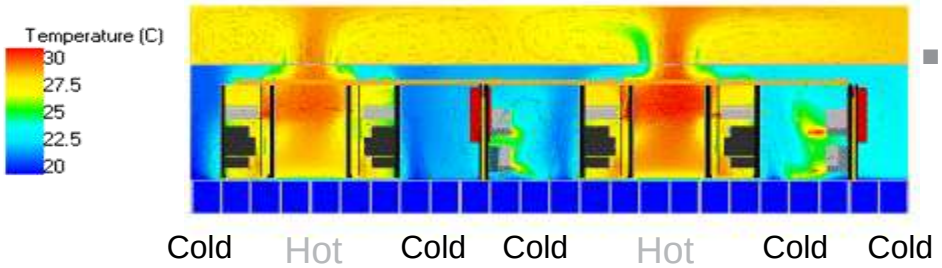
The Solution - Through Design Decisions

Above floor airflow management

- Open network frames are interleaved with server racks to reduce length of data cabling - reduced copper, reduced cost.
- All data cabling is at high level to eliminate cable dams and data cable penetrations, - reduced static pressure, reduced fan power, reduced electrical cost.
- Novel Hot-Aisle/Cold-Aisle/Cold-Aisle layout overcomes typical problems with open frames - improved cooling performance, increased resilience, reduced cooling costs.



- Typical problems with open frames
  - Open network frames cause breakdown of the Hot-Aisle/Cold Aisle concept.
  - Hot exhaust air from server racks recirculates around the network equipment causing overheat.



- New Citigroup layout
  - Hot exhaust air from server racks is captured by ceiling plenum.
  - Network equipment in open frames is cooled successfully.

The Solution - Through Contractor Engagement

Contractor Involvement

- LEED® language in each specification section
- LEED® Pre-Construction Manual
- Pre-Bid Meetings
- Post/Award Meetings
- Subcontractor Orientation

The Contractors role in specific LEED® Credits

- Erosion and Sedimentation Control Plan
- Commissioning Coordination
- Construction Waste Management
- Performance-based Material and Resource Selection
- Construction IAQ Management
- Low Emitting Material Management

At Project Completion

	Projected	Achieved	Maximum
Sustainable Sites	6 points	11 points	14 points
Water Efficiency	4 points	5 points	5 points
Energy & Atmosphere	4 points	11 points	17 points
Materials & Resources	6 points	8 points	13 points
Indoor Environmental Quality	14 points	13 points	15 points
Innovation & Design process	2 points	5 points	5 points
Project totals	**36 points**	**53 points**	**69 points**

