

Green & Beyond: Data Center Actions to Increase Business Responsiveness and Reduce Costs

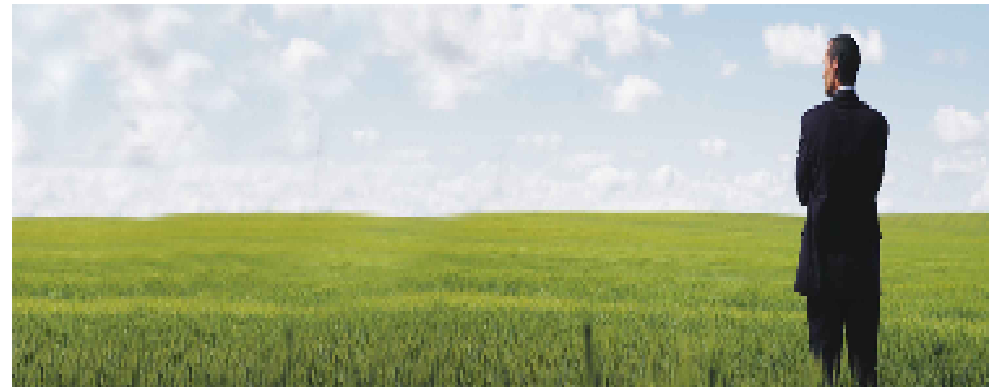
*Andy Soon
Site & Facilities Services Sales Leader,
Global Technology Services, IBM Malaysia*





AGENDA

- **Introduction To Green Data Center**
- **5 Building Blocks of Green Data Center**
- **Reducing cost for new and existing data centre**
- **Closing**





Energy usage and cost are the drivers for change

Increasing IT Demand



- Server growth 6X, Storage growth 69X this decade¹
- Average power consumption per server quadrupled from 2001-2006²
- Data centers energy use doubling every 5 years³
- 66-73% of clients will be expanding their data centers in next 12-24 months⁴

Increasing Cost Pressures



- Reducing enterprise costs is now the #2 CIO priority in 2009⁵
- Global electricity prices are increasing 10-25% per year⁶
- Data center operating costs are 3-5 times the capital costs over 20 years

Responsiveness To Change



- 78% of data centers are > 7 years old⁸
- 29% of clients identified data center power and cooling affect server purchase decisions⁹
- Technology densities are growing 20x this decade⁷



Let's build a smarter planet.



Five building blocks provide the tools to operational savings and business growth.

Double your IT capacity

- In the same energy footprint

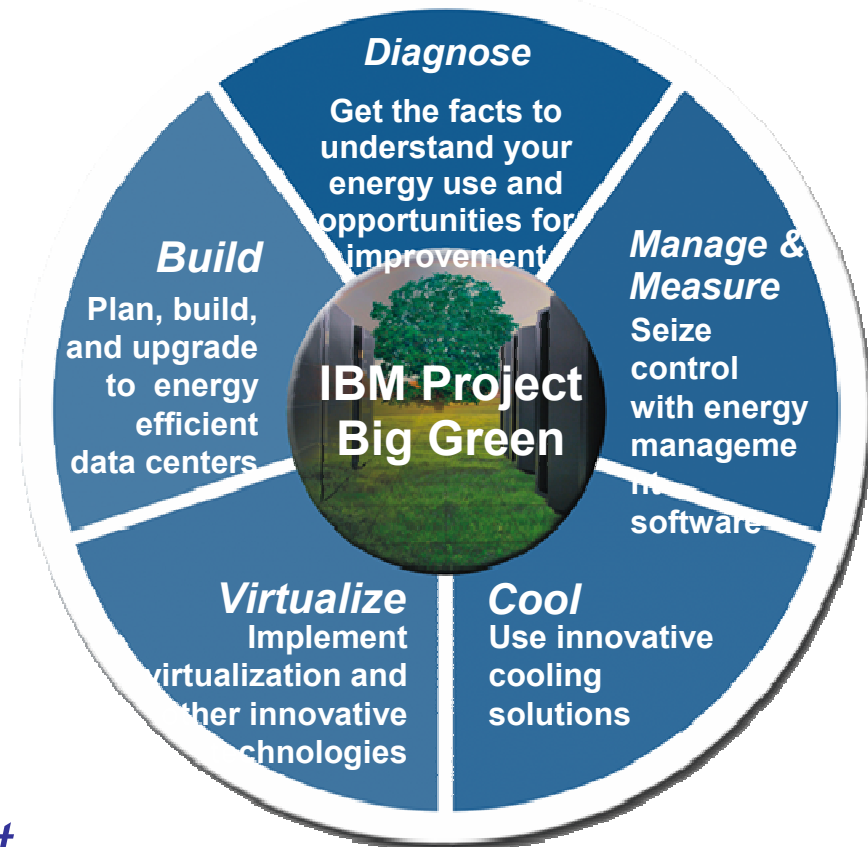
Reduce operational costs

- 40-50% energy savings
- \$1.3M / yr savings

Positive environmental impact

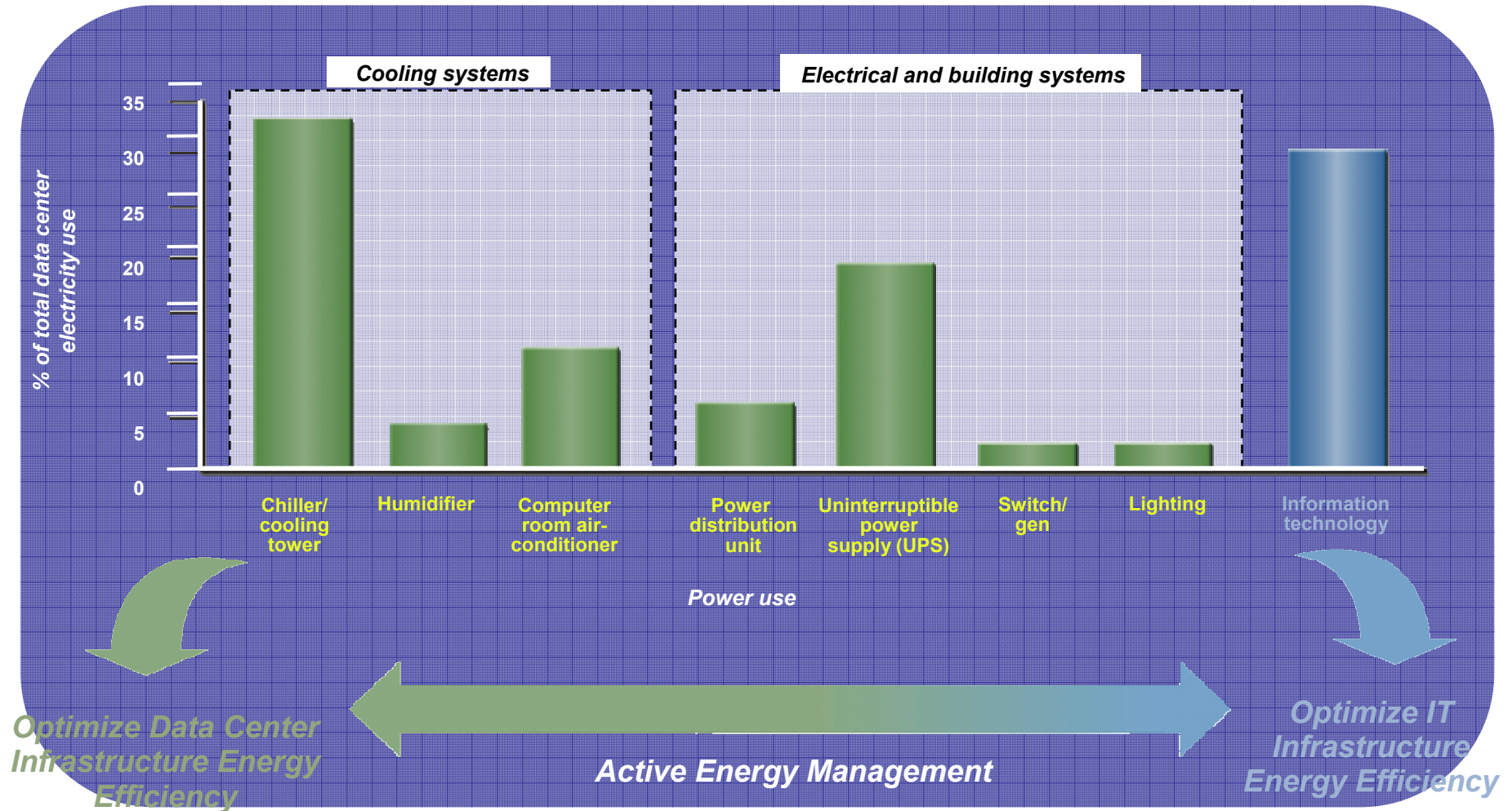
- 1,300 less cars or 3.5M less pounds of coal

Going green impacts the pocketbook and the planet.



