# Re-Engineering to a "Green" Data Center, with Measurable ROI

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CEO and Founder

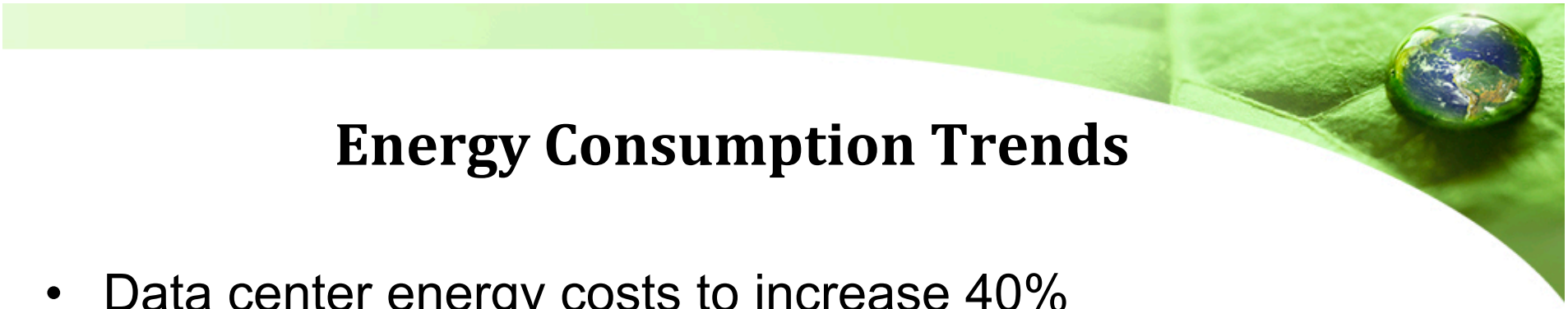
# Agenda

- Data Center Energy Trends
- Benchmarking Efficiency
- Systematic Approach to Improve Energy Efficiency
- Best Practices

# Data Center Energy Consumption

- Energy doubled from 2000 to 2006
- Projected to double again by 2011
- 61 billion kWh in 2006,
  100 billion kWh by 2011
- $4.5 billion in 2006,
  $7.5 billion by 2011

Source: EPA, Report to Congress on
Server and Data Center Energy Efficiency



# Energy Consumption Trends

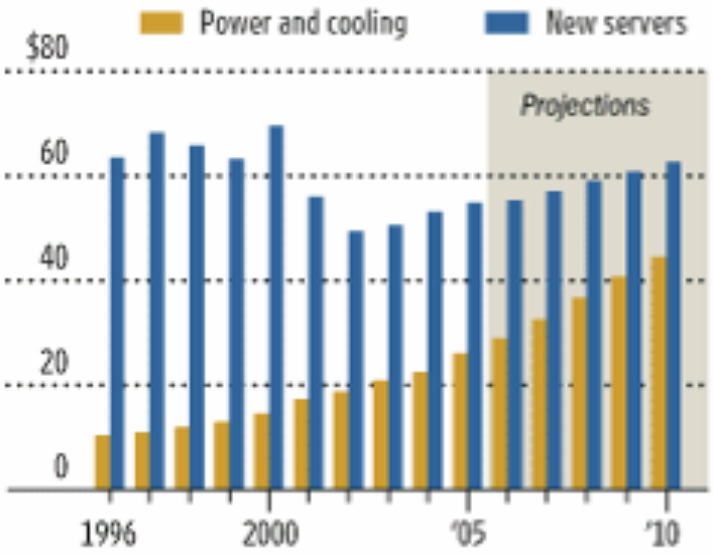
- Data center energy costs to increase 40%
  - Source: EPA, Report to Congress
- 42% of data center managers expect to run out of power capacity within 24 months
  - Source: Uptime Institute
- 39% of data centers managers expect to run out of cooling capacity within 24 months
  - Source: Uptime Institute
- “Power is expected to be 30% of IT budget within 2 years”
  - Source: Gartner Group
- “Greater regulatory compliance is here to stay.”
  - Source: Gartner Group

# Data Center Market Drivers


THE WALL STREET JOURNAL.

**Surging**

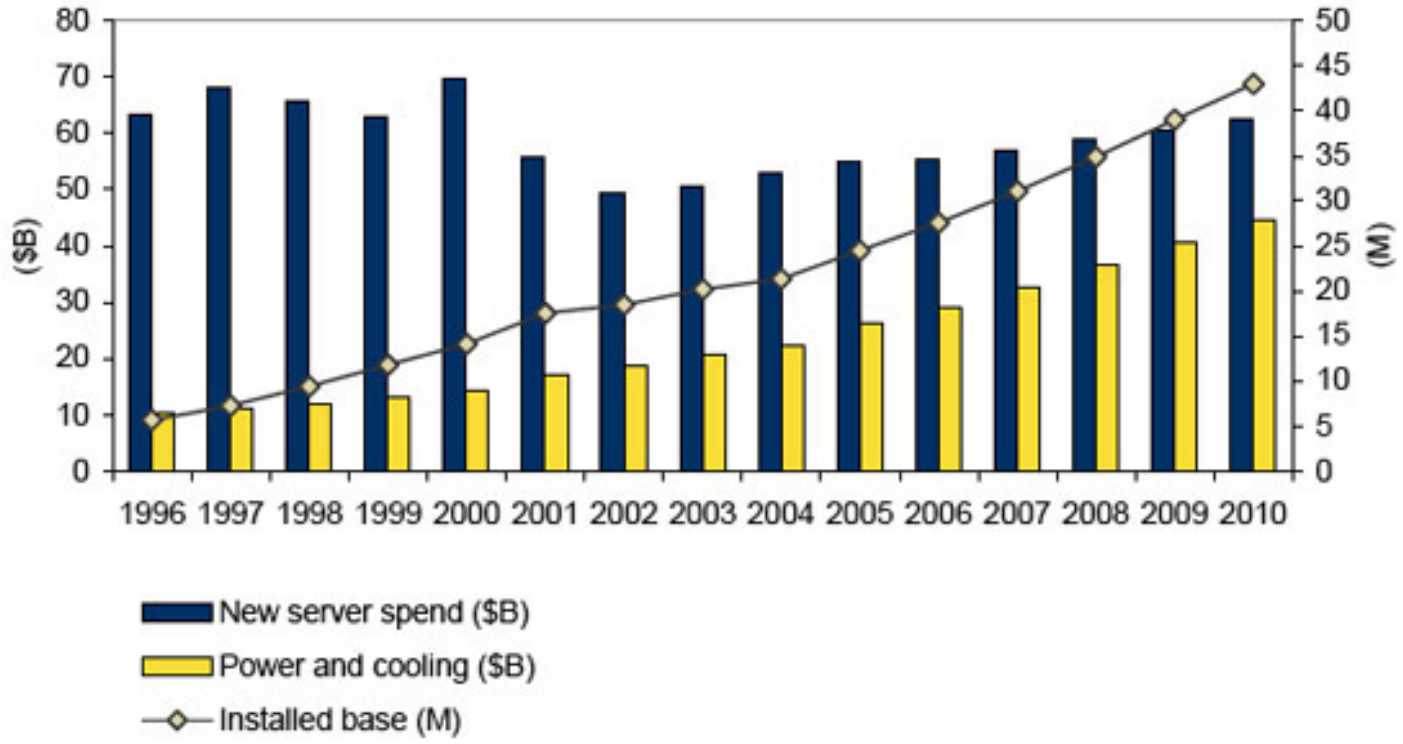
Spending on new servers, and power and cooling expenses for world-wide installed server base, in billions of dollars