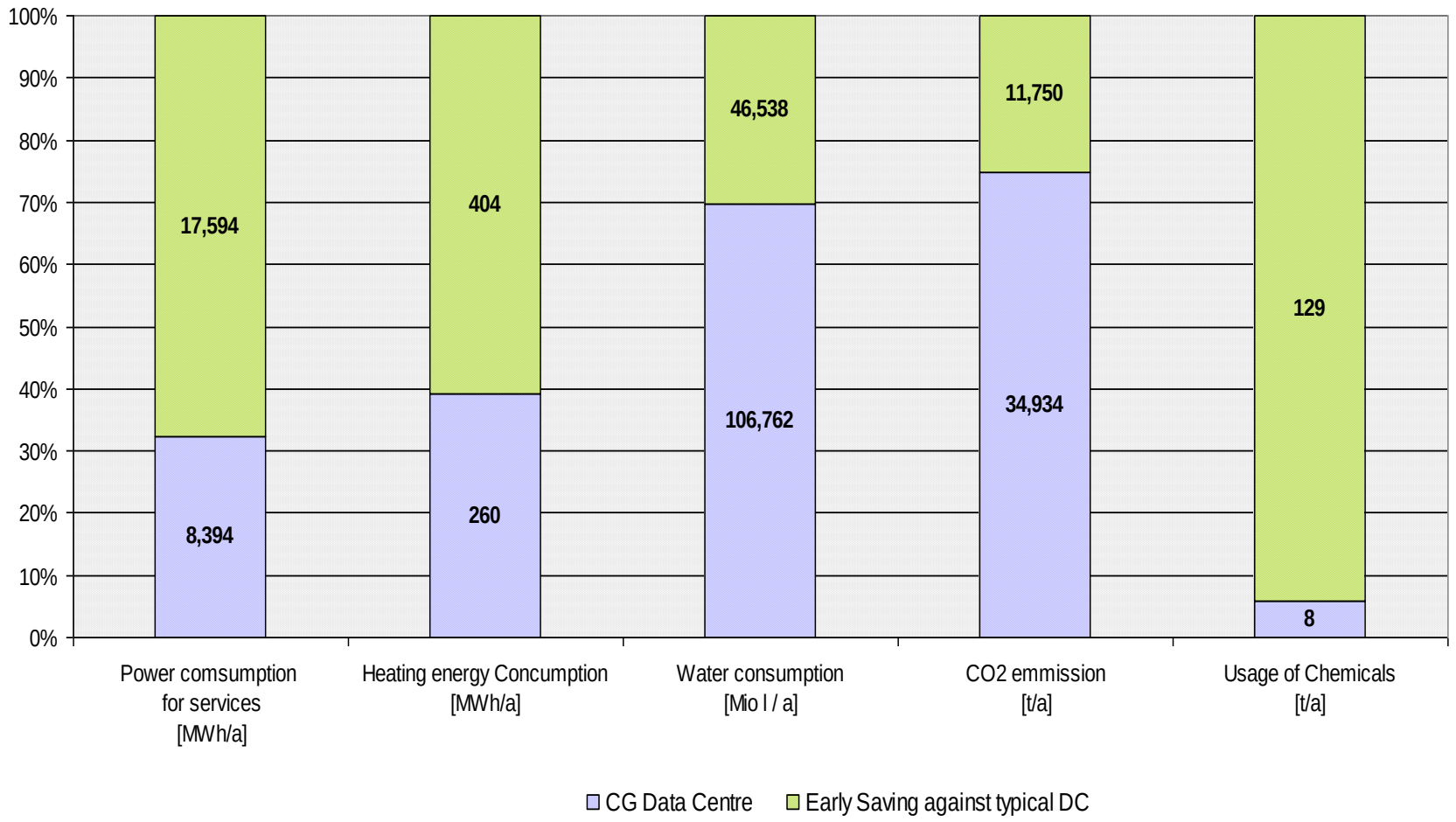
Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52+ point

Final LEED new Construction rating - Platinum

What does this all give us?

Optimised Cooling design	**enhanced free cooling rate of 63%,** COP of 11% by using VSDs, all primary pumps with VSDs	- 9,601 MWh_{el}/a
Enhanced CRAC unit design	Power consumption reduced from 9.3 kW to 3.3 kW per Unit	- 4,134 MWh_{el}/a
Advanced Cooling tower design	Power consumption reduced from 74 kW to 22 kW per Cooling tower by using High efficiency CT with single fan on top; fans speed controlled by VSDs	- 929 MWh_{el}/a
All pumps with VSD	Consequent use of VSDs for all pumps to allow running pumps on their designed operation point	- 110 MWh_{el}/a
Usage of Rotary UPSs	Power loss reduction via UPS from 9% to 2%	- 3,066 MWh_{el}/a
Light control	Light controlled by presence	- 85 MWh_{el}/a
Heat recovery systems	Usage of high efficiency heat recovery systems in all fresh air systems	- 404 MWh_{th}/a
Heat pumps	Heat pumps for heating water generation instead of boilers	- 33 t CO_2/a
Advanced water treatment design	Cooling tower bleed recovery combined with water storage facilities and reverse osmosis plant	- 46 Mio l H_2O, - 94% Chemicals

