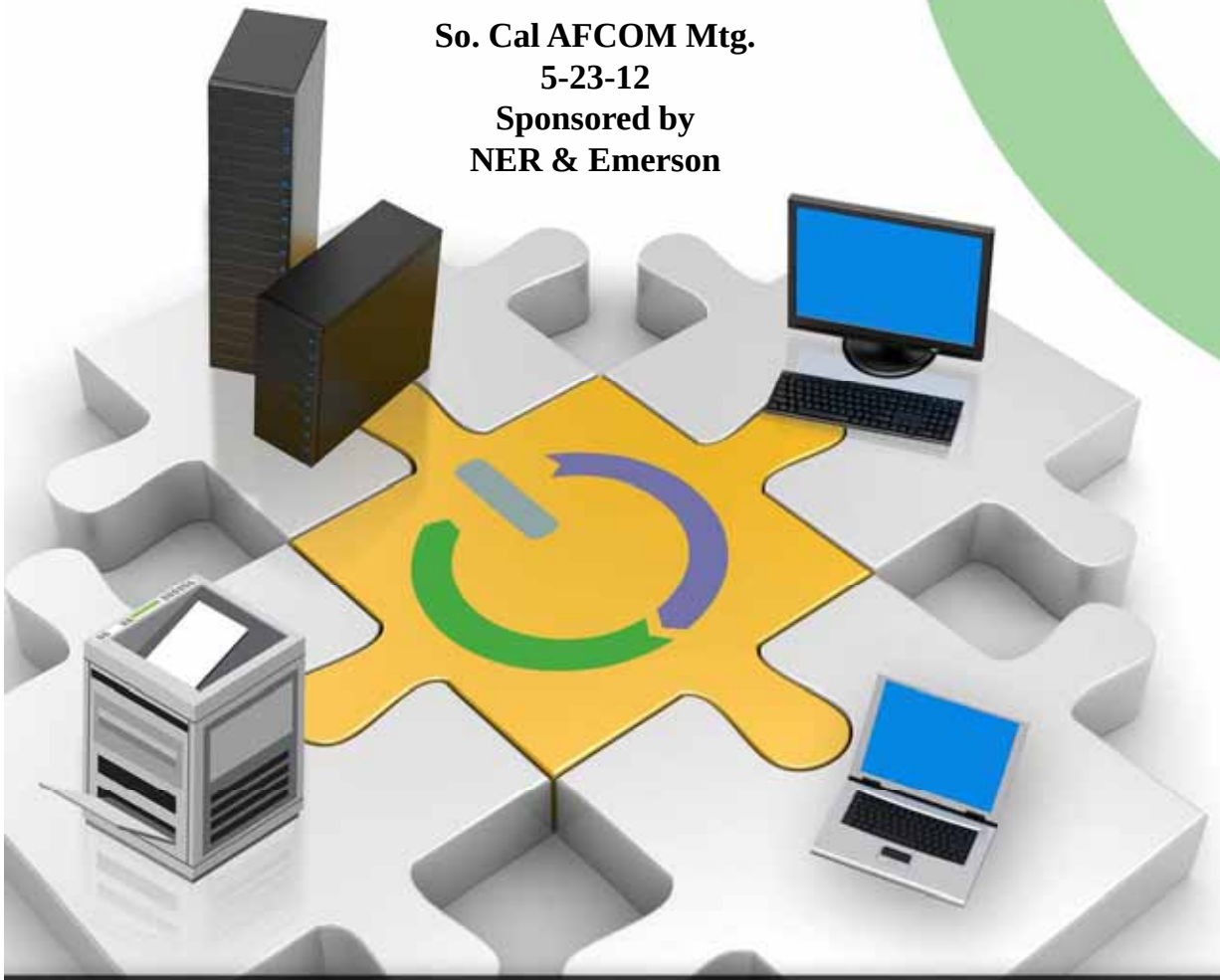
So. Cal AFCOM Mtg.
5-23-12
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Network Power

NER DATA CORPORATION

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Data Center Cooling
Critical Facility & Infrastructure Optimization

Presented by

Greg Stover
SVP NER Data Corporation



About – NER Data Corporation
Data Center Infrastructure Optimization

- **NER has been a leading data center solutions provider to Fortune 1000 companies, thru our partners, for over 30 years!**
  - Comprehensive list of solutions and services
  - We are **Cooling-Power-Monitoring/DCIM** efficiency experts
  - Vendor neutral approach to data center optimization

    * Over 20 different Manufacturing & Innovation partners

- **NER is a hybrid business enterprise**
  - Domestic manufacturer of enclosures, media storage and most recently Air Movers & Monitoring Strips
  - Value-Added Master Distributor and Integrator
  - Critical Infrastructure Services and Solutions provider

Our Focus/Drivers

Infrastructure Constraints & Challenges



- **Power, Space and Cooling**
  - Capacity constraints, distribution and scalability
- **Increased Rack Density (** 2-4kw, 8-12kw, 15-30kw and beyond**)**
  - Storage & virtualization projects air straining infrastructure & manageability – Dynamic loads will complicate the issue
- **Optimization v. Build-Out**
  - 75% of IT organizations/data centers will have to move, outsource and/or remodel as a result of power, cooling and infrastructure capacity issues
- **Energy Efficiency – A topic @ the C-Level**
  - Greening and optimization initiatives that show an ROI and lowered TCO are driving aggressive corporate level decision making
- **D**ata **C**enter **I**nfrastructure **M**anagement

