7 Best Practices for Increasing Efficiency, Availability and Capacity

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XXXXXXXX

Liebert North America

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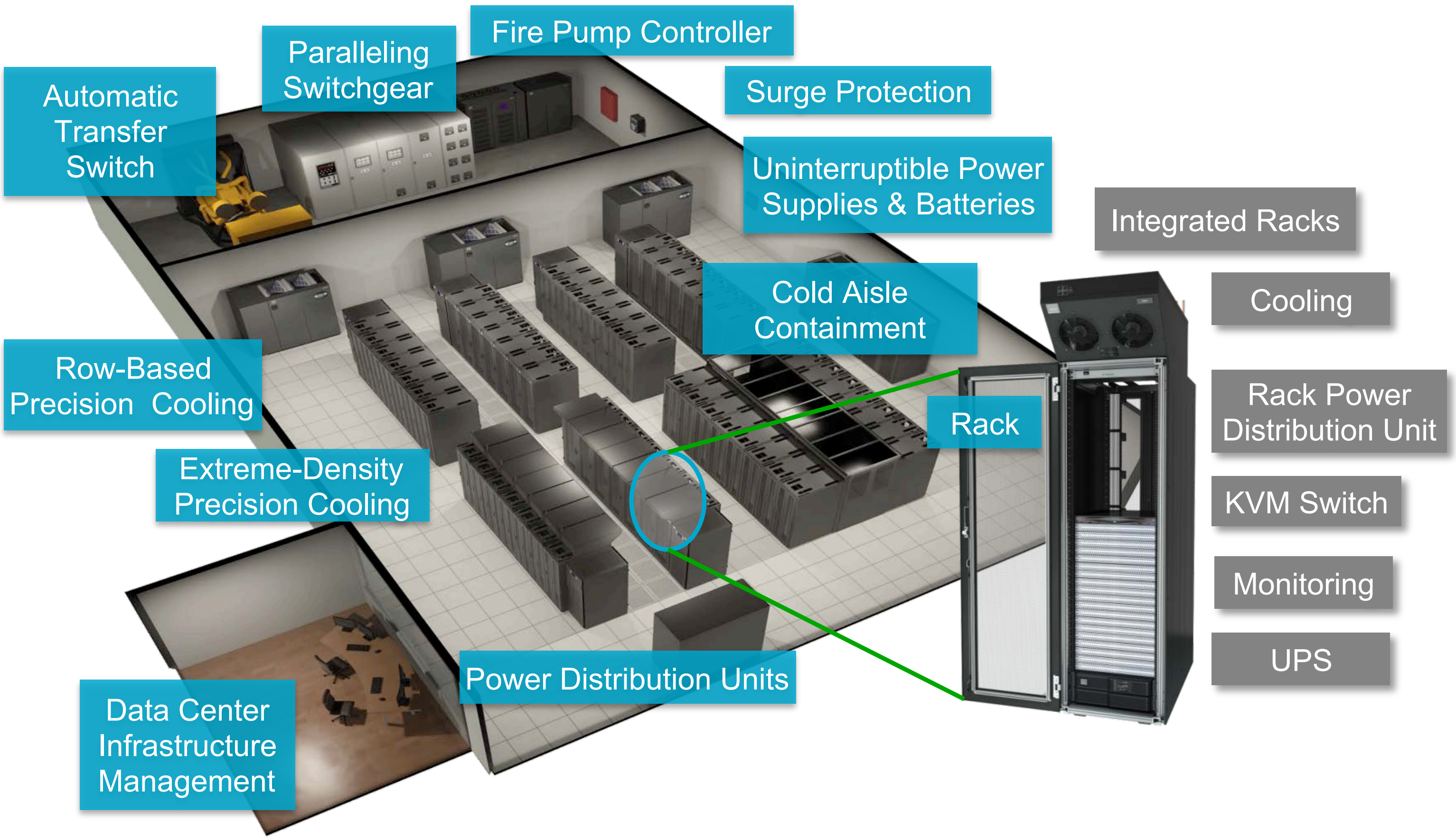
Emerson Network Power: The global leader in enabling Business-Critical Continuity



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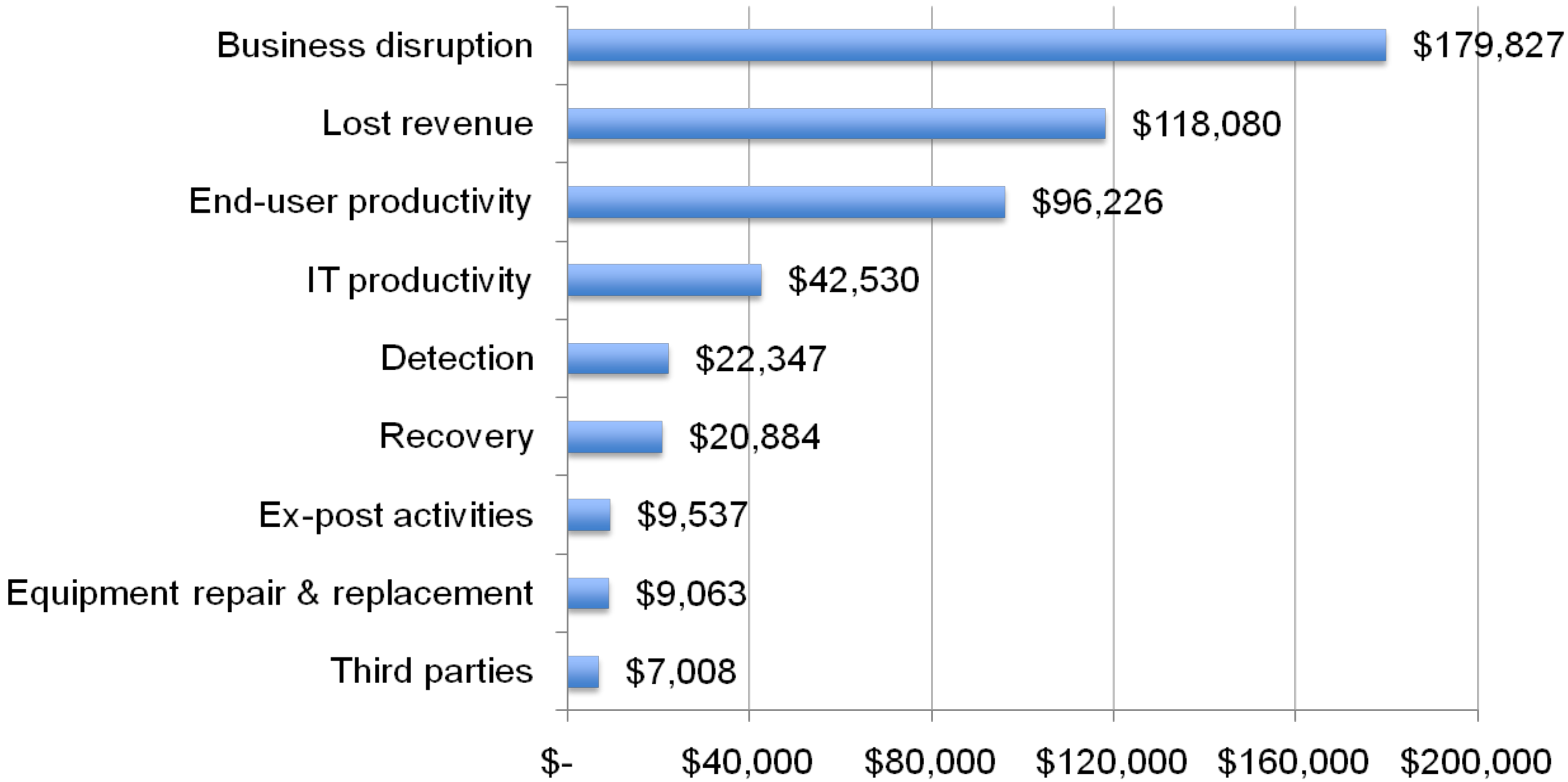
Cost of data center downtime by category



Source: 2011 National Study on Data Center Downtime

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Top data center concerns

Spring 2008	Spring 2009	Spring 2010	Spring 2011
Heat Density	Heat Density	**Monitoring & Management**	**Availability**
Power Density	Energy Efficiency	Heat Density	**Monitoring & Management**
Availability	**Monitoring & Management**	**Availability**	Heat Density
Monitoring & Management	**Availability**	Energy Efficiency	Energy Efficiency
Energy Efficiency	Power Density	Power Density	Power Density
Space Constraints	Space Constraints	Space Constraints	Space Constraints

