rzero

DRIVE ENERGY SAVINGS WITH

Occupancy-Based Demand Control Ventilation

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Executive summary

As commercial utility rates rise by an average of 4.0% per year, building owners and operators are seeking all opportunities to reduce costs while maintaining tenant satisfaction. Heating, Ventilation, and Air Conditioning (HVAC) systems account for ~40% of a commercial building's total energy use, making them a top operational cost driver.

Occupancy-Based Demand Control Ventilation (O-DCV) reduces energy waste by adjusting ventilation dynamically based on real-time occupancy trends across your building or entire portfolio. Drawing from years of customer utilization data, R-Zero discovered that average peak occupancy is about 51%, with significant variation by the minute, room, and floor - insights that help inform both energy strategy and leasing decisions.

Unlike running the HVAC on a fixed schedule, O-DCV uses real-time data to ensure ventilation is delivered exactly where and when it's needed. This dynamic control reduces HVAC energy use in unoccupied zones, cutting HVAC energy costs by up to 30%, while collecting the utilization insights needed for smarter portfolio planning.

In this whitepaper, we will explore:

- How O-DCV works and why it's an immediate cost-saving solution that's quick and easy to deploy
- Simple integration strategies that enable O-DCV adoption within your existing building infrastructure

Key Challenges

Modernizing commercial buildings

Managing commercial office buildings has become increasingly complex as shifting occupancy patterns expose the limitations of taking a static approach in today's dynamic operating environment.

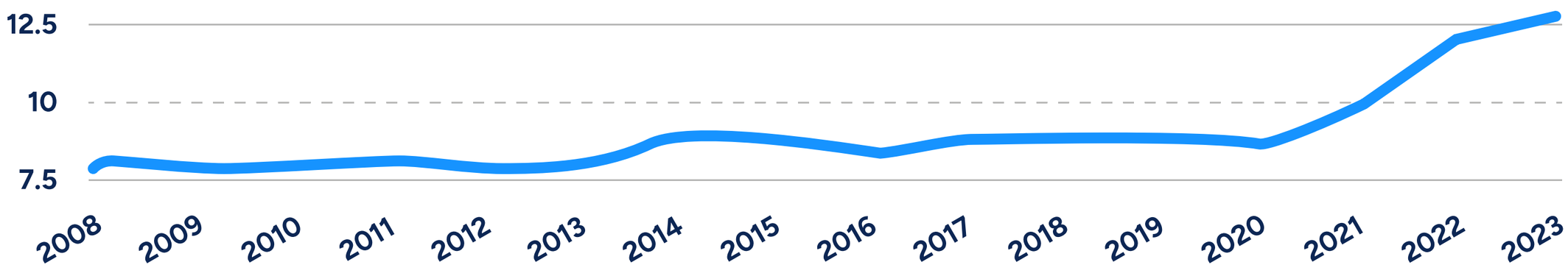
As a result, building owners and operators are finding themselves struggling to balance operational efficiency with tenant experience. Multiple factors contribute to making this challenge a moving target.