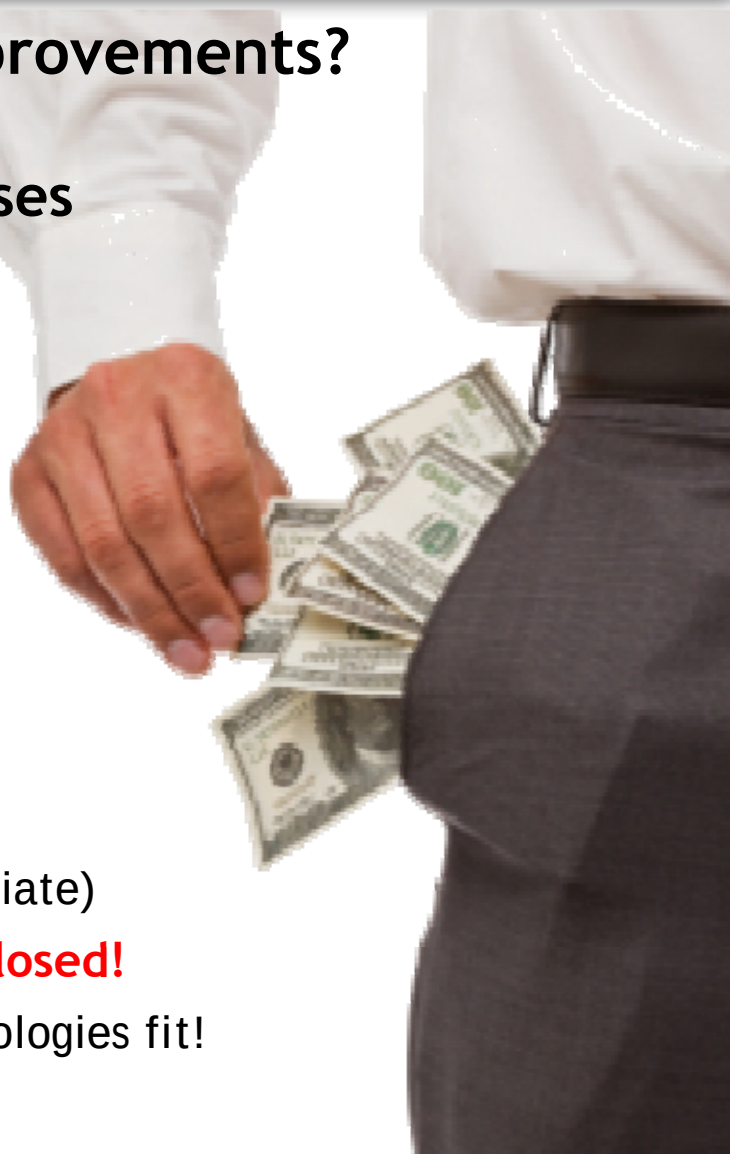
Why Optimize Cooling? Why Care?

- **What Can You do with Efficiency Improvements?**

  - **Minimize Cap-Ex & Operating Expenses**
    - Put the savings in your pocket
    - Become Green and improve sustainability
    - Match work being done to expense

  - **Increase capacity / manageable load**
    - Extend the useful life or your data center
    - Increase/improve cooling system redundancy

  - **Control your own Destiny!**
    - Keep Data Centers & Jobs in So. Cal (if appropriate) for your business ☺ **Inefficient DC's will be closed!**
    - You decide where and how Colo & Cloud technologies fit!



CA. Data Centers and Title 24 – ~~January 2013~~ Just in - Now 2014

The California Investor Owned Utilities (IOUs) are actively supporting the California Energy Commission (CEC) in developing the state's building energy efficiency code (Title 24)

Some Things to Expect:

- VAV/VFD's on CRAC/H's - will likely be a requirement
- Containment - Separation of Hot and Cold air streams will likely be a requirement – No position being taken on Hot vs. Cold
- Economization – Utilization of "free cooling" will be required (water or airside)
- Require Adiabatic humidification- (evaporative or ultra sonic)
- Performance Methods - always an option!

These will likely become new code January 1, ~~2013~~ /2014

The Basics - Simplified



- Get cold air/cooling resource where it needs to be, when it needs to be there, in just the right amount
- Remove heat before it can mix and/or cause hot spots

3 keys to cooling efficiency success

1. Cooling side - Supply efficiency
2. Airflow/supply - Delivery efficiency/Mixing/Containment?
3. Heat/exhaust side – removal/Mixing/Containment?

Dynamically matching supply w/load requirement!

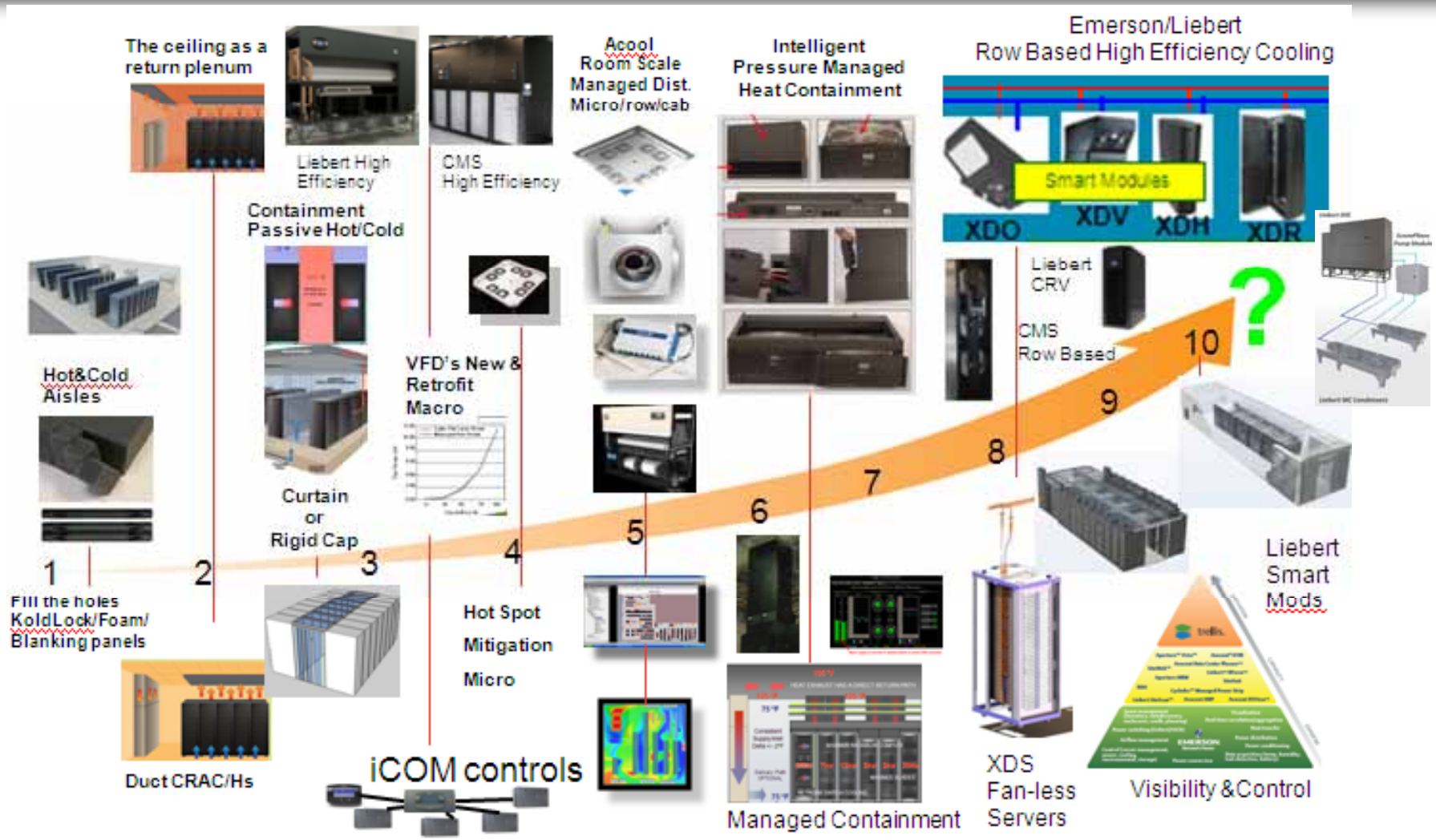
How do we improve efficiency ?



