Air Distribution and Efficiency through Air Turnover Systems

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Agenda

- Problem Statement
- Understanding Options
- Design Considerations
- Case Study

Manufacturing

- ~75 Million sqft of New annually
- ~12 Billion sqft of Existing

Warehouses

- ~350 Million sqft of New annually
- ~15 Billion sqft of Existing

Only 15-20% of Existing Inventory Is Mechanically Cooled Today

Role of Healthy Environments



TEMPERATURE



AIR QUALITY



EMPLOYEE COMFORT AND PRODUCTIVITY

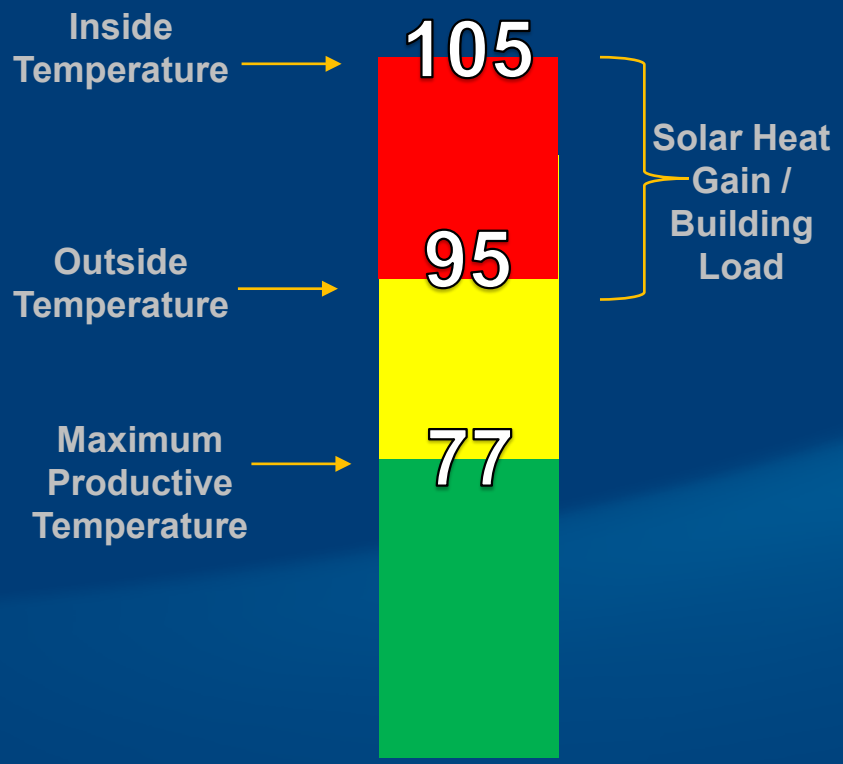
“Many building owners and business leaders underestimate the financial toll of poor temperature control in the workplace”

Heat Impact on Workers

Impact	Cost to Company
Lost Productivity	• Higher labor cost per unit • Lower output • Missed deadlines
Higher Absenteeism	• Overtime • Larger workforce
Higher Turnover	• Recruiting and training • Learning curve
Heat Related Illnesses	• Worker compensation claims



Heat Impact on Worker Productivity



Worker productivity decreases by 1% for every degree above 77° F

ASHRAE Journal – December 2018

Example:

Outside Temperature: 95° F

Inside Temperature: 105° F

Productivity Loss: 1% * (105 – 77) = ***28%***

Heat Increases Turnover — and Each Departure Is Costly

Rising indoor temperatures drive absenteeism, safety incidents, and quits

Cost per employee turnover

Typical range: 3–6 months of salary

Covers recruiting, screening, onboarding, and ramp-to-productivity
Includes supervisor time, overtime/backfill, quality loss, and safety drift
Back-of-napkin: salary × 0.25–0.50 (≈ 3–6 months)
Example: $60,000 salary → ~$15,000–$30,000 per departure

Tip: Quantify impact by combining your monthly quit rate with salary band and replacing/ramp timelines.