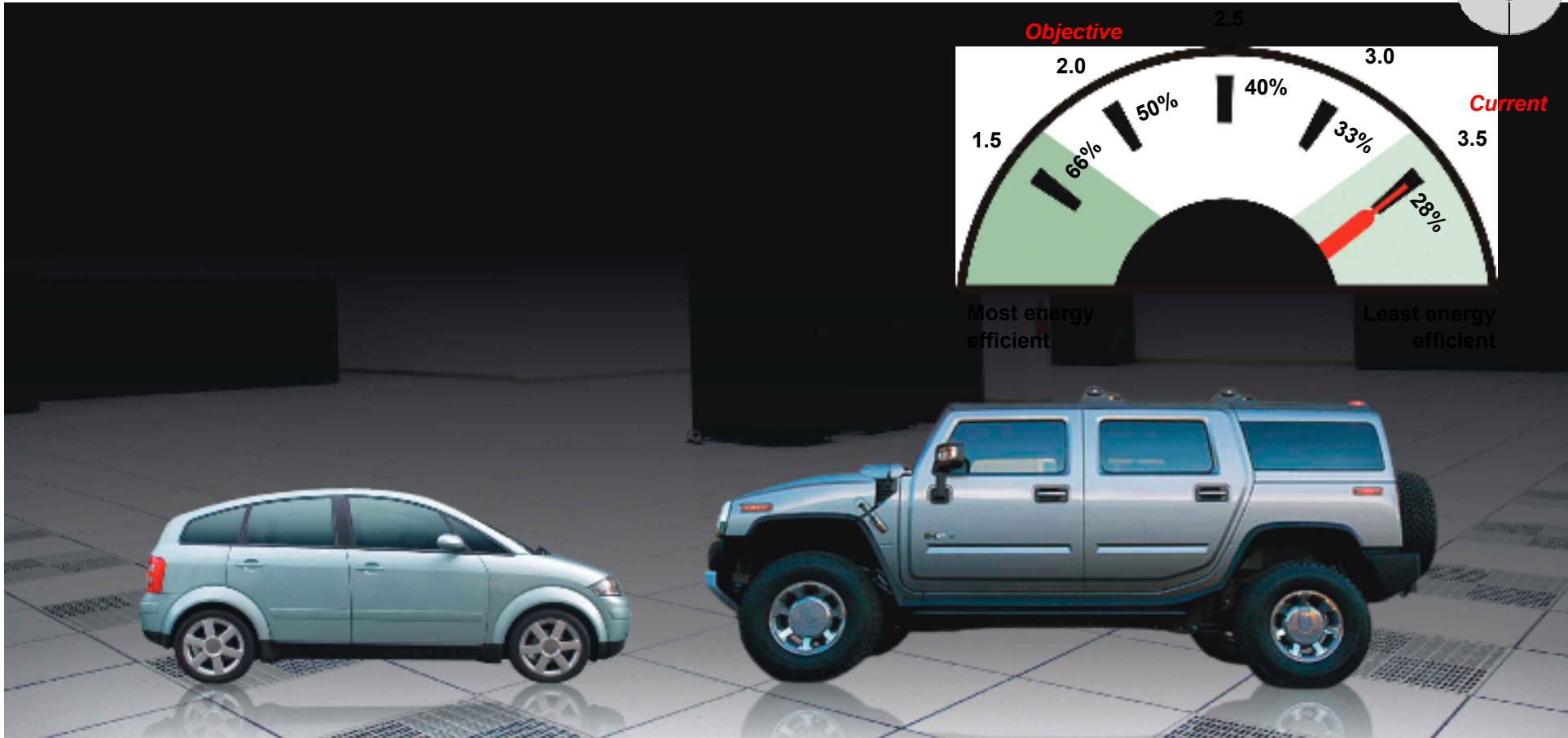


Cooling, Power and IT are the 3 largest consumer of energy in a data center





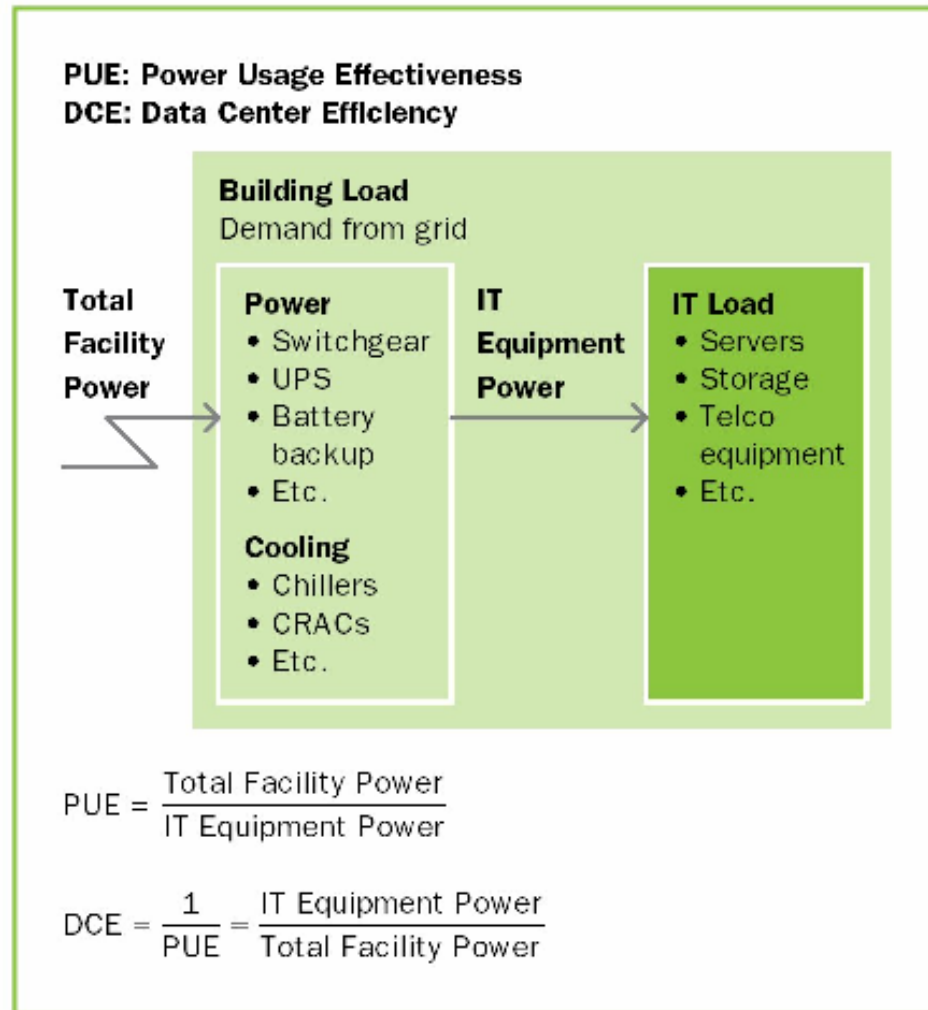
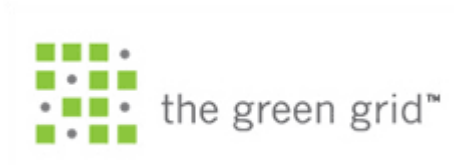
How energy efficient is your data center?



Use a simple “MPG” equivalent for data center energy efficiency to find out where you are today



Data Center Energy Efficiency Metric

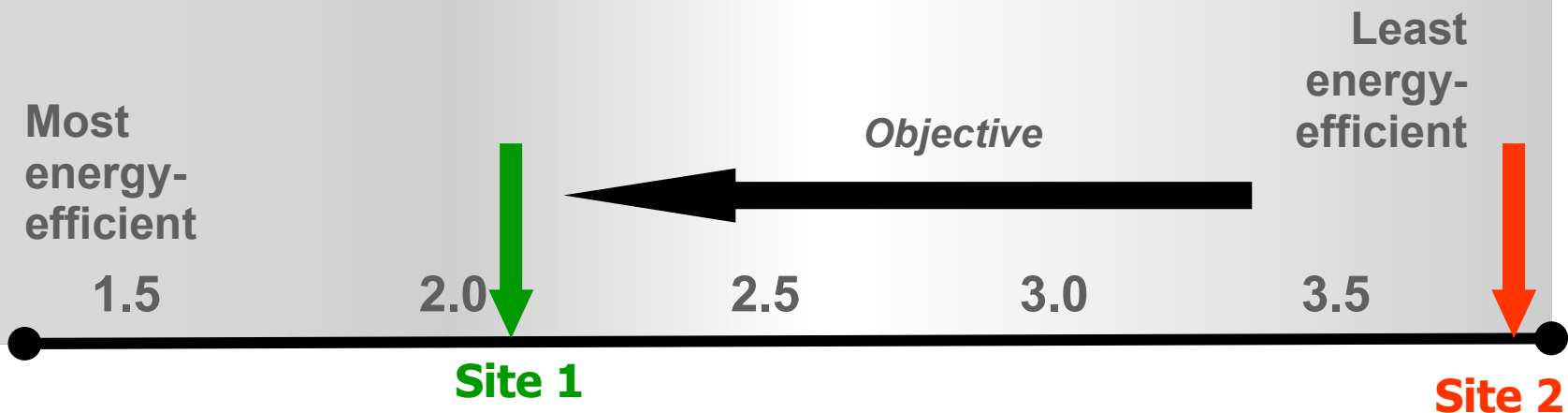


Source: <http://www.thegreengrid.org/>



PUE Scale

- | Provides a marketplace comparison
- | Demonstrates the potential range of improvement for efficiency projects



0.1 PUE decrease will save \$70,000 per year @ \$0.2/kWh for a typical 1MW load

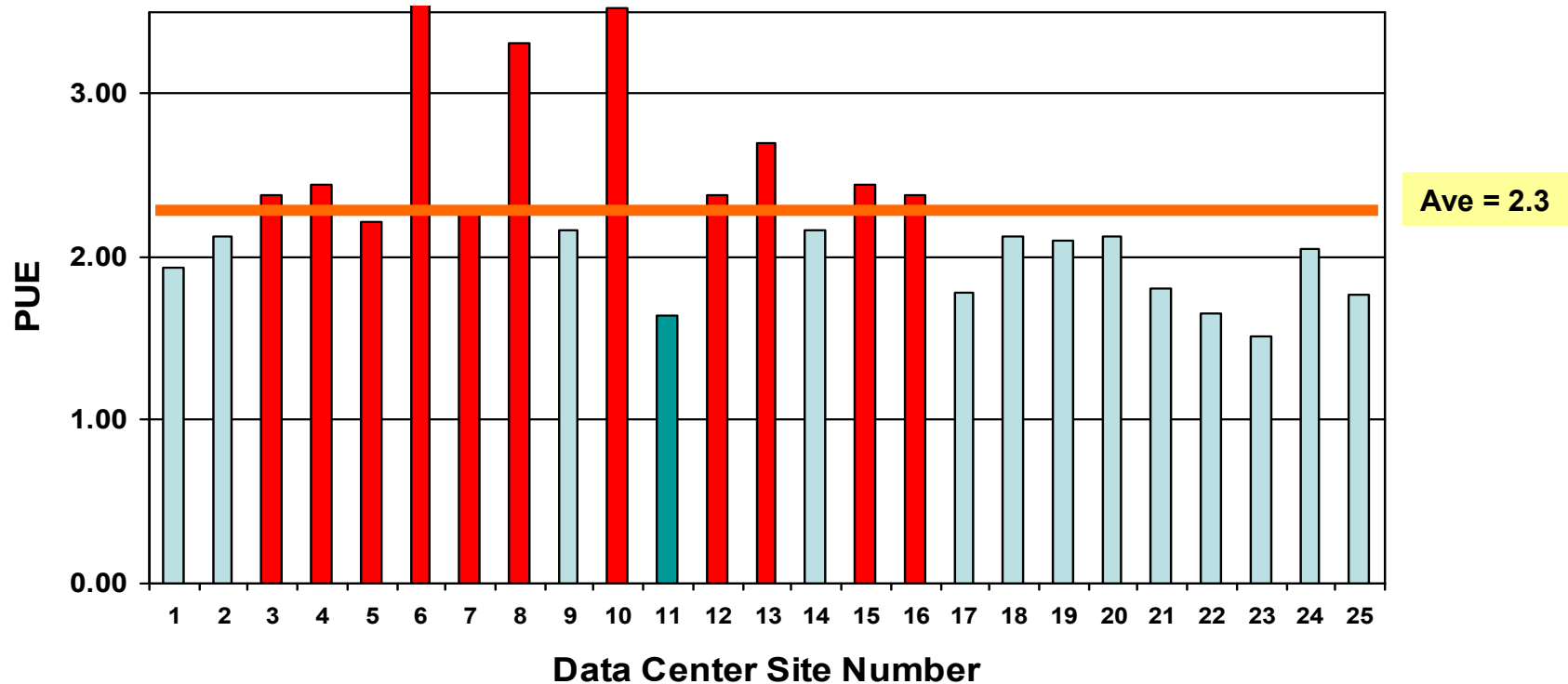


Industry snapshot of PUE ratings in data center

Green = PUE < 1.7 (Excellent) Red = PUE of 2.2-2.7 (Fair)

