

Data Center Energy Management Approaches

Jay Dietrich
Program Manager: Energy &
Climate Stewardship
Corporate Environmental Affairs



AGENDA

- **TYPES OF DATA CENTERS**
- **ORGANIZATIONAL STRUCTURE FOR DATA CENTER MANAGEMENT**
- **ENERGY EFFICIENCY OPPORTUNITIES**
- **ADDITIONAL OPPORTUNITIES**

TYPES OF DATA CENTERS (Not an Exhaustive List)

- **Business Process Operations: Transactional Support for 7 x 24 Operations**
 - **Owner Operates the Facilities and IT (See Organizational Discussion)**
 - **One Owner for Facility/Single or Multiple Owners of IT**
 - **Cloud Computing: Single Operator of Facility and IT w/ Multiple Applications Operators**

- **Development Data Centers: Used to Design Physical and Software Products**
 - **7x24 Operations**
 - **But... Likely to Have Much More Varied Workload**

- **Business Continuity and Recovery Services:**
 - **Routine Back-up**
 - **Recovery Services: Text and Actual**

- **Hardware Test Facilities: Highly Varied Physical Presence or Depending on Point in Product Cycle**

ORGANIZATIONAL STRUCTURE

- **Data Center Owner:**
 - **Responsible for Meeting Serviceability and Reliability Commitments**
 - **“Owns” and Manages the IT Equipment**
 - **Expects the Facilities (Cooling) Operations to be Transparent to Its Operations**
 - **Does Not Own the Power Bill**

- **Facility Owner**
 - **Manages the Delivery of Power and Cooling**
 - **Operates the Data Center to the IT Teams Specifications**
 - **Typically Pays the Power Bill**

FACTORS IN CONSIDERING ENERGY EFFICIENCY INVESTMENTS

- **Who Owns the Project?**
 - **Responsibility for the Investment**
 - **Where Will the Cost be Booked & What is the Payback?**
 - **Which Budget Realizes the Savings?**

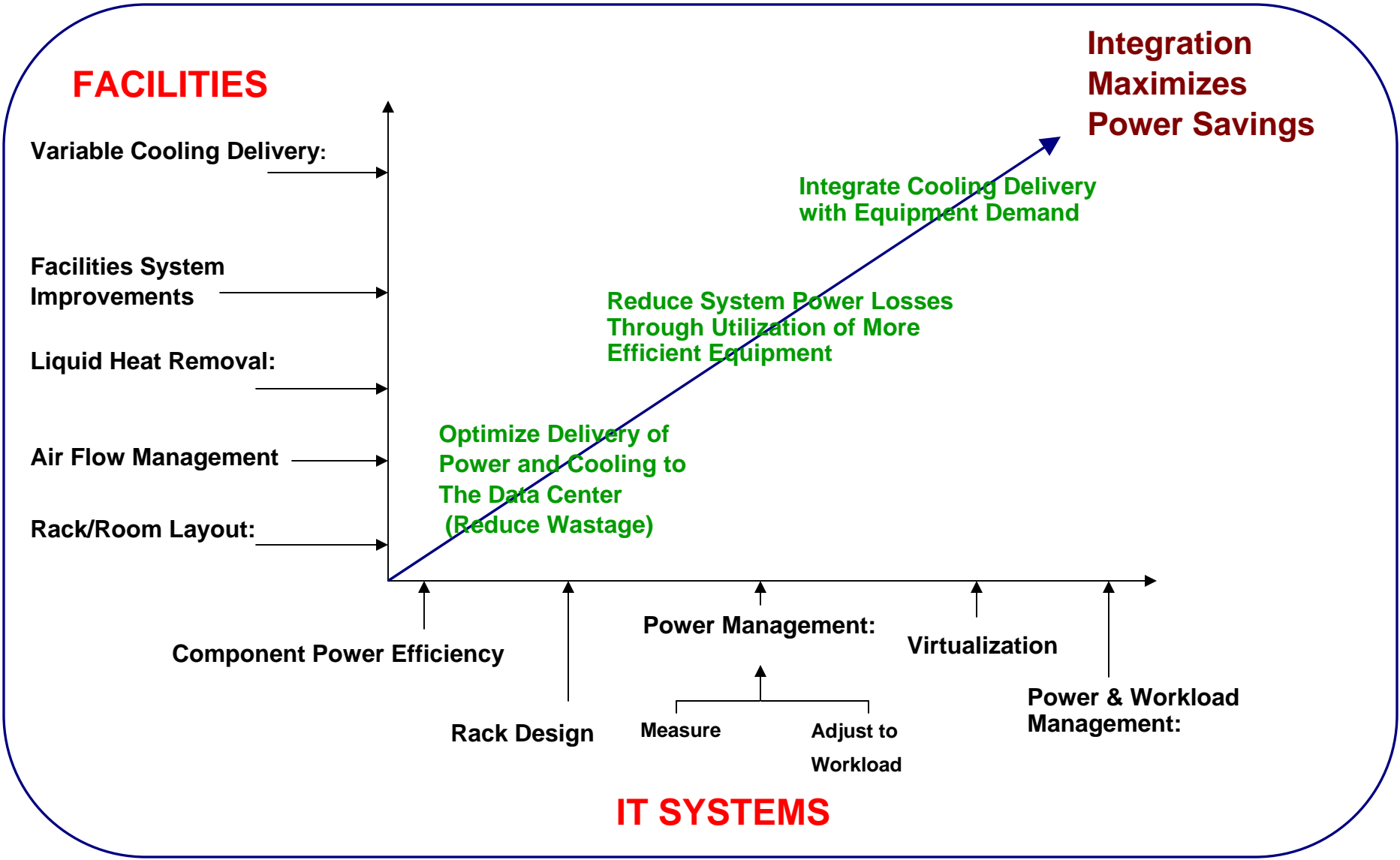
- **How will the Project Affect Serviceability and Reliability?**
 - **Power Reliability**
 - **Thermal Reliability and Integrity**
 - **Who Owns the Risk?**