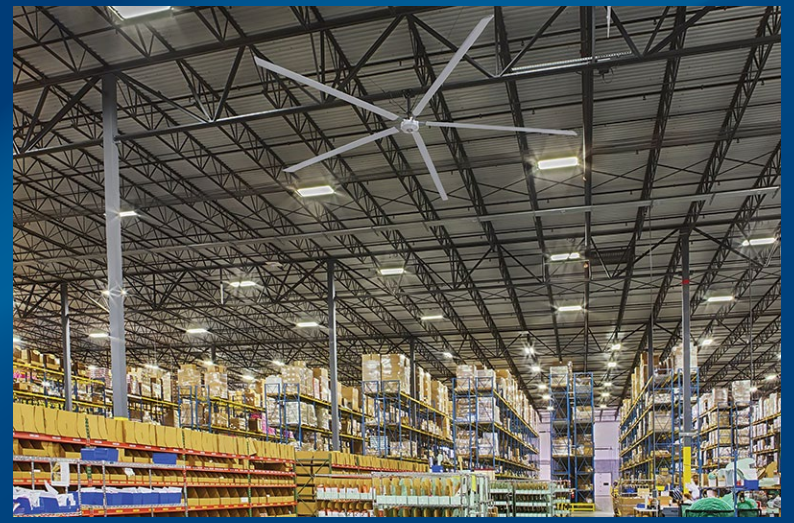
Common Cooling Options for High Bay Spaces

Untempered Ventilation/Exhaust/Air Movement

Evaporative Cooling

Ducted Mechanical Cooling Systems

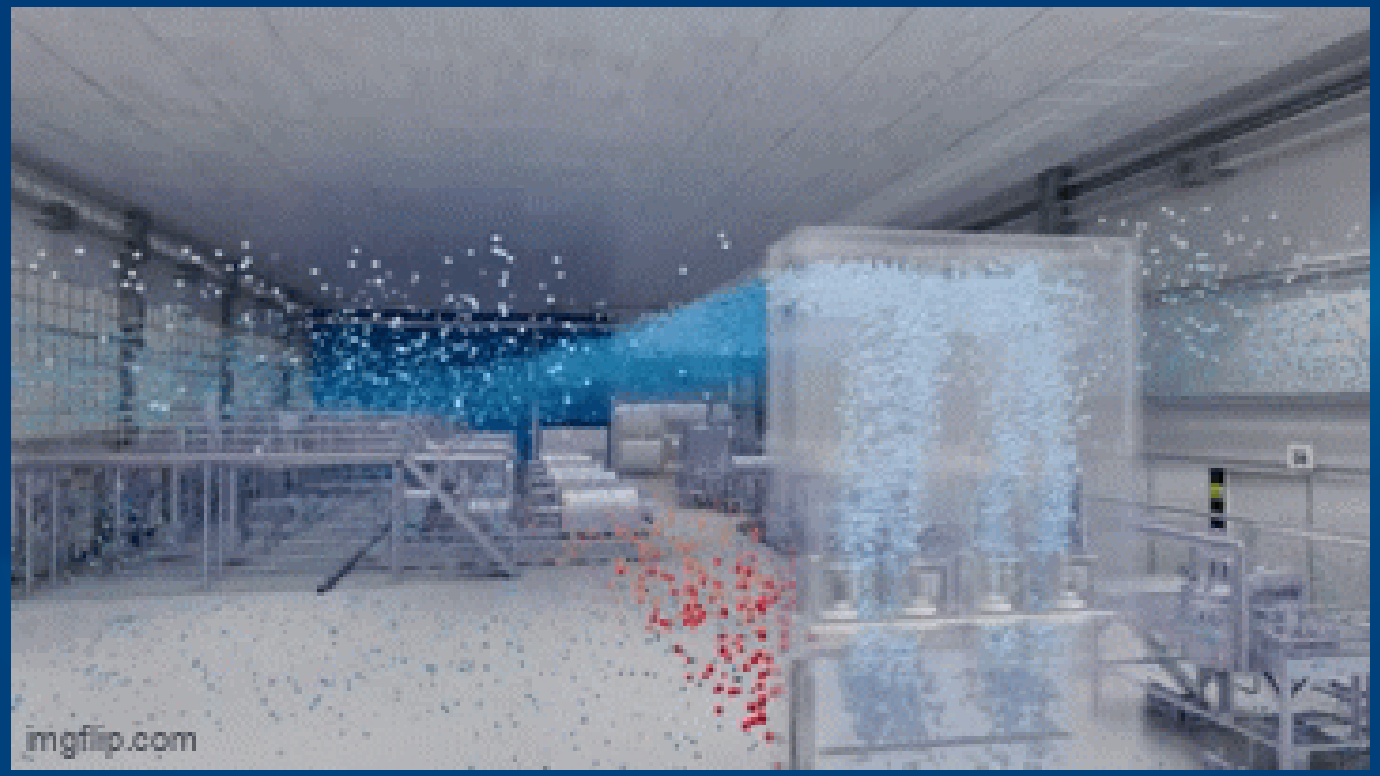
Air Turnover Unit Systems







Air Turnover Units



- Vertical Non-ducted Air Handling Unit
- Floor Mounted with Adjustable Height to Throw Over Racks & Machinery
- Match to DX Condensing Units or Chilled Water System

