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# Efficient Infrastructure for Data Centers

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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



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# 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



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# 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



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# 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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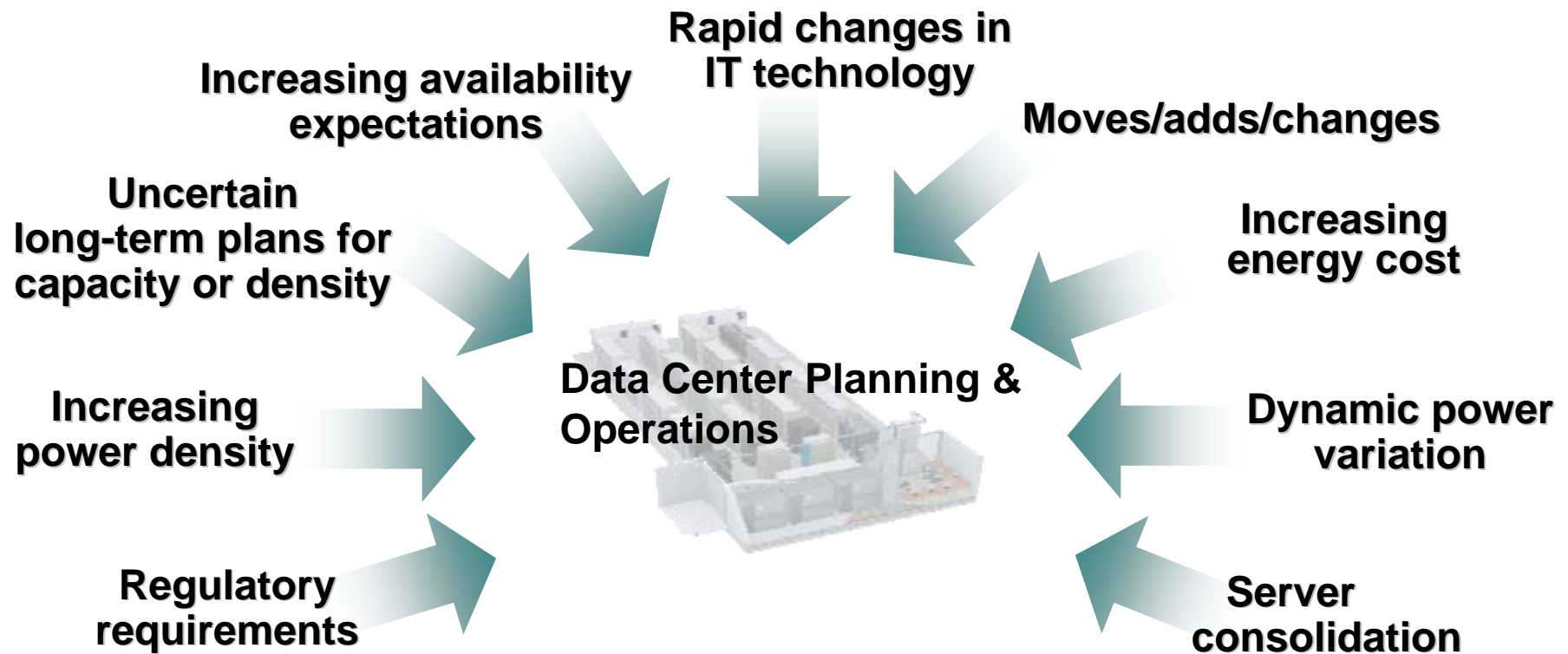
# Why is Data Center Efficiency Important?

