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Efficient Infrastructure for Data Centers

Better Buildings by Design Conference

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Learning Objectives

- At the end of this program, participants will be able to
  - Retain knowledge of current HVAC design considerations.
  - Acknowledge how to ensure proper space-cooling and circulation, scalability/modularity of systems for future growth.
  - Distinguish right sizing of HVAC equipment to serve IT equipment heating needs.
  - Listen to the latest innovations in HVAC technologies for data center applications.

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Agenda

- Data Center Industry Overview
- Why is Efficiency Important?
- Drivers of Inefficiency
- What you can do
- Q & A

Data Center Industry

- **Data Centers – Industry News & Trends**
  - US Congress – Public Law 109-431
  - Environmental Protection Agency Report
    - Current Growth Statistics
      - 2003 – Present – Energy use doubled
      - 2006 – 61 billion kWh, approx $4.5 billion
        - Similar to electricity consumed by 5.8 million households
        - Peak Load = 7 GW, equivalent to output of 15 baseload power plants
        - Federal Government – 6 billion kWh, approx $450 million

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Data Center Industry

- **Data Centers – Industry News & Trends**
  Environmental Protection Agency Report
  - Growth Projections
    - By 2011 – Consumption to surpass 100 billion kWh
      - Represents $7.4 billion in electrical costs
      - Peak Load = 12 GW – would require an additional 10 power plants

Data Center Industry

- **Progress is being made**
  - You are here
  - Standards are being developed
    - PUE
    - DCiE
  - Utilities are recognizing and providing incentives for energy efficient data centers

Why is Data Center Efficiency Important?

- Corporate Priorities on Efficiency
  - "Go Green" Initiatives
  - Reduce Carbon Footprint
- Data Centers high kW per square foot

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Why is Data Center Efficiency Important?

OFFICE SPACE

Facility Size	45,000 sqft
Average Annual kWh per sqft	24.73
Average Annual utility bill per sqft	$3.15

DATA CENTER

Data Ctr size	1,400 sqft
Average Annual kWh per sqft	1,203.43
Average Annual utility bill per sqft	$134.74

4,575% more expensive

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Why is Data Center Efficiency Important?

- More than 50% of power going into a data center goes to power & cooling systems – NOT IT loads
  - The typical 1MW (IT load) data center is continuously wasting about 400kW or 2,000 tons of coal per year due to poor design
- Every kW saved in the data center saves about $1,000 per year
- Every kW saved in the data center reduces carbon dioxide emissions by 5 tons per year
- Every kW saved in a data center has a carbon reduction equivalent to eliminating about 1 car from the road
- A 1% improvement in data center infrastructure efficiency (DCiE) corresponds to approximately 2% reduction in electrical bills.

