Making Data Centres Efficient & Resilient

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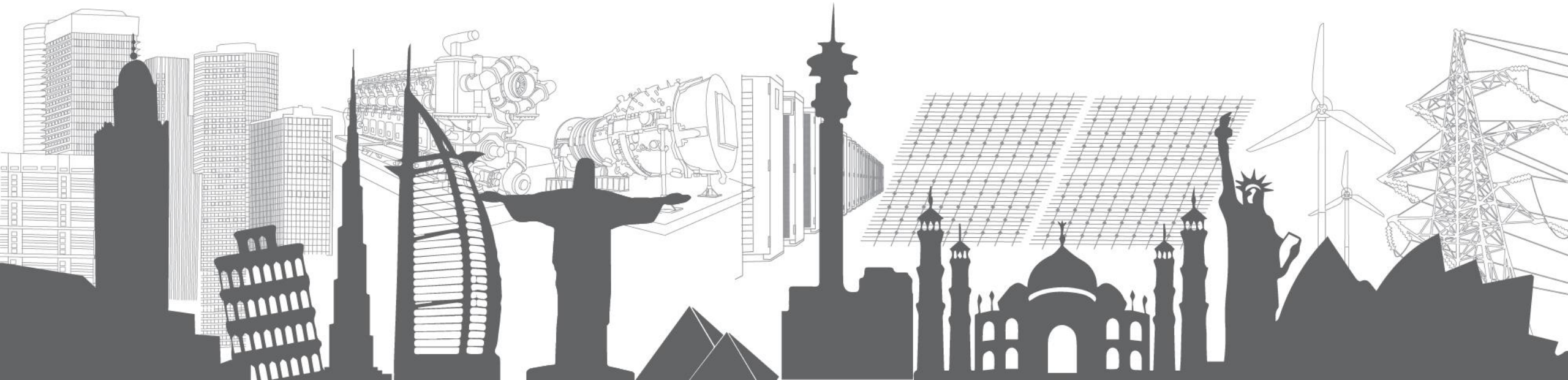
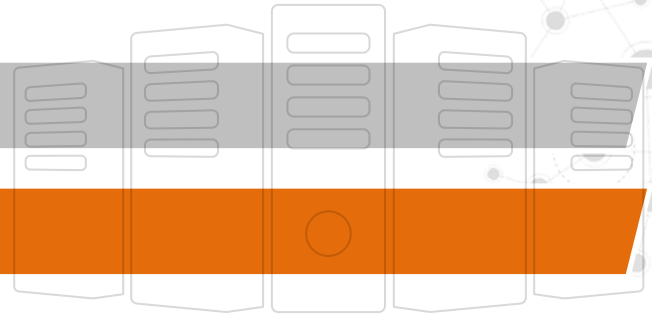
Sterling & Wilson



Covers

- Availability & Reliability
- Availability classes
- Examples of multidata center resiliency.
- PUE Vs Resiliency
- Data center energy pie
- Some tips on energy efficiency measures
- Current & future design strategy
- Impact on global energy foot print
- Q& A.



Flashback Forbes magazine in 1999

A SEMINAL ARTICLE AUTHORED BY PETE HUBER & MARK HILLS WITH A WONDERFUL TONGUE IN CHICK TITLE, " ***DIG MORE COAL – THE PC'S ARE COMING".***

THE OPENING PARAGRAPH SAYS SOMEWHERE IN AMERICA , A LUMP OF COAL IS BURNED EVERY TIME A BOOK IS ORDERED ON LINE. THE CURRENT FUEL ECONOMY RATING :- ***ONE POUND OF COAL TO CREATE , PACKAGE , STORE AND 2 MEGABYTES OF DATA.***

THE INTERNET MAY SOMEDAY SAVE US BRICKS , MORTAR AND CATALOGUE PAPER BUT IT IS BURNING UP AN AWFUL LOT OF FOSSIL FUEL IN THE PROCESS..

What Is Availability

- Availability is the probability that a component system is in a condition to perform its intended function. While similar to reliability, availability is affected by more events than a failure requiring repair or replacement of components system.

$$\text{Availability} = \frac{\text{Uptime}}{\text{Uptime + Downtime}}$$

$$\text{Availability} = \frac{\text{Uptime}}{\text{Uptime + Scheduled Downtime + Unscheduled Downtime}}$$

Common Downtime Event

Scheduled Downtime

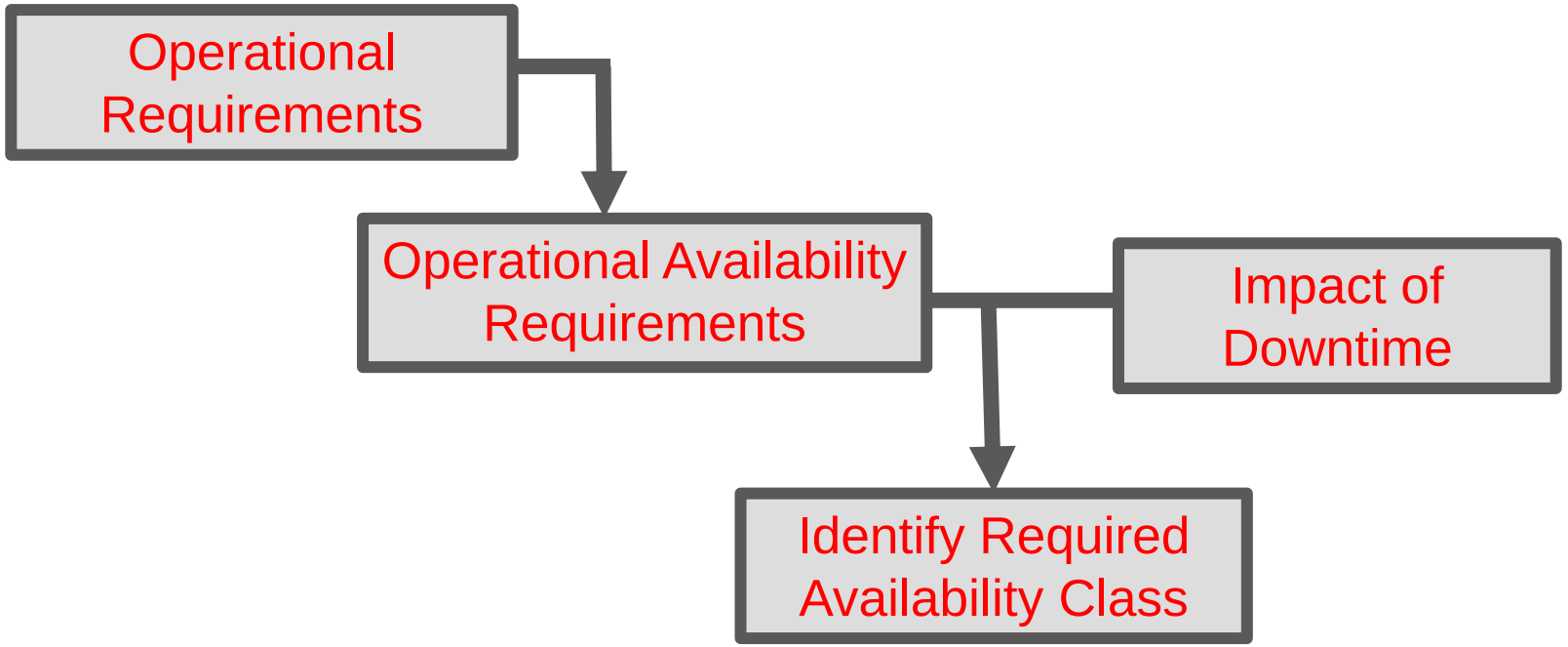
- Preventive Maintenance
- System and equipment setup and upgrades
- System testing/optimization
- Scheduled facilities related events
- Remedial maintenance