- ▮ 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



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# Drivers of Inefficiency

## Education

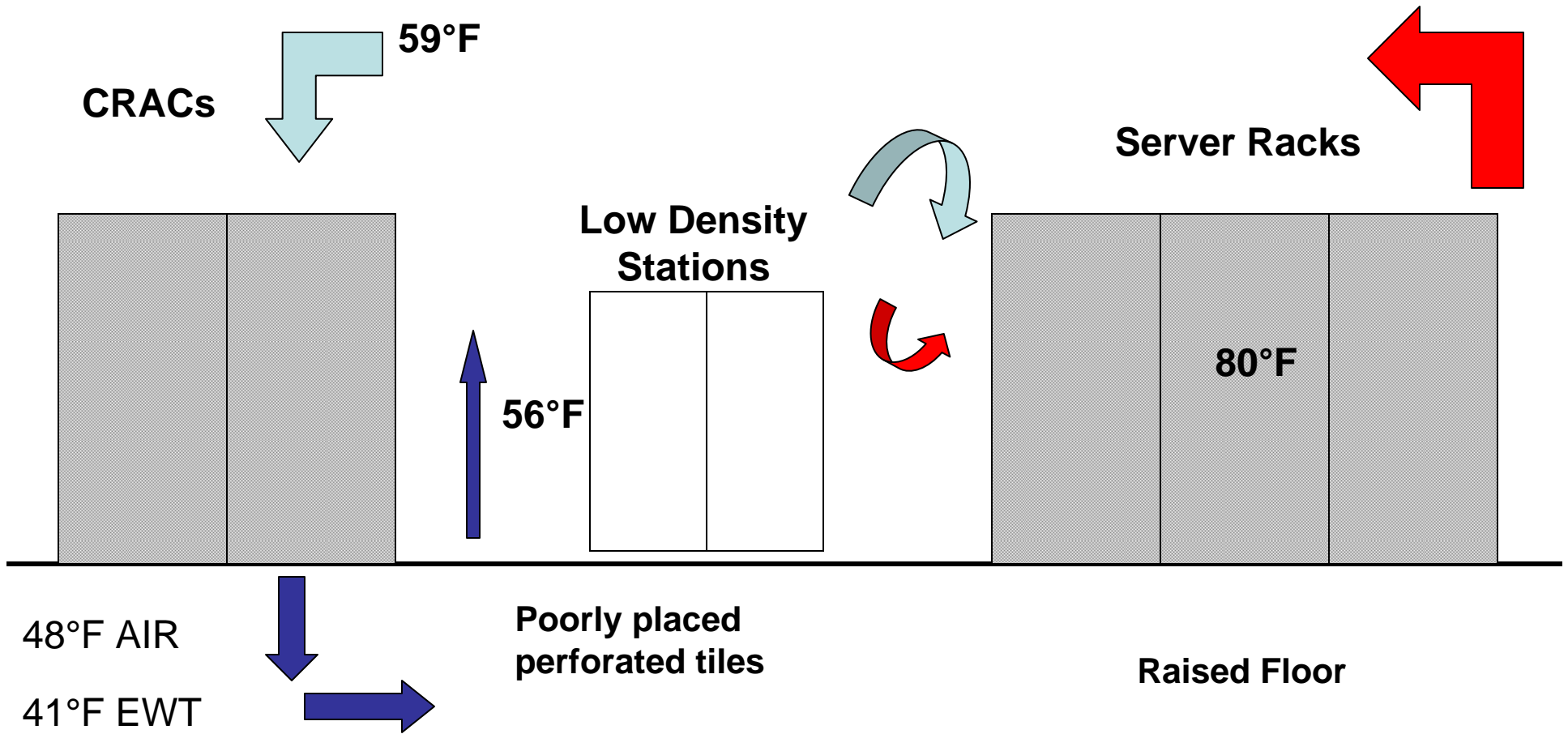
- What is a “30 ton” unit
- Hot Aisle should be hot
- Reactionary additions of cooling
- Opening windows, turning on fans

## Airflow Management

- Rack/Row Orientation



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# 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



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# 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



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# 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**



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# What Can You Do?

## ▮ Understand What You Have

### ▮ IT Load Profile

- ▮ Device Name

- ▮ Make/Model

- ▮ Run rate Load

- ▮ Not nameplate rating



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# 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



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# What Can You Do?