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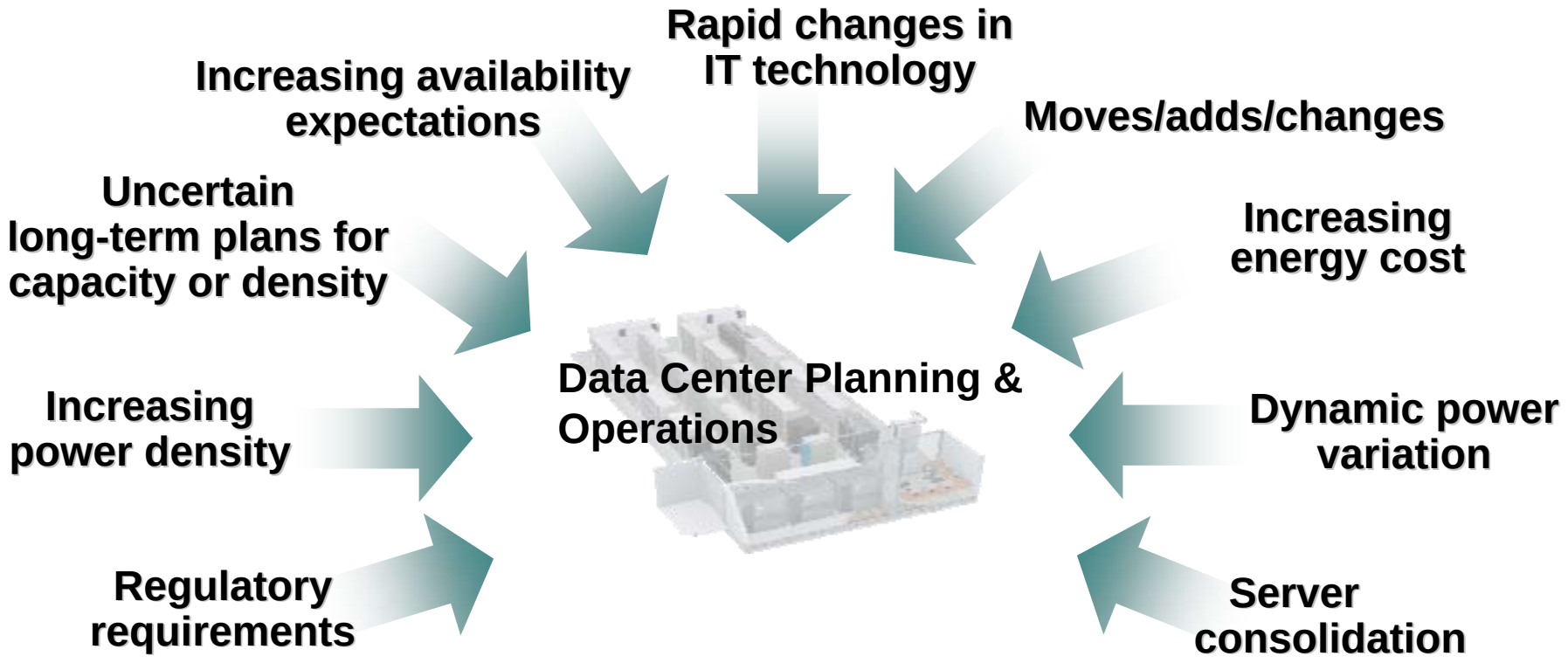
Most Data Center Pressures Affect Efficiency



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Drivers of Inefficiency

- Oversizing of power and cooling equipment