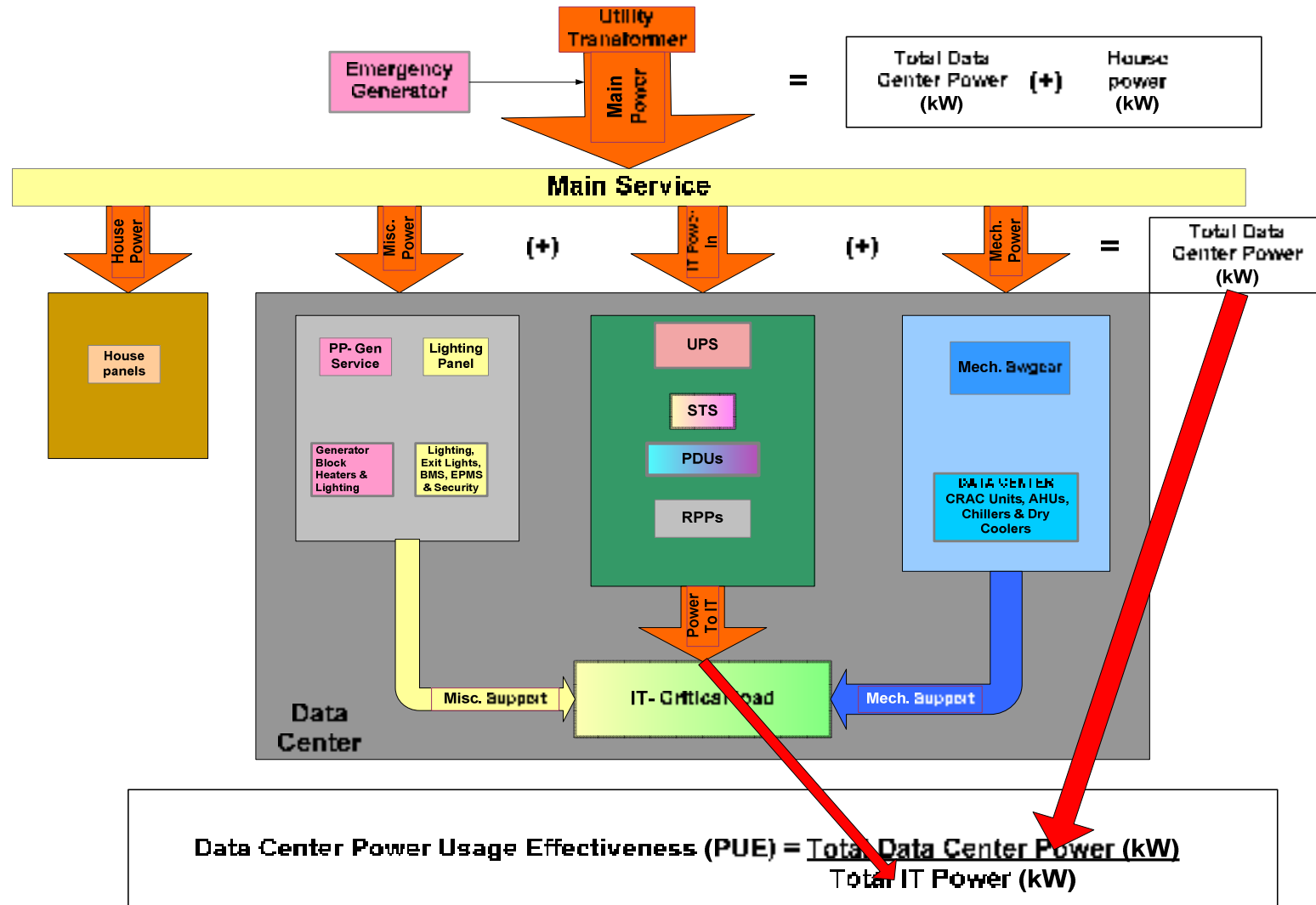
Include benefits 23% average savings; < 2 year payback, size done (big, small)

IBM Assessments of PUE's in Data Centers





Power Utilization Efficiency (PUE)





IBM assesses the client's data center's energy efficiency

- **Benefits from an assessment**
 - Potential for 10 to 40 percent savings on the infrastructure electric bill
- **Data center energy efficiency assessments** from IBM can help the client understand their energy use and identify measures to help improve energy efficiency by providing:
 - An assessment of the energy usage of the cooling, electrical and building systems that support the IT equipment
 - Identification of opportunities to improve energy efficiency that can:
 - Reduce costs
 - Free up power for use by IT equipment
 - High level business-case financial justification for efficiency improvements based on potential energy cost savings, prioritizing potential investments
 - Comparison to a data center energy efficiency standard





Energy Assessment Recommendation provide potential cost savings

Basic Energy Cost Calculations								
	Size of Data Center (sq mt)	Power consumption Design point (watt/sq mt)	Total DC power (kW)	Yearly power consumption (kWh)	Cost per kWh (\$)	Annual Total DC Power bill	IT equip Power consumption (%)	DC Infrastructure Power consumption (%)
	1000	600	600	5256000	\$ 0.10	\$ 525,600	30	70
Cost Savings Calculator								
	Annual DC Infrastructure Power Cost	Annual DC Infrastructure Power Savings (%)	Annual DC Infrastructure Power Savings (\$)	Tons of CO2 saved per year	Cars taken off the road per year			
	\$367,920	25	\$91,980	581	102			



DCEEA tool (Site tab)

Data Center Strategic Energy Assessment

File Edit Window Adobe PDF Type a question for help

Version 3.2 Home Selected Site: **Bharti, CPDC, Sec-62, Noida** Site Test Plan Energy Switchgear Plant Adjust Fuel Air Flow Benchmark Recommend Cost Equipment Tools

Owner: Bharti
 Address: A-14, Sec-62
 City: Noida
 State: UP
 Zip Code: India
 Country: India
 Climate Zone: 1A [Map](#)

Who: The Client (name) has requested the audit team (name) to carry out this audit.
 Why: The purpose of this audit is to identify the performance of the data center infrastructure (M&E systems), to compare it against system specific and climate specific conditions, and to make a series of high level recommendations in terms of cost benefit indications
 When: Preparator work for the audit commence in (month, year) and the audit took place in (month, year)

Percentage of Cooling System Types

M1: Air cooled chillers and CRACs	5 %
M2: Water cooled chillers and CRACs	0 %
M3: Air cooled DX CRACs	95 %
M4: Glycol dry cooler and DX CRACs	0 %
Must add up to 100%	100 %

Electrical System Configuration

No Redundancy (N)
 With Redundancy (2N, N+1, N+2, etc)

Units

SI (metric) Units Inch-Pound Units

Miscellaneous Required Information

Design Load Density (Watts/square meter)	914.9
CO ₂ emissions / energy delivered to site (kg CO ₂ /kWh)	0.94
Annual energy cost of facility (house and data center) in US \$	\$3,268,723
Annual energy cost allocated to data center in US \$	\$2,876,476
Perceived Tier Level	III

Electricity Emission Factors

Type	Non-Annex I
Country	India
Gas	kg CO ₂ /kWh
Coal	kg CO ₂ /kWh
Oil	kg CO ₂ /kWh
All Fuels	0.936 kg CO ₂ /kWh

[US emissions by zip code](#)

Default Values

Tons of Coal burned / MWh of thermal energy (Tn Coal / MWh)	0.5
CO ₂ absorbed by average tree per year (kg CO ₂ / tree year)	6.67
CO ₂ emission by driving a car round the world (kg CO ₂ / drive)	13,078
Tons CO ₂ / year produced by a car on the road (Tn CO ₂ / year)	6

Windows taskbar: 7:00 PM Sunday 4/19/2009, 98% battery



DCEEA tool (Energy tab)

Energy Audit 2.6 | Home | Selected Site: **Site name** | Selected Form: **Energy Usage** | Site | Test Plan | **Energy** | Switchgear | Plant | Adjust | Fuel | Air Flow | Benchmark | Recommend | Cost | Equipm

Enter 0% if measured at MV or 1.3% if measured at LV: | Enter measurement losses: | Data Entry Method: | Enter growth adjustment (increases average power): kW | Enter growth adjustment: kW

Electric Utility Energy					IT Equipment				
Month	Year	Days/Month	Hours/Month	Power (kWh)	Avg Power (kW)	At UPS Input (kW)	At Server (kW)		
1	Jan	2006	31	744	378400	509	115827		
2	Feb	2006	28	672	397600	592	104619		
3	Mar	2006	31	744	354800	477	115827		
4	Apr	2006	30	720	475600	661	115827		
5	May	2006	31	744	350800	472	115827		
6	Jun	2006	30	720	420000	583	115827		
7	Jul	2006	31	744	495200	666	115827		
8	Aug	2006	31	744	408800	549	115827		
9	Sep	2006	30	720	435800	605	115827		
10	Oct	2006	31	744	435800	586	115827		
11	Nov	2006	30	720	455200	632	115827		
12	Dec	2006	31	744	410400	552	115827		
Totals				8760	5018400	6884	1378716		
Average				730	418200	574	114893		
							1892	1324	Utility / IT Ratio
							158	110	5.20

Average Power (Mains & IT)

Legend: Utility Average Power (blue line with diamonds), IT Average Power (pink line with squares)

Instructions

Hard data will be collected from energy bills and BMS / EPMS systems To be provided by the client and analyzed by Audit Team.

Electric Utility Energy Usage and Maximum Demand to be considered in model at MV level. If utility energy is measured at LV level, the losses of MV/LV transformers need to be added (assume 1.3%).

IT Energy to be considered at supply point to servers (after PDU(s), Static Switch(es) and distribution/RPP(s)). If UPS measurements are taken consider the losses in the PDU's and STS's, since they reside on the load side of the UPS. The efficiency of the PDU varies between 96% and 97.5%. The efficiency of the STS varies between 98.5% and 99% at 480 V and 97% and 97.5% at 208 V.

Use only last 12 months in total.

Begin by clicking on the Month cell.