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



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# 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



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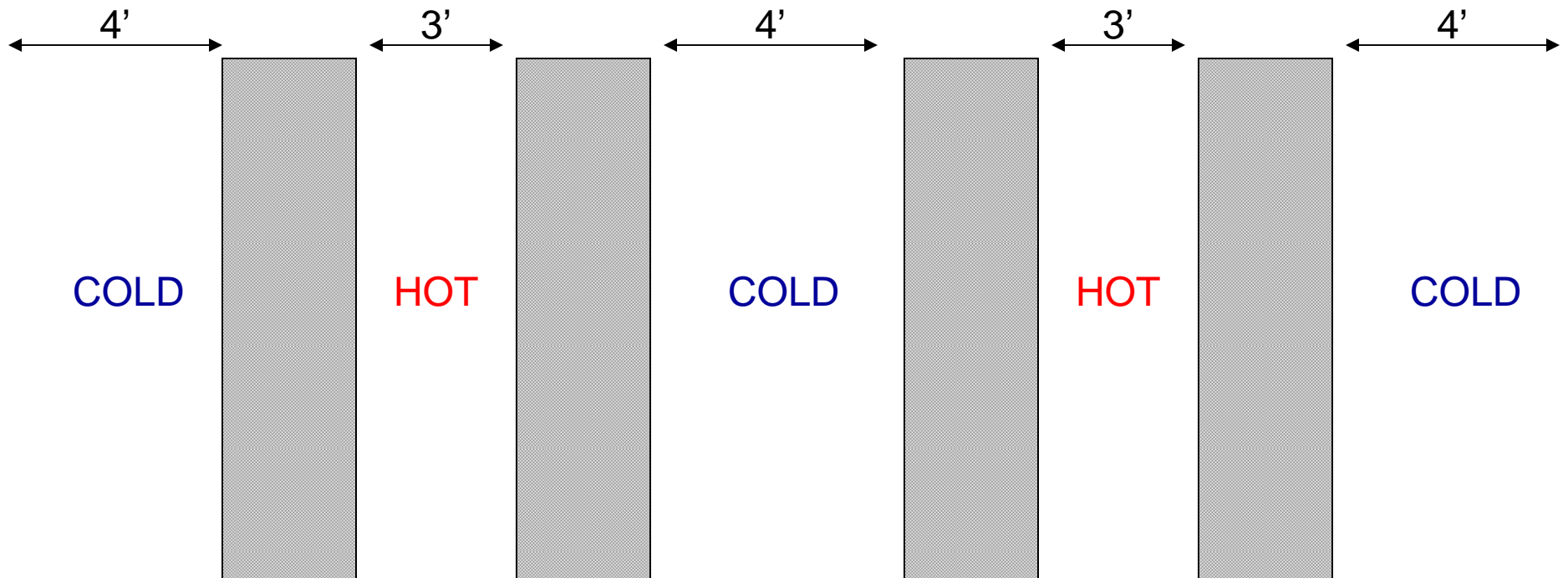
## What Can You Do?