Utility costs are impacting OpEx

Average Commercial Electricity Price

U.S. cents per kWh

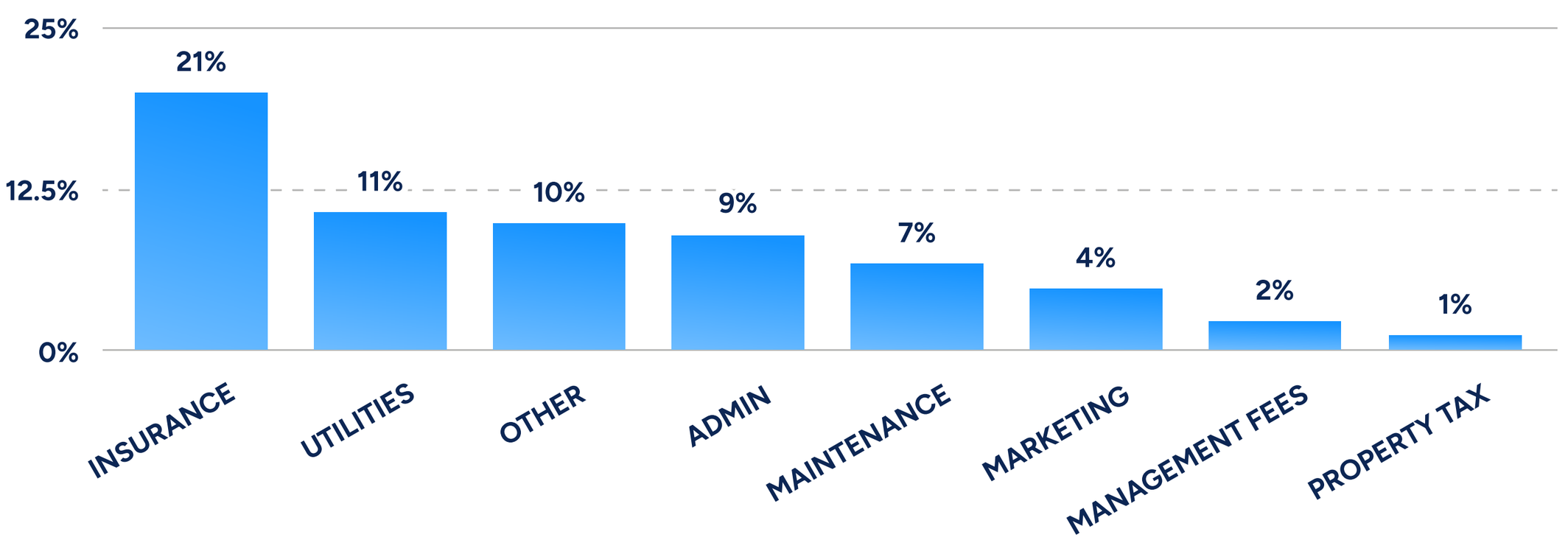
US commercial electricity rates change from 2005 baseline in 2024-2025 projected.
Source: Energy Information Administration



Office OpEx Growth by Expense Type

U.S. Q2 2021 - Q2 2023 CAGR

Source: AFIRE



Key Challenges

Modernizing commercial buildings

Escalating operating costs

Energy accounts for 20-40% of total operating expenses in commercial buildings and is now one of the fastest-growing cost categories, second only to insurance. In some regions, peak demand charges alone have surged by up to 25%, driven by increasing energy demand and grid strain.

Adapting to evolving occupancy patterns

Hybrid work, flexible office use, and shifting tenant demands have reduced and destabilized average and peak space utilization. Yet many buildings still run on static schedules that ignore real-time occupancy, resulting in wasted energy and higher costs.

Outdated & rigid building systems

Many buildings rely on on-premises Building Management Systems (BMS) that are not designed for bidirectional integration with modern API-based cloud systems that can provide signals from occupancy, network, weather, or traffic data. Cybersecurity concerns limit connectivity of many building systems to on-premises solutions.

Overburdened facility teams

While smart building technologies promise efficiency, overly complex systems focused on issue detection overburden already under resourced facilities teams. Without a way to automate building response to occupancy changes, many automation efforts fail to deliver their full value.

Workforce constraints

Facilities teams are facing a shrinking labor pool and an aging workforce, making it harder to staff, train, and retain skilled operators. As experienced personnel retire and new talent is scarce, maintaining complex building systems becomes increasingly challenging. Without solutions that simplify operations and automate routine tasks, labor shortages will continue to limit efficiency gains and strain already stretched teams.

What is O-DCV and how does it work?

Occupancy-based demand control ventilation, or O-DCV, accurately measures real-time occupancy in every HVAC zone and dynamically matches ventilation rates and outside air volume requirements to actual occupancy across the building.