Mechanisms to realize cooling efficiency

1. Reduce or eliminate oversupply
2. Reduce fan energy (turning off units or using VFD's)
3. Safely raise supply air temperatures
4. Safely raise chilled water temperatures (if applicable)
5. Optimization Compressor performance (if applicable)
6. Increase economization utilization (if applicable)

Cooling Optimization is a Process not an Event!
The Options are many!



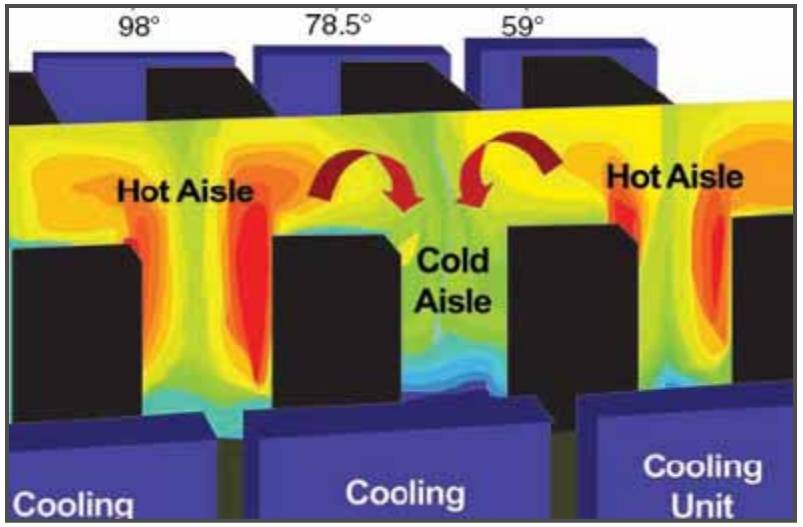
Cooling Realities

Reducing Oversupply …a distribution problem

- Mixing of hot exhaust with cold supply air is the #1 cause of inefficiency and contributes significantly to hot spots
- 40% of available cooling can be utilized/wasted due to bypass/mixing) and over-provisioning to eliminate hot spots
- Typically, supply air is well below ASHRAE standards (77°F - 81°F)
- You can gain a "30% improvement in infrastructure energy efficiency from improved airflow management" according to the EPA (2007)
- Despite a gross over-supply by 1.8/2.5 times, 10% of racks still experience hot spots

Temperatures to Understand

- Supply Temp
- Server Inlet Requirement *
- Return Temp

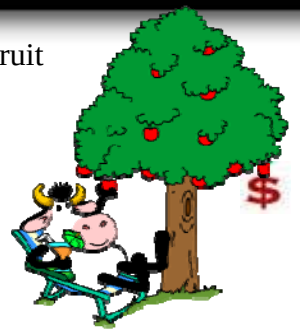


Basic Best Practices – Cooling efficiency
Point Solutions and other ideas!

- Why? @ .07kw it's $3.88 per cfm/year of bypass air (Bick Group)

- Fill the wholes - All of them (w/Plenum rated material)
  - If it's not delivering cold air directly to Server inlets - fill it!
    (room envelope, fill around pipes, cable cutouts, use blanking panels)
  - Remove Comfort tiles - Hot Aisles are suppose to be HOT

Low Hanging Fruit





Before





After





















The Progression of Hot & Cold Air separation towards containment perfection! More Best Practices

4 Easy Steps to upgrade your Data Center for Heat Containment

Using ceiling plenum return

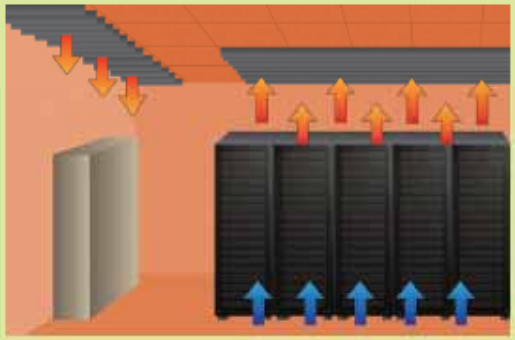
Consult with Opengate and learn how easy it is to avoid overhead cable trays or other obstructions with the flexible rack positioning of Opengate EC

No Ceiling? Opengate has a revolutionary new way to contain the heat in facilities where it would be difficult to install or no ceiling is in place

Retrofit & expand without disruption • Fully utilize cooling

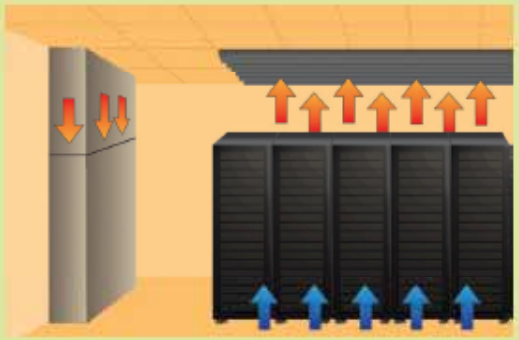
1 Open Ceiling Plenum

- Measure Environment using ASHRAE guideline of 59° from floor at 3 locations
- Remove Tiles above CRAC/H and above Rear 1/3 of racks
- Measure Environment after allowing ~1 hr for thermals to stabilize



2 Ceiling Heat Return

- Connect Cooling Return Duct to ceiling plenum and trim ceiling grid
- Remove Rack Top Panels and replace with EC modified top panels
- Measure Environment after allowing ~1 hr for thermals to stabilize & record improvements