  - Redundancy in “big boxes”
- Ineffective Rack/Row orientations
- Lack of Airflow Management
- Reactionary additions of cooling
- Humidification

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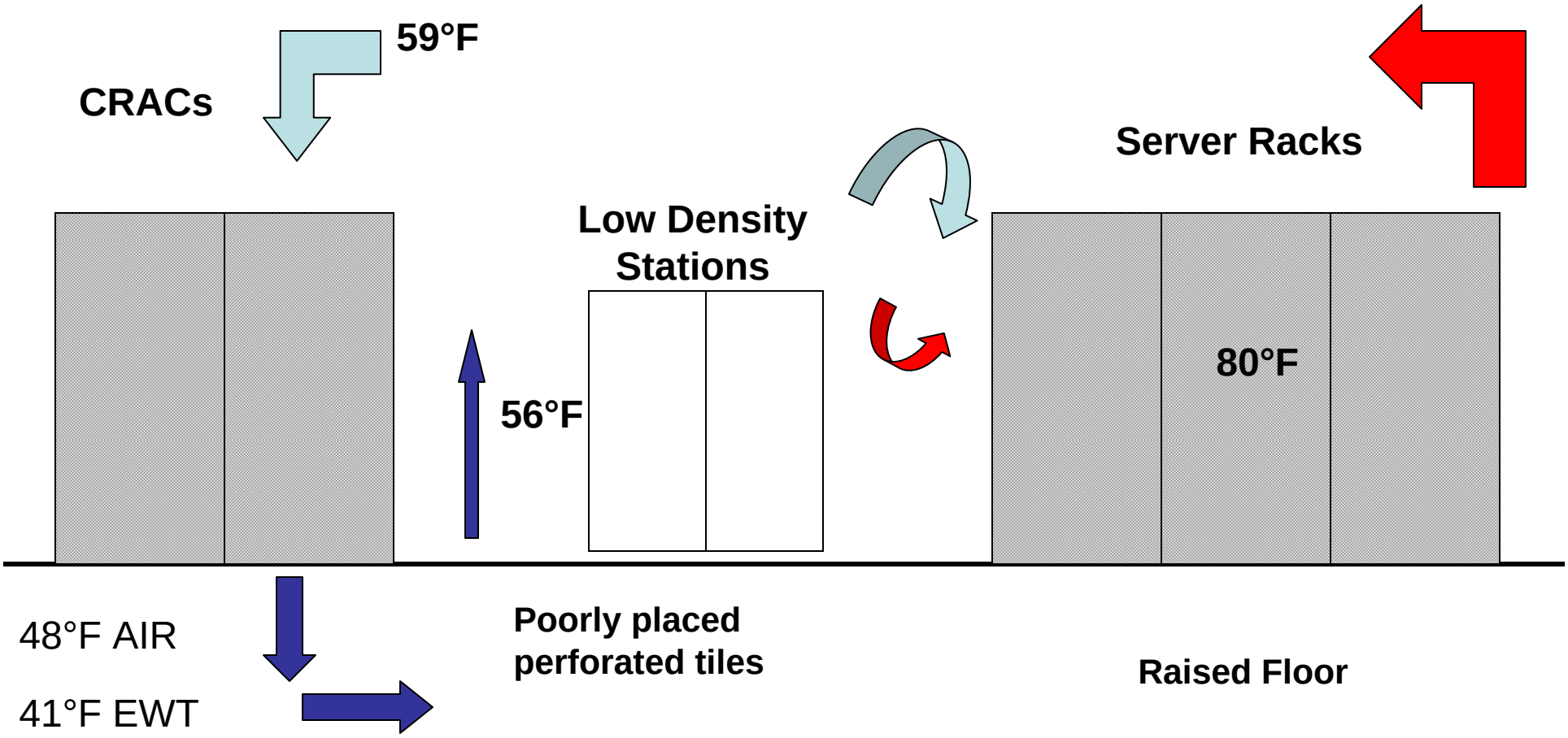
Drivers of Inefficiency

