

High-tech Buildings Research and Demonstration Projects



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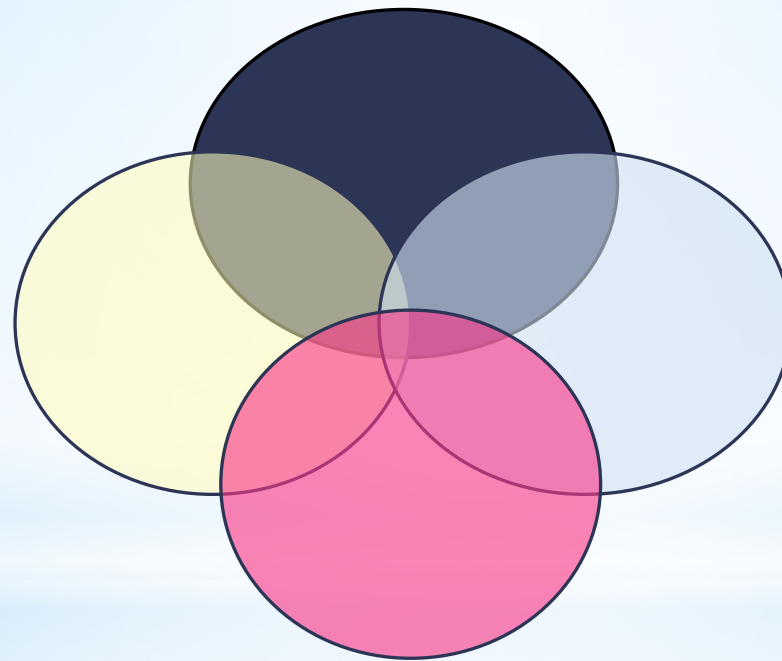
High-Tech Buildings

data centers

cleanrooms

hospitals

laboratories



Large Energy Footprint

Continuous Operation

High Energy Intensity

Little Focus on Energy Efficiency

Common Infrastructure Opportunities

Process Energy Opportunities



Why High-Tech Buildings?

- * High Process Loads
- * Uninterruptible Power
- * Stand-by Generation
- * HVAC
 - * Chilled water plants
 - * Reheat
 - * Free cooling
 - * Ventilation/air-change rates
- * Combinations
 - * data centers in labs or hospitals
 - * Cleanrooms (operating rooms) in hospitals

Similarities of Building Types

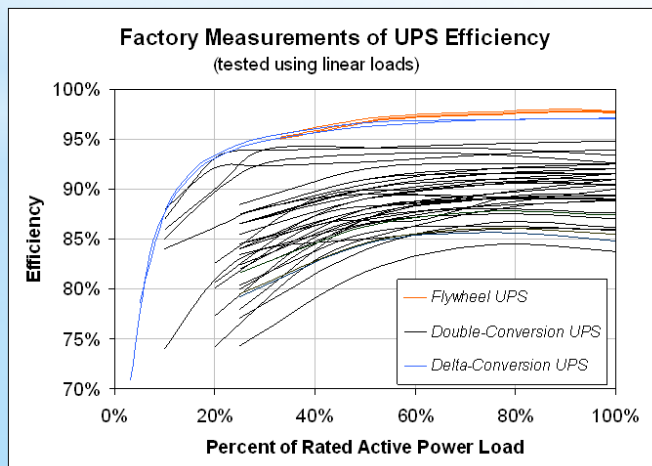
- * Design Rules of Thumb – Lack of Science Based Design and Operation Criteria
- * Education – Awareness of Opportunities
- * Lack of Public Benchmark Data
- * Exempt from Building Codes
- * Resources Applied to Process/Mission
- * Lack of Integrated Monitoring and Control
- * Redundancy Options
- * Sizing Issues
- * Capital Cost vs Operating Cost

Similar Barriers to Efficiency

- * Continued High-Tech Innovation is Important to Most State's Economies.
- * Public Goods Programs Play an Important Role in Focusing on Energy Since this is not Always High Priority to Industry.
- * Continuity and on-going Technical Advancement is Key as High-Tech industries evolve rapidly.
- * Public/Private Collaboration essential to Success.