Increase power per rack
Practical for retrofit & new construction

3 Contain the Heat

- Attach the EC10, EC20 or EC30 to rack top
- Replace Rear Doors w/solid type or locate panels to block perforate
- Place Side Panels between each rack for ASHRAE accepted front-to-top airflow
- Measure Environment after ~1 hr for thermals to stabilize & record improvements



4 Unity Cooling™

For your facility, record and compare total sensible cooling to total UPS load.
Record and Compare total airflow supply from CRAC data and total airflow consumption using calculation shown.

kW	Total Sensible Cooling:	
	Total UPS Load:	
CFM	Total CRAC/H Load:	
	*Total IT air flow use:	

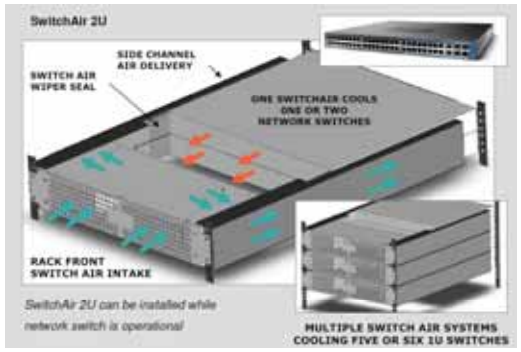
* 120 CFM / kW of total load (120 x total UPS load) will provide an adequate average of total IT airflow consumption

- Reduce Cooling to match the actual IT Load or increase load to utilize existing cooling capacity
- Record and Compare total sensible cooling and total UPS load
- Record and Compare total airflow supply from CRAC data and total airflow consumption using calculation shown

IT HEAT contained managed

Mechanical Airflow Manipulation

Supply & Return Paths – Localized Fixes





< Fan Assisted Air Mover

Heat Removal >



Dynamic Airflow Management

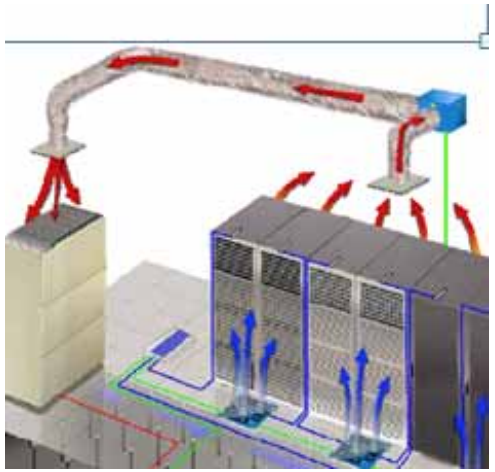
In-Rack Airflow Delivery and Distribution
Under-Floor and Overhead Air Movers
Intelligent Airflow Distribution and Management
Pressure-Managed Heat Extraction



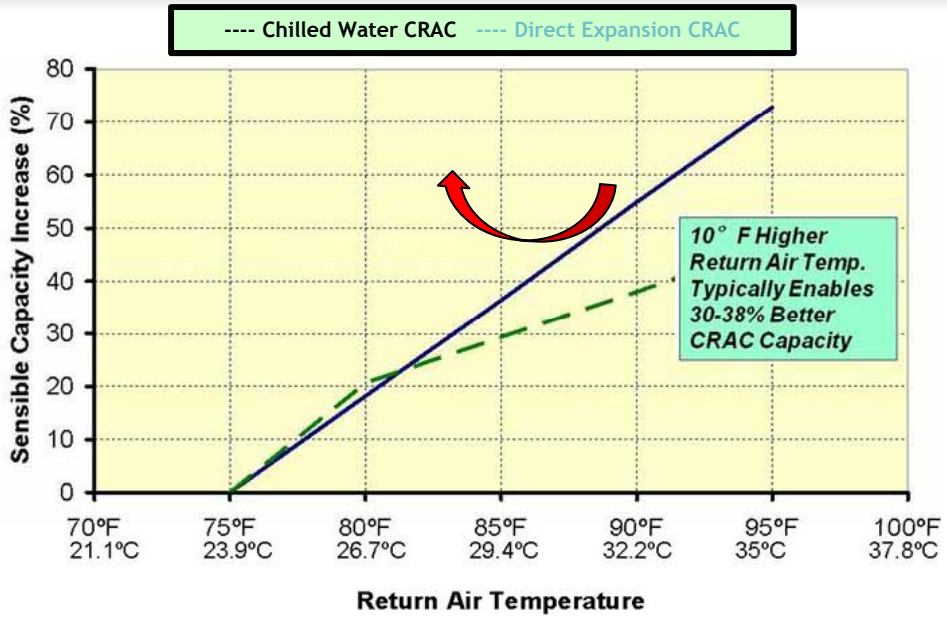
< Air Distribution Cabinet

Heat Removal >

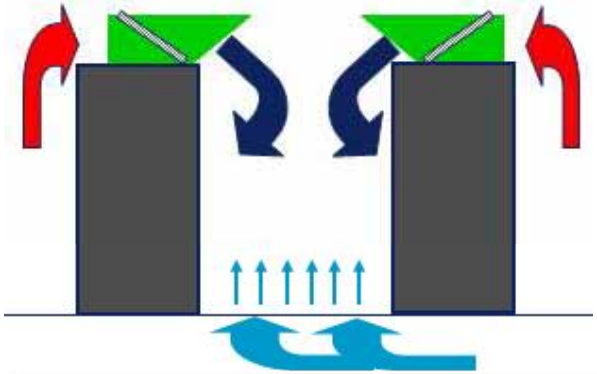




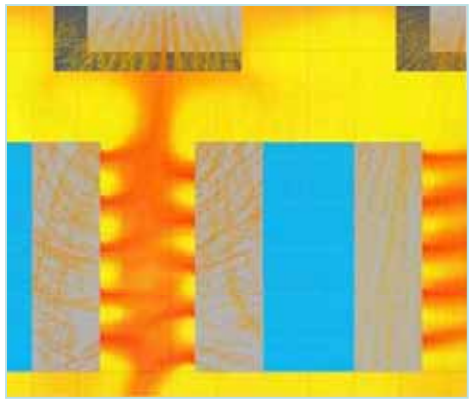
Maximizing the Temperature Back to the Cooling Unit is Optimal – Airflow Mgt. (Cont)