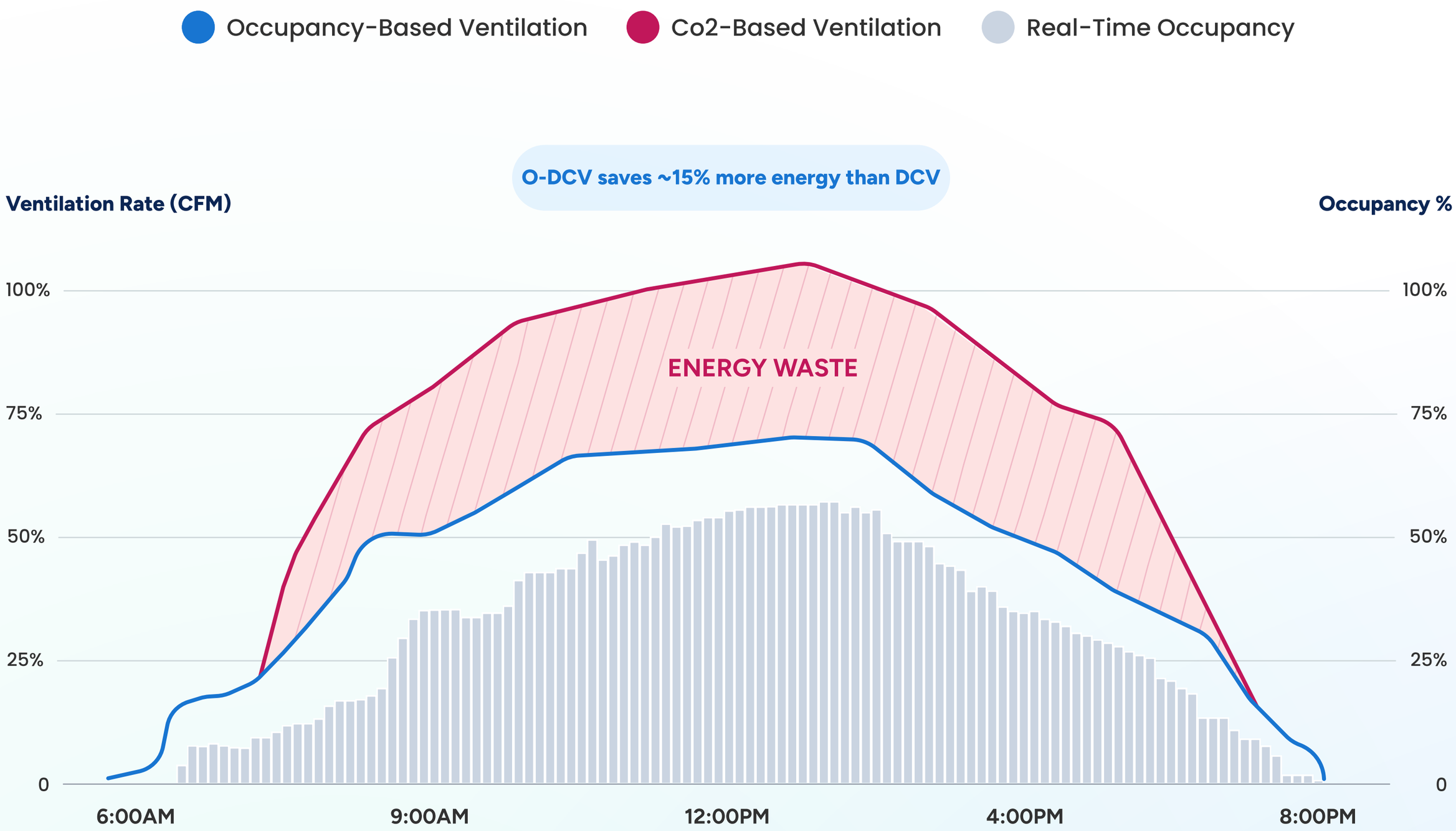
In a changing landscape of workplace utilization, this method dramatically reduces energy use compared to a fixed 6am–8pm HVAC schedule, which is designed to run at maximum capacity regardless of occupancy.

Traditional Demand Control Ventilation (DCV), which adjusts ventilation based on CO_2 levels, is a precursor to O-DCV.

The real difference between the two methods is that traditional DCV relies solely on CO_2 sensors, which come with several limitations. CO_2 sensors require frequent calibration, are prone to drift and inaccuracies over time, and involve significant maintenance. In-duct sensor placement adds wiring complexity and introduces latency, making them slow to reflect real-time occupancy shifts. In contrast, O-DCV uses in-situ occupancy sensors, installed directly within each room or zone, that deliver immediate, accurate data; enabling ventilation to respond dynamically to actual space usage.

While CO_2-based DCV was a meaningful innovation over the last 30 years and aligned with earlier ASHRAE code requirements, today's more granular, cost-effective occupancy measurement makes a far more precise approach available to building owners.

Occupancy-Based DCV vs. CO_2-Based DCV (Energy Use)



What is O-DCV and how does it work?