- Legacy Design Overview
  - Design assumptions
    - Watts per square foot
  - Oversized Power and Cooling
  - Redundancy in “big boxes”
  - Room based cooling
  - Multiple standalone systems

Drivers of Inefficiency

- Education
  - What is a “30 ton” unit
  - Hot Aisle should be hot
  - Reactionary additions of cooling
  - Opening windows, turning on fans
- Airflow Management
  - Rack/Row Orientation



Drivers of Inefficiency

- Humidification
  - Extremely energy intensive
  - Dehumidifying – requires cooling and heating in the data center
  - Tight humidity bands in the Data Center
    - Not required by modern servers

Drivers of Inefficiency

- Humidification
  - Lack of recalibration
  - Growth and addition of CRACs
    - Initial load deployment sized for humidity load
  - Lack of central monitoring
    - Common to see 2 CRACs units sitting next to each other in opposite modes

What Can You Do?

- Step 1 – Be Realistic
- Step 2 – Understand What You Have
- Step 3 – Behavior & Education
- Step 4 – Airflow Management
- Step 5 – New Technologies

What Can You Do?

- Understand What You Have
  - IT Load Profile
    - Device Name
    - Make/Model
    - Run rate Load
      - Not nameplate rating

What Can You Do?

Rack Number #	Device Name	Make/Model	Rated input voltage	Rated input current	Load (watts)
1	KVM01	Avocent DSR2020	100 to 240 VAC		27
	VUS-GLLMS-02	HP Proliant DL380 G4	100 - 132 VAC, 200 -240 VAC	7.5 A (100 VAC), 3.8 A (200 VAC)	493
	VUS-GLLMS-03	HP Proliant DL380 G4	100 - 132 VAC, 200 -240 VAC	7.5 A (100 VAC), 3.8 A (200 VAC)	493
	VUS-GLSEC-01	HP Proliant DL380 G5	100 to 132 VAC, 200 to 240 VAC	10 A at 100 VAC 4.9 A at 200 VAC	644
	VUS-GLUSB-03	HP Proliant DL380 G5	100 to 132 VAC, 200 to 240 VAC	10 A at 100 VAC 4.9 A at 200 VAC	644

What Can You Do?

- Behavior & Education
  - Cooling Objectives
  - Want hot air to be hot
  - How to rack equipment
  - Blanking panels
  - Airflow patterns

What Can You Do?

- Airflow Management
  - Single best approach to improving efficiency
  - Neglecting airflow management reduces CRAC capacity by 50% or more
    - Raised floor leakage (broken tiles, cable openings)
    - Poorly placed overhead supplies & rack exhausts
    - Underfloor obstructions

What Can You Do?