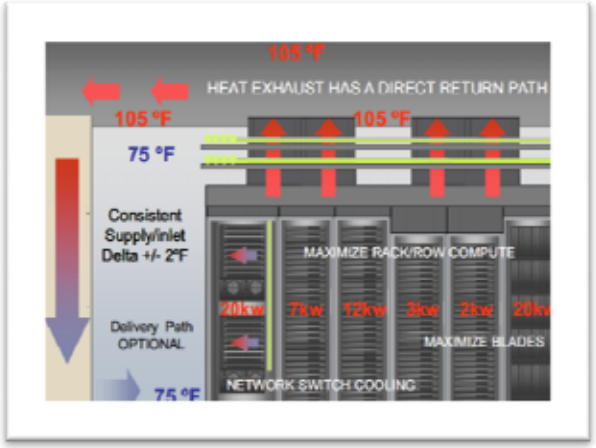


- Higher Precision Cooling unit ΔT & SHR
- Recovers stranded capacity
- Efficiency gain from 15% to 20%







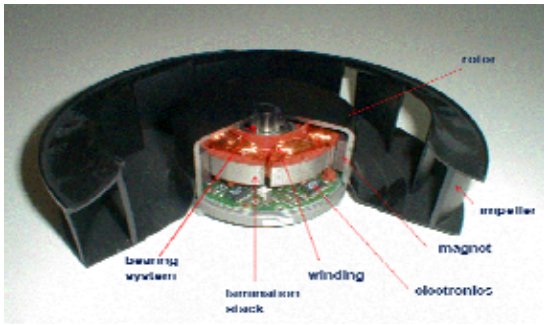


Advanced Technology – EC Plug Fans (CW)

How efficiently can I get the Air where it needs to be?

- Direct drive (no belts)
- 60% to 100% fan speed (VFD/VAV)
- Fan speed matches the chilled water valve position, based on the room heat load
- At lower speeds (< 70%), EC plug fans can save **over half of the fan energy** versus standard cooling methods
- Field Retrofit Kits Available for many models
- Limited on external static capability







CW
EC Plug Fan Benefits – Fan Speed Reduction

Fixed Speed

3 Units ON, 1 in Standby

- Fans must operate at 100% to meet demand
- 3 units X 8.1kWh =

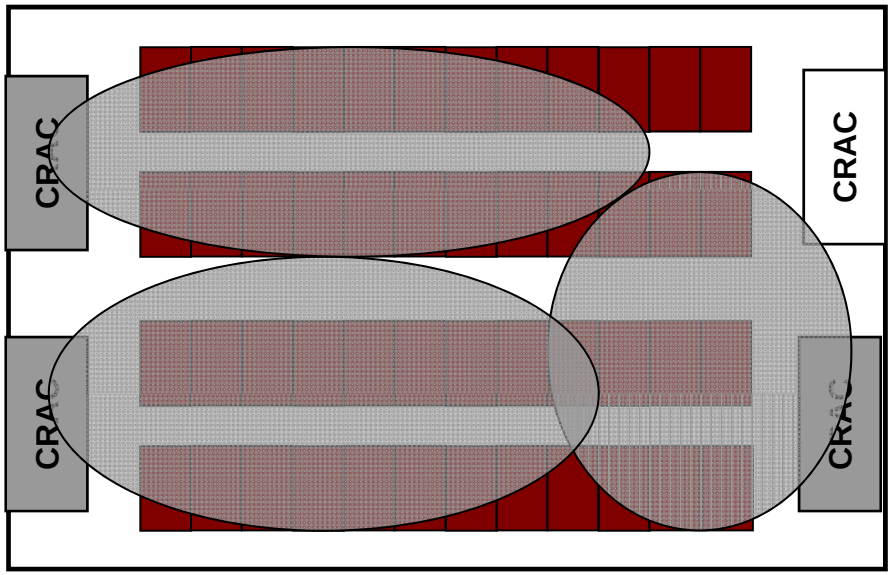
24.3kW per hour

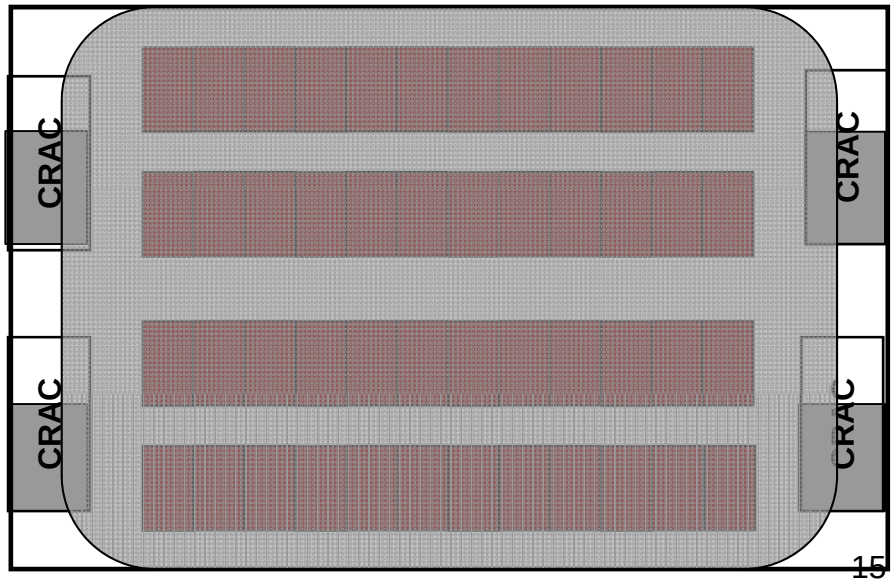
Variable Speed

4 Units operating together

- Fans can operate at 75% to meet demand
- 4 units X 3.43kWh =

13.72kW per hour





Automated Intelligent Controls
Example = Verizon Wireless iCOM Case Study



Total of (32) DH380AUAA00's
existing units operating as a single zone
High energy costs due to excessive cooling

Automated Controls

- w/supply Manipulation
- Zonal Mgt.
- Real-Time Control

- AdaptivCool
- **Liebert iCOM** (in study)
- Environet
- Synapsense
- Vigilent
- Others

Verizon Wireless

iCOM Controls Case Study Summary

- Total of (32) DH380A's units operating as a single zone
- 32 units / 6 zones (w/ 9 units on standby)
- iCOM with (6) vNSA switches and (2) *iCOM* Wall Mount
- Total cost of upgrades ~$184,000
- Total cost of installation ~$60,000