Source: IDC

# Density Implications

Worldwide Cost to Power and Cool Server Installed Base, 1996–2010




Source: IDC, 2007

# The Environmental Perspective

A server generates as much $CO_2$

**Server** (usually on 24x7)
440 Watt Server
3,942 kWh/year
5.3 Tons of $CO_2$

**Auto Travel**
Toyota Camry
15,000 miles/year
5.3 Tons of $CO_2$

Source: Sun Microsystems

# Green versus $$$

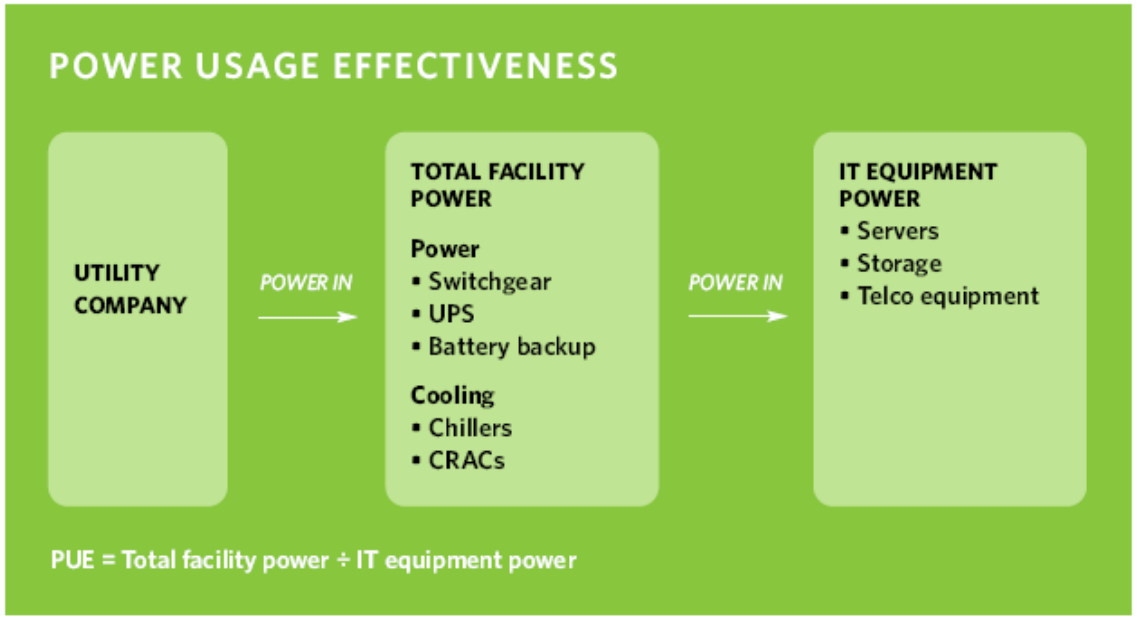


- IT Budgets are down in 2009
  - Need to do more with less
- A systematic approach to Efficiency
  - Start with “Low hanging Fruit” for a quick ROI
  - Improving Cooling & Air Flow yields dramatic results
  - Rebates available from some energy companies

# PUE / DCiE

Power Usage Effectiveness (PUE)

$$\frac{\textit{Total Facility Power (kW)}}{\textit{IT Equipment Power (kW)}}$$



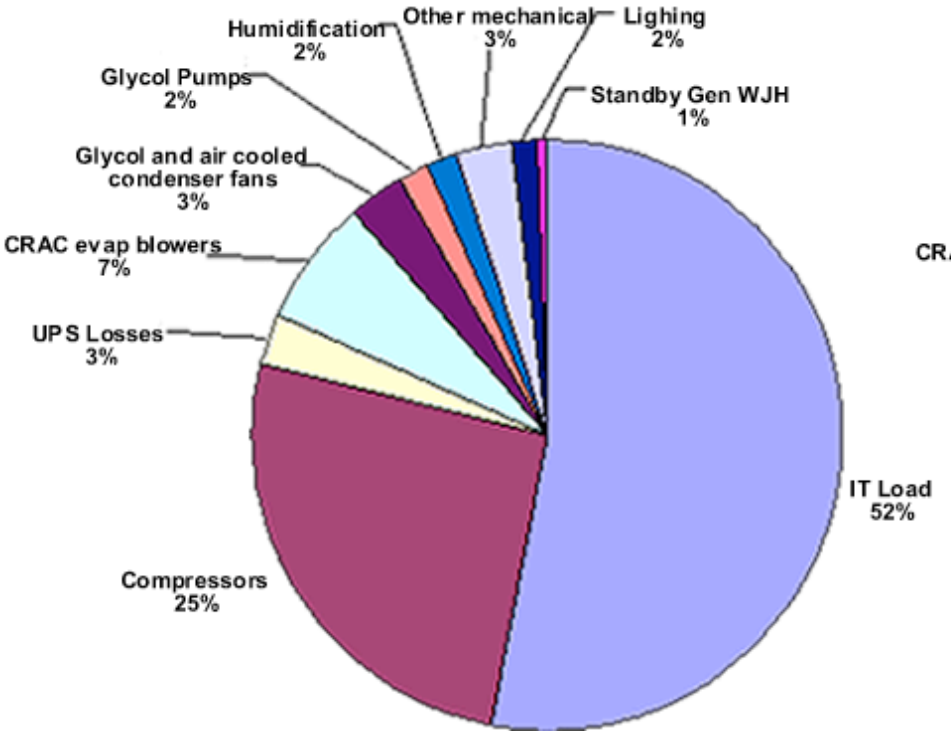

| PUE | DCiE | |
|---|---|---|
| 3.0 | 0.33 | Very Inefficient |
| 2.5 | 0.40 | Inefficient |
| 2.0 | 0.50 | Average |
| 1.5 | 0.67 | Efficient |
| 1.2 | 0.83 | Very Efficient |