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



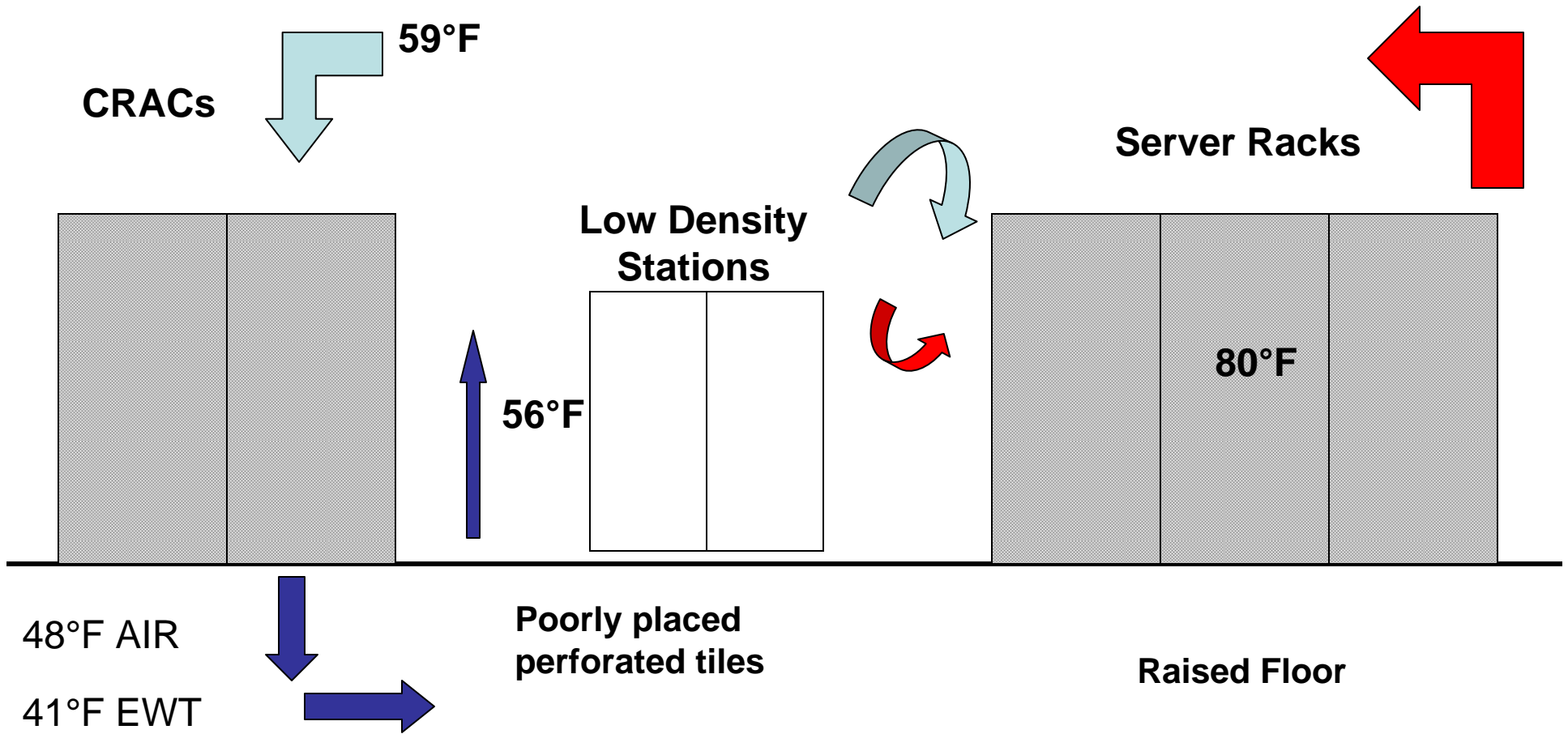
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# Hot Aisle Cold Aisle Configuration