Other Considerations

- * Energy Benchmarking for Labs, cleanrooms, data centers
- * Research Roadmaps for High-Tech Buildings
- * Spotlight on equipment efficiency - UPS systems and Power Supplies
- * Low Flow Fume Hood Research
- * Multiple Demonstrations of Emerging Technologies
- * LEED™ Type Criteria for Labs and Data Centers
- * Assistance to Federal Data centers
- * Data center assessment tools – DC Pro



High-Tech Building Activities

- *DC Power for Data Centers

- *Novel Control Strategies

- *Novel Cooling Strategies

- *Evaluating Modular Cooling – “Chill-off”

Technology Demonstrations

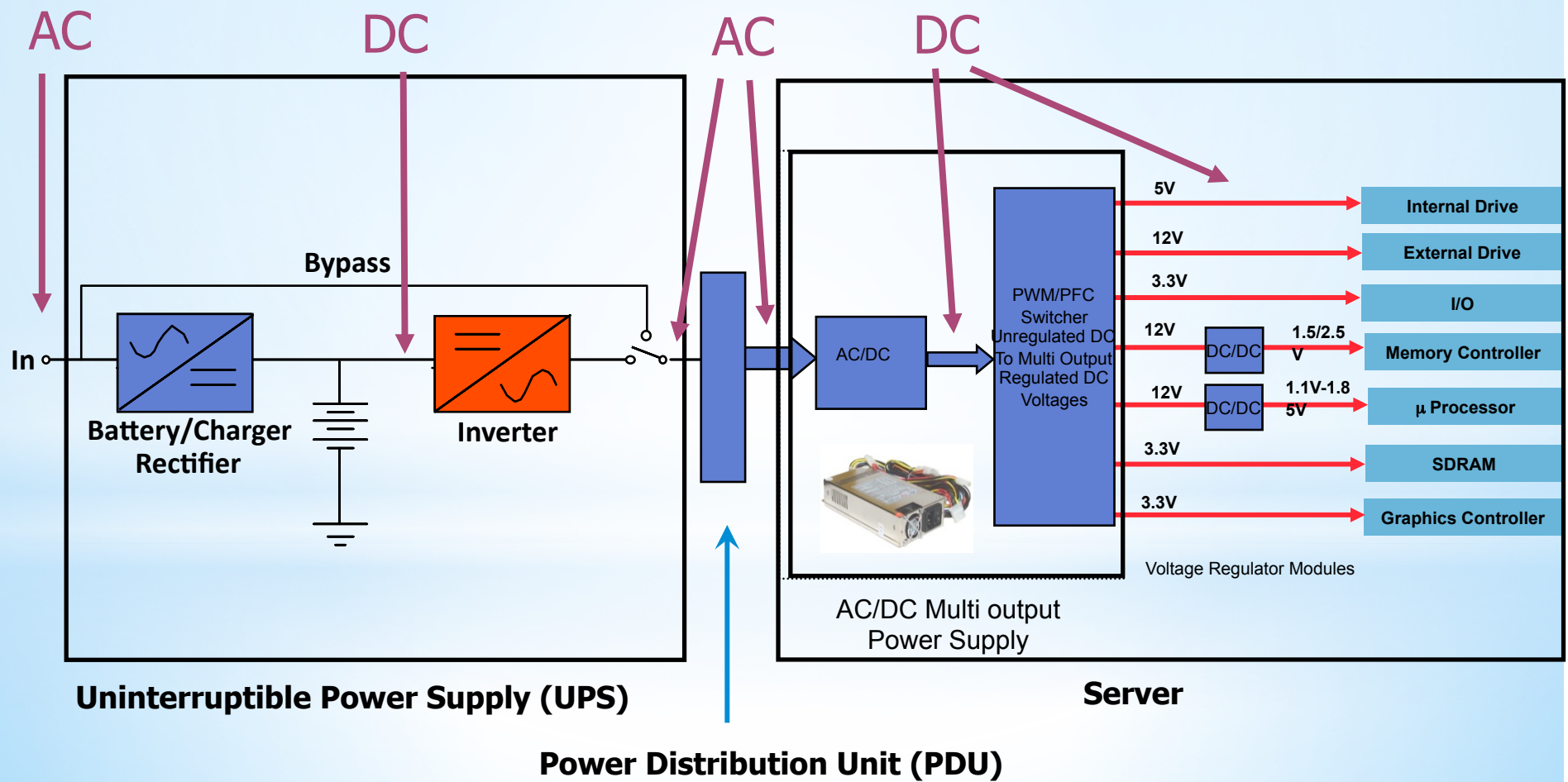
DC Power for Data Centers

- Proof of Concept demonstration at Sun Microsystems
- Demonstration at UC San Diego – on-going
- Industry group advocating DC
- Emerge Alliance promoting 24V. and 380V. DC
- DC products being developed
 - Rectifiers
 - Power supplies
 - Connectors