Power Usage Effectiveness (PUE)

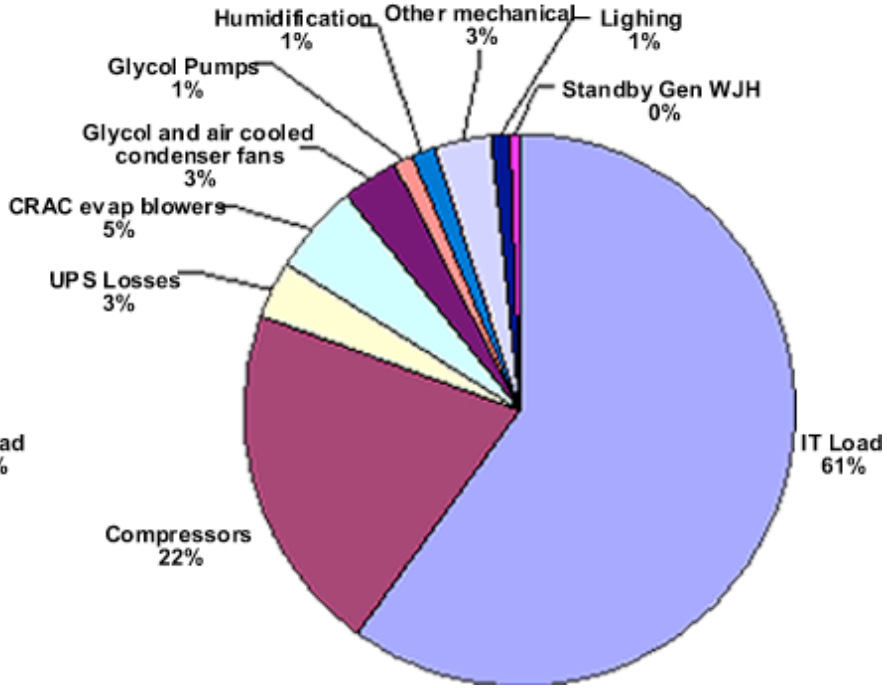
Data Center infrastructure Efficiency (DCiE)

# Improving Energy Utilization

Goal:  Reduce overall power, especially non-IT power




**Decent PUE/DCiE**



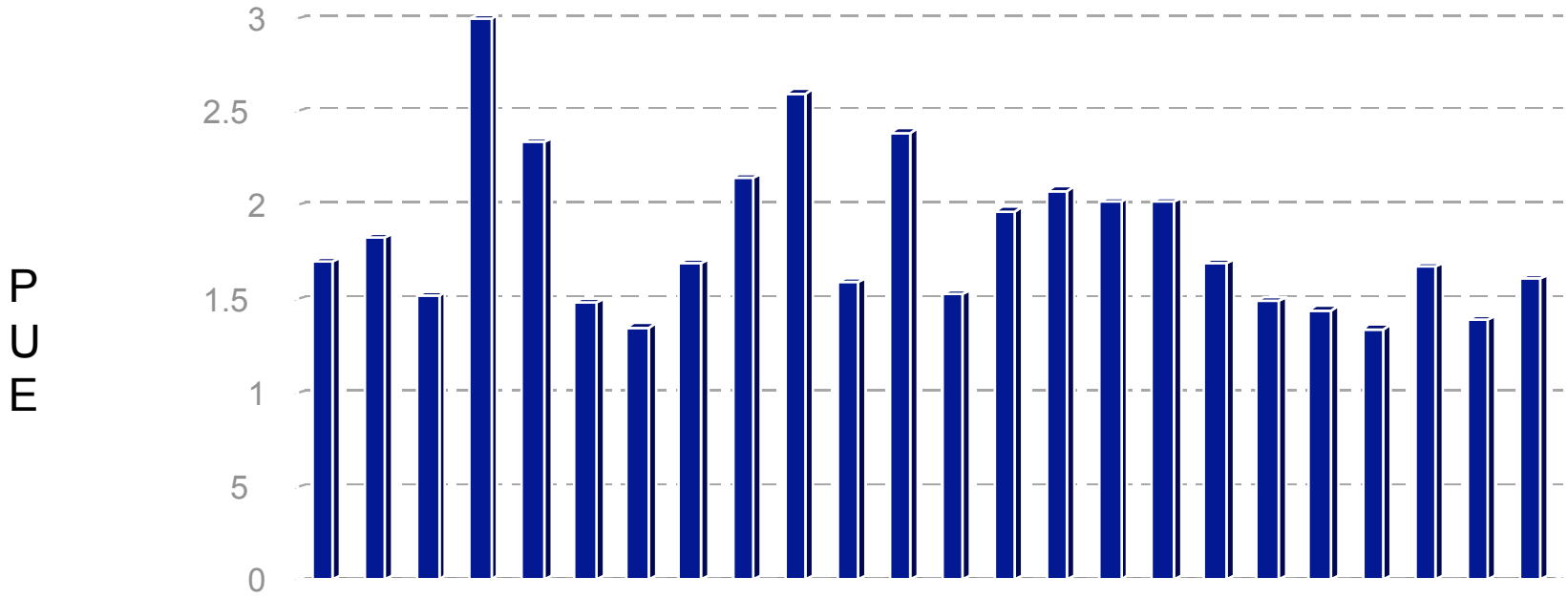

**Improved PUE/DCiE**

# Calculating PUE

- What to measure and how often?
- Importance of consistency
- How to measure
  - Manual readings of BMS, UPS, PDUs
  - Instrumentation
  - Real-time measurement & Real-time PUE
    - Wireless meters and sensors
    - Branch circuit monitoring
    - Power usage software

# Efficiency Benchmarking

- With funding from PG&E and others, Lawrence Berkeley National Laboratory conducted benchmark studies of 22 data centers:




  - Data Center energy Productivity (DCeP)
  - PUE controversies
    - “PUE Wars”, “PUE Marketing”, “PUE/DCiE vs. CADE”

# Systematic Approach to Improve Efficiency

- Perform Data Center Survey
- Research best practices & ROI
- Research potential rebates
- Get executive managerial buy-in
- Establish efficiency team & goals


- Determine methodology
- Install instrumentation & software
- Perform energy utilization audit
- Calculate current benchmark