Data Analysis Comments



Diagnose - Data Center Energy Efficiency Assessment

Provide facts to reduce energy consumption by 25 to 35% annually



Client requirements

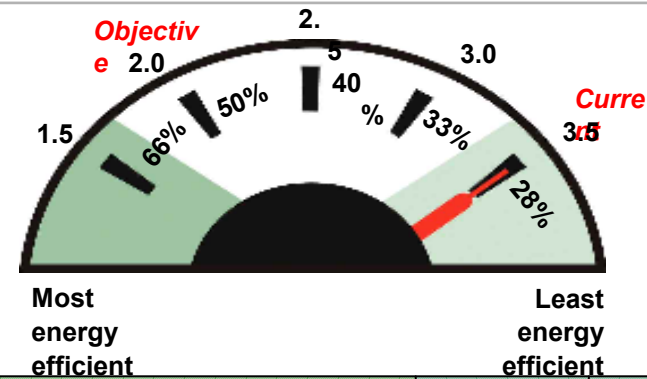
- Support IT growth with an existing 5,000 sq ft center
- Improve data center energy efficiency & reduce costs

Solution

- Comprehensive, fact-based analysis
- Evaluate cooling system components, electrical systems and other building systems
- Provide baseline metric (MPG) for data center energy efficiency
- Deliver roadmap of cost justified recommendations

Benefits

- Up to 53% annual energy savings
- 40% annual savings on actions with < 2 year payback
- \$125-170K annual energy savings



Improvements	Cost (\$K)	Payback
Reduce recirculation & bypass of cooling air	< 5	< 1 year
Increase CRAC air discharge temperature	< 5	<1 year
Adjust indoor temperature & relative humidity	< 3	<1 year
Turn off CRAC's where no IT equipment load	< 1	immediate
Improve UPS efficiency	40-140	1-2 years
Consider transferring IT loads to two PDUs	Varies	varies
Implement occupancy sensor light controls	< 5	1.5 years
Variable speed scroll compressors	300	18 years
Total	60 - 700	1 To 18 years



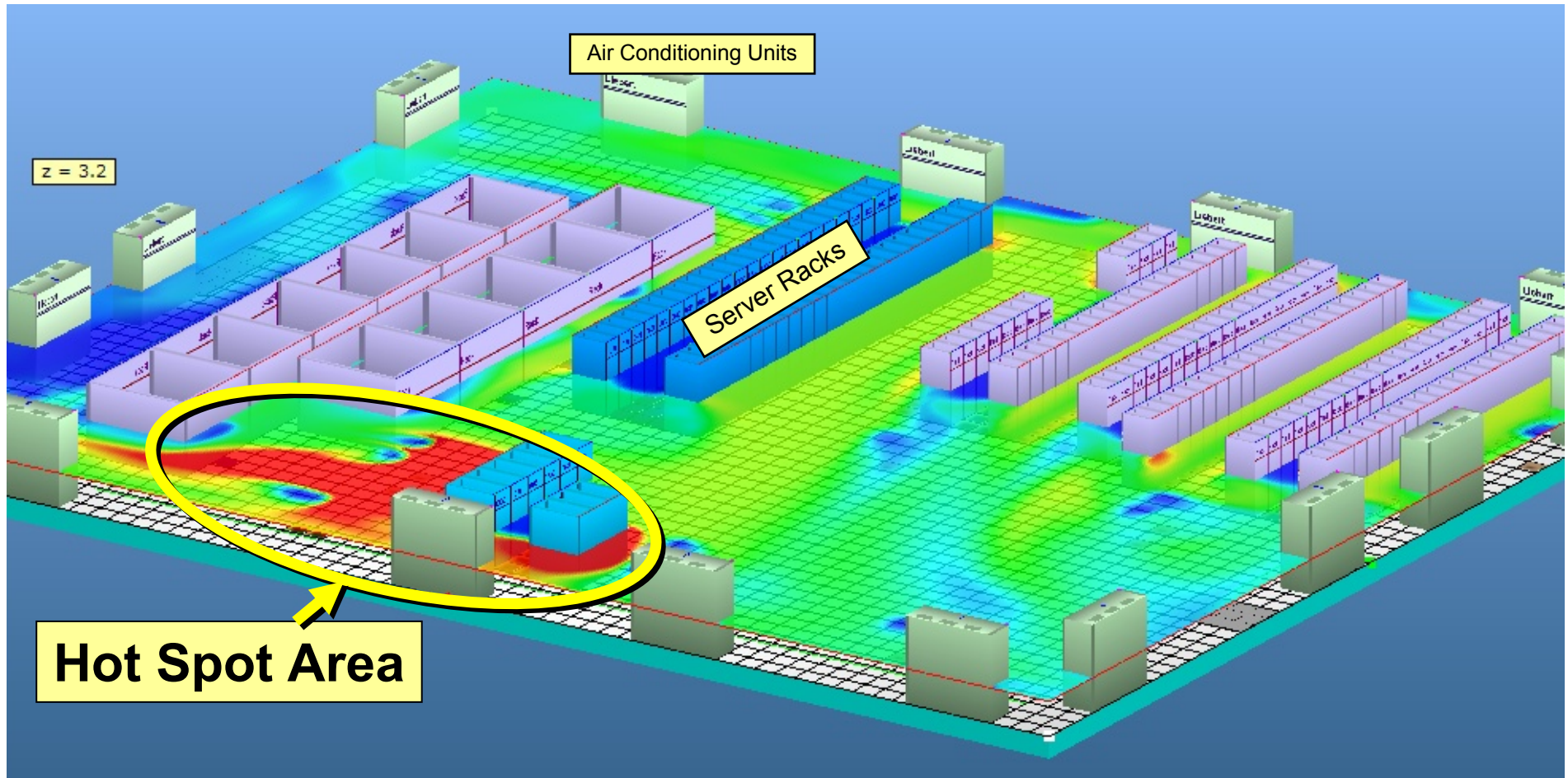
IBM RDHx “Cool Blue” Innovative Cooling



- ***Rack Cooling fitted at rack rear door***
 - ***Passive Cooling - no fan or moving parts to fail***
 - ***No fans – no power consumption***
 - ***No additional noise added***
 - ***No white space needed***
 - ***Rack neutral***
 - ***Fits existing racks - no IT downtime***
 - ***100% heat neutralization below 15kW per rack***
 - ***Secondary CW Loop operates at low pressure (13-20 psi)***
 - ***Highest TCO saving***
-