- **Will the Account Be Receptive to the Change?**
 - **Impact of Different Ownership Models Discussed Earlier**

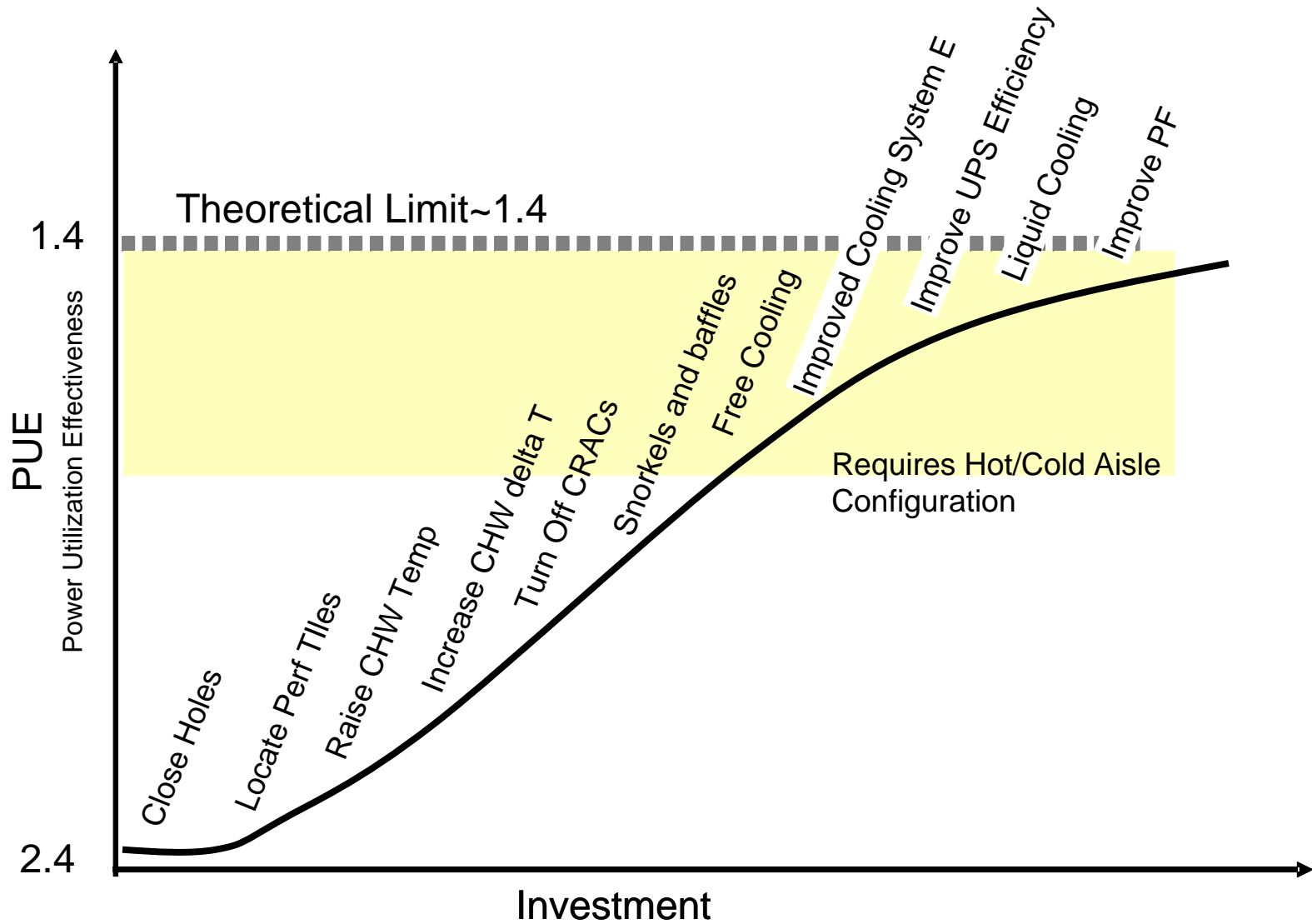
- **Will the IT and Facilities Equipment Support the Change?**