Source: Data Center Users' Group Survey

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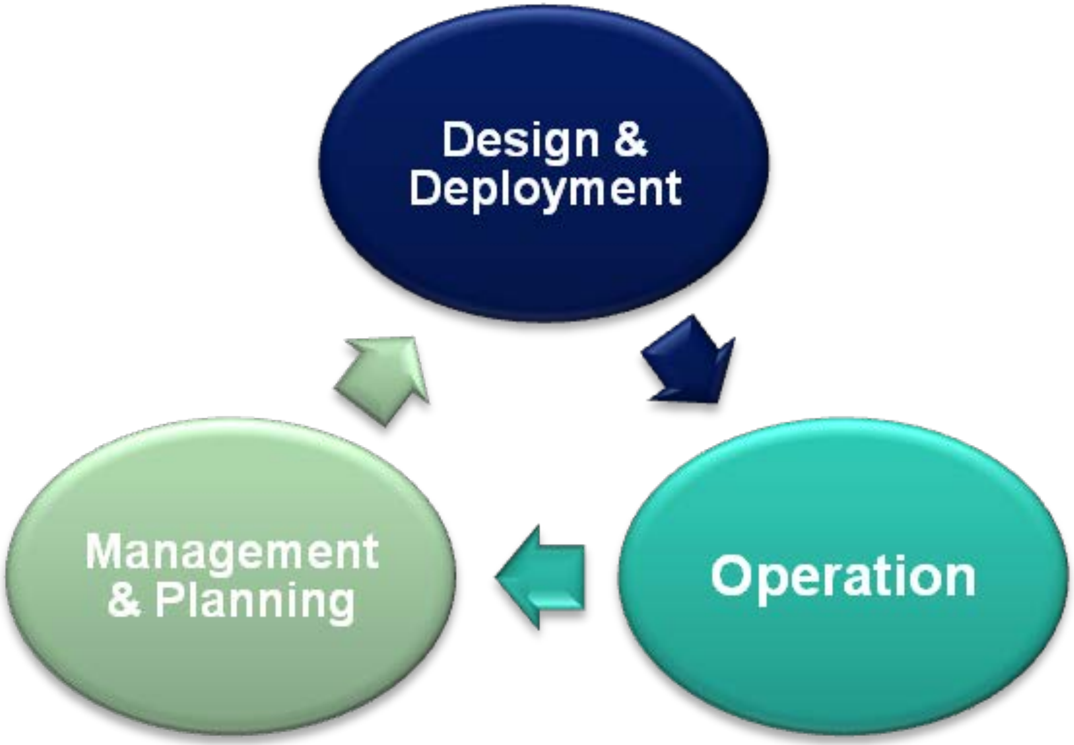
The Emerson approach



Efficiency Without Compromise™

Incorporate the 7 best practices into the design and operation of your data center

#1: Maximize Return Air Temperature at the Cooling Units to Improve Capacity and Efficiency

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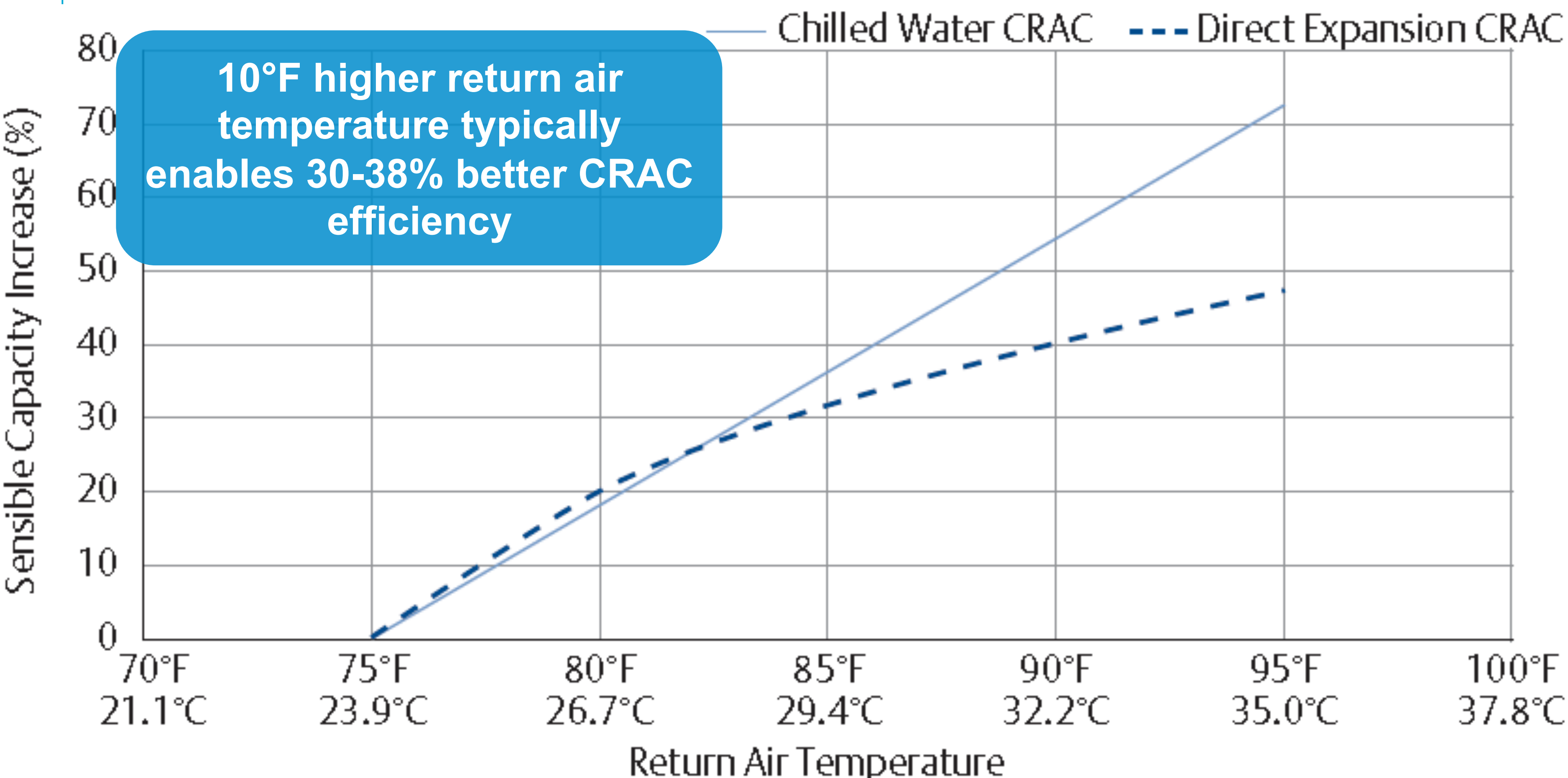
Higher return air temperature equals higher capacity and efficiency