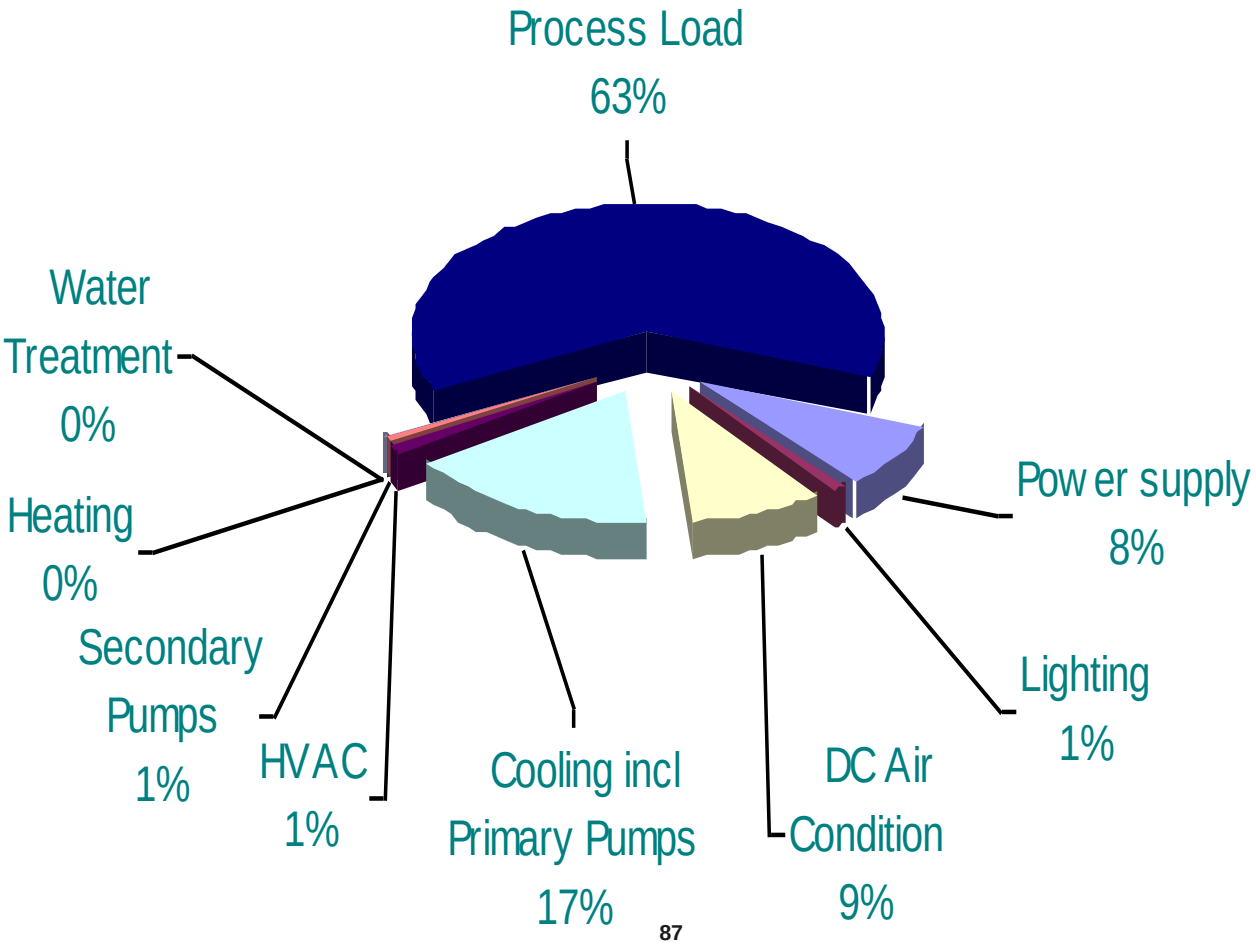
What does this all give us?



What does this all give us?