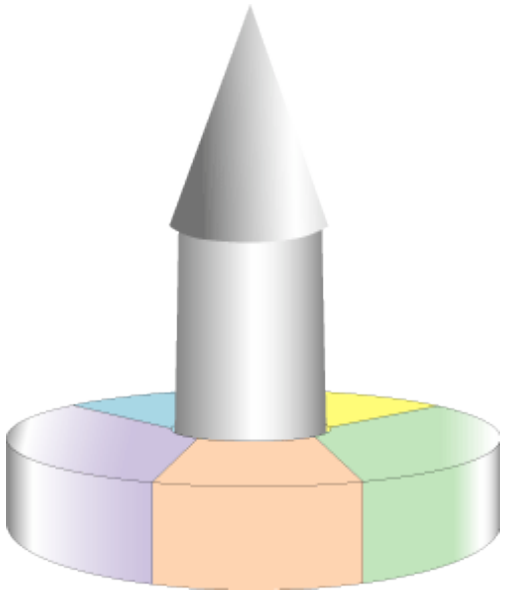
- Data Collection
- Environmental Monitoring
- Analysis

Log and Report:
- Facilities Data
- Infrastructure Data
- IT Equipment Data
- Environmental Conditions
- Design and any limitations

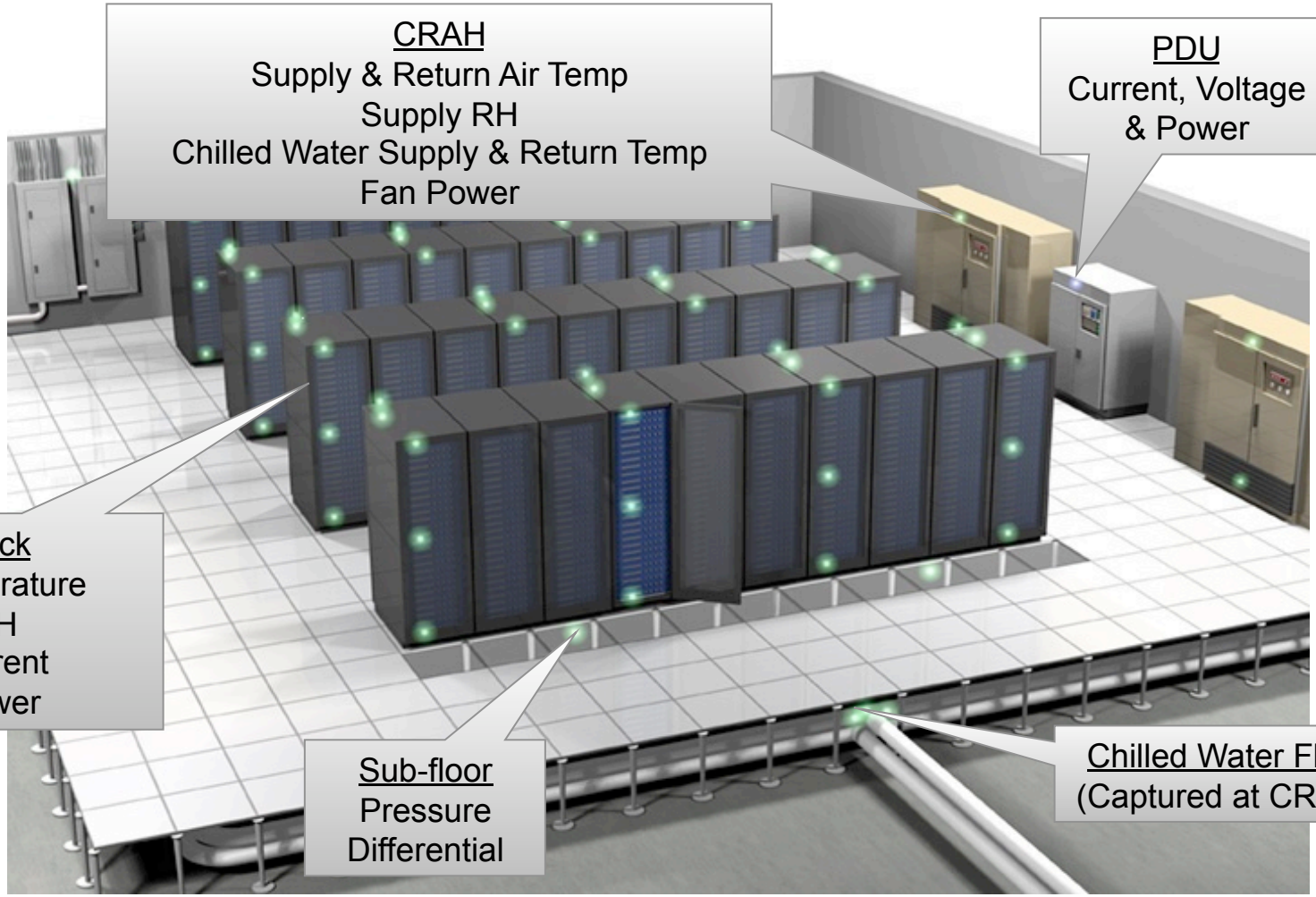
- Develop Action Plan
- Set Goal for Benchmark
- Implement improvements
- Update Benchmark
- Communicate

# Low-cost/No-cost Best Practices

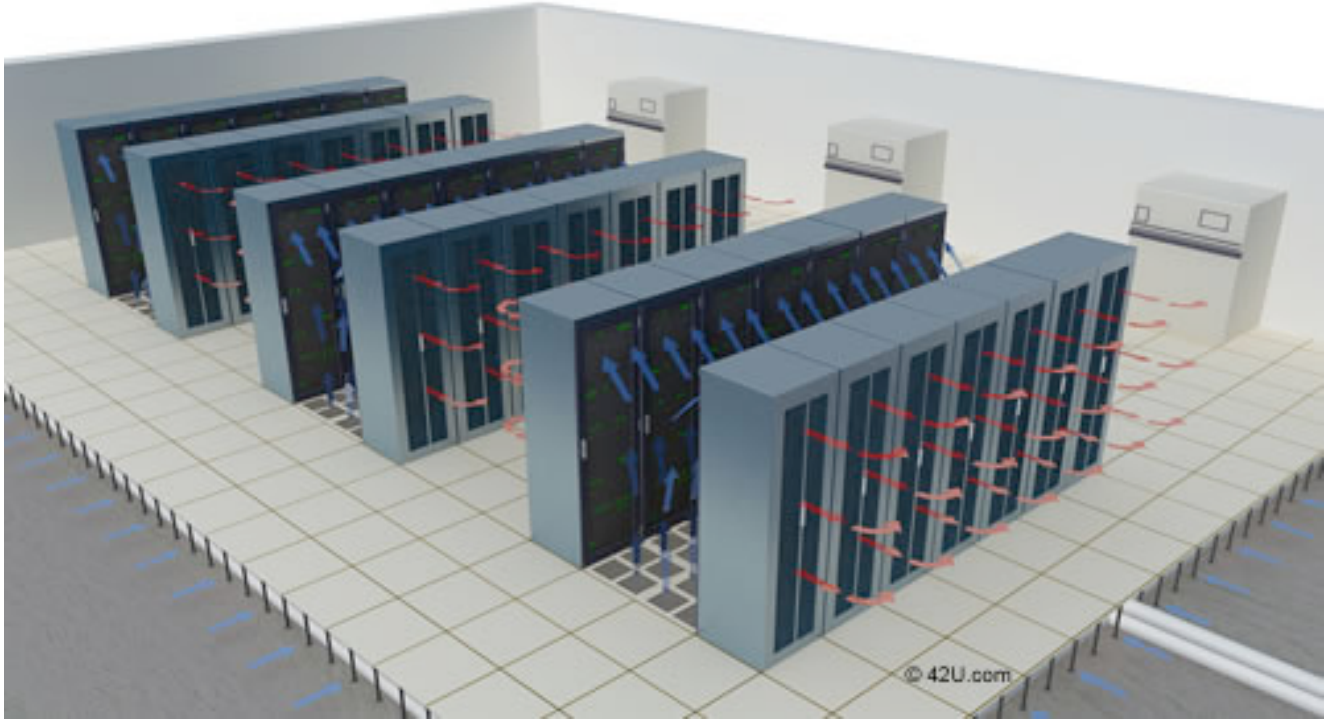
- Basic Airflow Management
  - Tune Hot Aisles/Cold Aisles
  - Seal Floor leaks
  - Tile arrangement
  - Cable obstructions
  - Close rack openings
- Reduce excess cooling
- Retire unused servers
  - Eliminate unused IT equipment