Intelligent Controls

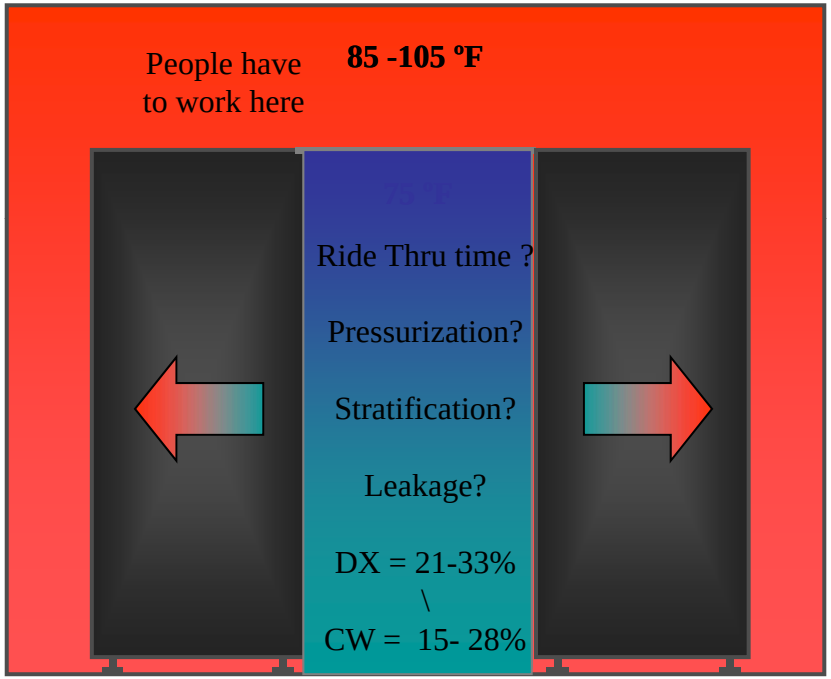


Dynamic Mgt.

- **Approximately 200 kW per hour savings**
- **Total of 1,752,000 kW (of unnecessary usage) per year savings**
- **Total Annual Savings ~$211,000**
- **Total Install Cost ~$244,000**
- **Simple Payback ~1.2 years (Pre-Incentive)**

CACS & HACS – Passive Containment
Further Separating - Supply Air from Exhaust Air
Containment lowers Fan Power/energy use 30-50%

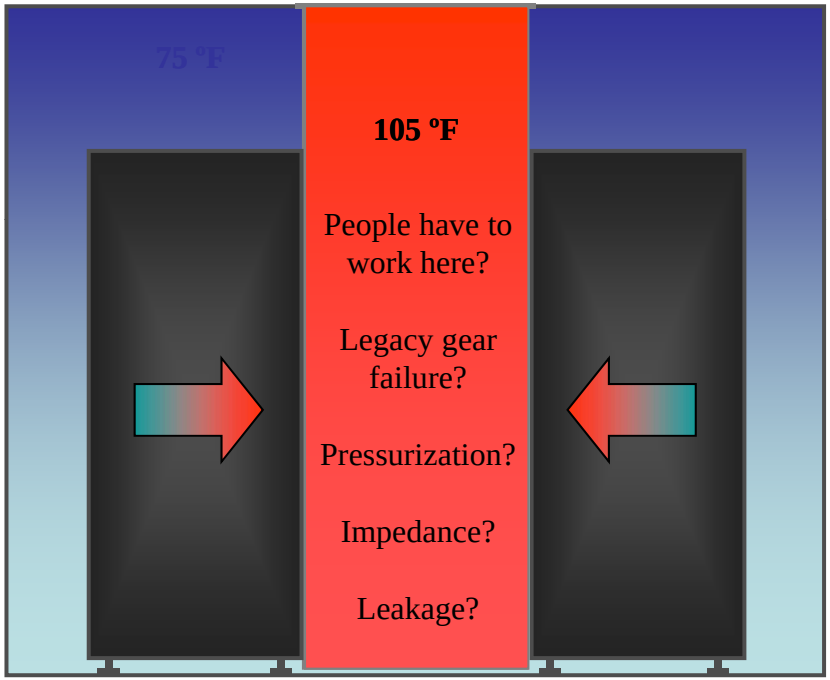
Cold Aisle Isolation



Considerations

Aesthetics
Fire Marshal/Code
Insurance Carrier
Fuse-able Link Maintenance
Impedance

Hot Aisle Isolation



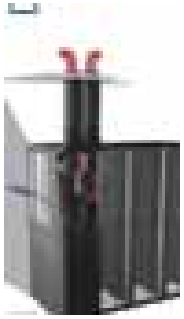
Types

Curtains – Fuse-able links
Rigid Panels – Cutouts & Fuse-able links
Drop Away Panels – Nat'l FM rating
Retractable – Fuse-able links
Doors – Sliding & Swing

HACS (cont) Chimney's (Passive & Containment lowers Fan Power/energy use 30-50%

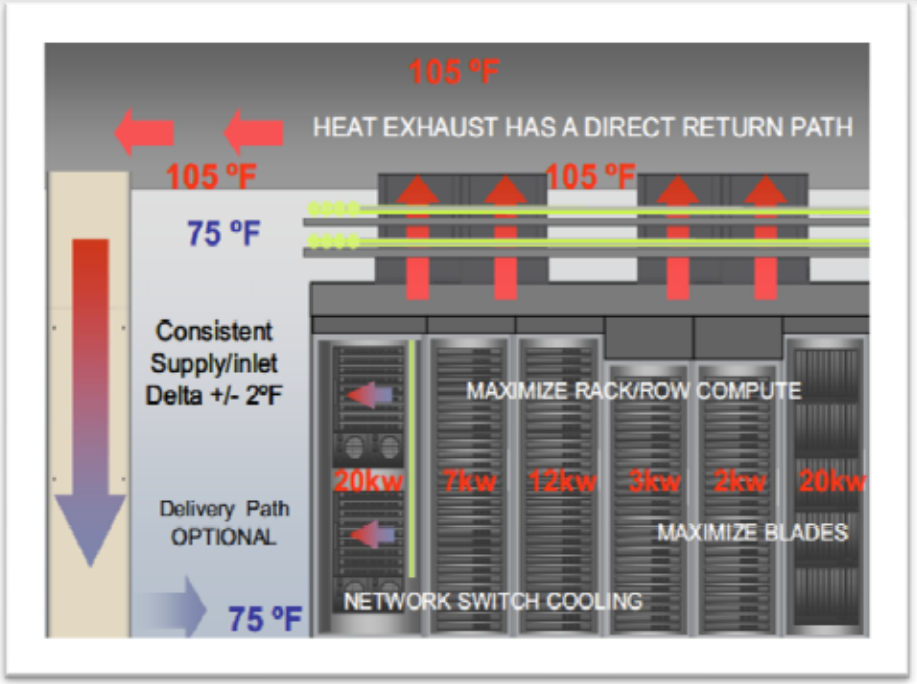












Types

Per Cabinet/Row Based/Containment Aisle
Passive
Mechanical Assist
Managed/Intelligent