Technology Demonstrations

DC Power Demonstration Seeks to Reduce Data Center Power Conversions



*Novel Control Strategies

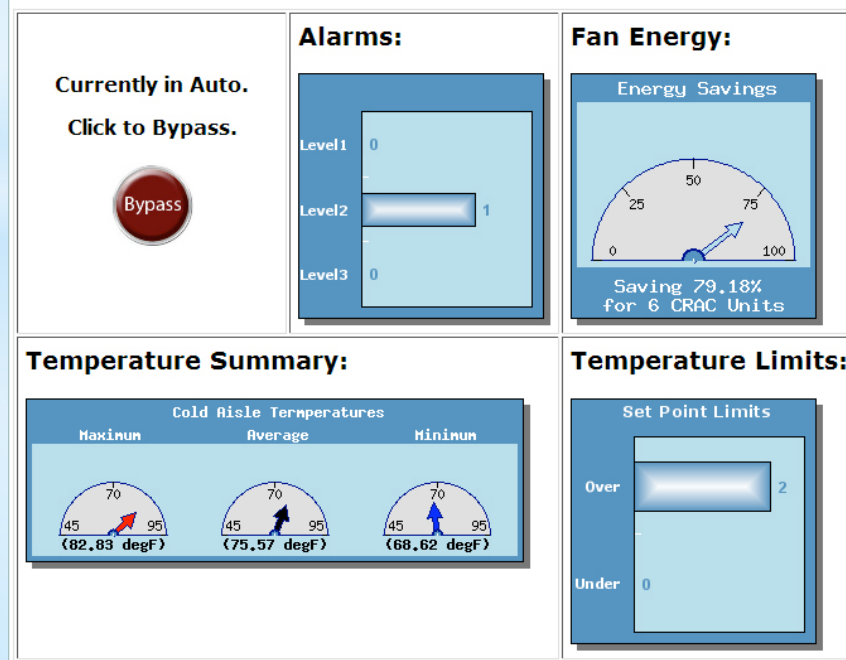
- Use of Wireless monitoring and control – Demonstration at CA Franchise Tax Board
- Use of sensors in IT equipment to control building HVAC systems – Demonstration at Intel Corp.
- Use of wireless network to visualize thermal and pressure gradients – Demonstration at LBNL