Unscheduled Downtime

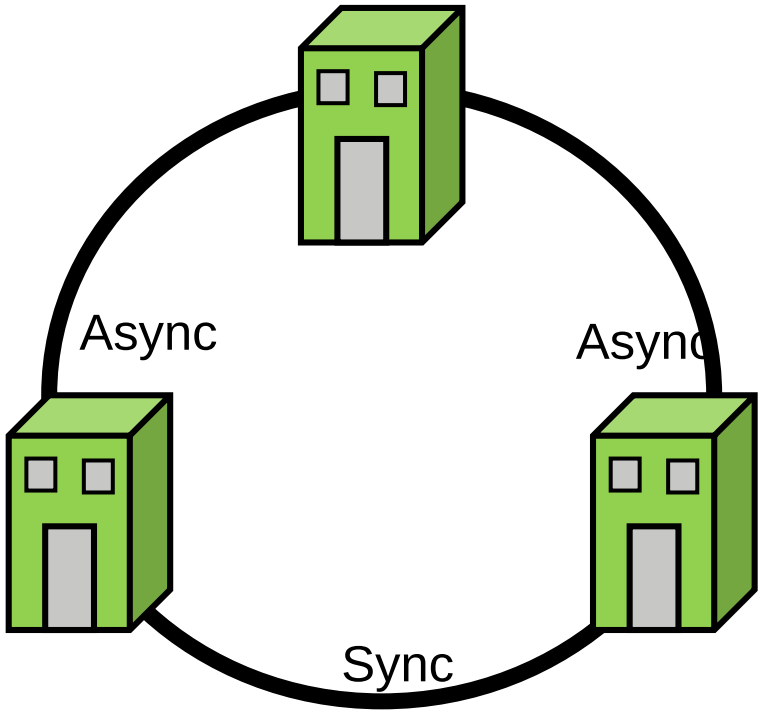
- Repairers due failure
- Maintenance delay
- Facility- related failures/outages

Availability Class ANSI/ BICSI002-2014

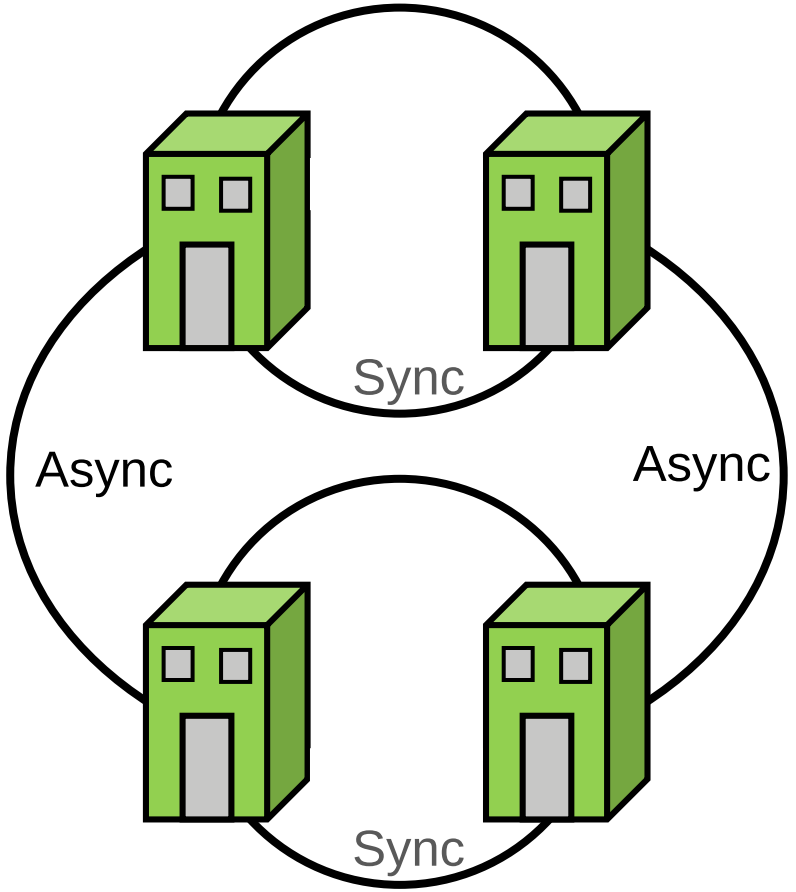
- Operational requirement
- Operational availability
- Impact of downtime