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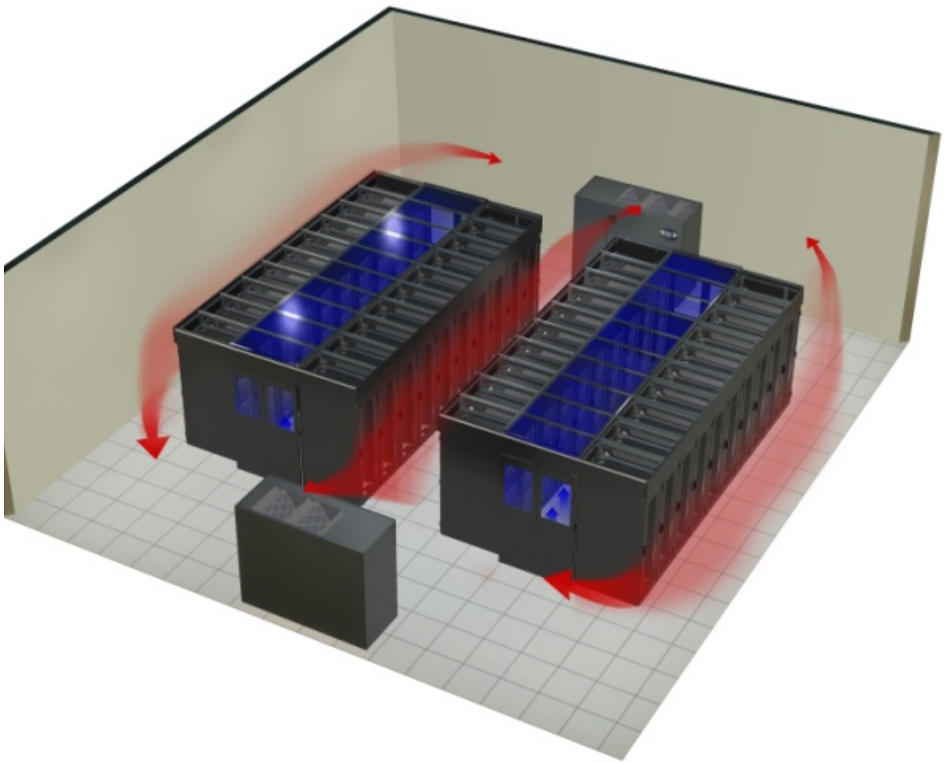
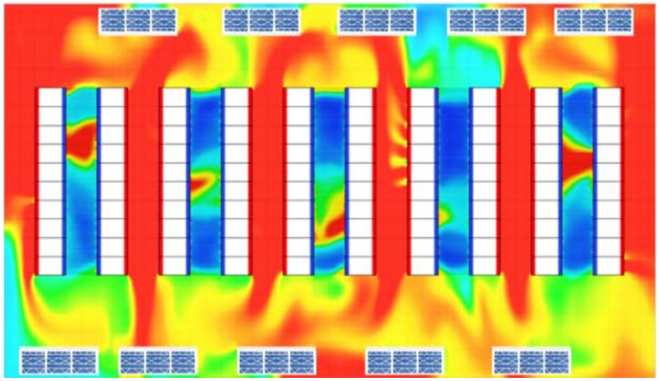
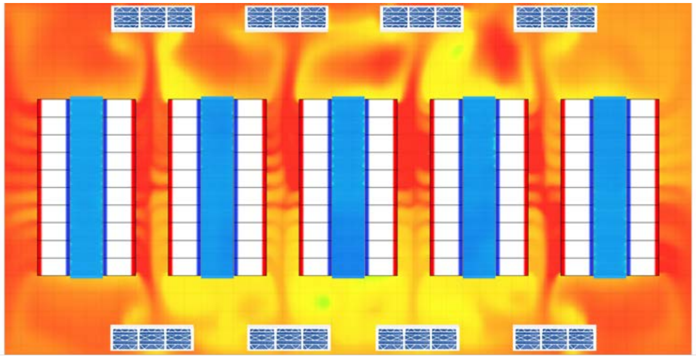
Optimizing efficiency and capacity through containment







Hot-aisle/cold-aisle arrangement creates the opportunity to further increase cooling unit capacity by containing the cold aisle

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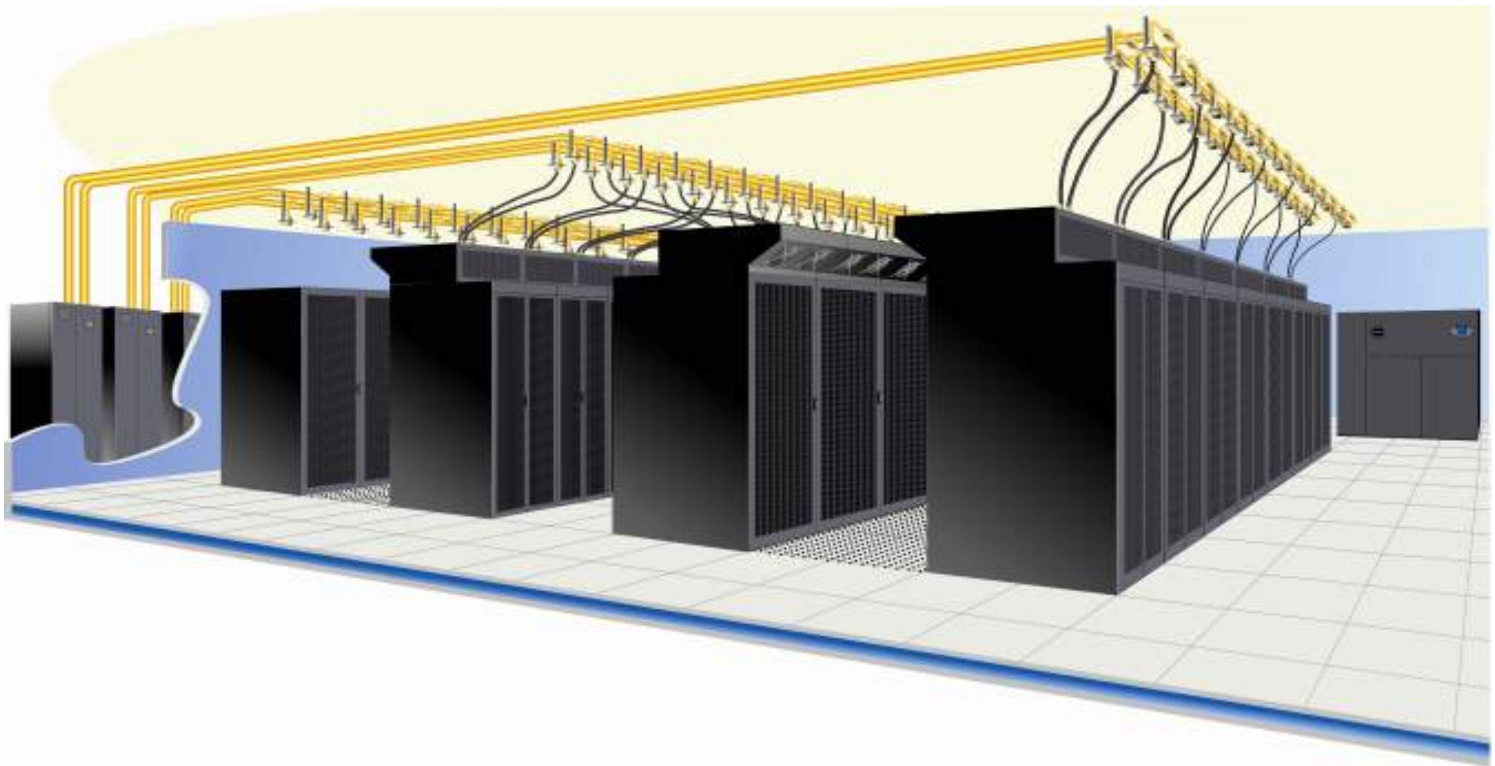
Supplemental capacity through sensible cooling



Refrigerant-based cooling modules mounted above or alongside the rack increase efficiency and allow cooling capacity to be matched to IT load.