# Measure Environmental Conditions

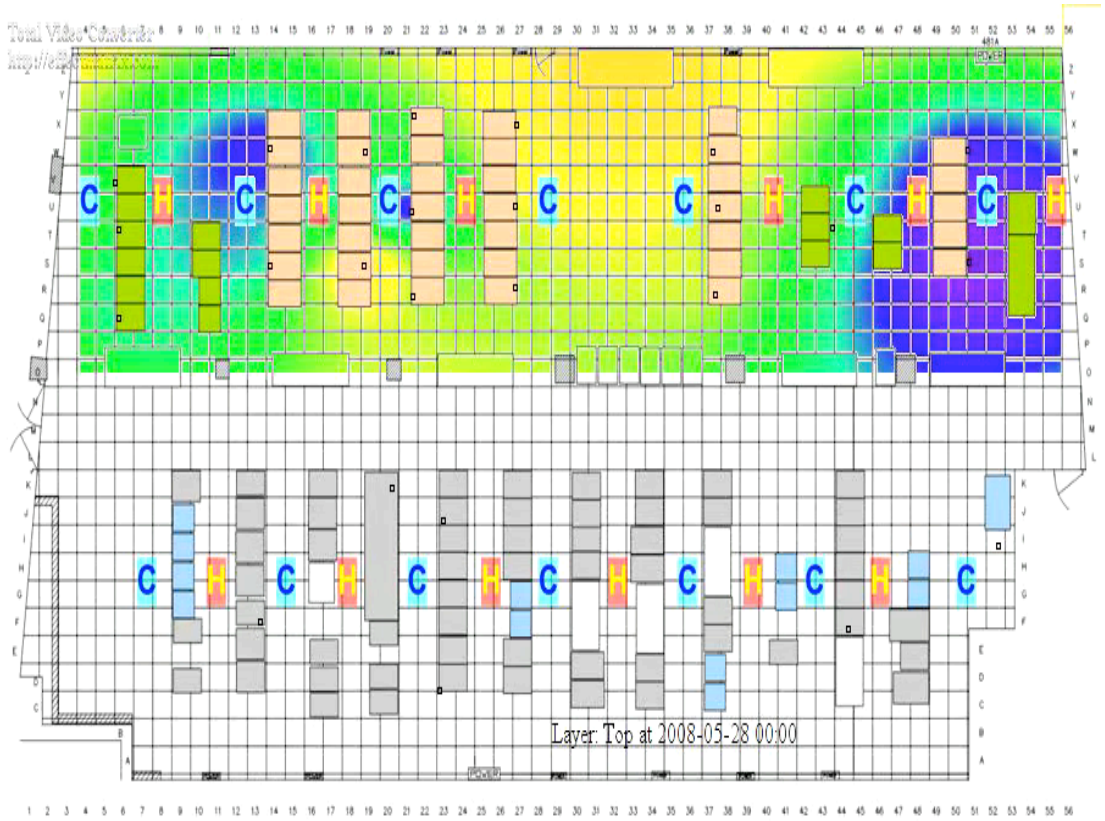


# Hot Aisles / Cold Aisles

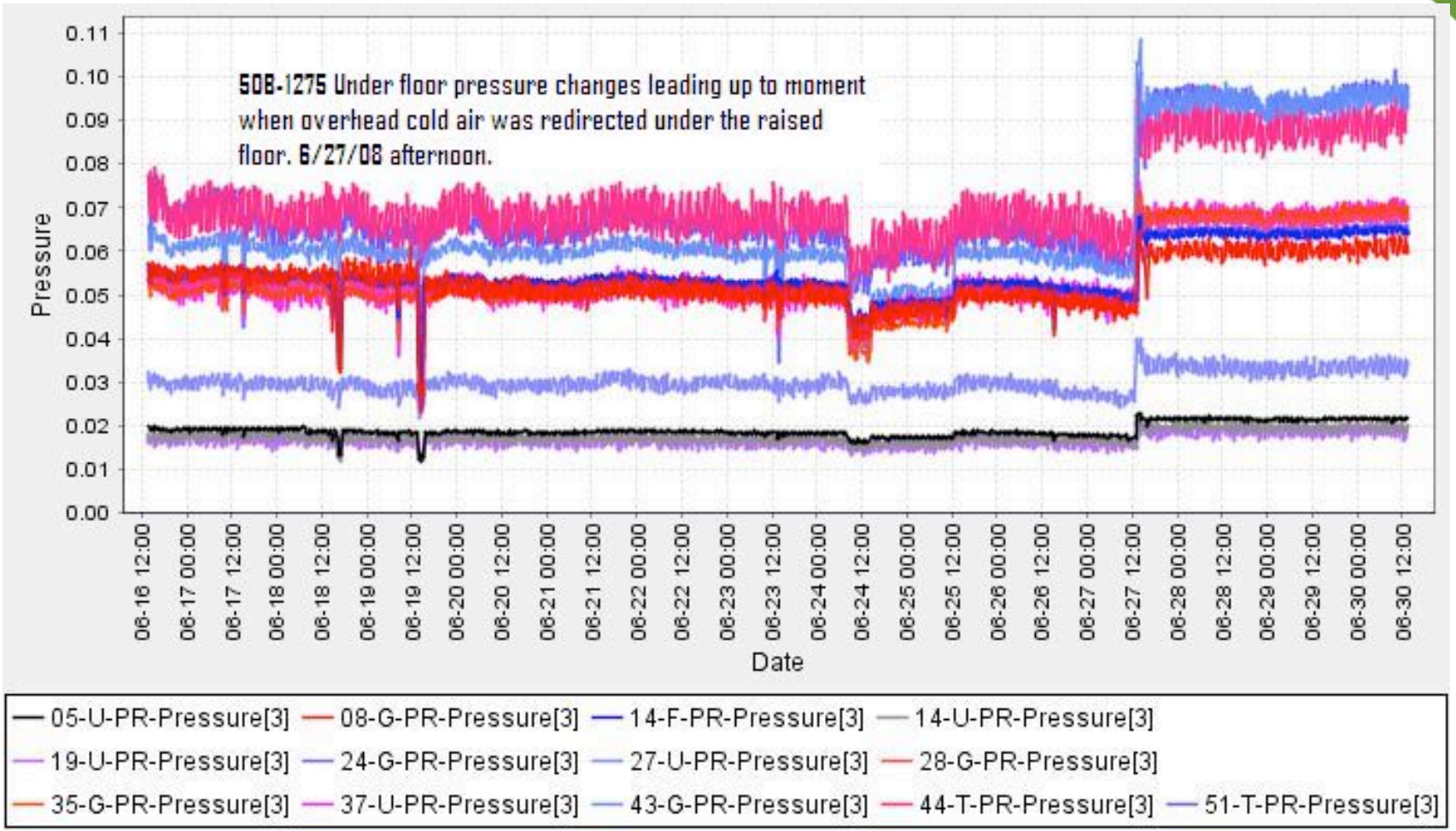



- Cold Air directed to cold aisles
- Hot Air exhausted from hot aisles
- Bypass Airflow / Air Mixing should be monitored and tuned
- Limit obstructions and seal openings within rows, floor, and racks

# Eliminate Excess Cooling



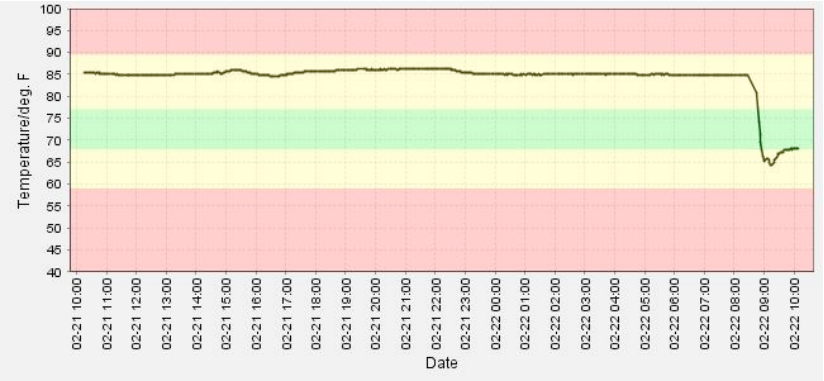
# Air Flow Tuning



# Rack-Level Air Flow Management

- Impact of a single blanking panel
- Consistent results for
  - Floor leaks
  - Tile arrangement
  - Cable obstructions

**Top of rack**




**Middle of rack**

# Refresh or Remove Unused IT Equipment

- Cascading effect of power consumption
  - 1 Watt saved at server = 2.84 Watts saved