Private Cloud Multi-Data Centre



2 nos. **Class 3 solution with Three Class 2 Facilities**



2 nos. **Class 4 solution with Four Class 2 Facilities**

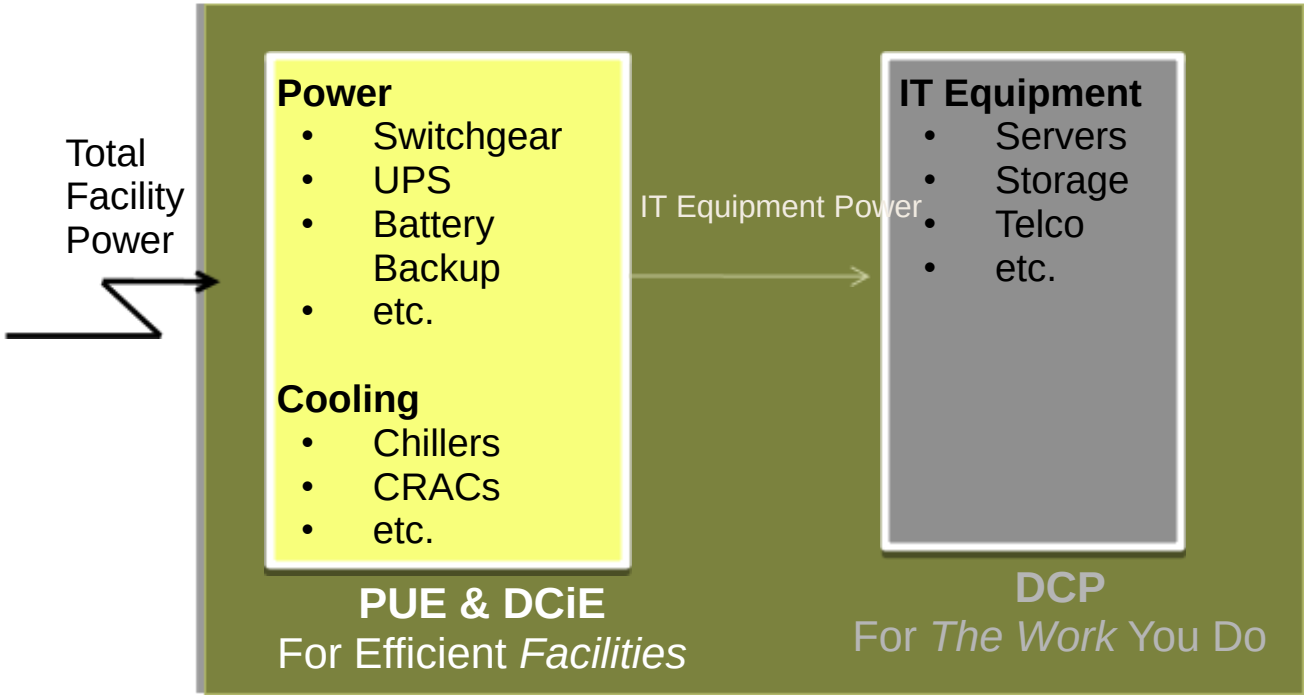
PUE (Power Usage Effectiveness)

$$\textbf{PUE} = \frac{\text{Total Facility Power}}{\text{IT Equipment Power}}$$

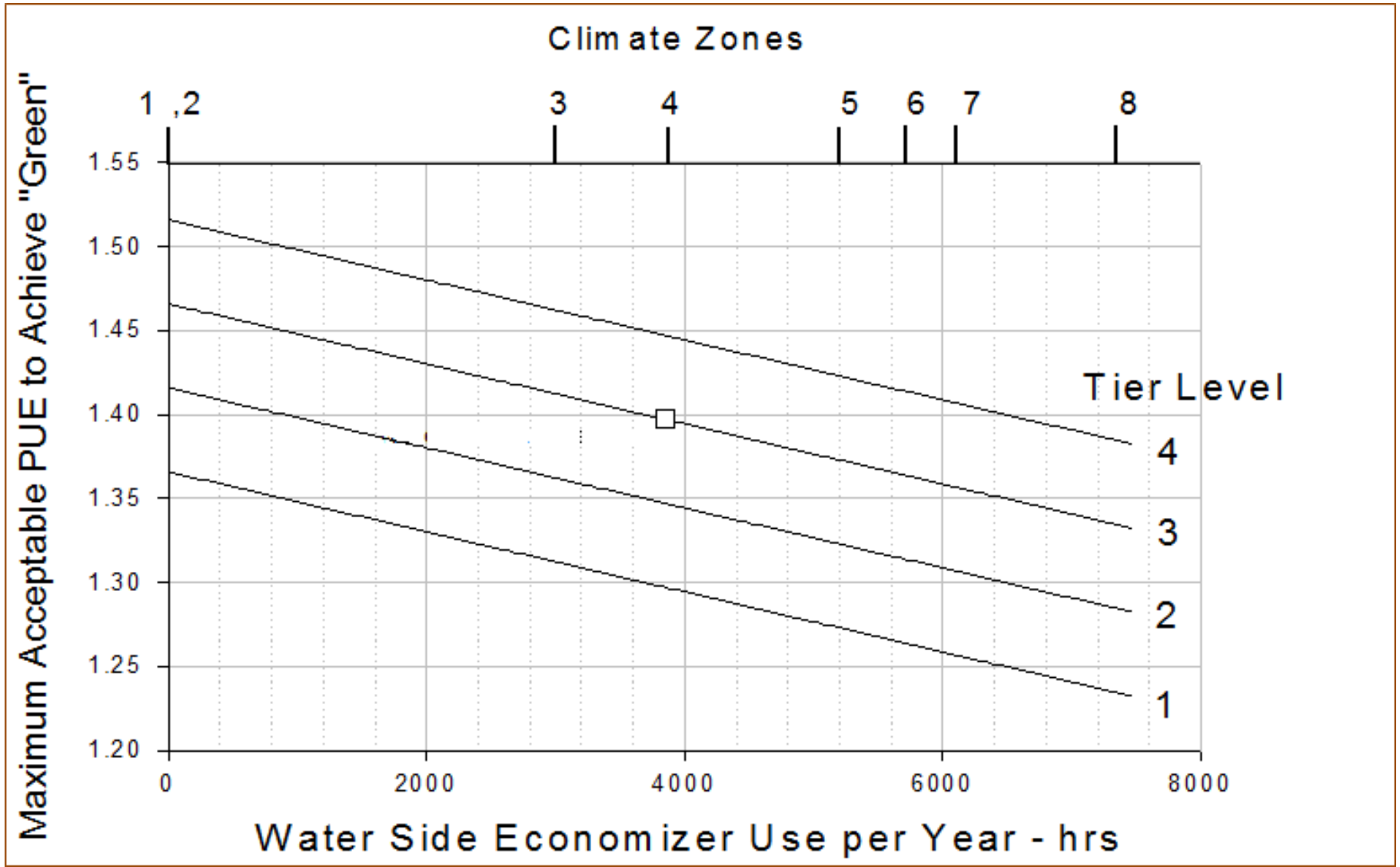
How efficient is my facility in delivering power to IT equipment?

$$\textbf{DCiE} = \frac{\text{IT Equipment Power}}{\text{Total Facility Power}} \times 100\%$$