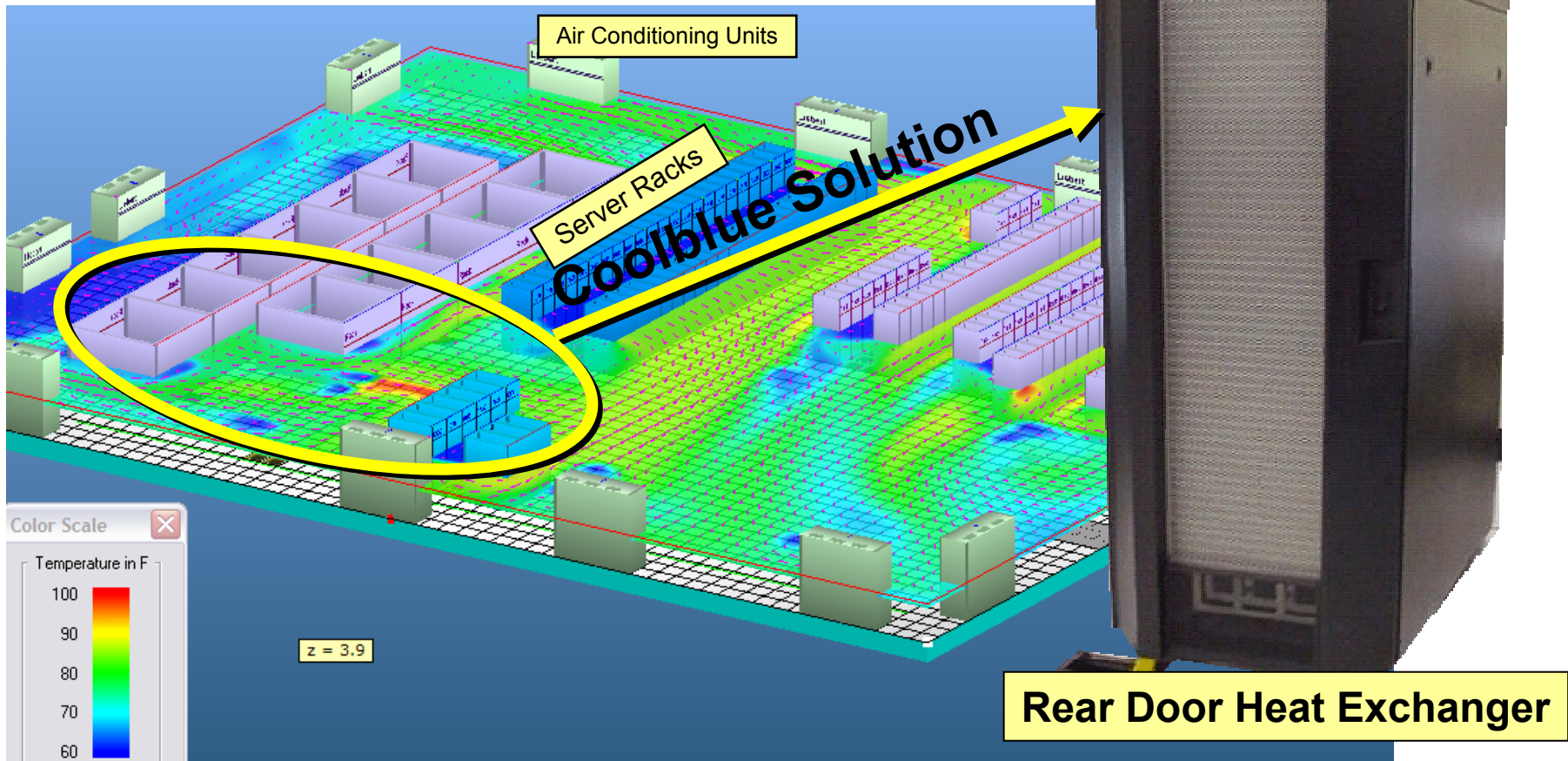
Hot Spots in Datacenter





IBM Rear Door Heat Exchanger

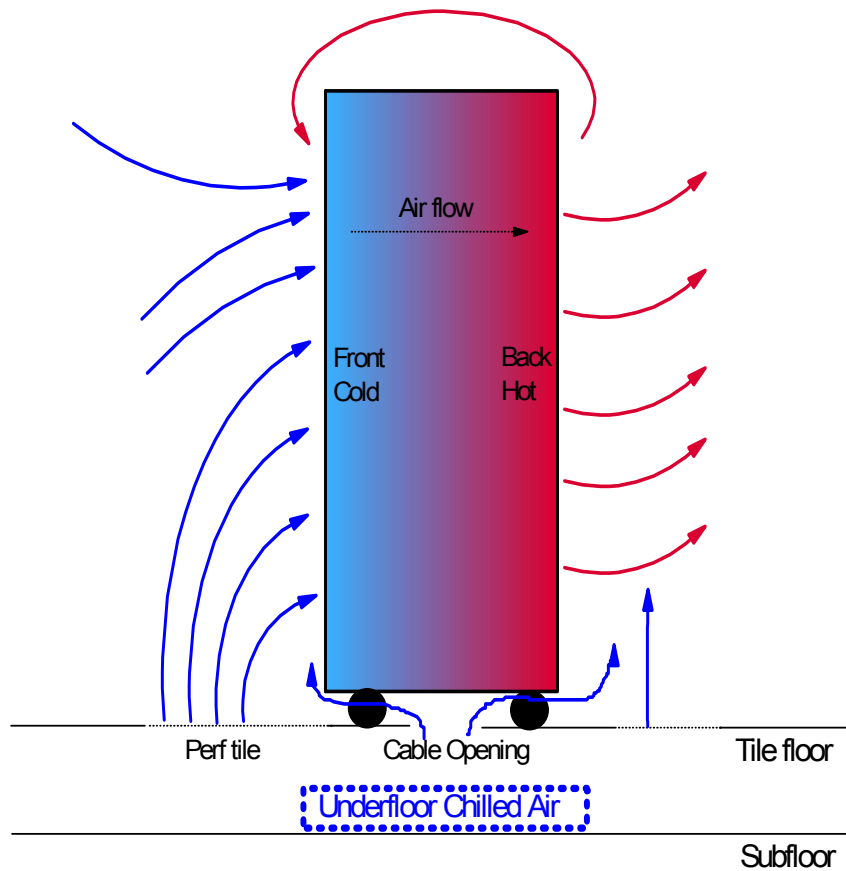
Eliminate Hot Spot in Data Center



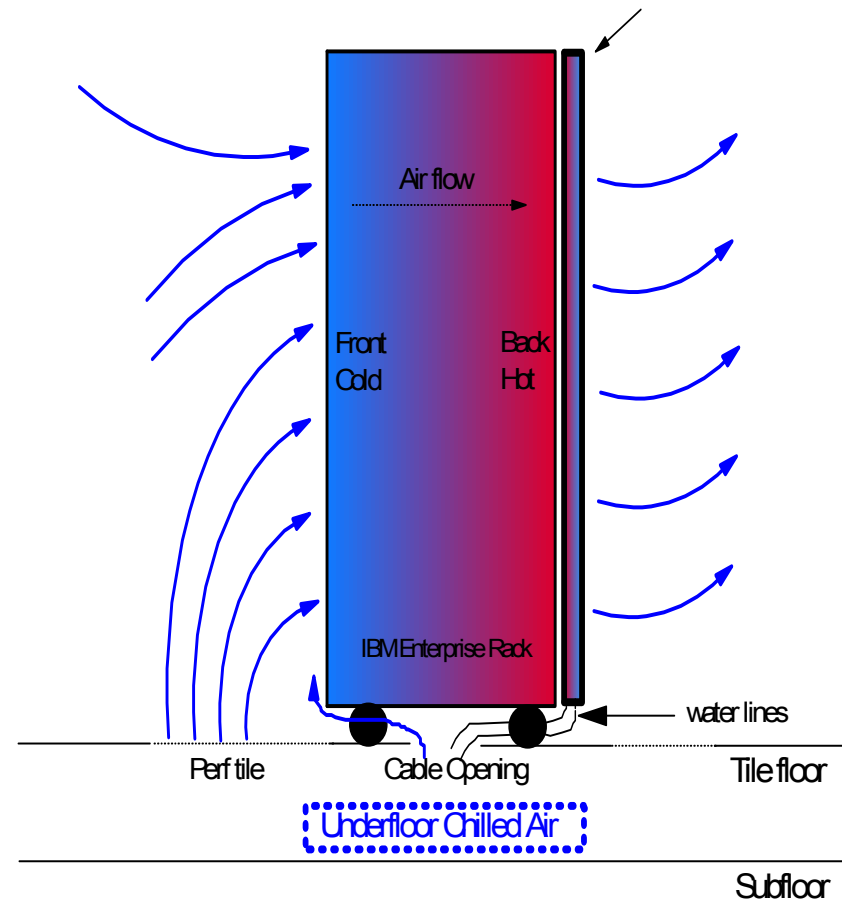


IBM RDHx "Cool Blue" Innovative Cooling

Heat Circulation



Rear Door Heat exchanger

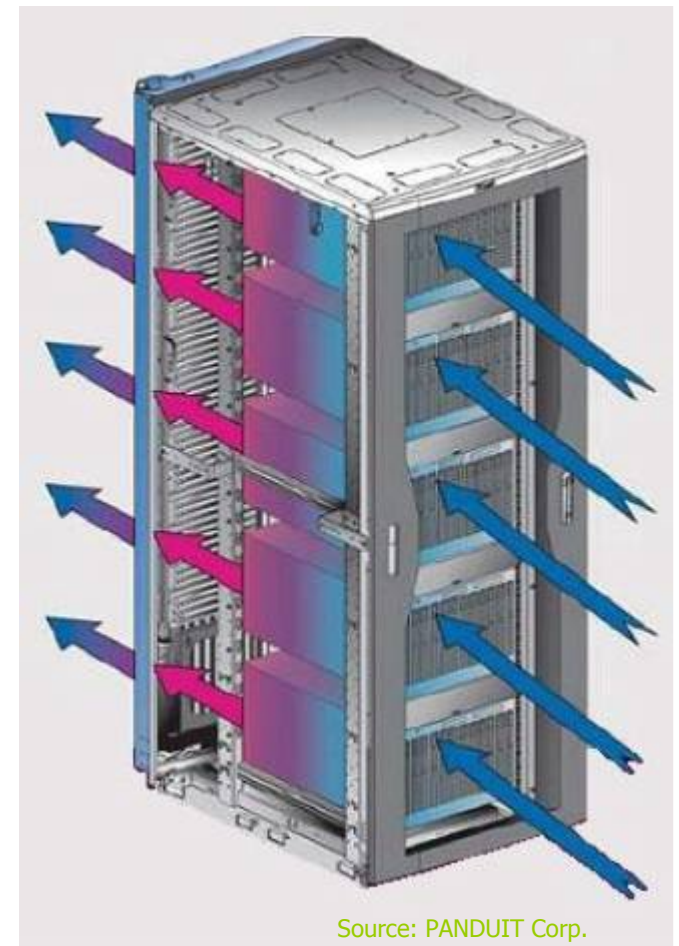




Removing the heat in specialized racks BEFORE the hot air gets into the hot aisle is an energy efficient approach



- Proven performance
 - Engineered by IBM with 30+ years in liquid cooling computers
 - Passive operation
- Increased density
 - Removes up to 60% of heat, or 20kW
 - Allows for high-density deployment
- Energy efficient
 - Lessens burden on CRAC/CRAH units
 - More efficient than fan based systems



Source: PANDUIT Corp.

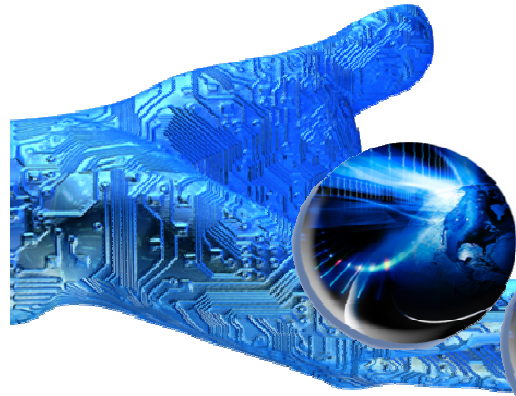


The RDHX can either be water cooled or air (refrigerant) cooled





Building a New Data Centre : [When and Where Does it Stop?](#)



A commitment for DC build is a lifetime **spending** commitment

What is the cost to operate a 1m² of DC ?

You need to see the the full picture

Strategy: Match your business needs to IT needs

Planning: Develop the roadmap for investment and Needs

Design: Transform the “Needs” into a buildable system

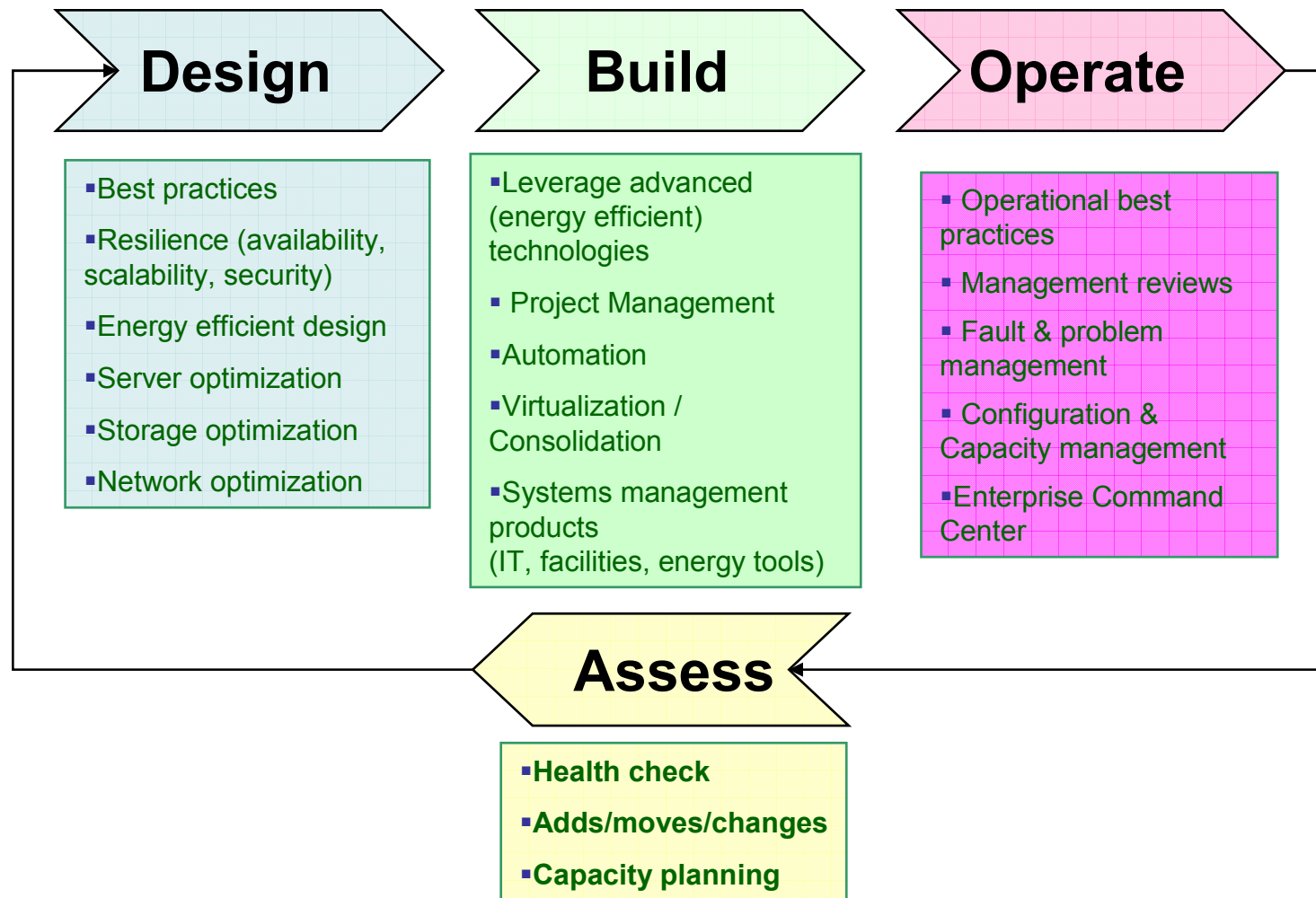
Construction: Implement with “Quality”, “Budget” and “Reliable ”