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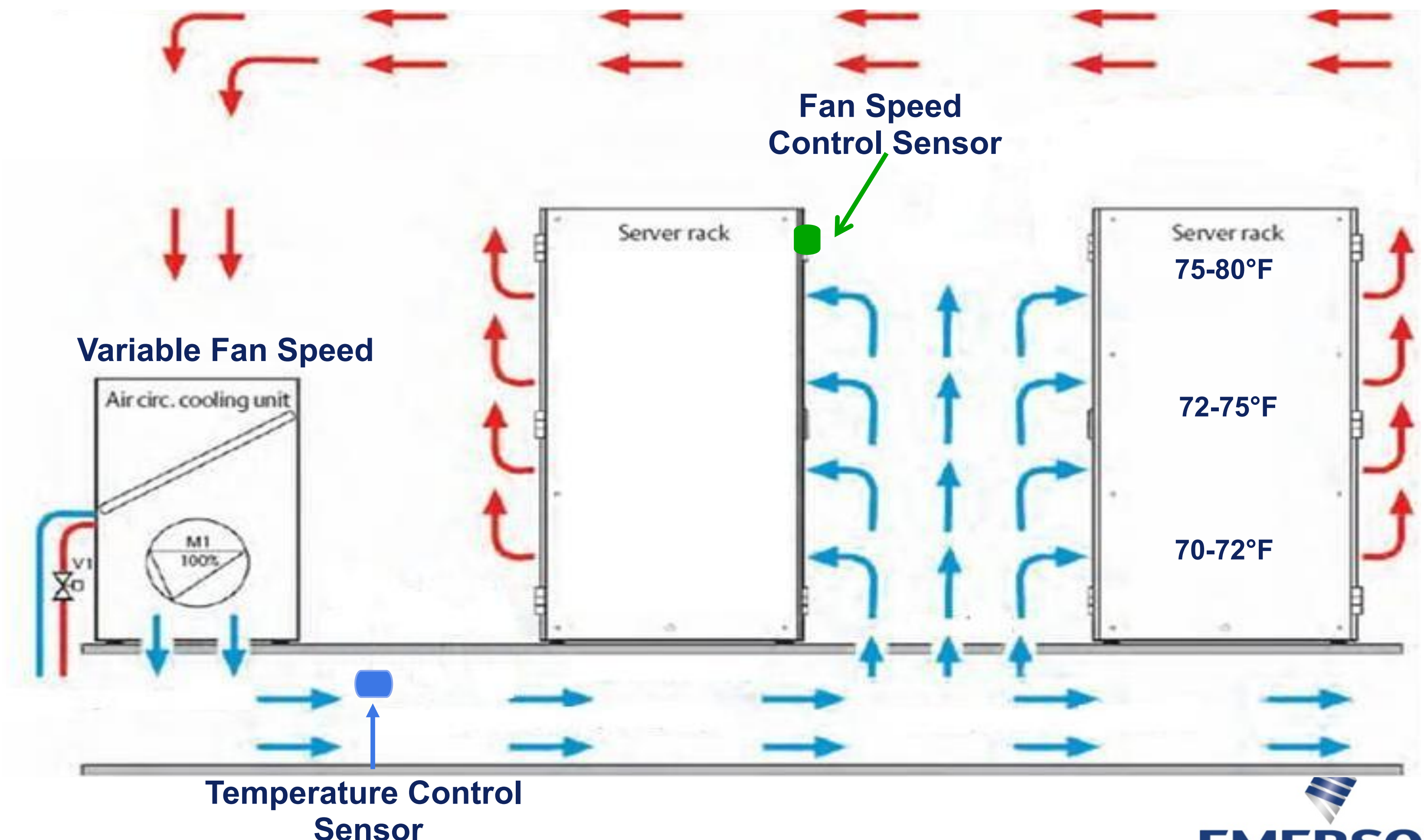
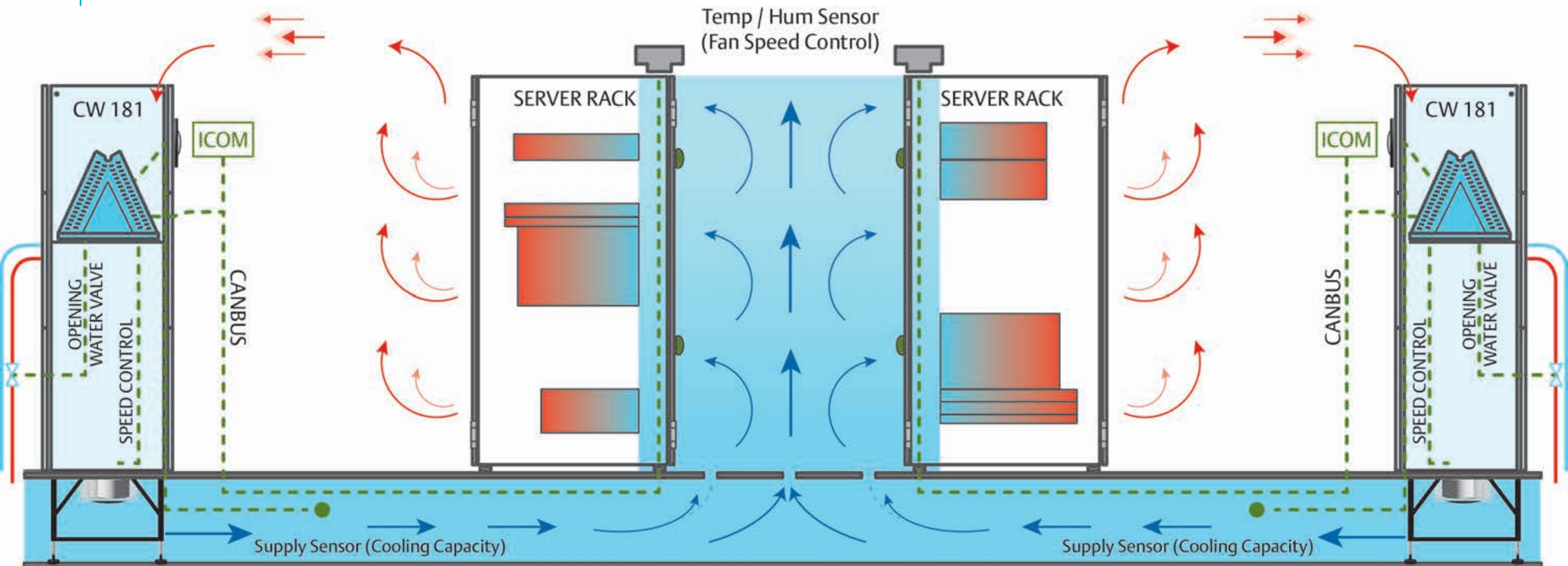
#2: Match Cooling Capacity and Airflow with IT Loads

Controlling cooling based on conditions at the server



Smart Aisle cooling



- Server-centric
- Manages capacity and air volume independently
- Adapts to changing conditions

Global cooling controls enhance efficiency

- Advanced energy saving control algorithms for multiple applications
  - Supply temperature control
  - Underfloor pressure control
  - Smart Aisle control
- Teamwork modes
  - Stops fighting
  - Enhances redundancy
- Standby / Lead-Lag unit rotation

#3: Utilize Cooling Designs that Reduce Energy Consumption

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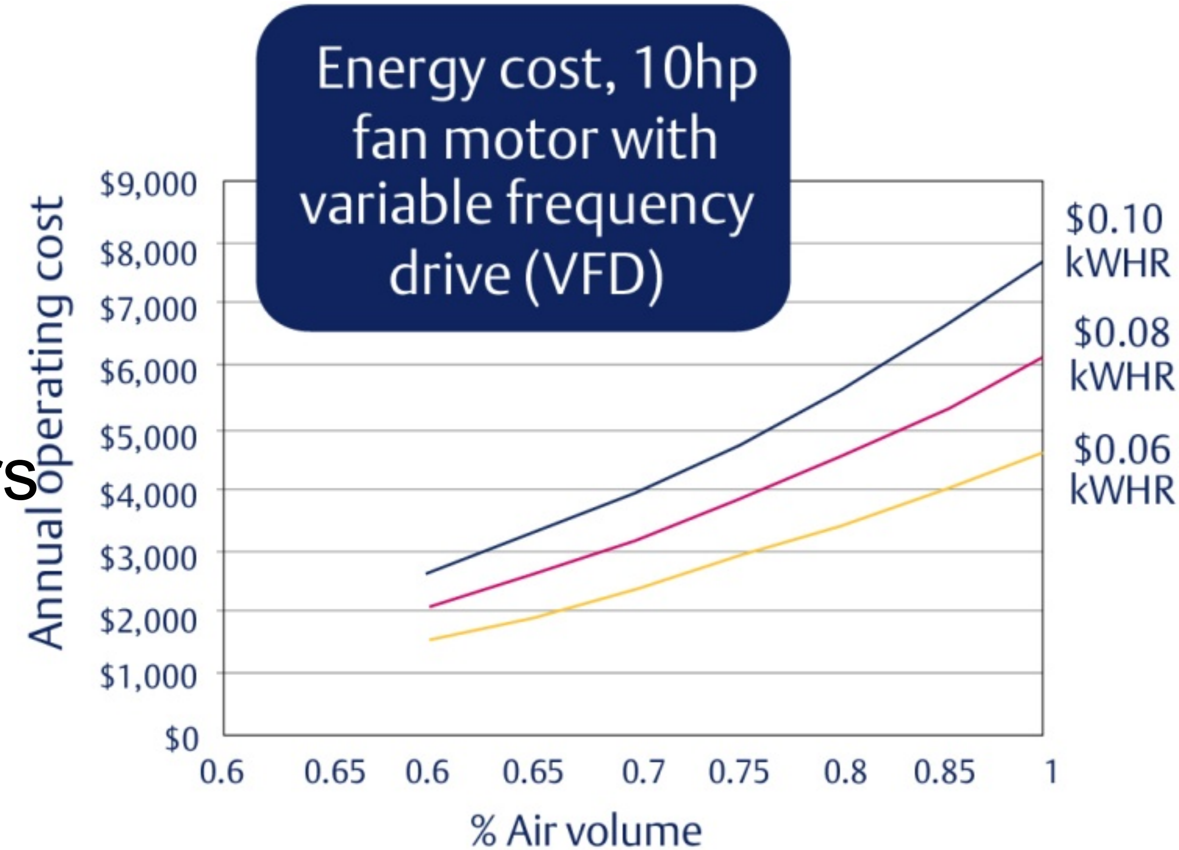
Matching cooling performance to room requirements with variable capacity

- Variable Capacity
- Fans
- Compressors
- Chillers
- Pumps
- Cooling Towers



Types of economizers

Chilled water systems

- Fluid economizers
  - Parallel chiller tower
  - Series chiller tower
  - Series air cooled
- Air economizers
  - Direct
  - Indirect
  - Evaporative

DX– refrigerant cooling systems

- Glycol system
  - Drycooler
  - Cooling tower
- Refrigerant only System Economizers
  - Pumped refrigerant