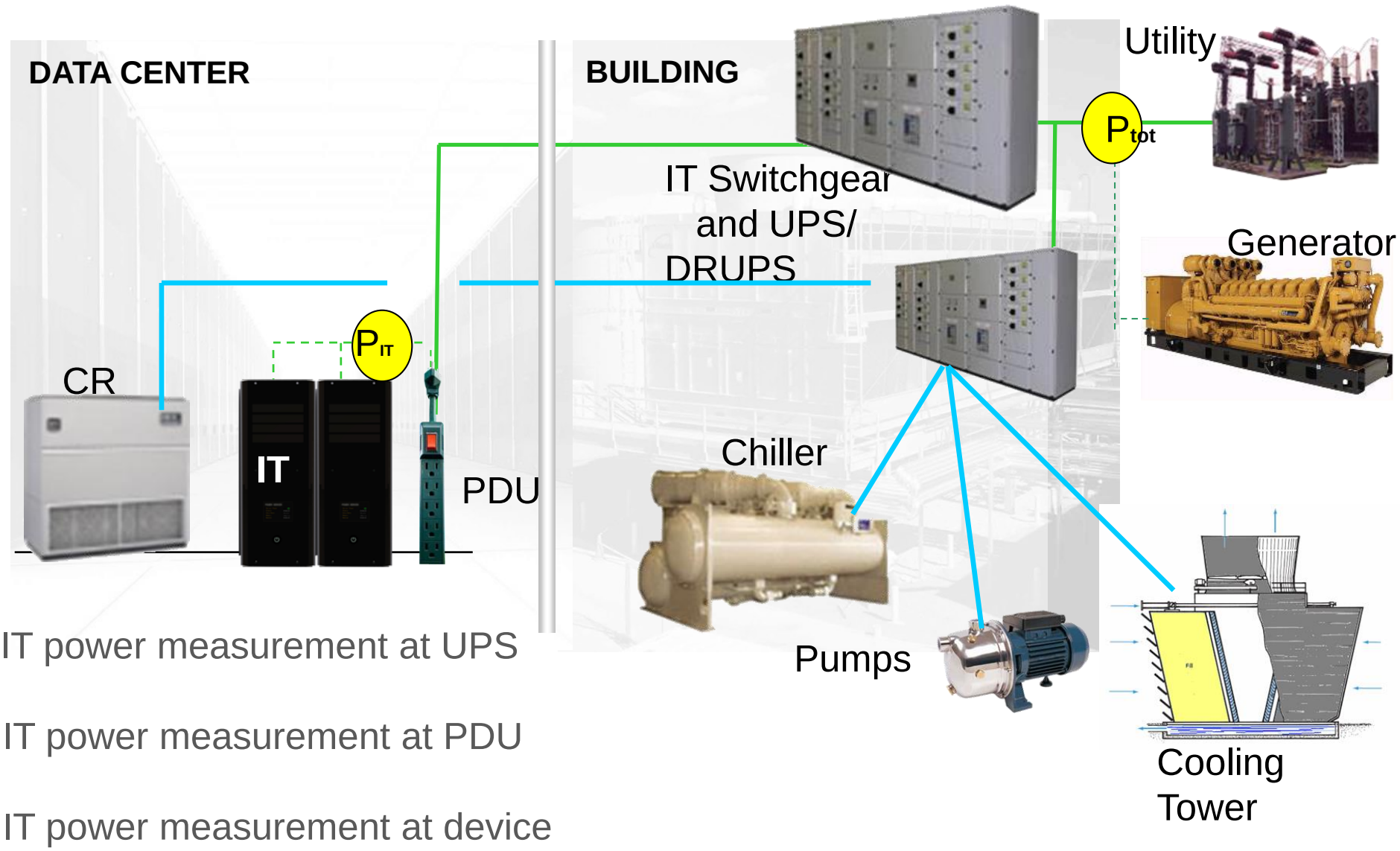
What % of facility power is delivered to my IT equipment?



Resiliency At The Cost Of Efficiency / PUE

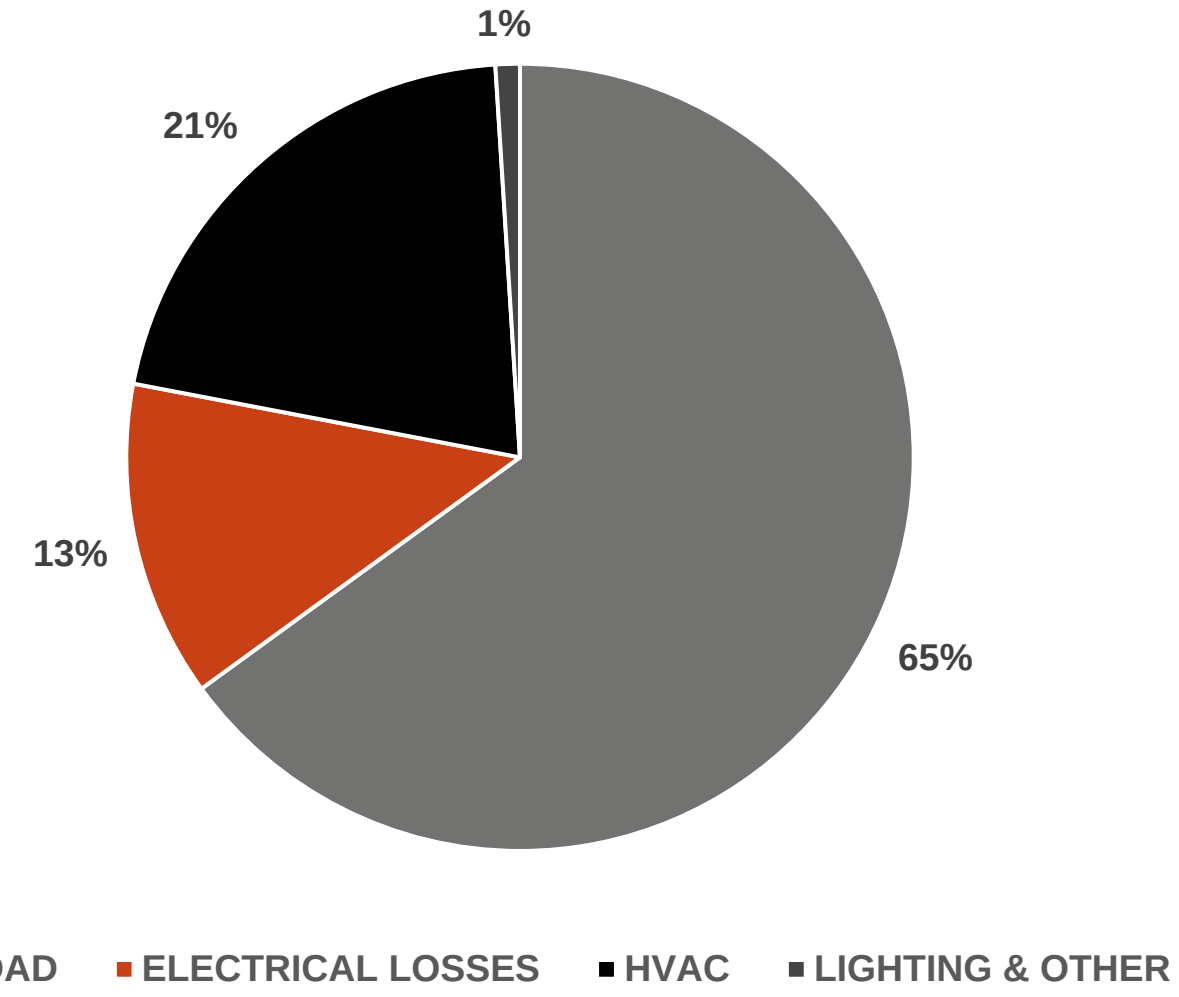


Different levels of PUE measurement



Level 1 :- IT power measurement at UPS outlet
Level-2 :- IT power measurement at PDU outlet.
Level-3 :- IT power measurement at device level