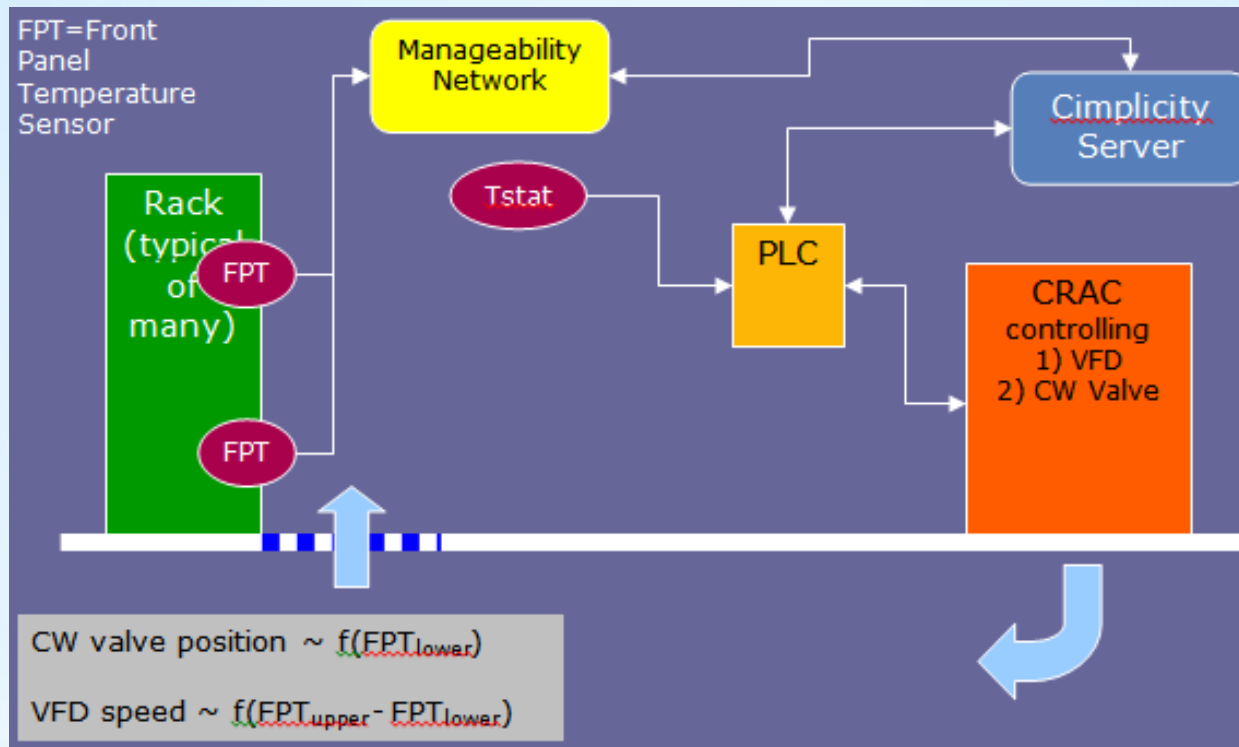
Control Technology Demonstrations

Wireless Sensor Network:

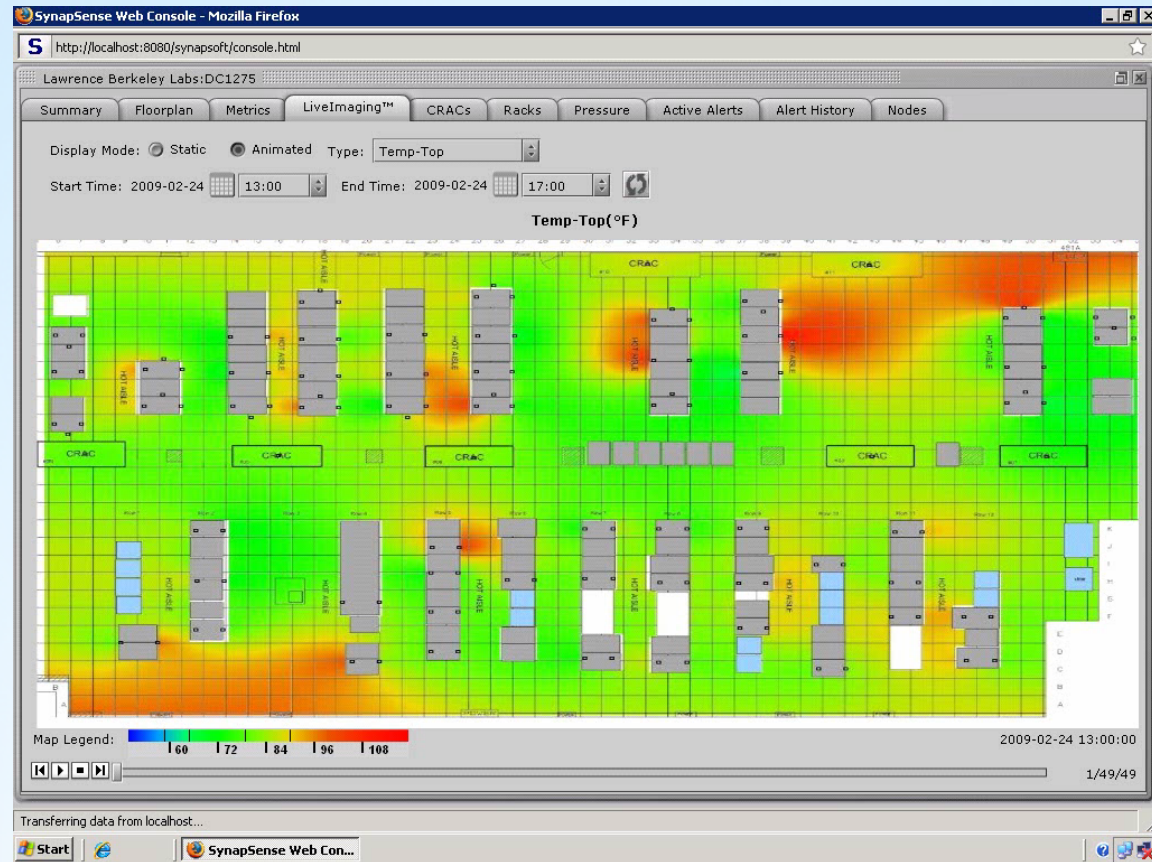
- 50 wireless temperature sensors
- Intelligent control software