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The issues– failures happen

Fluid economizers
- Water usage
- Complexity of valve system and controls
- Freezing weather
- Transient change over
- Capital cost

Fluid economizers
- Humidity control
- Contamination
- Freezing coils
- Transient change over
- Cost of indirect systems

DX Glycol systems
- Hours of free cooling
- “Extra coil” air pressure drop

Pumped refrigerant
- New technology

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Cooling only PUE annualized comparisons

- Pumped Refrigerant Economization

	ASCOP	Cooling PUE
– Houston	5.89	1.17
– San Francisco	7.91	1.13
– Columbus, Ohio	8.05	1.12
– Chicago	8.32	1.12
– New York	7.64	1.13
– Atlanta	6.62	1.15

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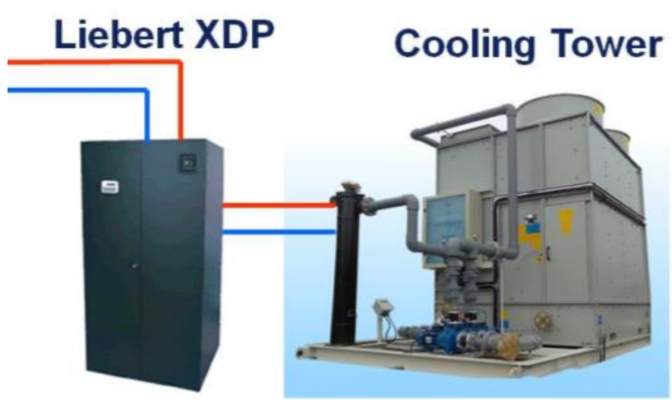
Direct server cooling without server fans



- Cooling to the chip with “cold plates”
  - 1U server modified with no fans
  - Pumped refrigerant fluid cooled
  - Performance tested by LBNL
- Efficiency benefit
  - No chiller required for many locations
  - Total energy consumed less than energy of the IT fans removed
  - **Is that a PUE of <1?**

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#4: Select a Power System to Optimize Your Availability and Efficiency Needs

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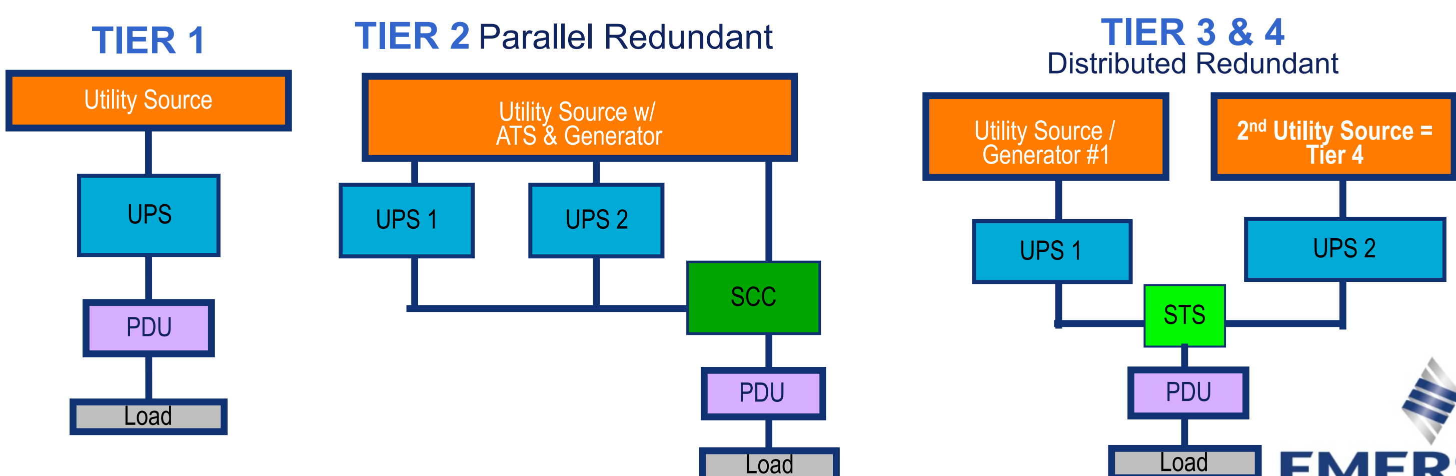
Four tiers of data center infrastructure availability

Data Center Infrastructure Tier	Description	Availability Supported
I: Basic Data Center	**Single path** for power and cooling distribution without redundant components.	99.671%
II: Redundant Components	Single path for power and cooling distribution with **redundant components**; N+1 with a single-wired distribution path throughout.	99.741%
III: Concurrently Maintainable	**Multiple active power distribution paths**, only one path active. Redundant components.	99.982%
IV: Fault Tolerant	**Dual bus distribution** with two paths active providing distributed redundancy	99.995%



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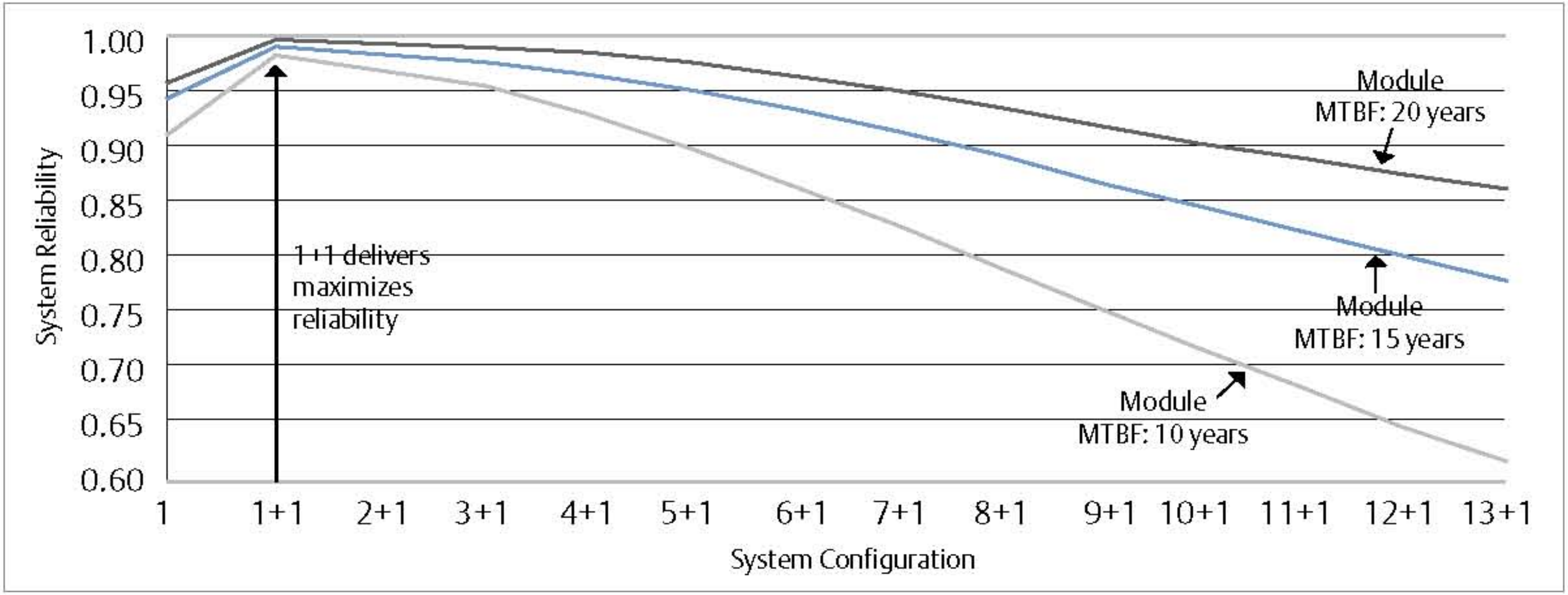
Increasing number of UPS in N+1 system increases risk of failure



Transformer-based vs. transformer-free UPS design

Characteristic	Transformer-Free	Transformer-Based
Fault Management		✓
Low Component Count		✓
Robustness		✓
Input / DC / Output Isolation		✓
Scalability	✓	
In the Room / Row	✓	
Double Conversion Efficiency	~96%	~94%
VFD (Eco-Mode) Efficiency	Up to 99%	Up to 98%