    source=Emerson Network
- Retire unused servers
  - “up to 30% could be turned off”
    source=Ken Brill
- Eliminate unused or rarely used IT equipment
  - Examples: Monitors & old KVM switches

# Repeat Process

- Research best practices & ROI
- Research additional rebates
- Report on ROI & PUE successes
- Get executive managerial buy in

- Use consistent methodology
- Perform energy utilization audit
- Calculate new benchmark


- Data Collection
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- Develop Action Plan
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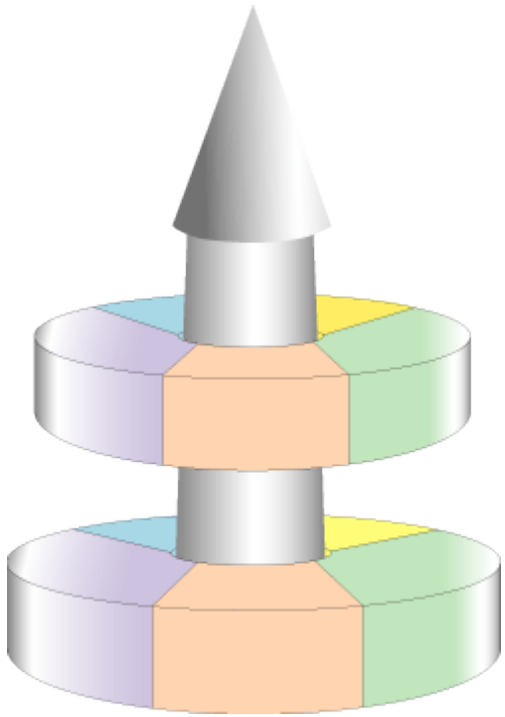
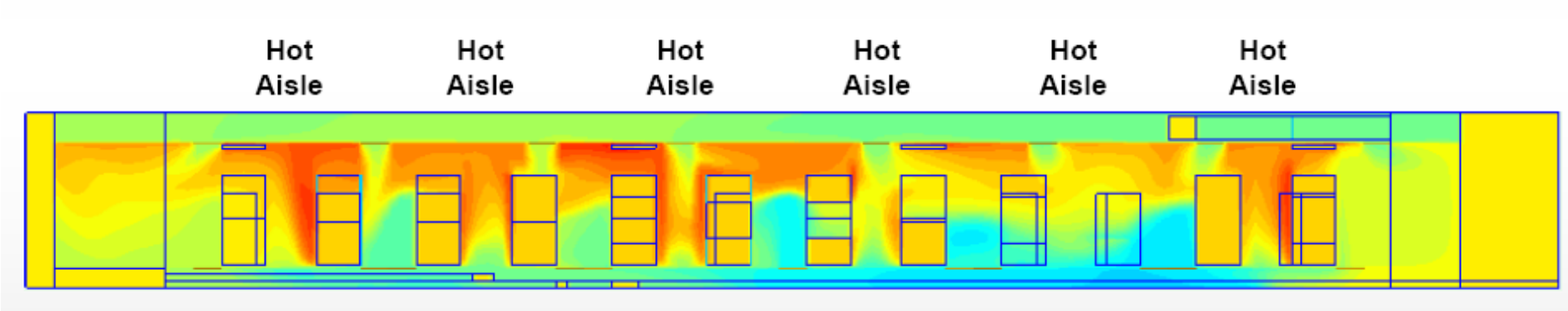
- Update Logs & Reports
- Document previous efforts
- Record successes