FACS Dashboard:





Using IT equipment to control Cooling Equipment

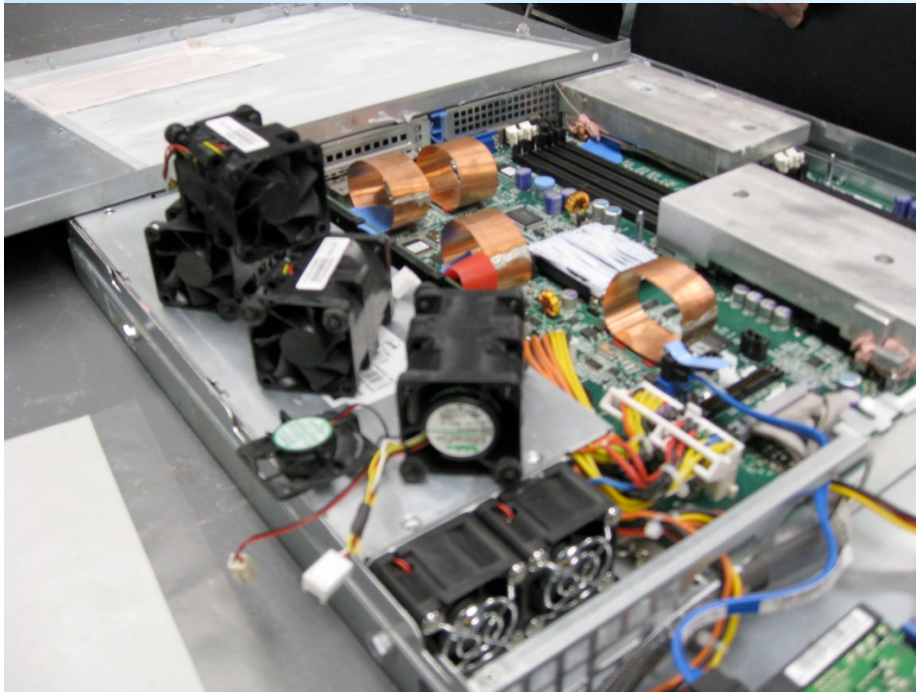


Visualizing Air Systems

*Novel Cooling – Clustered Systems

- Use convection to remove heat from servers
- Eliminate fans in servers
- Cool with higher temperatures
- Eliminate Compressor cooling