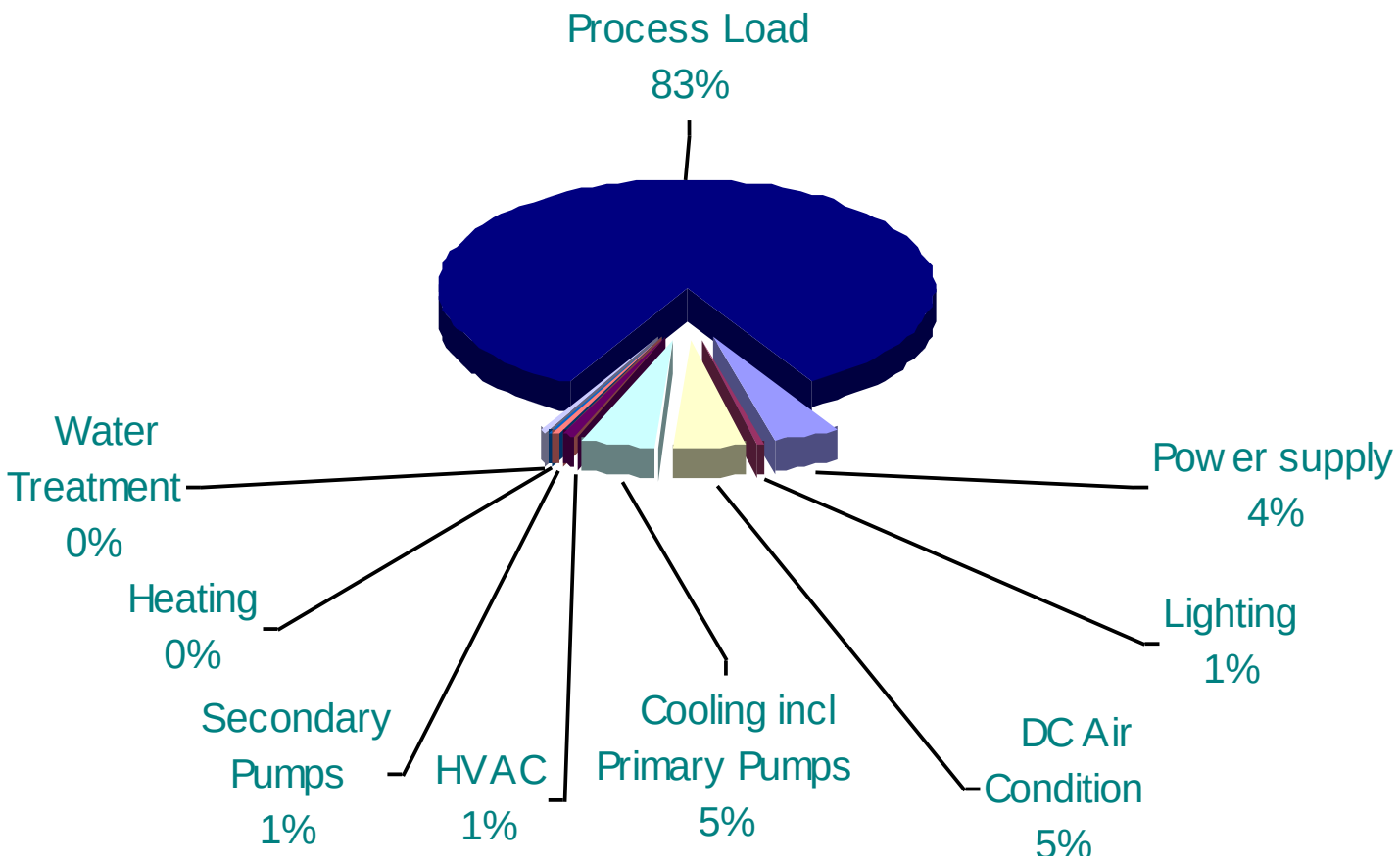
or to put it another way

- **Full load power consumption of a typical Data Centre- PUE = 1.58**



What does this all give us?

- **Full Load power consumption CG Data Centre – PUE 1.2**



Compromises

In truth none, what we do have is a data centre:

- with greater than tier IV reliability.
- that delivers the design loads.
- with a capital cost -8% than conventional facility.
- that uses 20% less energy in its services.
- that saves 11,700 tonnes of CO_2 per annum.

In Conclusion

Sound environmental design does make business sense

Can only be achieved by embedding the concepts of sustainability within the design, construction and operations processes.

Will only be achieved through a collaborative, integrated design and construction process.

Must start with the initial project planning and run through the whole building life cycle.

Can enhance, not compromise, the key criteria of reliability, performance and cost effectiveness.


Photography by
Christian Richters

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