- **Leadership in Energy Efficiency Data Center Operations**

DataCenter Energy Efficiency Opportunities



Steps to Improving Data Center Efficiency



ENERGY EFFICIENCY OPPORTUNITIES: IT Systems

- **Virtualization: Increase Server and Storage Utilization**
 - Operate Multiple Programs or Data Storage Routines on a Single System or Device
 - Increase Equipment Utilization
 - Can Reduce Energy Use by 10 – 90%

- **What is Required**
 - Existing or New Hardware.
 - Requires Significant Personnel Support

- **Metrics:**
 - Calculated or Measured Energy Use of Removed Equipment
 - Reduction in Power Use at the Meter
 - Best to Handle w/ Defined Boundaries

- **Example: US IBM Global Account Will Consolidated Over 1900 Servers Over 2 Years, Saving Over 40,000 MWH**

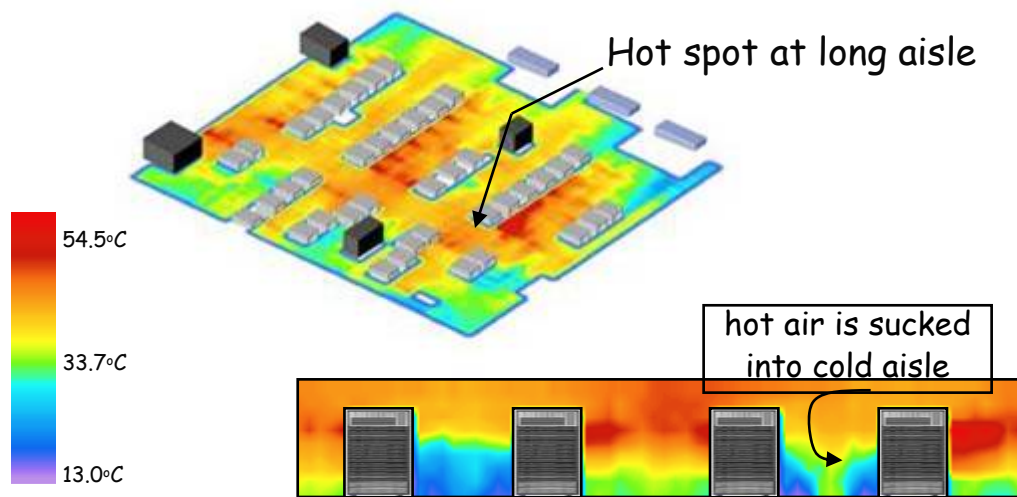
ENERGY EFFICIENCY OPPORTUNITIES: IT Systems

- **Enable IT Equipment Power Management:**
 - **Primarily Available on Servers Today**
 - **Processor, Memory, Network: Minimize Power When Idle**
 - **Needs to Be Turned on**

- **Metrics: Have you Turned it On?**

- **Opportunity 1 to 5% of Total Power if there are no Cooling Adjustments**

Facilities: Thermal Analysis and Optimization



Optimize data center thermal profile to eliminate hot spots and reduce energy consumption.