# Implement Additional Best Practices

- Cold Aisle Containment
- Hot Aisle Containment
- In-Rack Cooling
- Consolidate Servers
- Virtualization
- Analyze TCO when buying new equipment



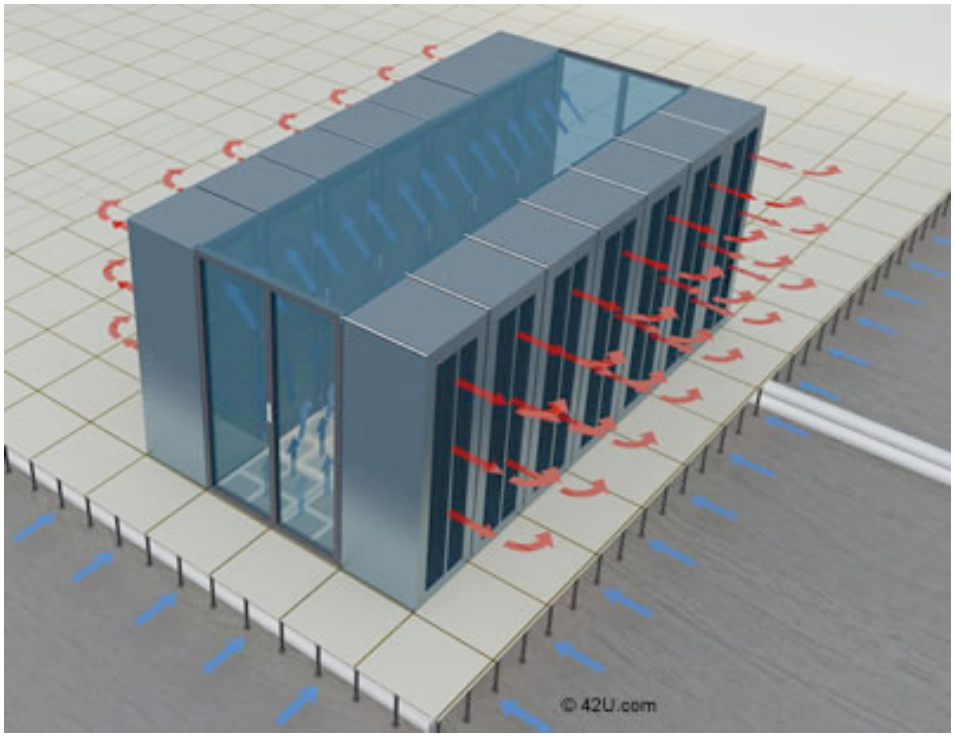
# Improve Air Flow Management




Air flow issues:

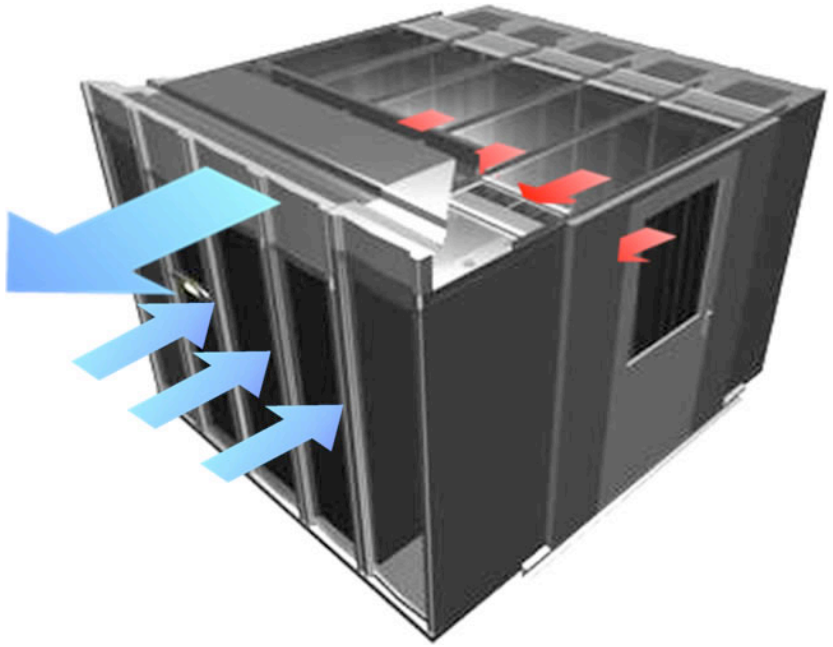
- Hot spots
  - Potential server downtime
- Cooling systems need to work harder than necessary
  - Excess power consumption
  - Additional energy costs