- Airflow Management Goal – Eliminate Air Mixing
  - Remove hot air exhaust from equipment before mixing occurs
  - Hot Aisle Cold Aisle configuration

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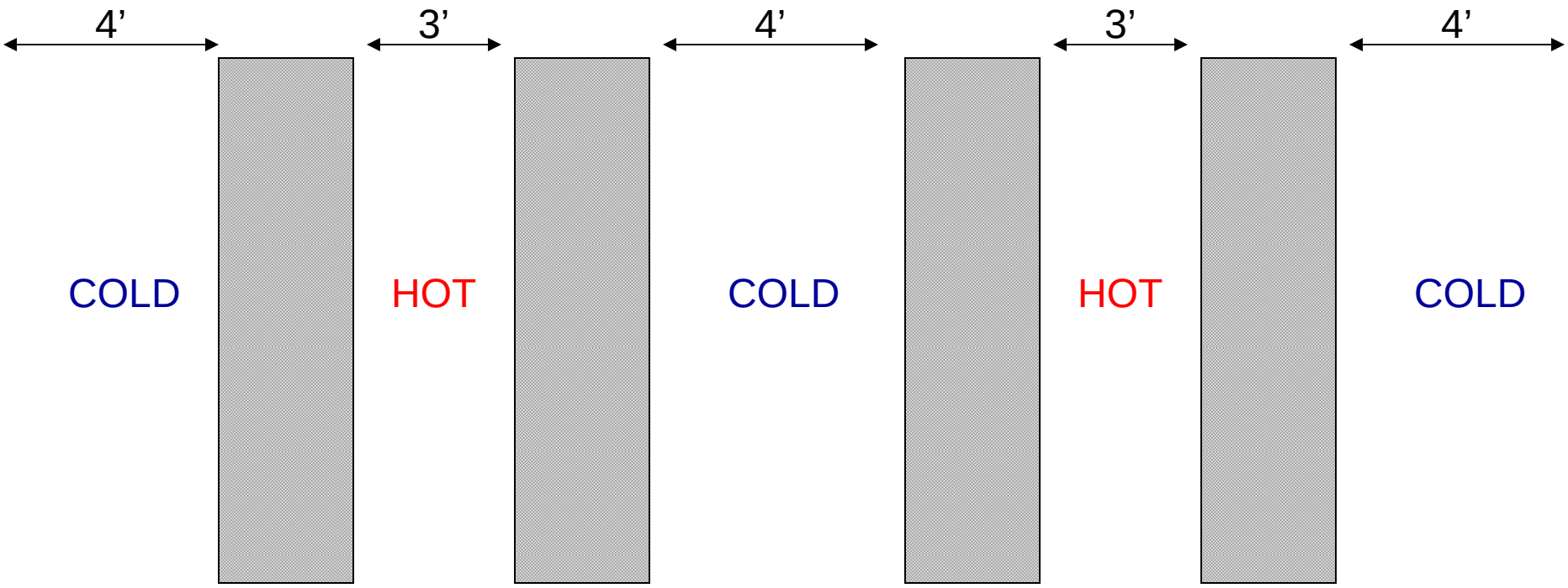
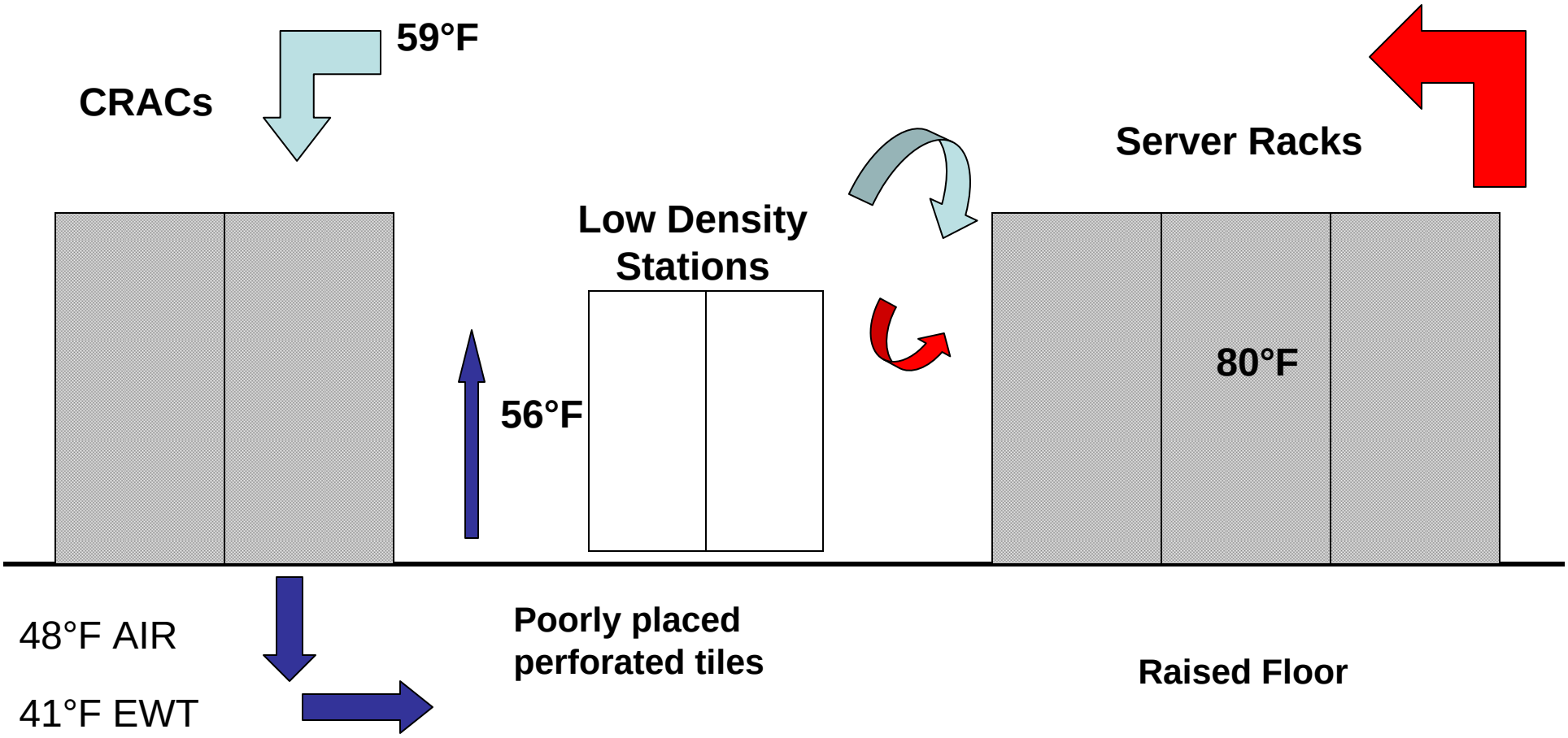
Hot Aisle Cold Aisle Configuration