Air Turnover Unit

Strengths

- **Simpler Installation**
- **Fewer Units**
- **No Ductwork**
- **Ground Mounted**
    - No Crane/Helicopter
    - No Roof Structure Modification
    - Ground Level Service

Struggles

- **Poor fit for partitioned or low-rise spaces**
- **Less flexibility if space changes**
- **Higher equipment cost**
- **Requires ground level footprint**
- **Requires system integration between Indoor and Outdoor unit**

Design Considerations

Determine Loads for the Space

Internal heat generation – Lighting, equipment (e.g., LP or electric fork trucks, conveyors), people

Envelope Load – Roof, walls, and slab

Infiltration – General infiltration through envelope and dock doors

- **Add seals to dock doors**
- **Avoid unnecessary ventilation and exhaust**

Determine Cooling Source

Direct Expansion

Chilled Water



Determine Heating Source

- Heat Pump
- Hot Water
- Gas Fired
- Decoupled source of heat



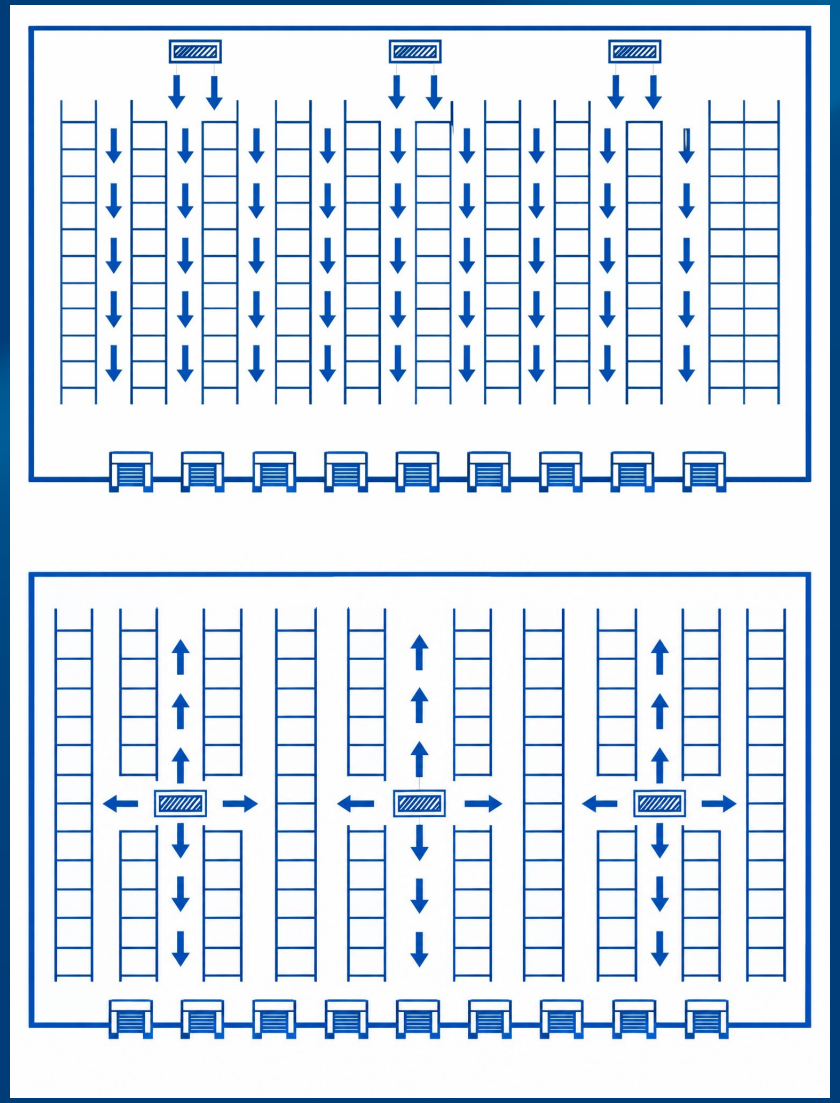
Mounting Location Options

Place unit along exterior wall

- Reduced impact to usable sq ft
- Allows for outdoor mounting and OA
- Limits unit size