# Cold Aisle Containment



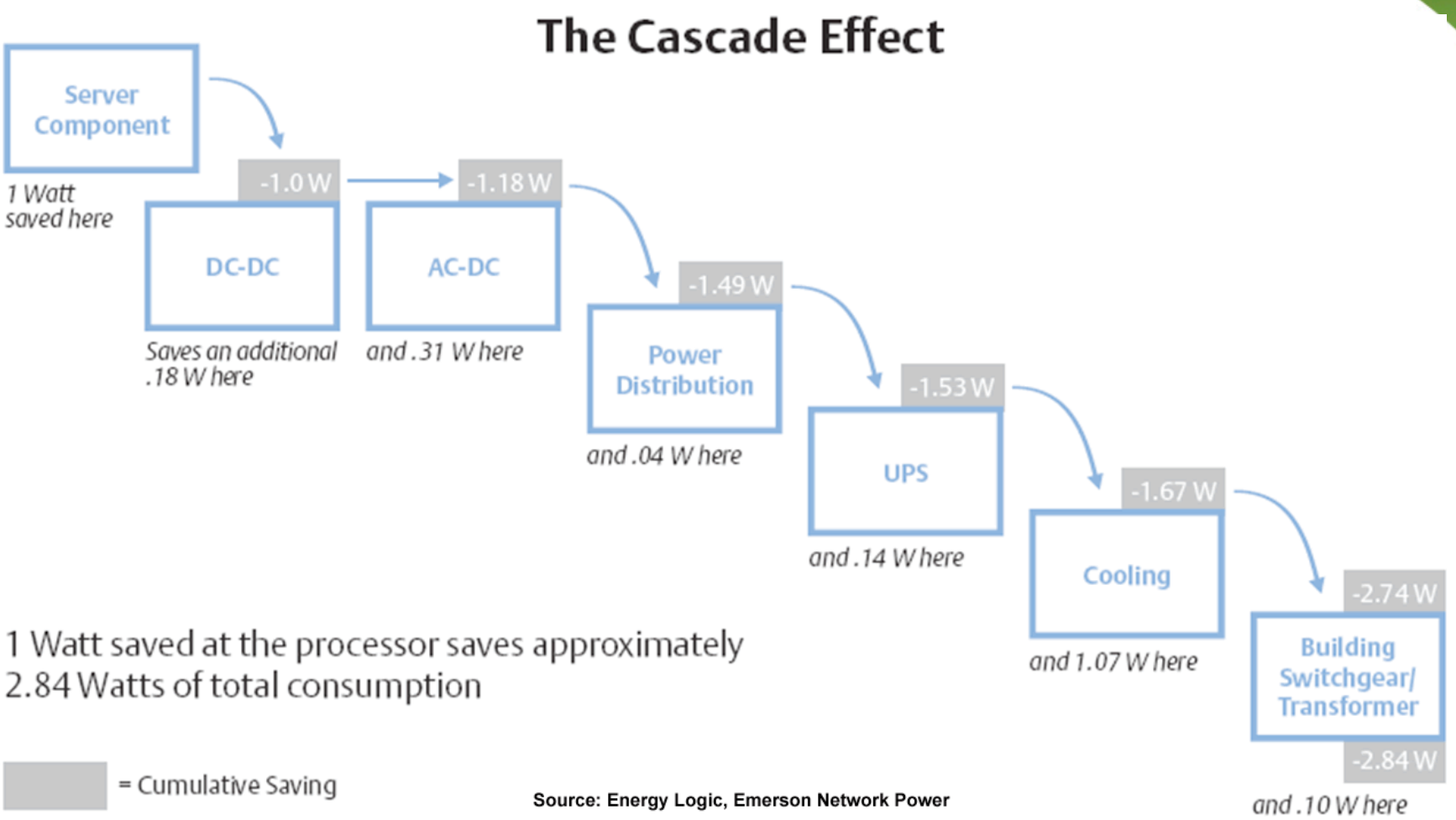

- Cold Air directed where needed
- No need to reconfigure existing rack layout, unless use In-Row cooling
- Relatively inexpensive and easy to install
- Care needed with Fire Suppression systems & change to Air Pressure
- CAC with VFDs can reduce fan energy use by 75% (source = LBNL)

# Hot Aisle Containment



- Hot air exhausted from data center or cooled with In-Row cooling
- Prevents exhaust air from mixing with cool air
- Can operate on raised or non-raised floors
- Some layout reconfiguration for existing facilities
- More expensive than CAC and more work with ducting and installation

# Importance of Consolidation & IT Efficiency



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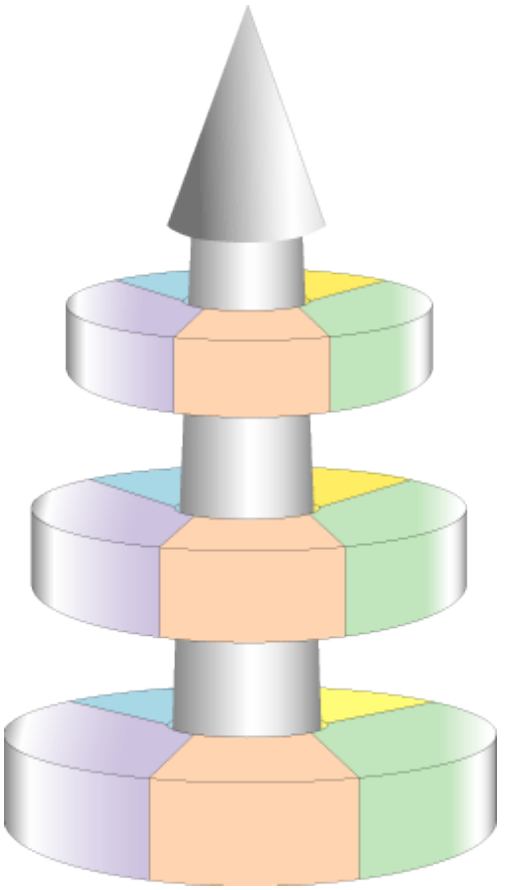
# Consider other Efficiency Practices

- Air-side Economizers
- Water-side Economizers
- Raising Supply Temperatures
- Close-Coupled Liquid Cooling
- Data Center Thermal Zones
- Data Center Containers/Pods



# Economizers

- Air-side Economizers
  - Free Air – save energy by using outside air
  - Hot air vented directly outside
  - Can be effective 24/7
  - Consider Humidity & Air Quality / Contamination
  - Free Cooling Map
- Water-side Economizers
  - No air contamination issues
  - Minimal impact on data center space

# Close-Coupled Cooling


- Bringing the heat transfer closer to the load
- Immediate hot air capture, better heat exchange across the cooling coil- improved operational efficiency of AC unit
- Cooling the load instead of cooling the room- less energy required to move air to the intended load and return it
- Water Cooling is 3500 times more effective than air

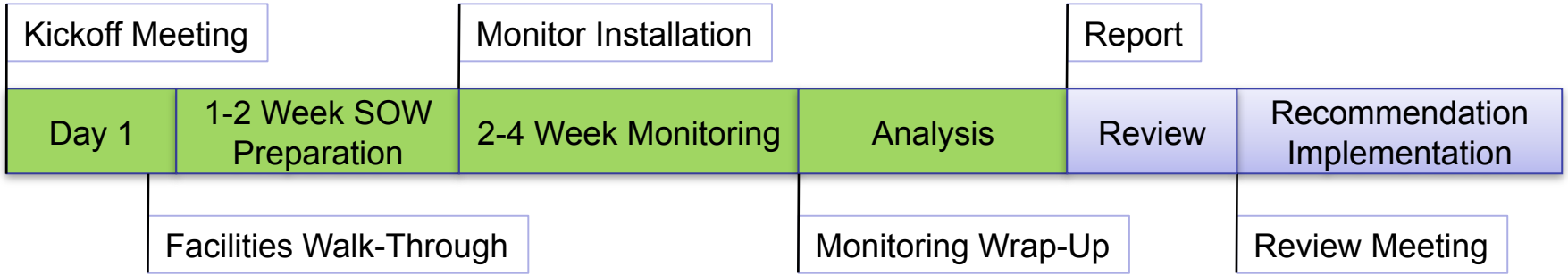
# Data Center Containers / Pods



- Rapid deployment - pre-engineered, pre-fabricated
  - No energy intensive construction projects
- Reduces waste of packing material, and CO2 needed to transport those servers from point A to point B
- Right-Sizing of Real Estate
- Right-Sizing of Cooling

# Engagement Life Cycle Example

- Engagement Design
- Begin Measurements
  - Debrief On On-Going Process
- Collected Data Available
- Analysis and Report Generation
- Deliver Findings & Recommendations
- Implement Recommendations
- Measure & Improve
- Repeat process

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