Operation: Preserve the DC and Running Costs





Critical success factors in designing, building and operating a Green data centre



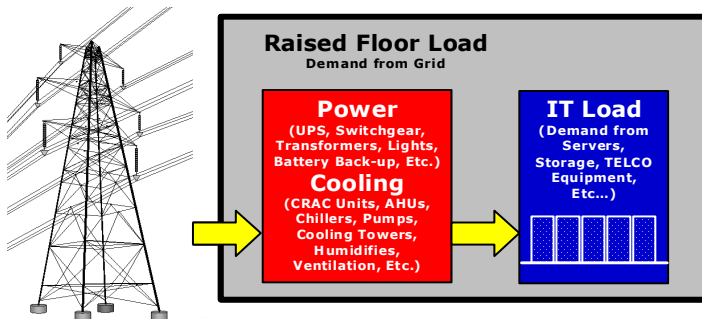


Industry Practices on Data Center Design

DCiE — Data Center (Infrastructure) Efficiency

PUE — Power Usage Effectiveness

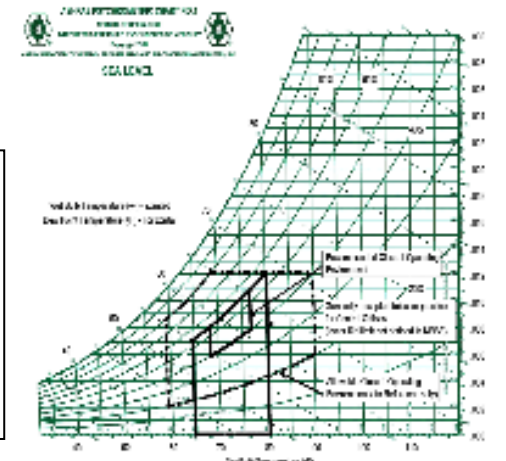
$$DCiE = \frac{\text{IT Equipment Power}}{\text{Total Raised Floor Power}} = \frac{1}{PUE}$$



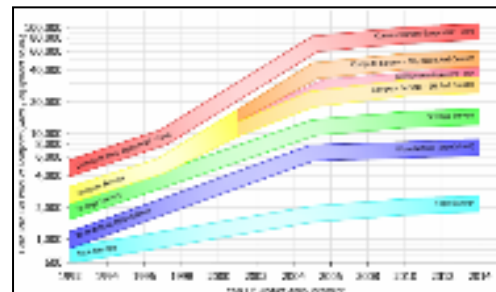
Uptime Institute

	Tier I	Tier II	Tier III	Tier IV
Number of Delivery Paths	Only 1	Only 1	1 Active 1 Passive	2 Active
Redundancy	N	N + 1	N + 1	S + S or 2 (N + 1)
Compartmentalization	No	No	No	Yes
Concurrently Maintainable	No	No	Yes	Yes
Fault tolerance to Worst Event	None	None	None	Yes

ASHRAE



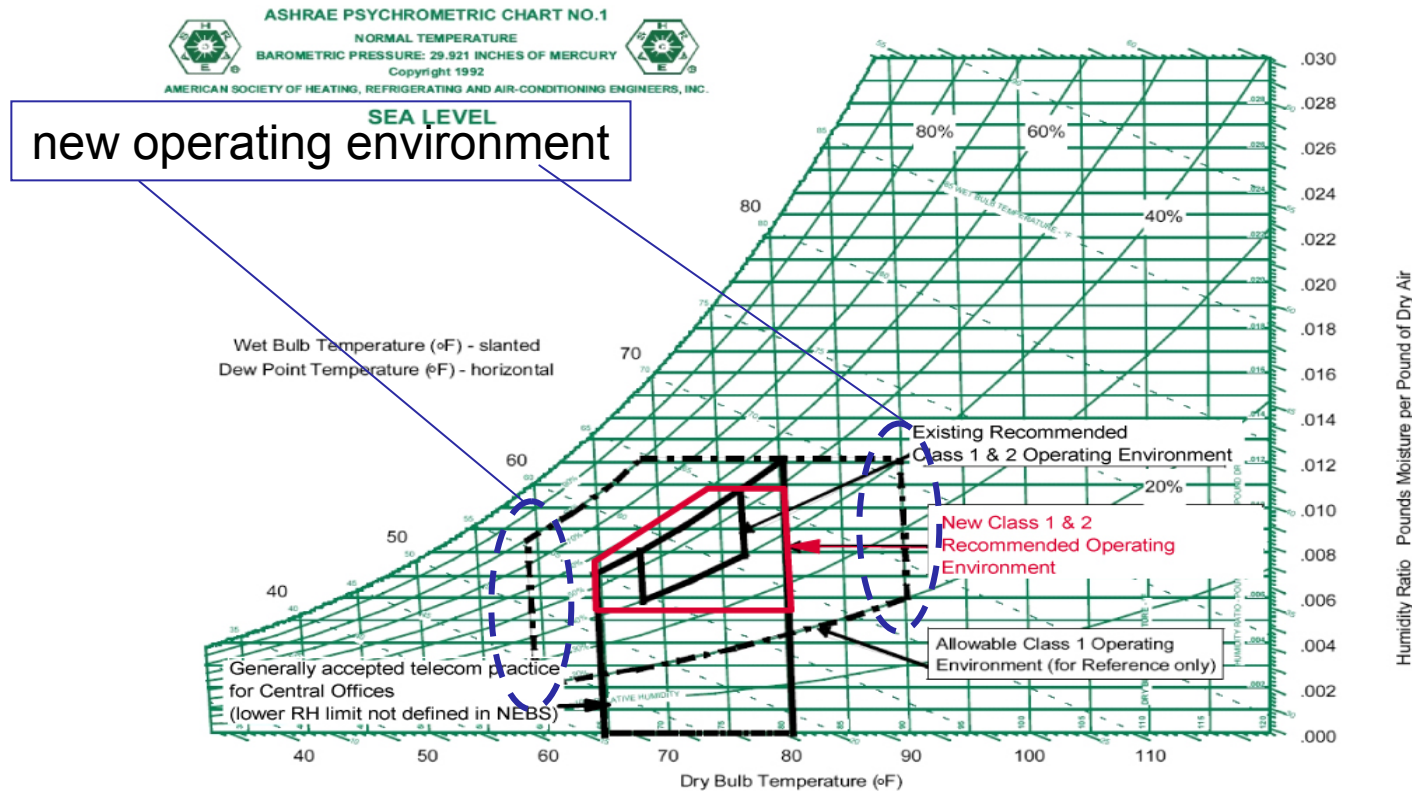
European Union – US Department of Energy and EPA





ASHRAE TC9.9 2008 Recommendations

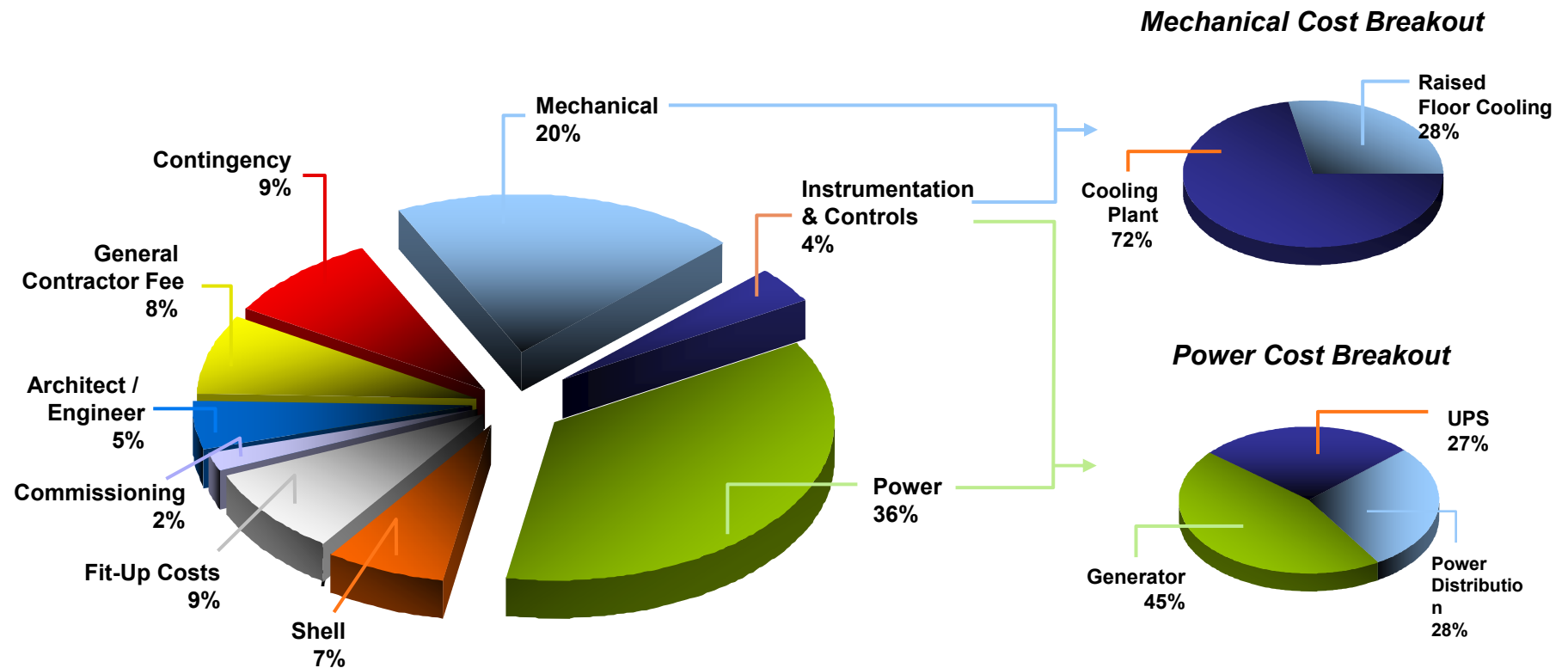
The data centers for ASHRAE classes 1 and 2, the new allowable environment range from 18degC to 27deg C . (previously 20degC to 25degC)



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You need to optimize around energy costs since they comprise 60 percent of the capital costs to build a new data center.*