Energy Consumption In Data Centers



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Energy Efficiency Measures - Some Tips

ICT EQUIPMENT

- Implement server virtualization
- Optimize data storage
- Enable power management features
- Specify high efficiency power supplies
- Rightsizing IT power

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Energy Efficiency
Measures-some Tips

Cooling plant

- Install variable speed drives.
- Cooling plant strategy.
- Increasing water efficiency (water cooled unit)
- Optimize pumping control.
- Use of waste heat , free cooling.
- Optimize chilled water & condenser water supply.
- Improve pumping efficiency.
- Direct expansion Vs chilled water system.

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Energy Efficiency
Measures-some Tips

IT power distribution

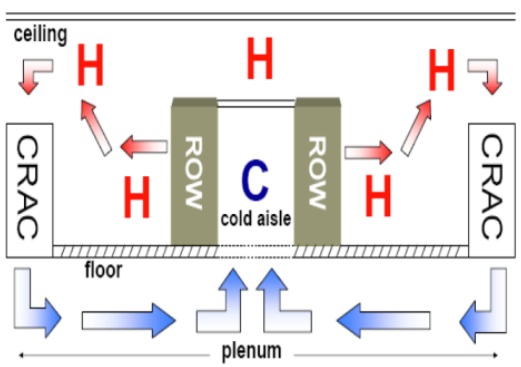
- Improve UPS efficiency
- Improve transformer efficiency.
- Bulbar Trunking : Reduced Losses.
- Low harmonics system to be designed with no capacitor panels.

Lighting

- Improving lighting efficiency.

Energy management

- Install monitoring equipment to measure efficiency & performance.
- Real time PUE monitoring software



Class[a]	Equipment Environmental Specifications for Air Cooling						
	Product Operations[b,c]					Product Power Off[c,d]	
	Dry-Bulb Temperature[e,g] °C	Humidity Range, Non-Condensing[h,i,k,l]	Maximum Dew Point[k] °C	Maximum Elevation[e,j,m] m	Maximum Temperature Change[f] in an Hour (°C)	Dry-Bulb Temperature °C	Relative Humidity[k] %
Recommended (Suitable for all 4 classes)							
A1 to A4	18 to 27	-9°C DP to 15°C DP and 60% RH					
Allowable							
A1	15 to 32	-12°C DP & 8% RH to 17°C DP and 80% RH[k]	17	3050	5/20	5 to 45	8 to 80
A2	10 to 35	-12°C DP & 8% RH to 21°C DP and 80% RH[k]	21	3050	5/20	5 to 45	8 to 80
A3	5 to 40	-12°C DP & 8% RH to 24°C DP and 85% RH[k]	24	3050	5/20	5 to 45	8 to 80
A4	5 to 45	-12°C DP & 8% RH to 24°C DP and 90% RH[k]	24	3050	5/20	5 to 45	8 to 80
B	5 to 35	8% to 28°C DP and 80% RH[k]	28	3050	NA	5 to 45	8 to 80
C	5 to 40	8% to 28°C DP and 80% RH[k]	28	3050	NA	5 to 45	8 to 80

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Energy Efficiency Measures-some Tips

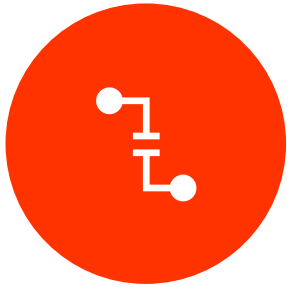
Environmental conditions

- Optimize supply air temperatures.
- Improve cooling unit controls.
- Optimize humidity control

Air Management

- Improve return air management
- Separate Hot & cold air streams.
- Improve underfloor pressure management
- Optimize IT equipment cabinet airflow.
- Improve CRAH/ AHU efficiency.

Current & Future Strategy Of Data Centre Design



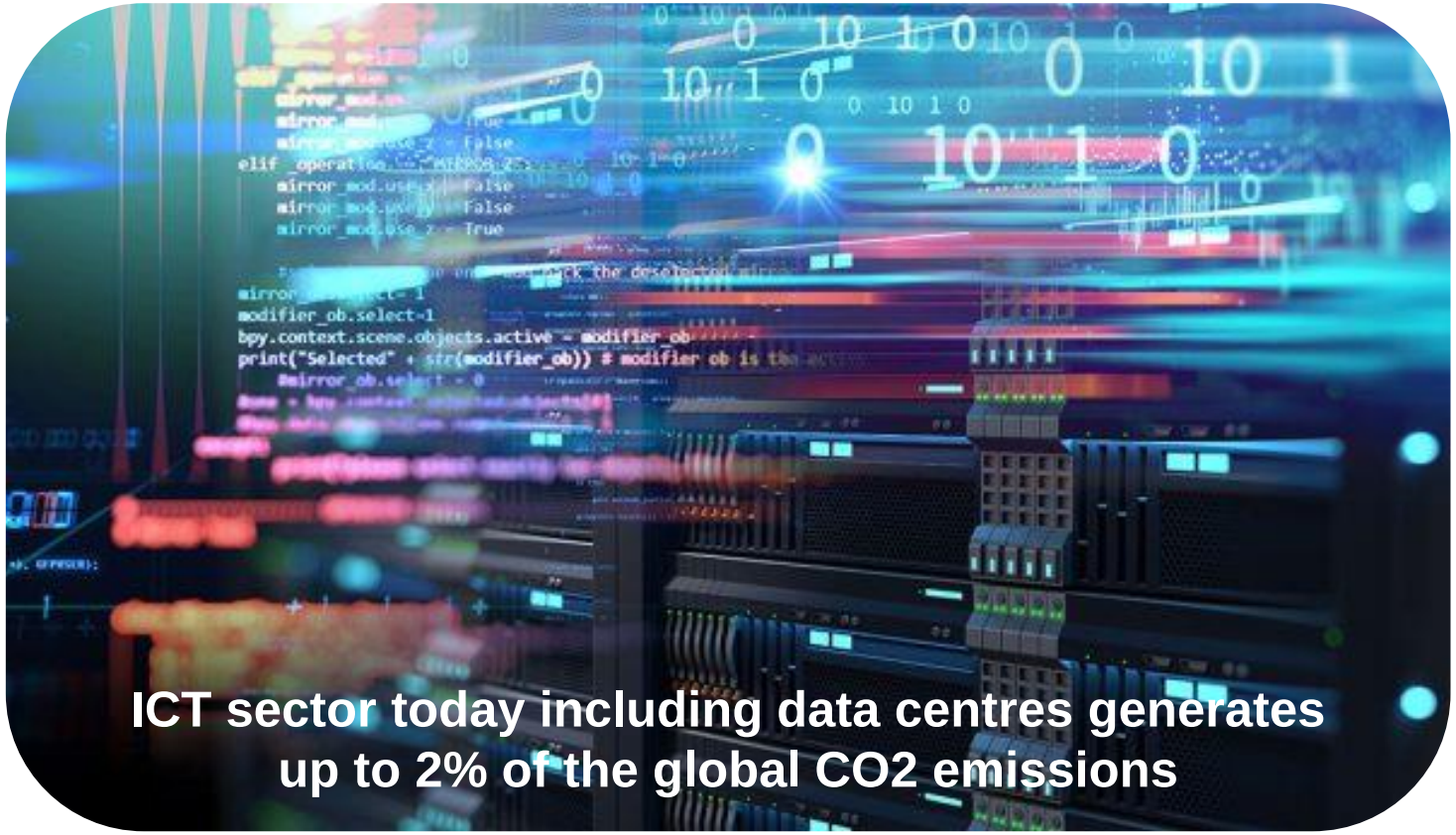
Redundant power & cooling system to provide higher level of reliability.