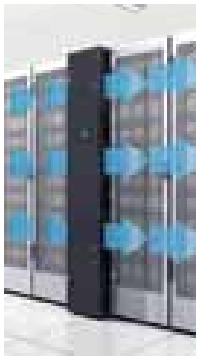
Considerations

Space – Hot Air return capability/strata
Fire Marshal/Code
Insurance Carrier
Impedance (how will it be overcome?)
Control Mechanism (Temprature or Pressure)
Ride Thru time

Close Coupled/Row-Based Cooling

As Supplemental Cooling
5-30kw

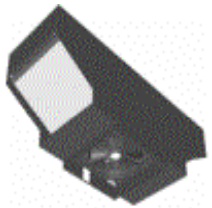




Most Heat Rejection Methods Available

<u>Things Consider</u>

Fan design/efficiency
Air distribution efficiency
Control methodology/Intelligence
Access/Maintenance





HD
Overhead designs

< Your Options are many >





Up To 40kw



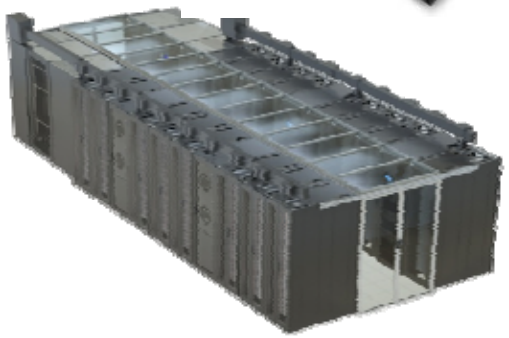
Liquid Cooling
40KW and beyond

As a turn key
Self Contained solution



20-400kw PODS
5-30kw/rack
Legacy or New Sites
Modular & Scalable
Room Neutral
Highly Efficient



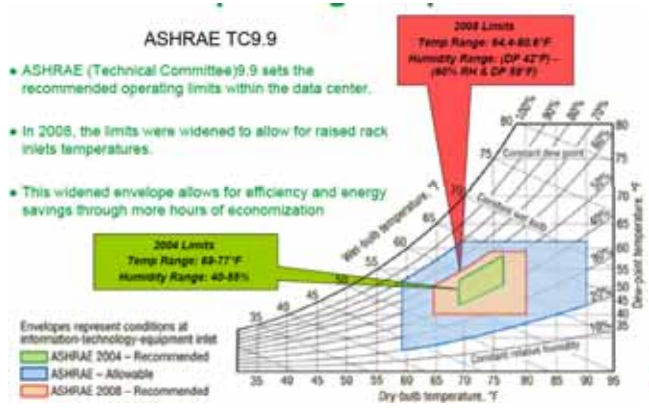


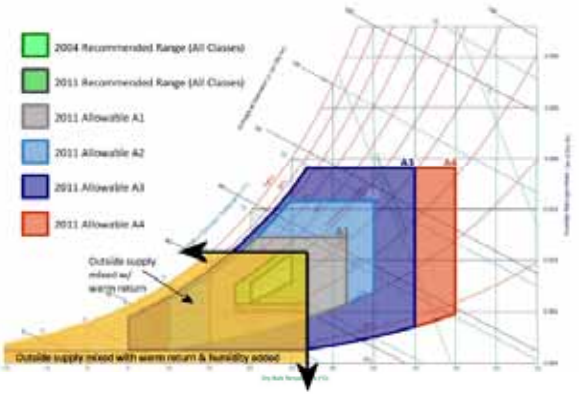
The future has arrived
Economization, Hybrids, Maps & Equipment

Driving these Trends

ASHRAE's Issues:

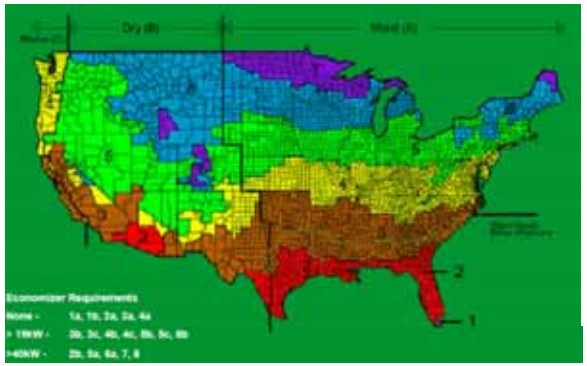
- Expanded Guidelines
- Climate Zone Maps
- Economization Maps
- Equipment Classes





Lots of considerations

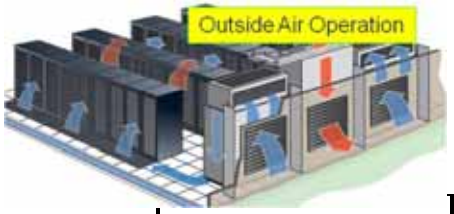
- Your equipment
- Air Quality
- SLA's /Tolerances





infrastructure Optimization Solutions

Old & New Technologies Abound
Hybrids, Evaporative, Heat Wheels



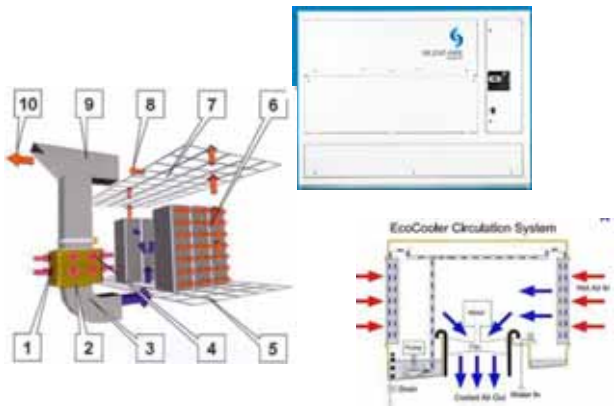
	Fluid Economizer		CW or DX w/ Air Economizer
	Cooling Tower	DX w/ Dry-Cooler	
Full Eco. Hours	34.0%	25.0%	0.6%
Partial Eco. Hours	35.4%	29.5%	26.6%
Total Energy Savings	51.7%	39.8%	13.9%