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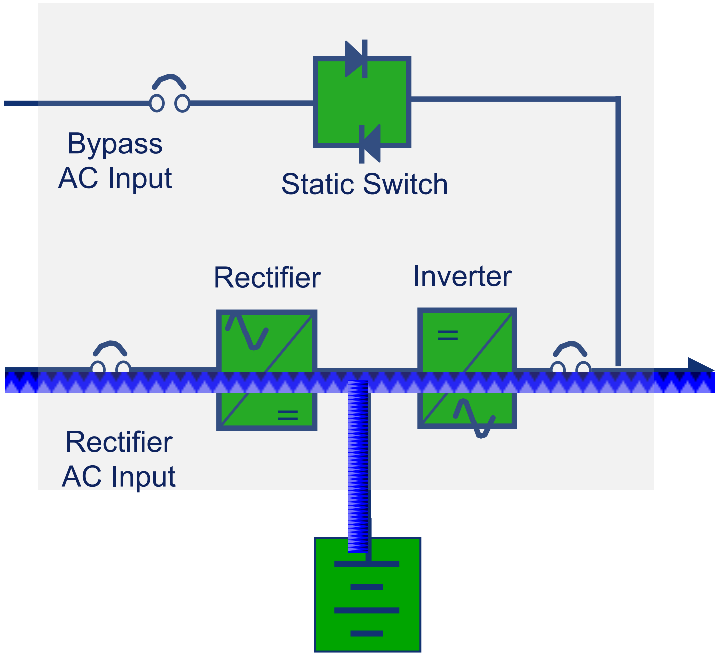
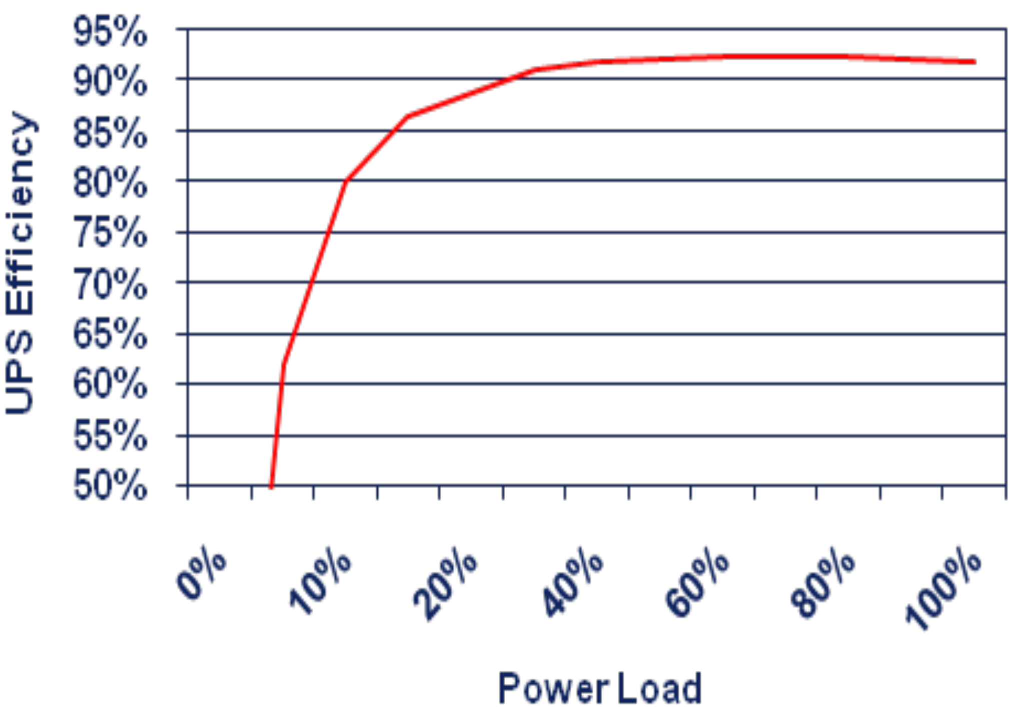
Bypassing the conversion process

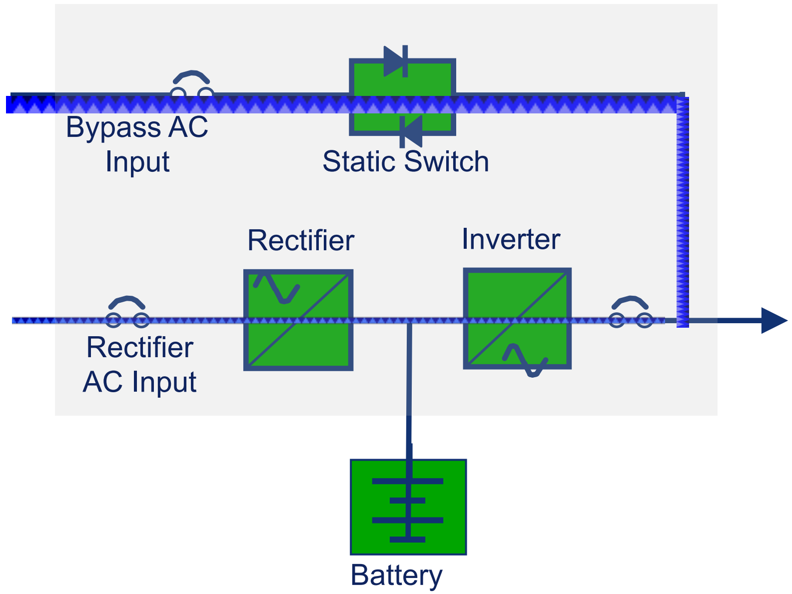
Double Conversion Operation (VFI Mode)

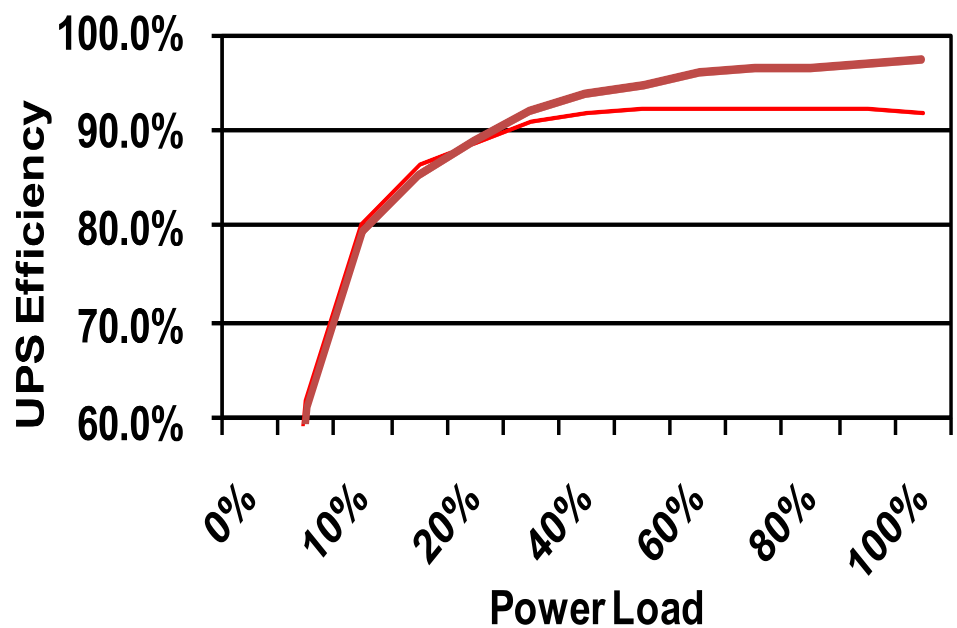




A more efficient option

Intelligent Eco-mode Operation (VI Mode)





- Inverter stays in Idle
- Corrects sags and swells but not frequency
- Bypass source is monitored
- Load harmonics profiled
- Learns off-peak times
- 3+% efficiency gain
- VI mode (inverter hot, also an option)

Intelligent paralleling reduces UPS energy consumption

3 Units @ 25% Load Each = 91.5% Efficiency

2 Units @ 38% Load = 93.5% Efficiency

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#5: Design for Flexibility Using Scalable Architecture that Minimizes Footprints