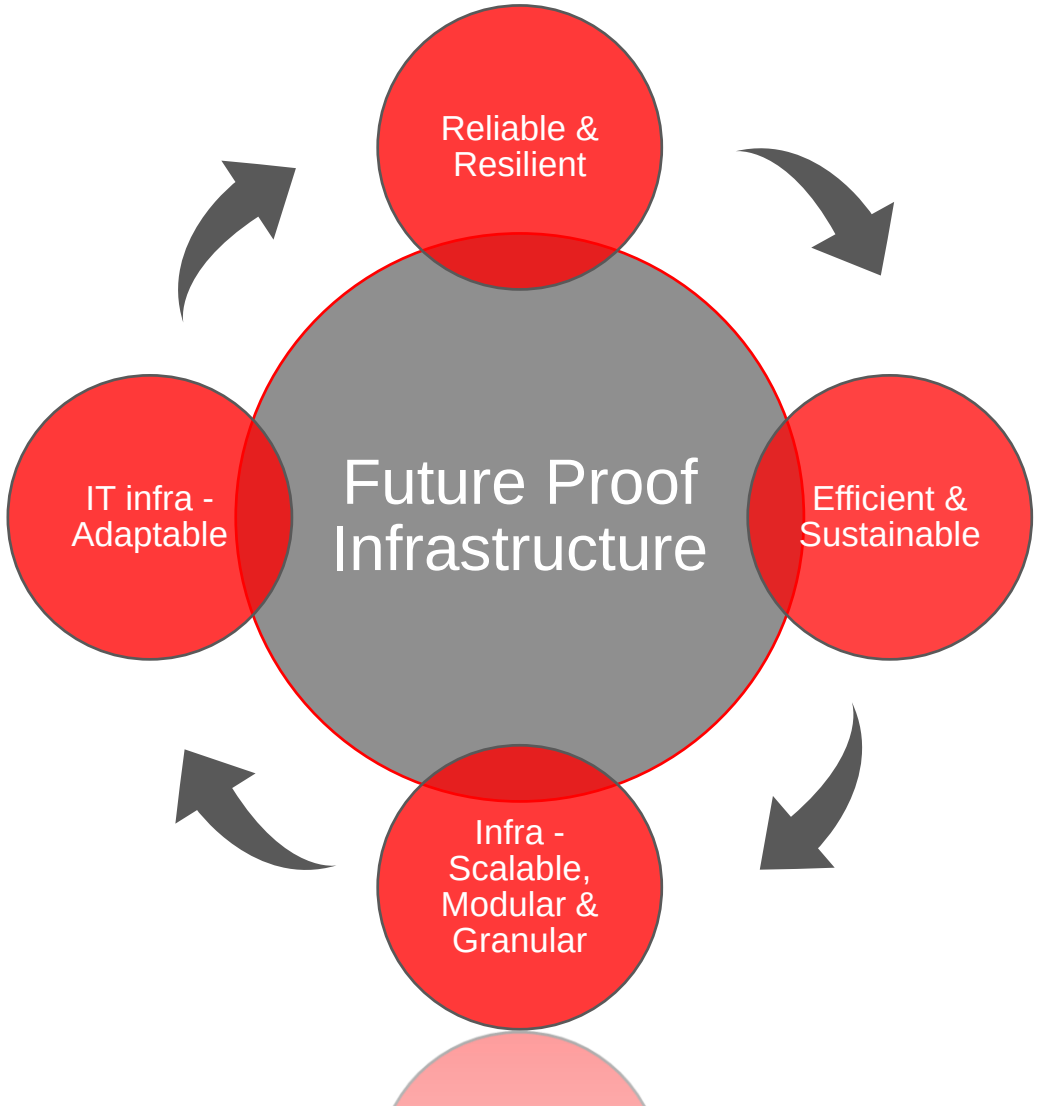
Additionally IT system frequently run at low average utilization , Over provisioning and associated cost like energy previously was considered to be acceptable for ensuring availability in the past.

With rising energy prices this is no longer the case, and the issue of energy consumption at the individual data centre level is becoming increasingly important as operational energy expenditures and environmental impact of the energy consumed begins to play an ever important role in overall cost of ownership of data centre.

The data centre sector in particular is estimated to account for the 1.4% of the global electricity consumption.