Technology Demonstration



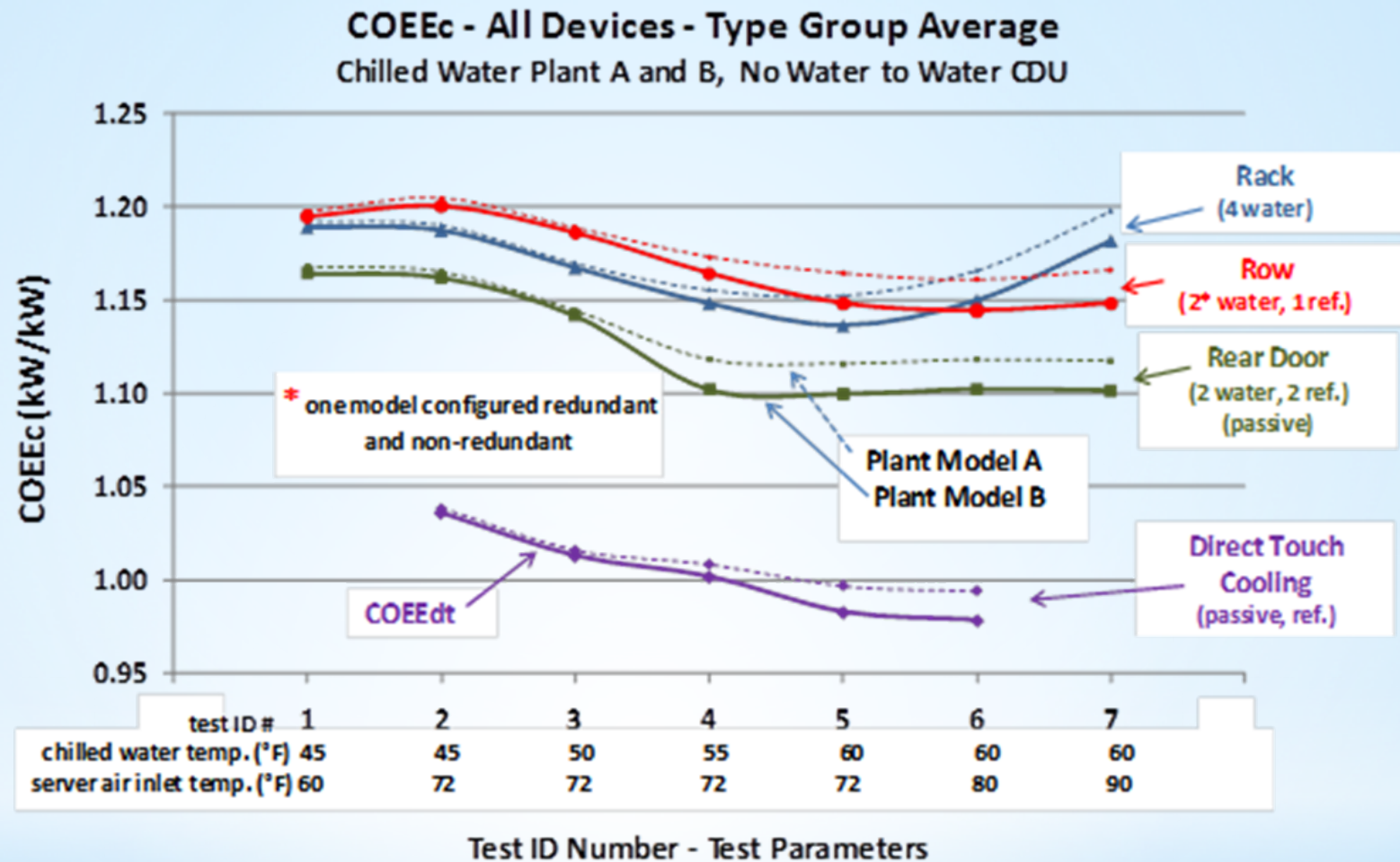
Clustered Systems

- * Demonstrations of New or Underutilized Technology Help Overcome Barriers by Showing Technology Successfully being Used.
- * Demonstrations have Stimulated Others to Try New Technologies. The Silicon Valley Leadership Group hosted a Data Center “Summit” Where Over 500 Professionals Learned of Demonstrations Hosted by End Users.

Benefits of Demonstrations

- * Collaboration with SVLG to Arrange Demonstration Projects
- * Many Demonstrations Presented
- * “Chill-Off” evaluation of Modular Cooling Solutions of particular interest to the Industry in past 2 Summits.

SVLG Demonstration Summit



“Chill Off” Findings

Modular Cooling Closely Coupled
to the Heat Source is Much Better
than Standard Practice

- * More Outreach and Training is Necessary to Get the Most From Current Technology.
- * More Innovation is Needed to Keep Pace With Growing Computational Appetite.
- * Collaboration with Industry Groups
- * Breaking Old Paradigms Will be Hard
 - Move to DC Power
 - Move to Liquid Cooling
 - More Use of Free Cooling
 - Move to Cloud Computing

Where Do We Go From Here?

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* Questions ?

Links

DOE Website

www.eere.energy.gov/datacenters

Lawrence Berkeley National Laboratory (LBNL)

<http://hightech.lbl.gov/datacenters.html>

LBNL Best Practices Guidelines (cooling, power, IT systems)

<http://hightech.lbl.gov/datacenters-bpg.html>

ASHRAE Data Center technical guidebooks

<http://tc99.ashraetcs.org/>

The Green Grid Association – White papers on metrics

http://www.thegreengrid.org/gg_content/

Energy Star® Program

http://www.energystar.gov/index.cfm?c=prod_development.server_efficiency

Uptime Institute white papers

www.uptimeinstitute.org