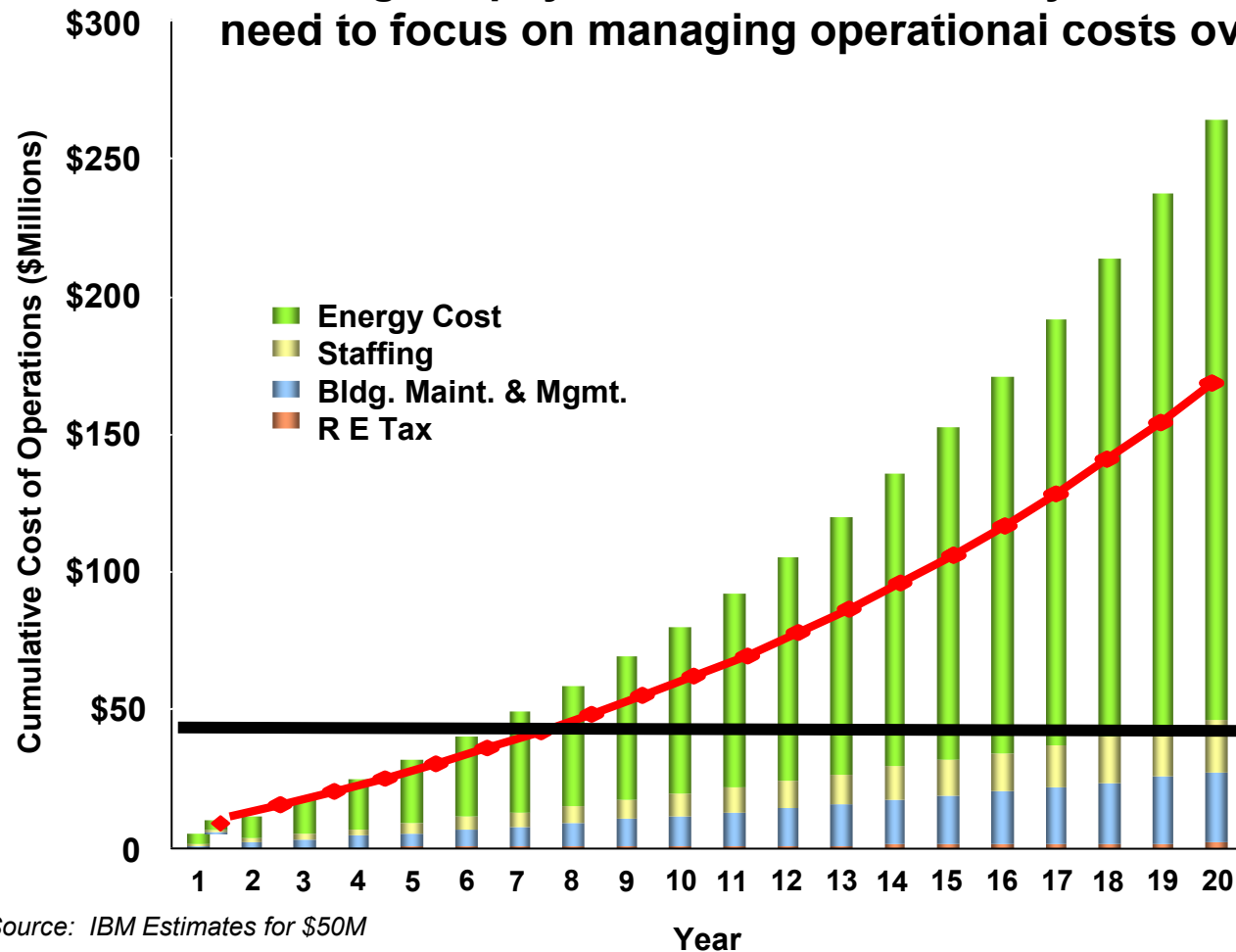
This chart illustrates why you need to optimize energy costs—not floor space.

* Source: IBM engineering estimates, 2008



Data center operating costs are up to three times the capital costs.

Building the physical data center is only a small part of the cost—you need to focus on managing operational costs over its lifetime.



Source: IBM Estimates for \$50M

Example: One 2,000sqft data center

- Cumulative cost to run a data center
- 10% annual energy increase
- Data center operational costs are 3-5 times the capital costs
- 75% of operation costs is for energy



Design for flexibility with modular data centers

IBM's Data Center Family™ solutions align to your business and cost objectives

Scalable modular data center



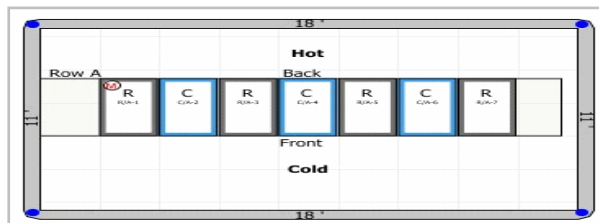
Enterprise modular data center



Portable modular data center



High density zone



- Turnkey center for 500-2,500 sq ft
- 20% less cost than traditional center
- Implement in 8-12 weeks

- Standardized design for 5- 20K sq feet
- Defer 40-50% capex and opex costs
- Save to 50% operational costs

- Fully functional data center
- Rapidly deploy in 12-14 weeks

- 35% lower cost than data center retrofit



What is Scalable Modular Data Center (SMDC)?

APC InfraStruXure + IBM Services and Solutions = SMDC

■ APC InfraStruXure

- Equipment racks
- UPS/batteries
- InRow cooling
- Power distribution
- Overhead cabling
- Monitoring



• IBM Services and Solutions

- Data Center Planning and strategy
- Solution Design
- Project Management / Project Administration
- Site fit-up (demolition / construction)
- Installation services
- **Power and Cooling Equipment**
- IT equipment relocation and integration
- IBM technology (BladeCenters, storage, etc.)
- Cabling solutions and services
- Other infrastructure needs:
 - Engine generator
 - Chiller
 - Fire detection/suppression
 - Rear Door Heat Exchanger
 - Etc.
- Post installation best practices consulting
- On-going capacity planning and support



Scalable Modular Data Center (SMDC) is an energy efficient solution that adds capacity as requirement grows

Scalability

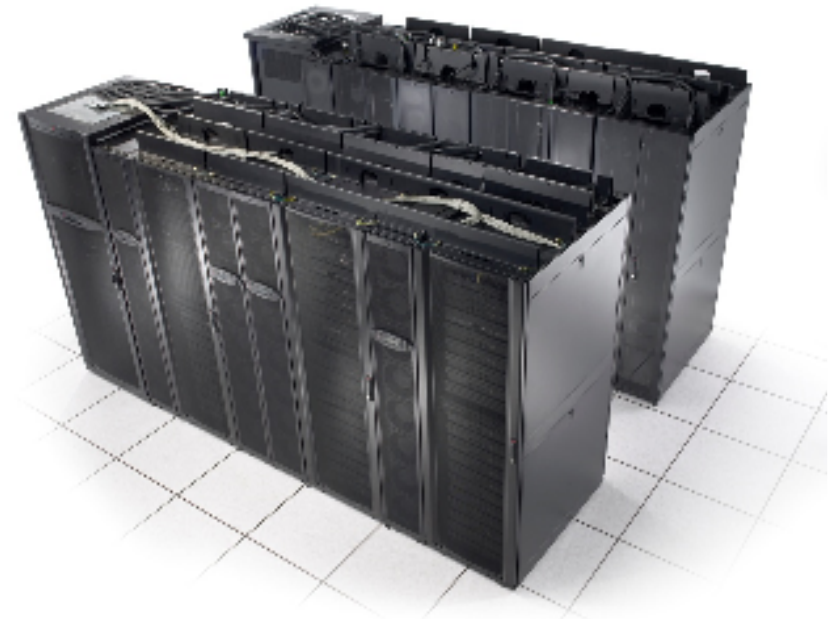
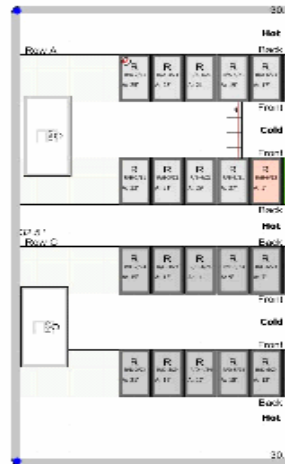
- Reduced startup costs up to 20%
- Reduced energy costs up to 40%
- Ability to scale with requirements

Modular design

- Quick deployment (8 to 12 weeks)
- Reduced energy costs
- Increased resilience

Benefits

- Energy efficient
- Scalable to easily meet the needs of today and tomorrow
- Space saving (up to 40% less space)
- Modular design for quick easy maintenance and growth
- High density computing environment support
 - Up to 30kW per rack and higher
 - Preconfigured IBM BladeCenter solutions

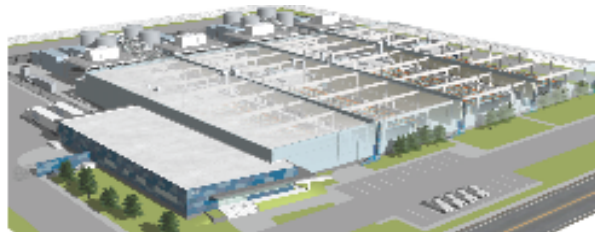


The scalable modular data center enhances ROI through minimized startup costs rapid deployment, and ongoing operational savings.