Current & Future Strategy Of Data Centre Design



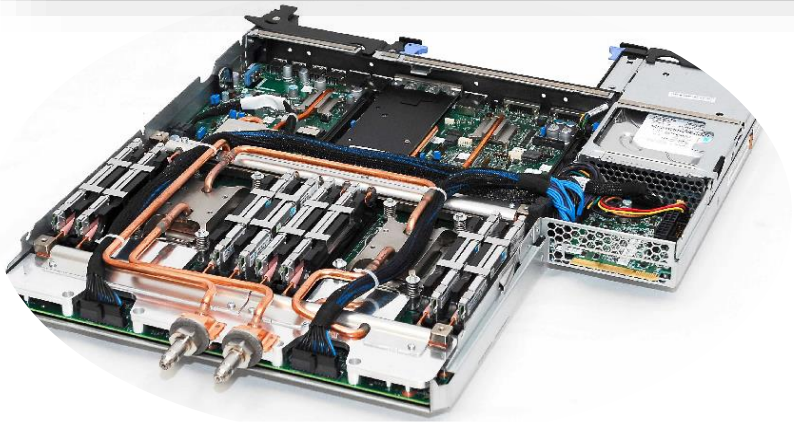


Liquid Cooling Will Rule HPC & The Edge - A Game Changer

ASHRAE Water Cooling DataCenter Classes

Table 1: 2011 ASHRAE Liquid Cooled Guidelines(I-P version in Appendix A)

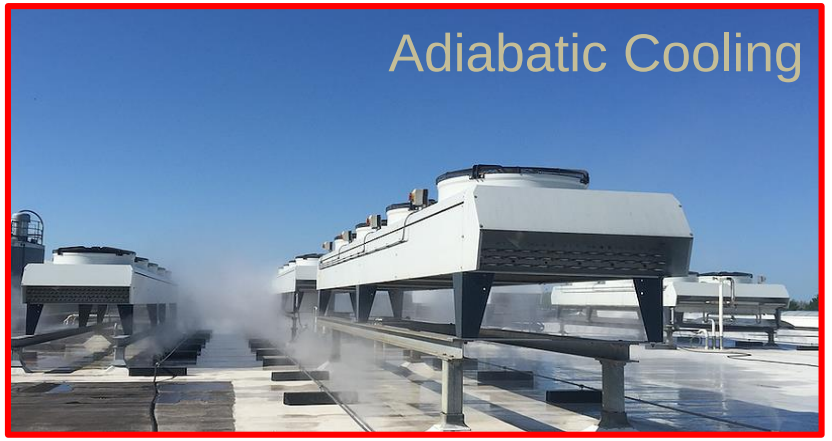
	Typical Infrastructure Design		
Liquid Cooling Classes	**Main Cooling Equipment**	**Supplemental Cooling Equipment**	**Facility Supply Water Temp(C)**
W1(see Figure 3a)	Chiller/Cooling Tower	Water-side Economizer (w drycooler or cooling tower)	2 - 17
W2(see Figure 3a)			2 - 27
W3(see Figure 3a)	Cooling Tower	Chiller	2 - 32
W4(see Figure 3b)	Water-side Economizer (w drycooler or cooling tower)	N/A	2 - 45
W5(see Figure 3c) See Operational Characteristics	Building Heating System	Cooling Tower	>45



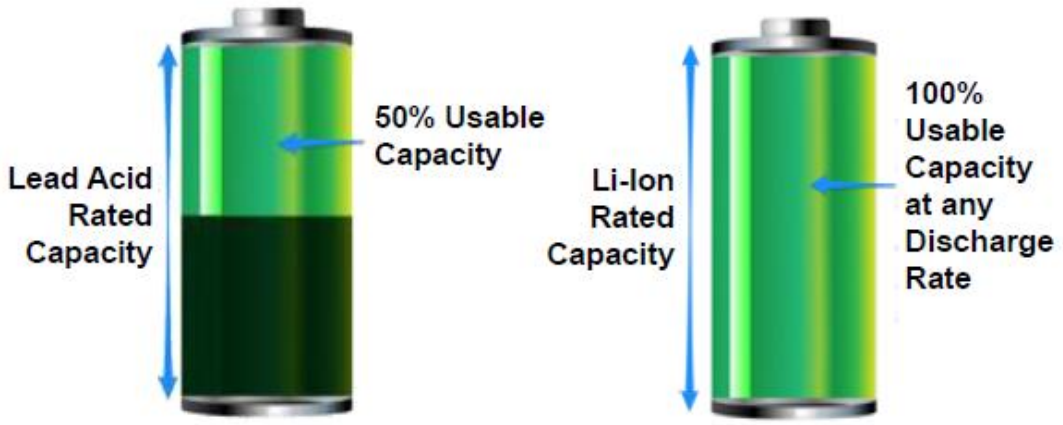
Benefits

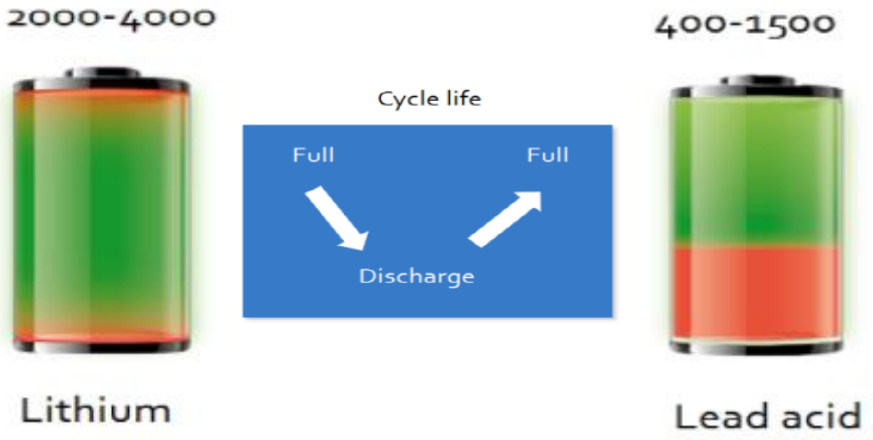
- Space efficiency
- Reliability
- Energy efficiency
- Quiet
- New EU regulations to cut green gas emissions. New F gas rules.
- New refrigerants may be way forward Another approach will be doing away from refrigerant and use hot water cooled server