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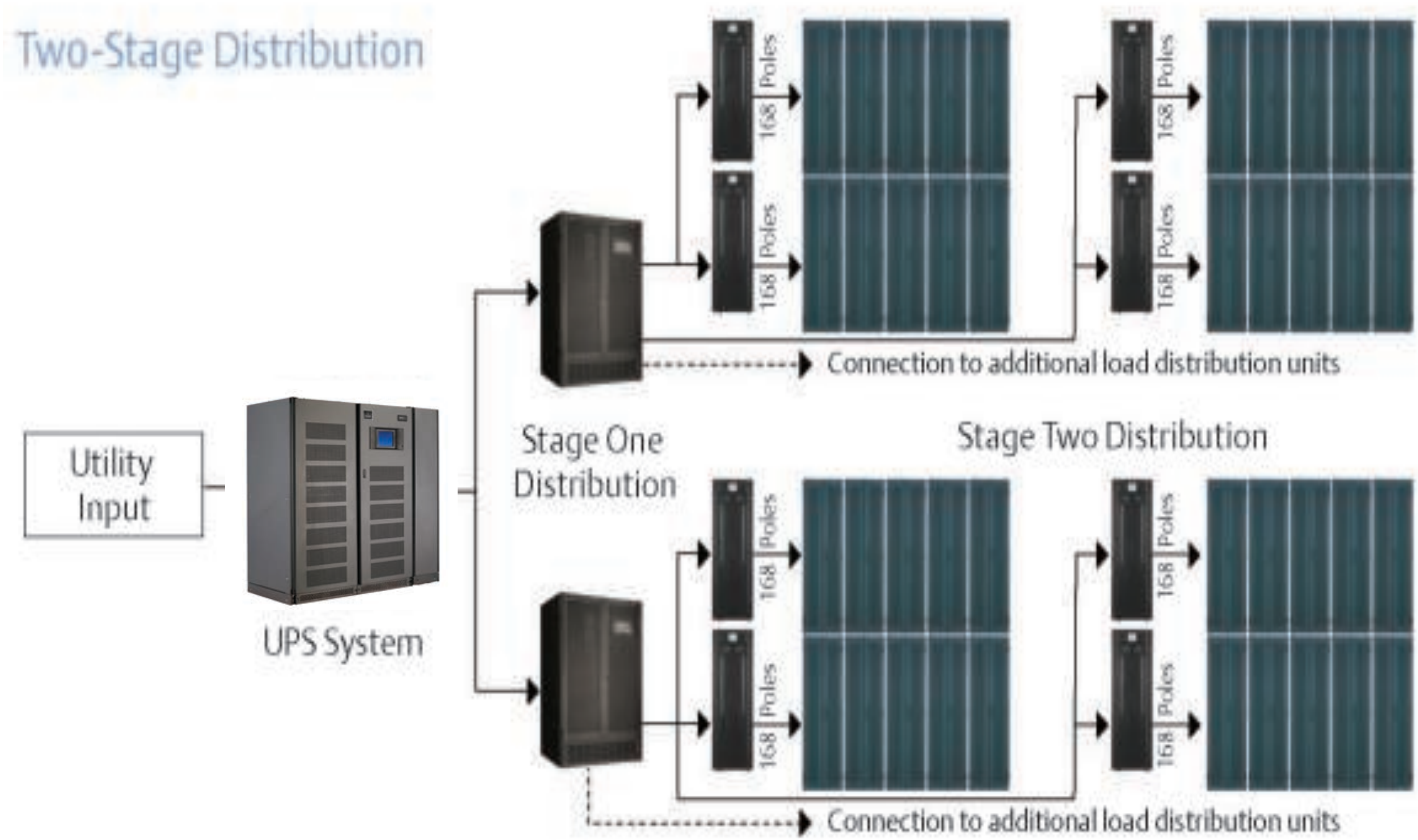
Two-stage power distribution provides needed scalability and flexibility



Moving power distribution and scalability closer to the rack

Modular busway, hot swappable, 100, 225 and 400 amp

Modular power strip / rack PDU

Modular row-based UPS scalable in 45kW cores

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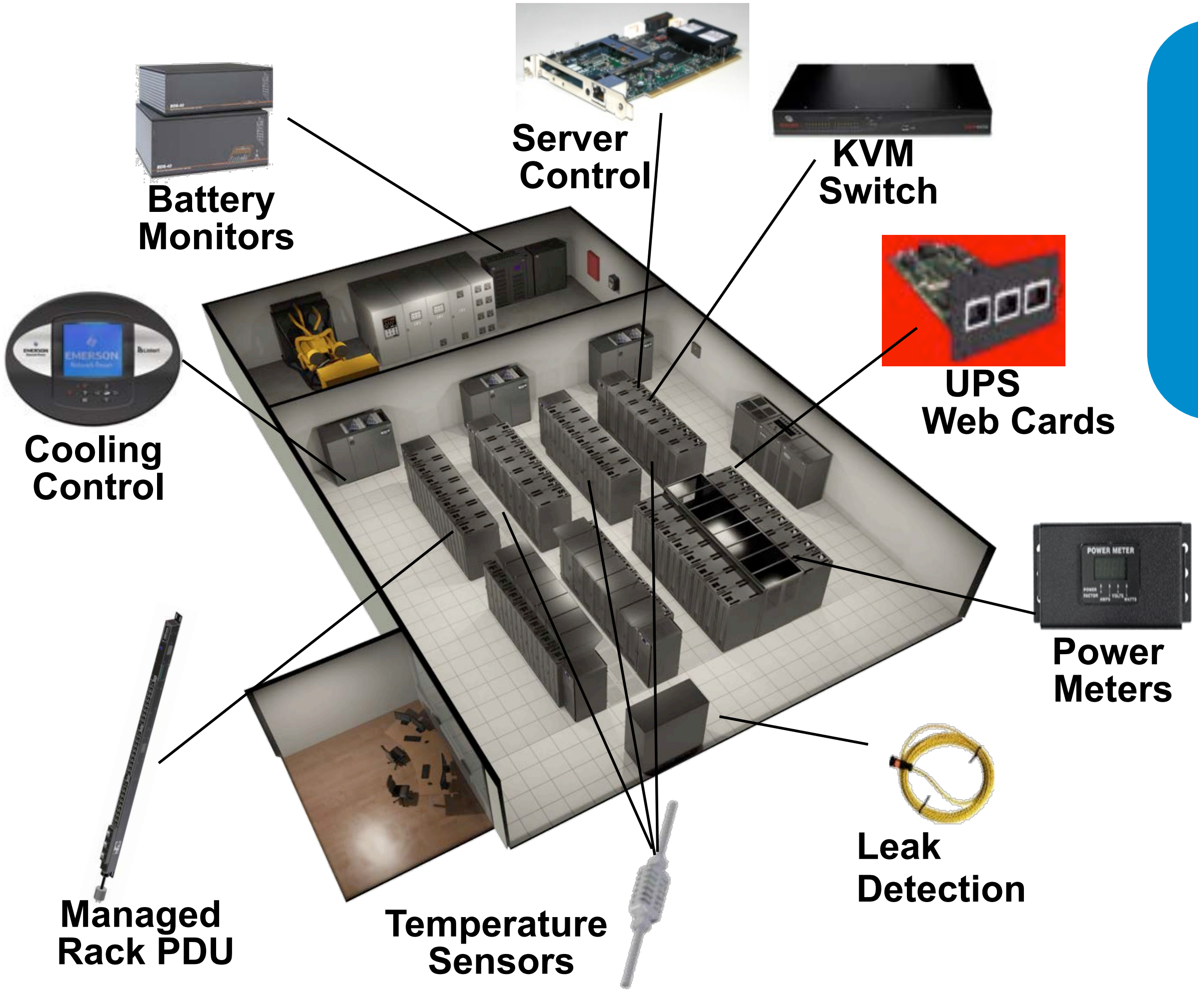
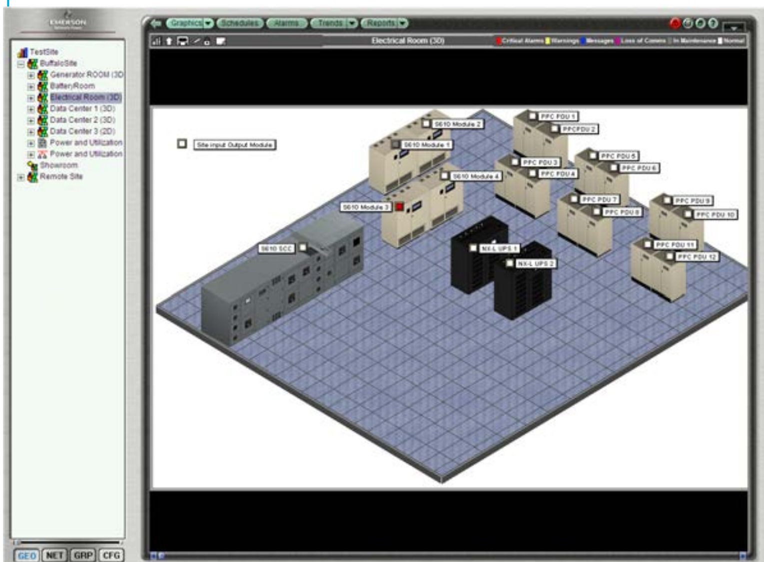
#6: Enable Data Center Infrastructure Management and Monitoring to Improve Capacity, Efficiency and Availability

Optimizing performance with data center infrastructure management and monitoring



Control begins with a solid instrumentation strategy

Improving availability



Auto track critical infrastructure systems:
alerts, alarms, monitoring & control.