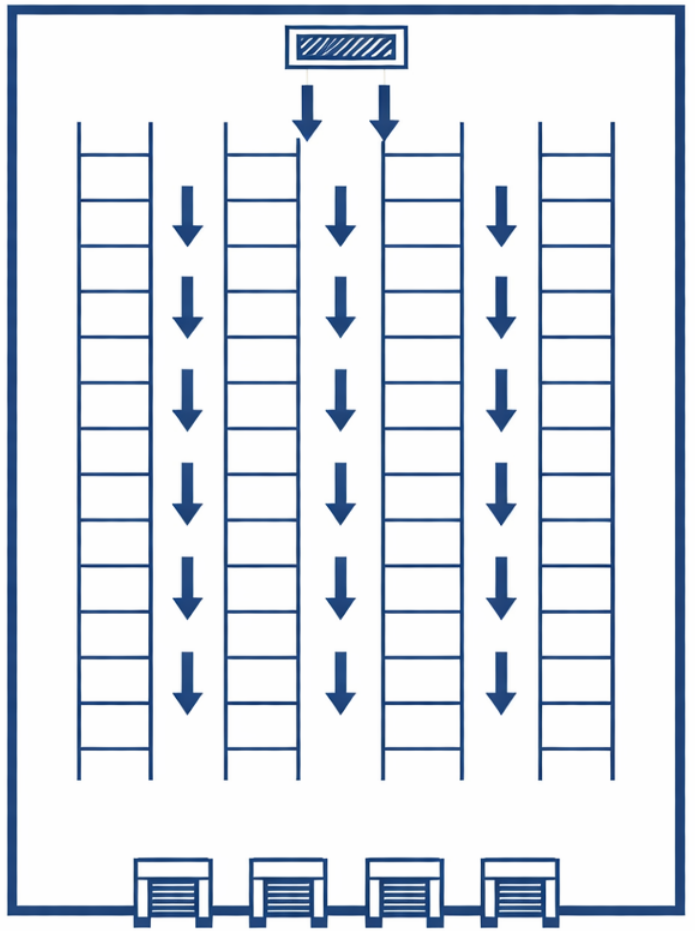
Place units centrally

- Increased impact to usable sq ft
- Indoor mounting only with no OA
- Allows for larger units



Unit Placement and Airflow Considerations

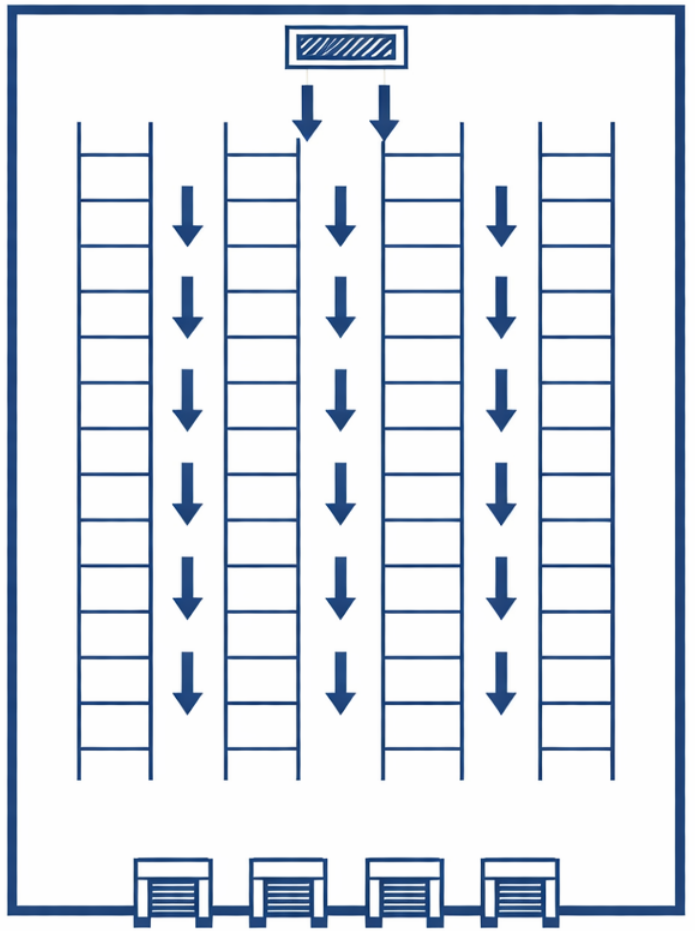
- Match unit size & qty to cooling load
- Ensure selected units can distribute air effectively
- Understand actual application needs
- Single units serve up to 100,000+ sq ft
- Increase discharge height above obstructions