Enterprise modular data center

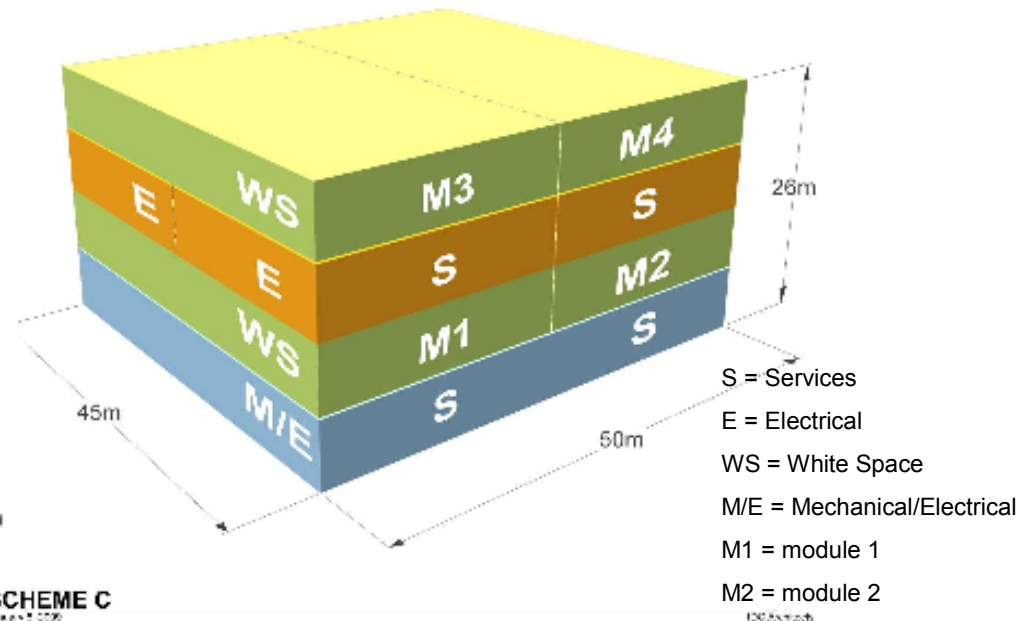
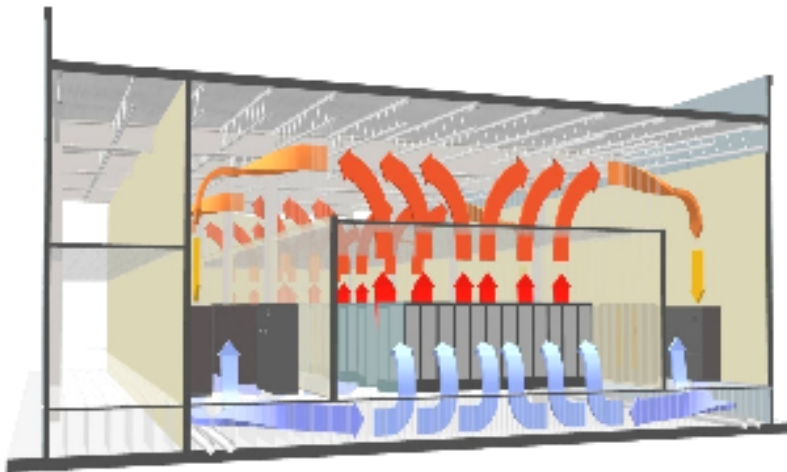
Enterprise modular data center



- Standardized design for 500 up to 2,000 square meter
- Designed for high availability
- Leadership energy efficiency with 66 percent DCIE
- 25 percent faster deployment than custom approach
- Open architecture involving leading vendors

Features

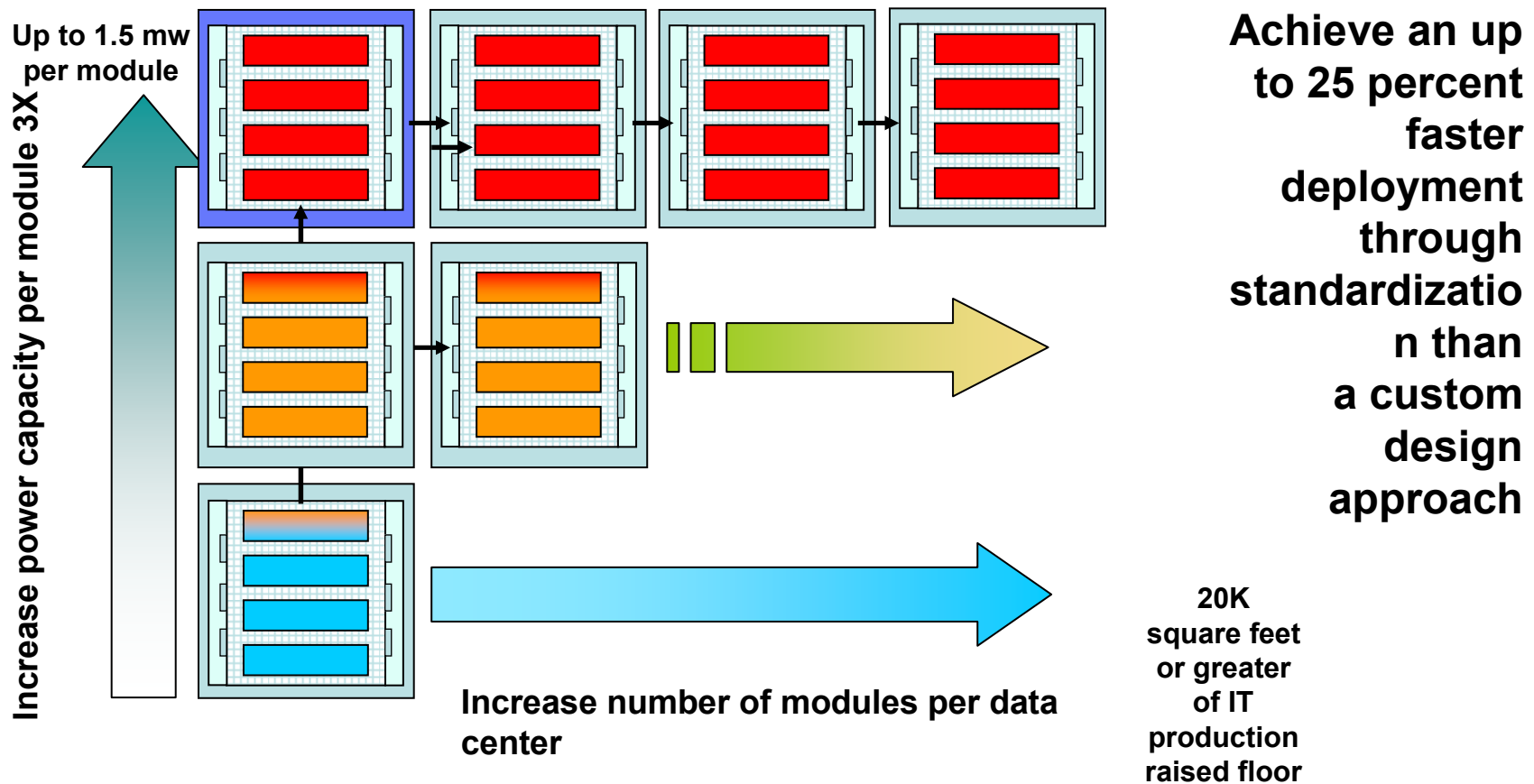
- High availability DC (0.5 to 1.5MW per module, 1 to 4 modules)
- Secured and weather shielded and contained at 80% land coverage
- Can accommodate Enterprise Command Center and 50 people
- Adjustable to meet the requirement 500 to 2000 sm (left sketch) using soft office spaces
- Façade to meet location architectural requirement





Enterprise modular data center solution allows you to incrementally increase both power capacity and floor space as needed.

Enterprise modular data center allows you to grow—without disruption to your IT operations.





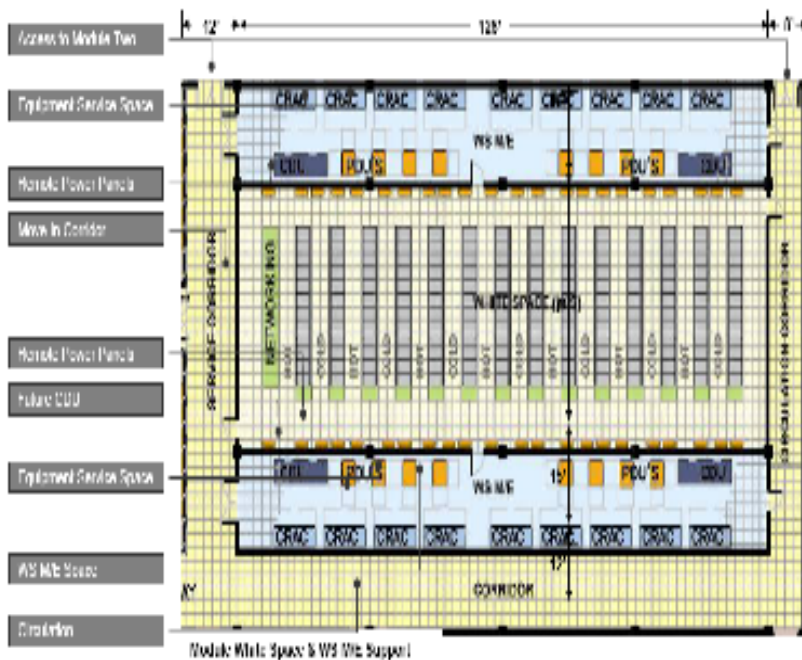
The enterprise modular data center solution can ease complexity while reducing risk through more available and predictable operations.

- **Provide expansion with no operational downtime by:**
 - Adding power and cooling capacity per module without disrupting existing operations.
 - Add square footage when needed without effecting operations of existing white space
 - Using plug and play, repeatable building blocks virtually eliminates engineering for a near worry-free expansion.
 - Replication of design allows for predictive reliability.
 - **Implement a highly reliable and cost-effective design that allows for:**
 - Redundancy, built for N+1 throughout the electrical and mechanical infrastructure.
 - Need based resiliency, can change from and within modules
 - Concurrent maintenance of all mechanical and electrical infrastructure down to the rack level.
 - Standardization leads to high availability
 - **Improve facilities management through a standardized operating environment with capabilities that can:**
 - Deploy anywhere in the world.
 - Provide predictable Instrumentation & Controls and Operations & Maintenance
 - **Extend required End-of-Life equipment replacement**
-



Design for flexibility in enterprise class data centers

Pay as you grow : align costs to IT needs with Enterprise modular data center



Meet unpredictable business and IT growth

- Enable 3x power & cooling growth at one-third cost
- Up to 12x power and cooling capacity growth

Align capital and operational cost to IT needs

- Defer up to 40% capital costs until required
- Defer up to 50% operational costs until required
- As much as 50% energy savings

Provide available and predictable operations

- Provide expansion without downtime to operations
- Provide standardized operating environment

Design to an “open architecture”

- Opportunities for OEM innovation
- Integrated leading vendor's capabilities



Data center actions can significantly reduce costs, improve resiliency and flexibility to meet changing requirements

Extend the life of an existing data center infrastructure

- 23% average energy savings from audits
- Up to 35% less cost to adopt new technology
- 30-70% TCO savings from virtualization
- Over 30% savings from energy efficient technology

Rationalize the data center infrastructure across the company

- Up to 50% reduction in operational costs
- Up to 15% operational savings from data center consolidation

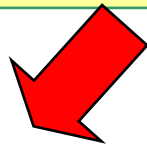
Design new infrastructure to be responsive to change

- Defer 40-50% capital and operational costs with a modular data center approach
- Save up to 50% operational costs from energy efficient design



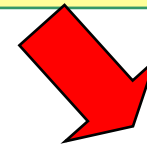
It's not what you KNOW, but what you DO that matters

Steps towards energy efficient and cost savings



• **Existing data center**

- Energy efficiency assessment
- Optimize efficiency with short and long term solutions
- Virtualize / consolidate your IT
- Use advanced technologies
- Measure and monitor savings



• **New data center / expansion**

- Design it right at the beginning
- Use advanced green technologies
- Scalable & Modular approach
- Consider holistic/integrated approach (IT, racking, cabling)
- Use thermal modeling or CFD



Let's build a smarter planet.



Thank
YOU