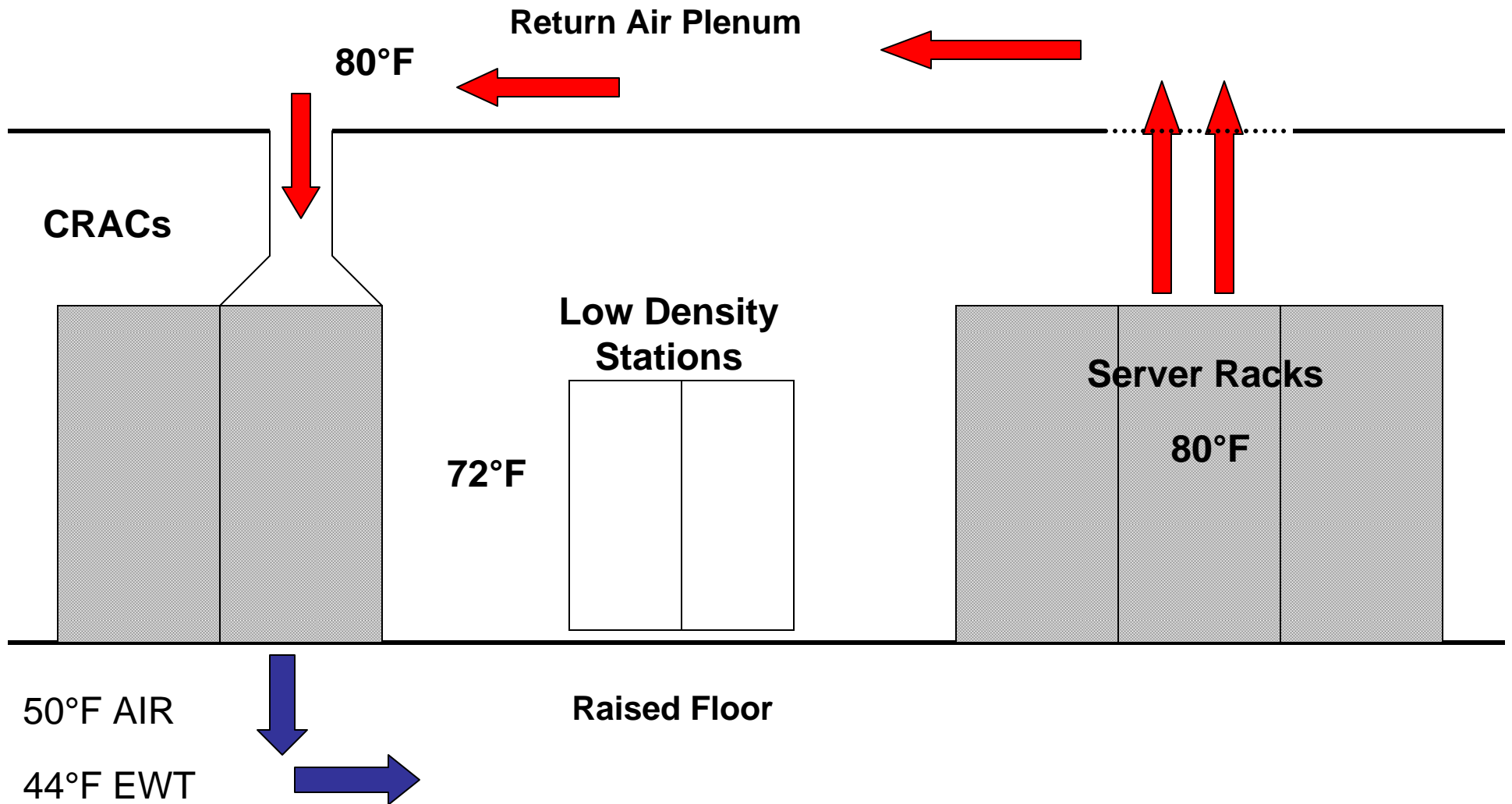


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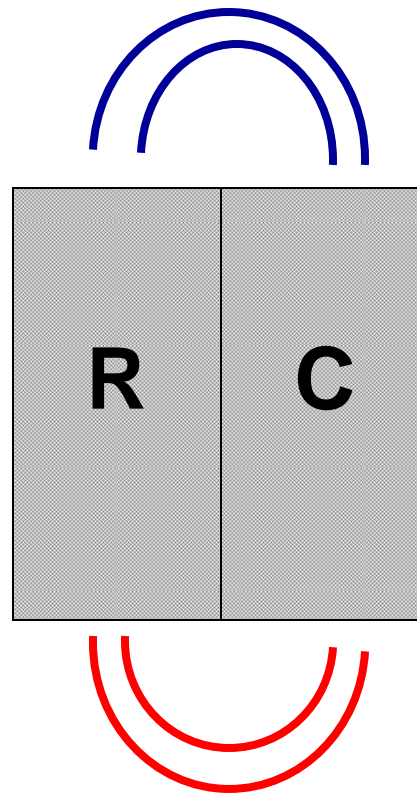
# What Can You Do?

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



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# In Row “Close Coupled” Cooling





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## What Did We Learn

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



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# 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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