Controls

- Generally constant volume fans
- Simple control by RA temperature for basic applications
- More complex control possible when required

(Humidification, Dehumidification, Remote Sensors)



Retrofit Case Study

Cooling Retrofit Case Study



BCI Packing
St Peters, MO

Installation & Design Optimization

80-Ton High Velocity ATO System

Floor-mounted; no structural roof work

Faster installation; less facility disruption

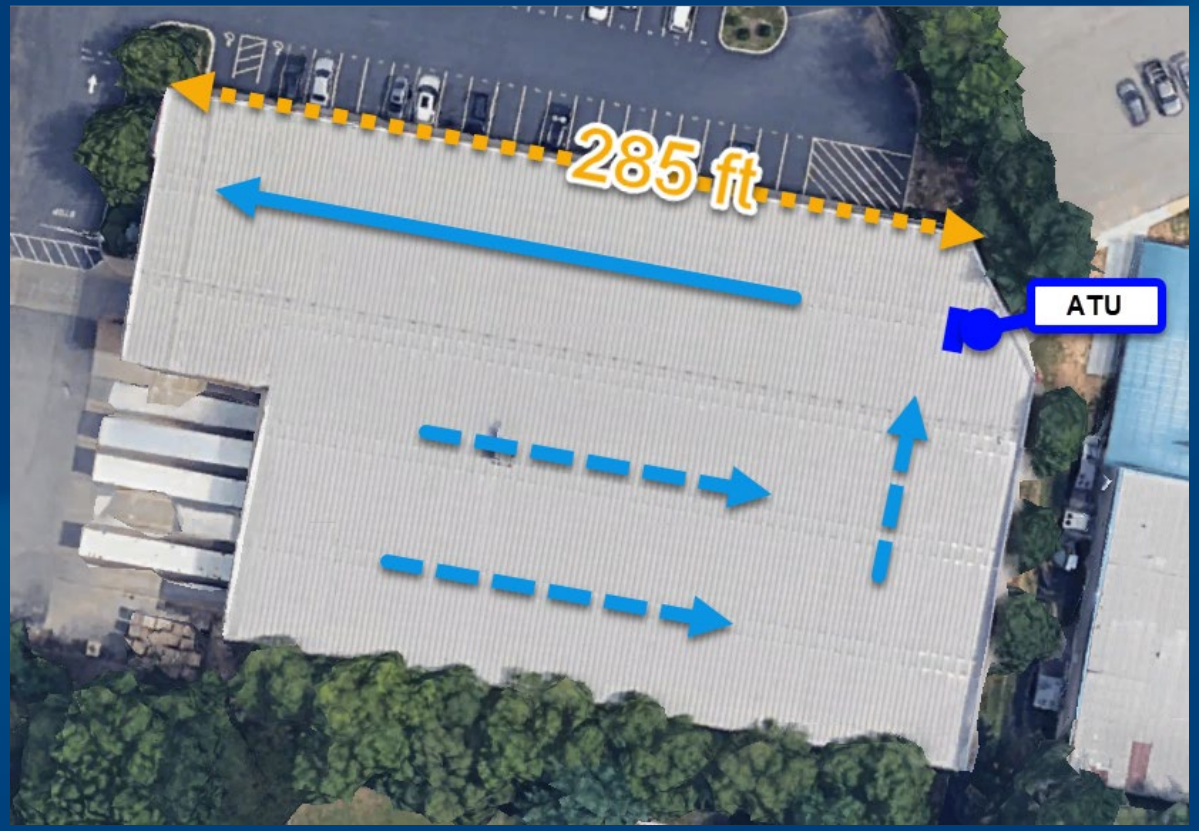
80 Tons of Packaged AC Units

Extensive ductwork required

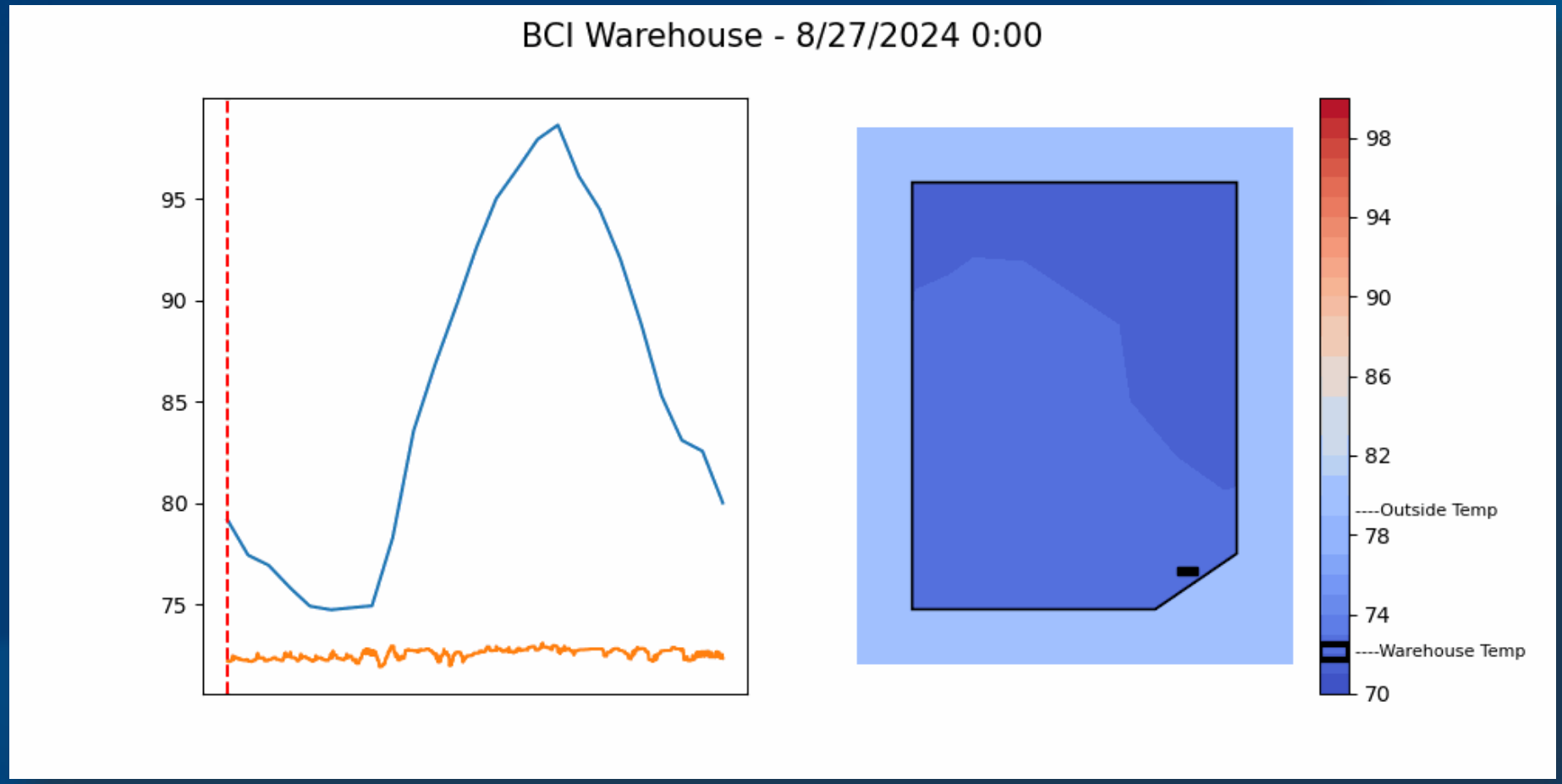
Structural modifications/roof work to support equipment

Longer installation timeline

Cooling Retrofit Case Study



BCI Packing
St Peters, MO


BCI Warehouse - 8/27/2024 0:00
95
90
85
80
75
98
94
90
86
82
----Outside Temp
78
74
----Warehouse Temp
70

Thank you