Thermodynamic Savings:

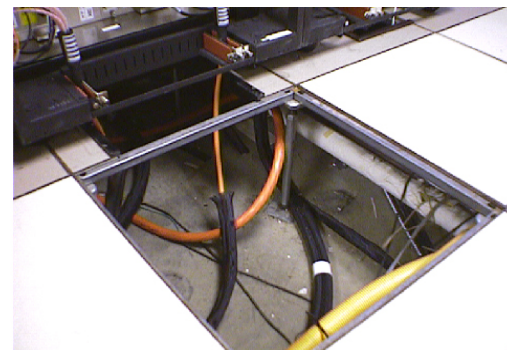
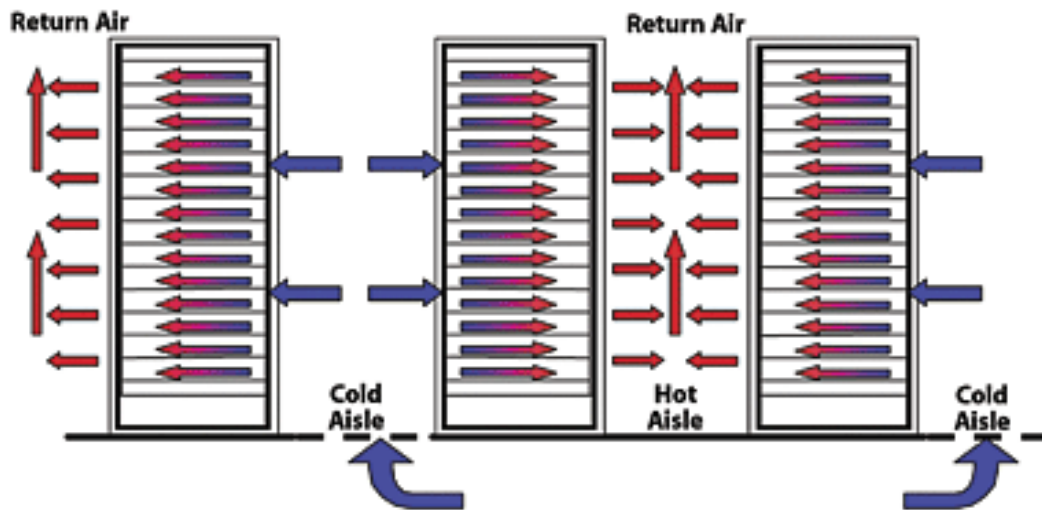
- reduces horizontal / vertical hotspots
- improves targeted air flow / air flow management
- removes plenum temperature variations

Transport Savings:

- improves ACU utilization
- improves ACU flows



Facilities: Best Practices Equipment Layout



Results of Thermal Assessment/Best Practices Implementation

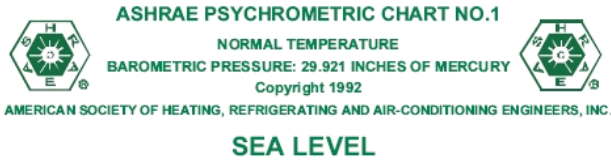
Existing Conditions			
UPS Load kW		Required # CRAC	Active # CRAC
5458	Hendrik Calculation	117	157
2242		33	45
1529		36	66
2564		40	58
3344		57	129
1855		39	55
1157		39	43
2660		66	91
20809		427	644

Best Practices Recommendations	
Shutdown #CRAC	Annual Savings
40	\$171,063
12	\$47,486
30	\$168,378
18	\$57,240
72	\$372,112
16	\$55,921
4	\$35,158
25	\$201,128
217	\$1,108,484

Actual Implementation		
# CRAC Shutdown	Annual Savings	
	MWh/yr	\$/yr
22	1,830	\$91,516
3	213	\$12,344
14	951	\$79,887
14	840	\$44,516
66	3,798	\$341,814
5	325	\$15,595
10	1,180	\$84,990
15	898	\$107,742
149	10,035	\$778,404