CW Plant

Glycool Option

Air Economizer Option

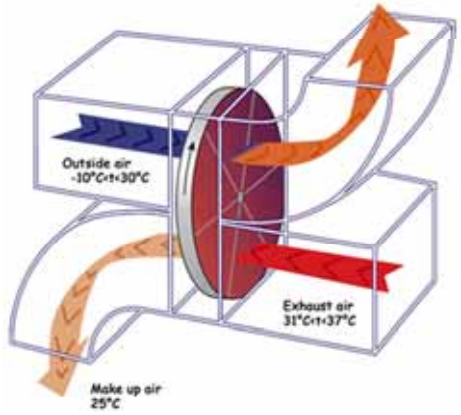
Evaporative Cooling providers exploding
Claiming up to 80% savings

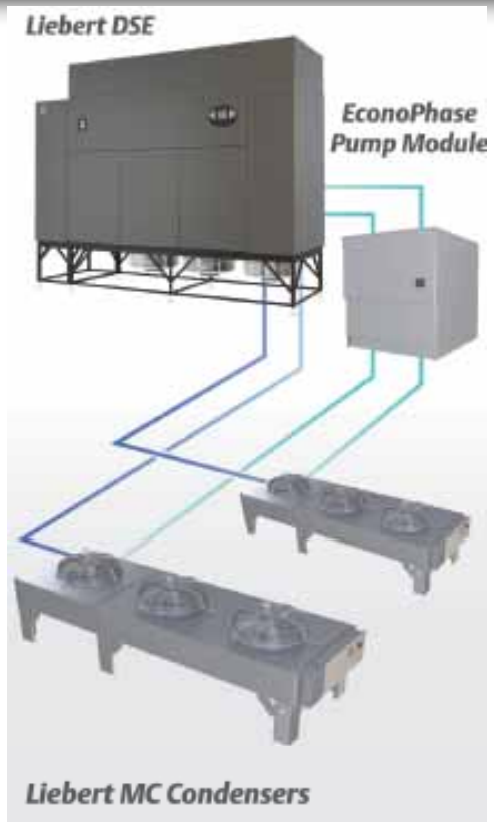




EcoBreeze = Air-to-air heat exchanger, evaporative cooling, w DX coolers for back-up

HEAT WHEEL Technology
Air to Air Heat Exchanger

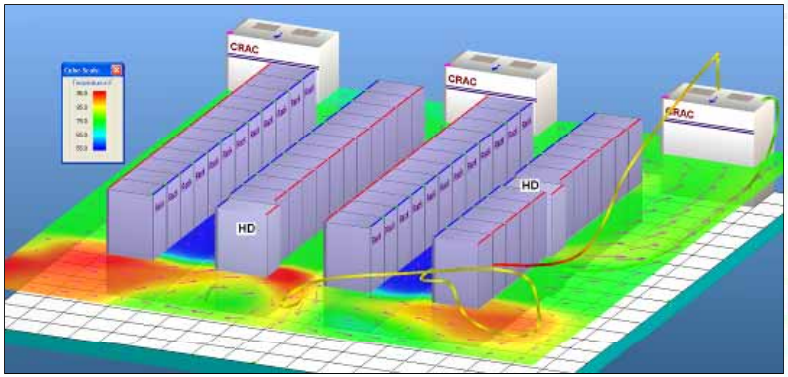


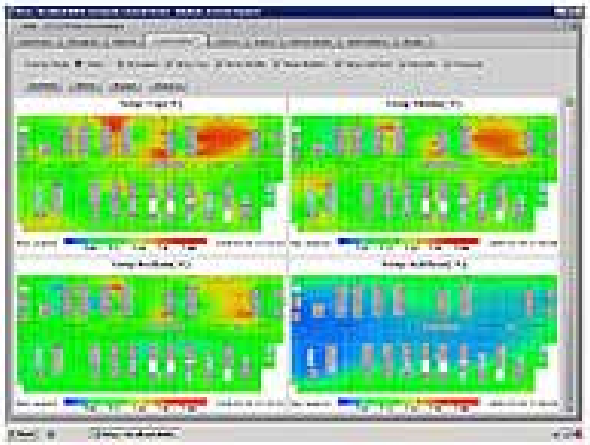


Up to 70% Savings
Tandem digital scroll compressors
EC plug fans
Staged evaporator coil
Electronic expansion valves
EconoPhase™ Pumped Refrigerant Economizer
Liebert iCOM® control

Can't Decide?
Computational Fluid Dynamics

- **As part of the most Optimization Assessments, vendors can create a Computational Fluid Dynamics (CFD) study to precisely predict air flow and air temperature anywhere in a computing environment through software simulations**
  - CFD modeling visually and scientifically identifies and depicts constraints and enables you to identify the best solutions for remediation
  - CFDs are used for failure analysis, redundancy scenarios, future layout and capacity planning





Thermal Map

New Tools/Software allow for :

- **Close Coupled Modeling**
  - **InRow/RowBased**
  - **Overhead**
  - **Rear Door**
- **Containment Modeling**
  - **Hot & Cold**
  - **Passive & Managed**
- **Chimney Heat Containment**
  - **Passive**
  - **Managed**

infrastructure Optimization Solutions

Can't Decide?
Optimization Assessment & Services

- **Implementing best practices, energy efficient designs, and power saving technologies require baseline information of your power and cooling usage**
- **Optimization Assessments captures " your data center data"**
  - On-Site capacity benchmarking
  - CFD modeling and analysis – how does air move?
  - Power & cooling efficiency analysis
  - Metrics analysis
- **Understand their expertise/experience**
  - What do they sell?
  - How long have they been interpreting CFD's
  - Look hard at the sample deliverable/process
  - Is the Assessment deliverable independent/transportable?



Some Recommendations



- Measure and Monitor your Power & Heat
- Eliminate problems/inefficiencies caused by heat & air mixing (can minimize effects of new technologies)
- Use Solutions that are demand/load responsive

  - Controls & Automation are critical
- Work with the Utilities – On the front side for rebates Incentives
- Become a pro-active partner with Facilities
- Benchmark/Baseline, Plan & model/visualize for the Future! Do an assessment!

THANK YOU – Q & A

gstover@nerdata.com or 949-360-1509