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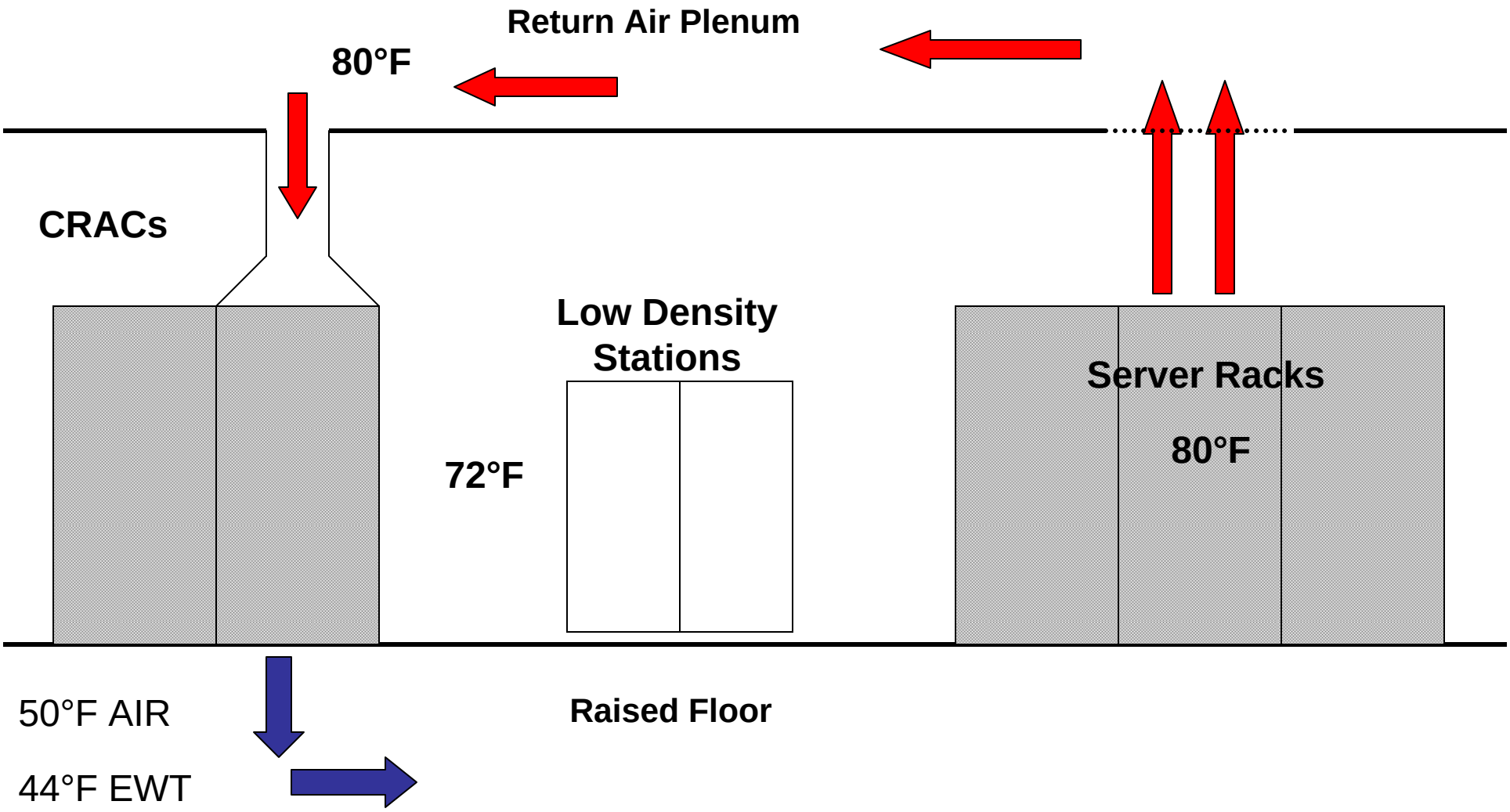
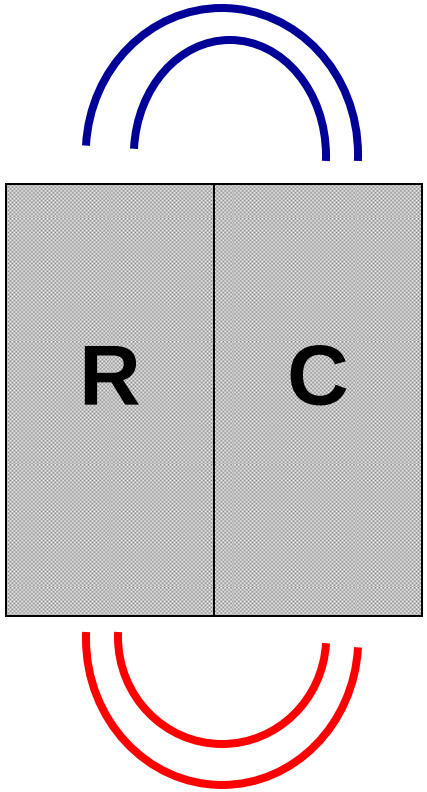


What Can You Do?

- New Technologies
  - Right Sizing
  - Segregate High Density/Low Density Loads
    - Containment
    - In Row Cooling

In Row “Close Coupled” Cooling



What Did We Learn

- Education is important
- Small changes – big difference
  - Supply/return locations
  - Blanking Panels
  - Hot/Cold Air segregation

What Did We Learn

- Efficiency Vermont can help
  - Efficiency audits
  - Rebates on products
  - Get them involved early

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Questions?

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