Some Other Technology Move

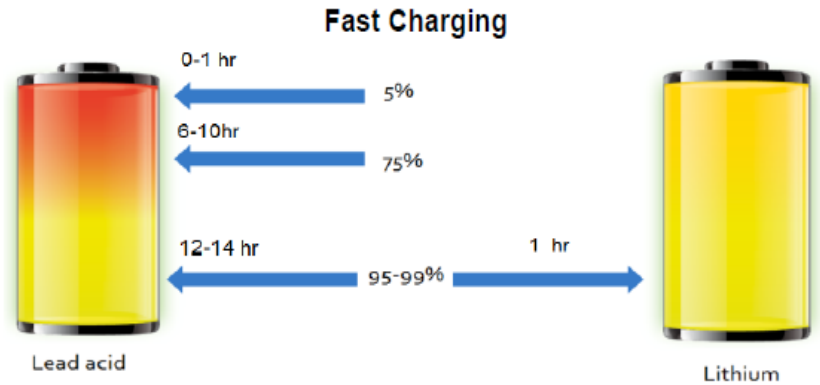


Li-Ion Batteries

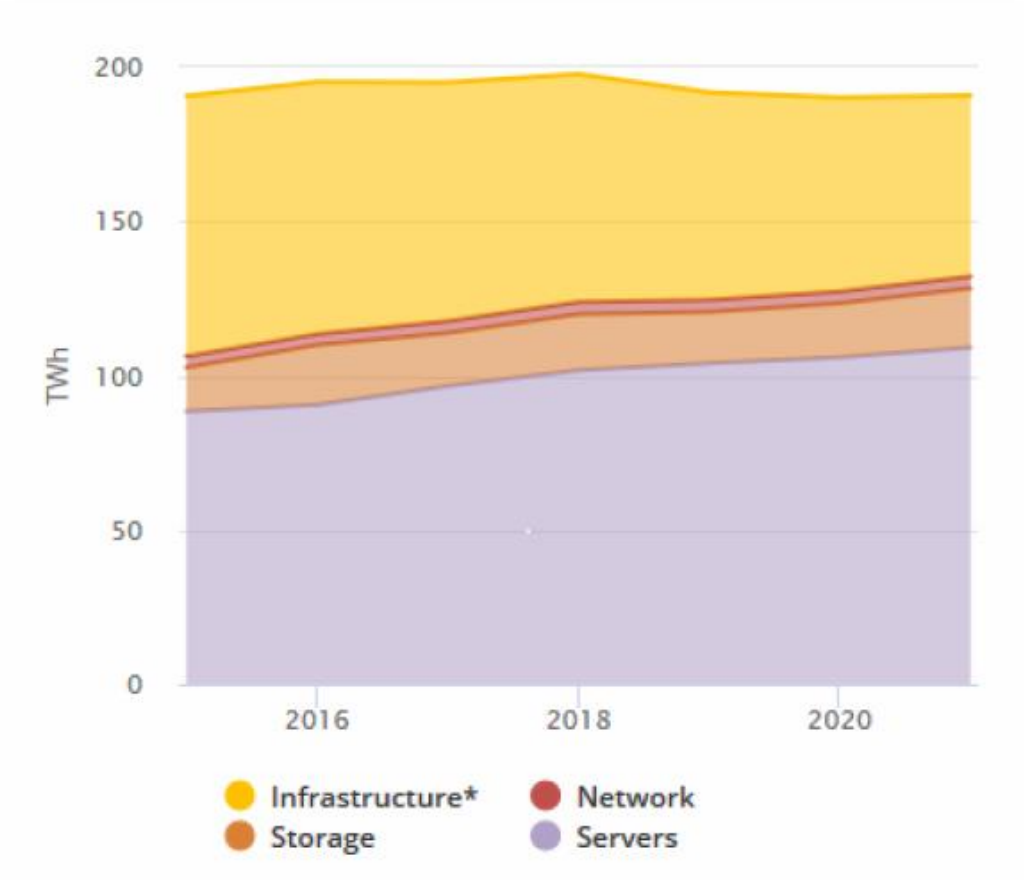


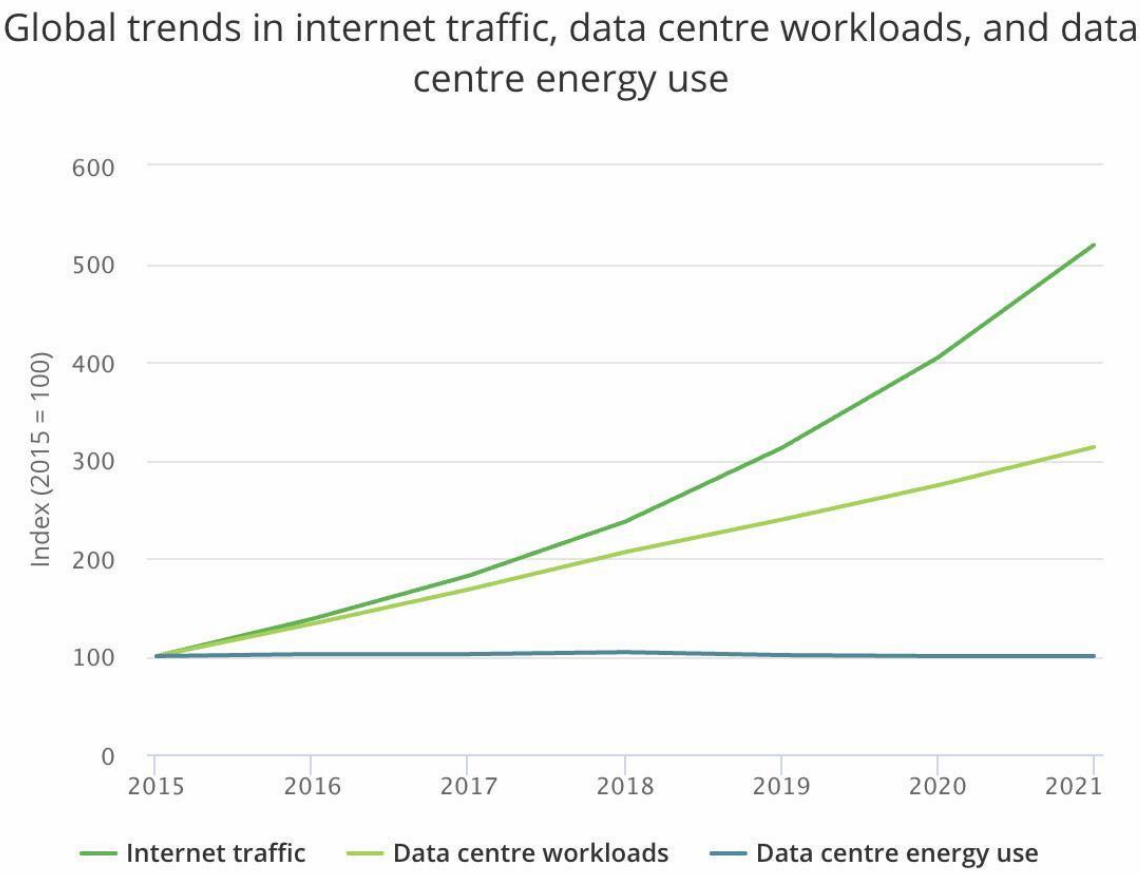


- Increased Life/ High Reliability: Fewer battery replacements
- High Energy Density: About three times less weight
- High Cycle Life: Up to ten times more discharge cycles
- Low Self Discharge: About four times less self-discharge
- Improved Efficiency: Four or more times faster charging



Global Trends





Though Internet traffics & data centre work loads have increased multiple fold. Total energy foot print remains constant.

ONE STOP SOLUTION FOR YOUR DATA CENTER NEEDS

Contact Us

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