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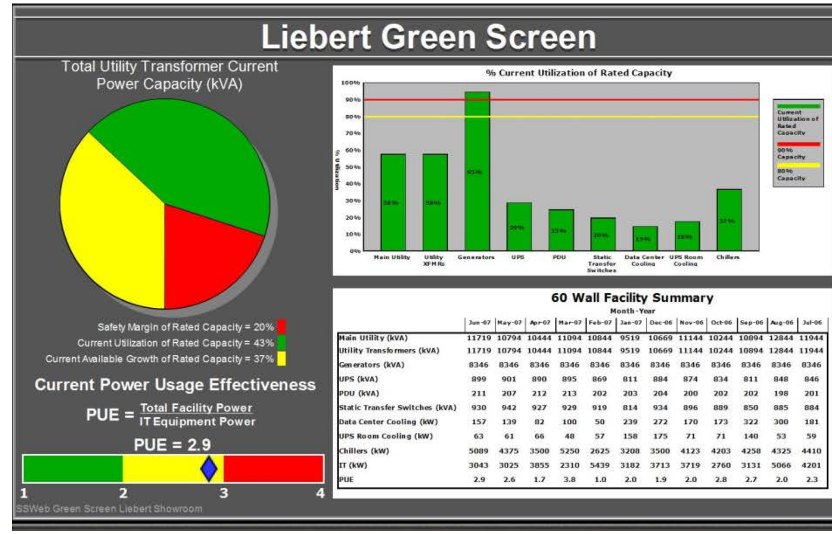
Increasing efficiency

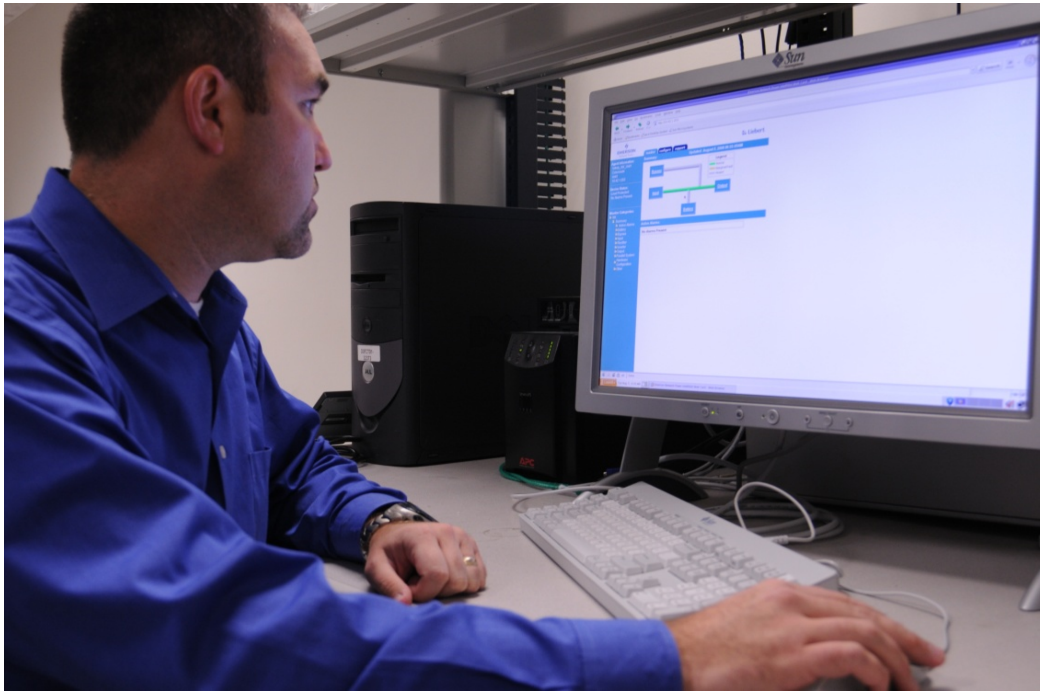


- Track, measure, trend and report on key data points
  - Temperature
  - kW
  - Watts
- Generate PUE metrics

Managing capacity

- Rack
- Row
- Room

- Air
- Power
- Distribution



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#7: Utilize Local Design and Service Expertise to Extend Equipment Life, Reduce Costs and Address Your Data Center's Unique Challenges

Consulting with specialists to apply best practices and technologies

Configuration support and design assistance

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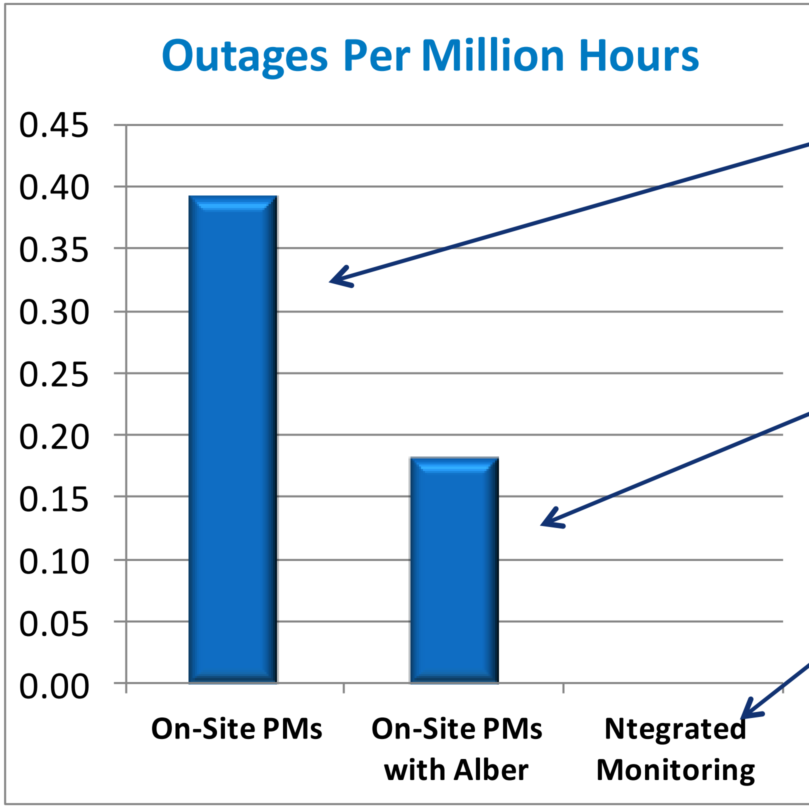
Preventive service elevates battery mean time between failure



Battery maintenance and no monitoring experience low reliability

Monitoring experience significant longer runtime before a failure

Remote monitoring have experienced ***no*** outages due to bad batteries

- 1.6 million run hours!

Study based on batteries under contract prior to the end of their expected service life

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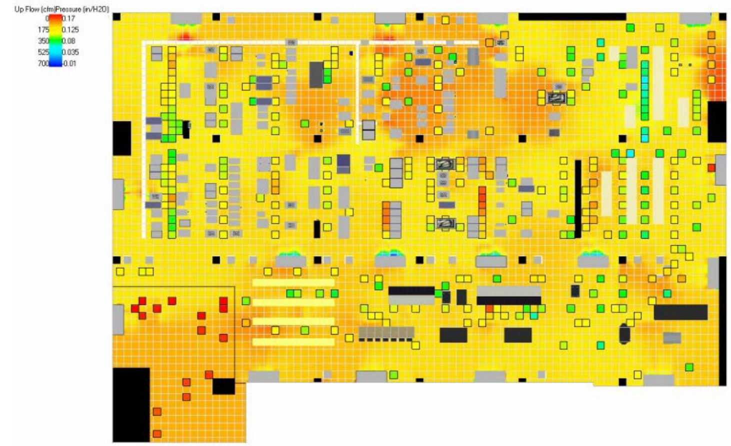
Supplementing preventive maintenance with data center assessments



Apply These Best Practices For Optimal Performance

1. Maximize the return air temperature at the cooling units to improve capacity and efficiency
2. Match cooling capacity and airflow with IT Loads
3. Utilize cooling designs that reduce energy consumption
4. Select a power system to optimize your availability and efficiency needs
5. Design for flexibility using scalable architecture that minimizes footprints
6. Enable data center infrastructure management and monitoring to improve capacity, efficiency and availability
7. Utilize local design and service expertise to extend equipment life, reduce costs and address your data center's unique challenges

White Paper:

Seven Best Practices for Increasing Efficiency, Availability and Capacity: The Enterprise Data Center Design Guide

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