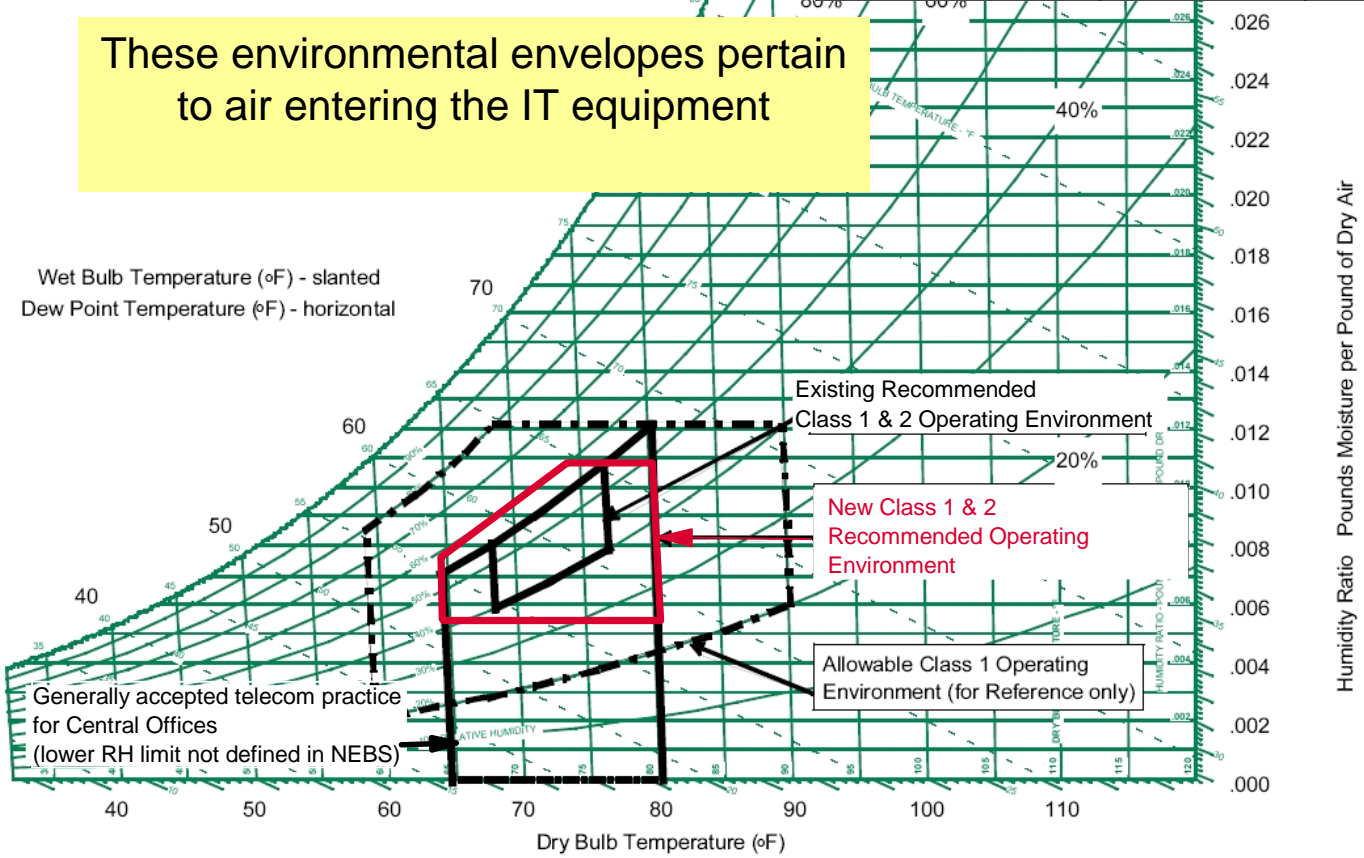
- **Metrics:**
 - **Number of CRACs Removed**
 - **Energy Reduction at the Data Center Meter**
- **Additional Opportunity: Adjust Data Specs to 2008 ASHRAE Specs**
 - **5-10% Reduction in Cooling Energy**
 - **Requires Sensored or Manual Temperature Management**
- **Success Dependent on Teamwork**

REVISED ASHRAE STANDARD



	2004 Version	2008 Version
Low End Temperature	20 C(68 F)	18 C(64,4 F)
High End Temperature	25 C(77 F)	27 C(80.6 F)
Low End Moisture	40 % RH	5.5 C DP(41.9 F)
High End Moisture	55 % RH	60% RH & 15 C DP(59 F)

These environmental envelopes pertain to air entering the IT equipment



Recommended Operating Conditions – Class 1 and 2

INTEGRATE COOLING DELIVERY WITH THERMAL CONDITIONS

- **Control Cooling Delivery Can Be Controlled Based on:**
 - **Data Center Thermal Conditions**
 - **Sensor Network**
 - **Control Algorithms & Variable Speed CRAC Units**
 - **IT Equipment Power Use: (In Future)**
 - **New IT Equipment Has Power Use Reporting Capability**
 - **Control Algorithms**
 - **Rack Level Liquid Cooling w/ Control Valve**

- **Metrics:**
 - **Power and Chilled Water Use over the Day (Instrumented)**
 - **Change in Data Center Room Temperature**

- **Opportunity: 5 to 10% of Data Center Power Use, Increasing as Newer Equipment with Greater Variation Between Idle & Full Load are Deployed.**

- **Example: Silicon Valley Lab Project w/ PG&E Incentives/Support**



ADDITIONAL OPPORTUNITIES

Leveraging Free Cooling





Liquid Cooling

On Site Power Generation