Key outcomes of implementing O-DCV

Energy savings

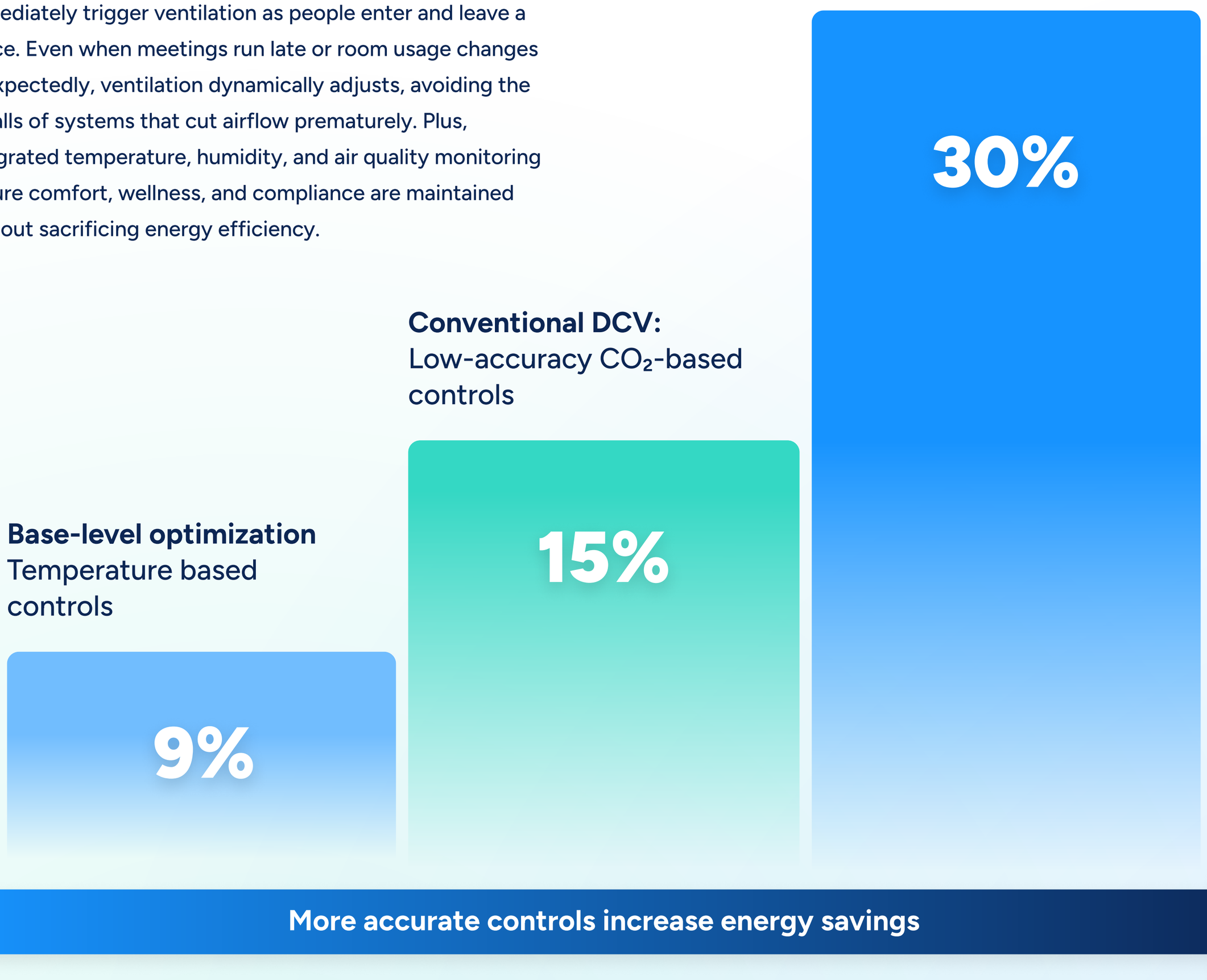
Optimizes airflow in real time, reducing unnecessary ventilation and lowering overall HVAC energy consumption by up to 30%. This results in measurable reductions in electricity and natural gas use — cutting total building energy consumption by an average of 14.5% which helps building owners and operators mitigate rising energy costs.

Operational savings

Prolongs HVAC equipment lifespan by decreasing system runtime and strain. Lower wear and tear means fewer repairs and extended filter life, reducing operating expenses and future capital expenses.

Improved indoor air quality without the lag

Delivers fresh air exactly when and where it's needed. Unlike traditional DCV, which waits for CO_2 levels to spike before adjusting airflow (often resulting in stuffy rooms and lagging response times), R-Zero's real-time occupancy sensors immediately trigger ventilation as people enter and leave a space. Even when meetings run late or room usage changes unexpectedly, ventilation dynamically adjusts, avoiding the pitfalls of systems that cut airflow prematurely. Plus, integrated temperature, humidity, and air quality monitoring ensure comfort, wellness, and compliance are maintained without sacrificing energy efficiency.



What is O-DCV and how does it work?

How to implement O-DCV in your building in 3 steps:

1. Collect real-time occupancy data

Sensors placed strategically throughout the building capture occupancy levels at the room, zone, or floor level. This data is then mapped to specific ventilation zones.

2. Integrate data into building systems

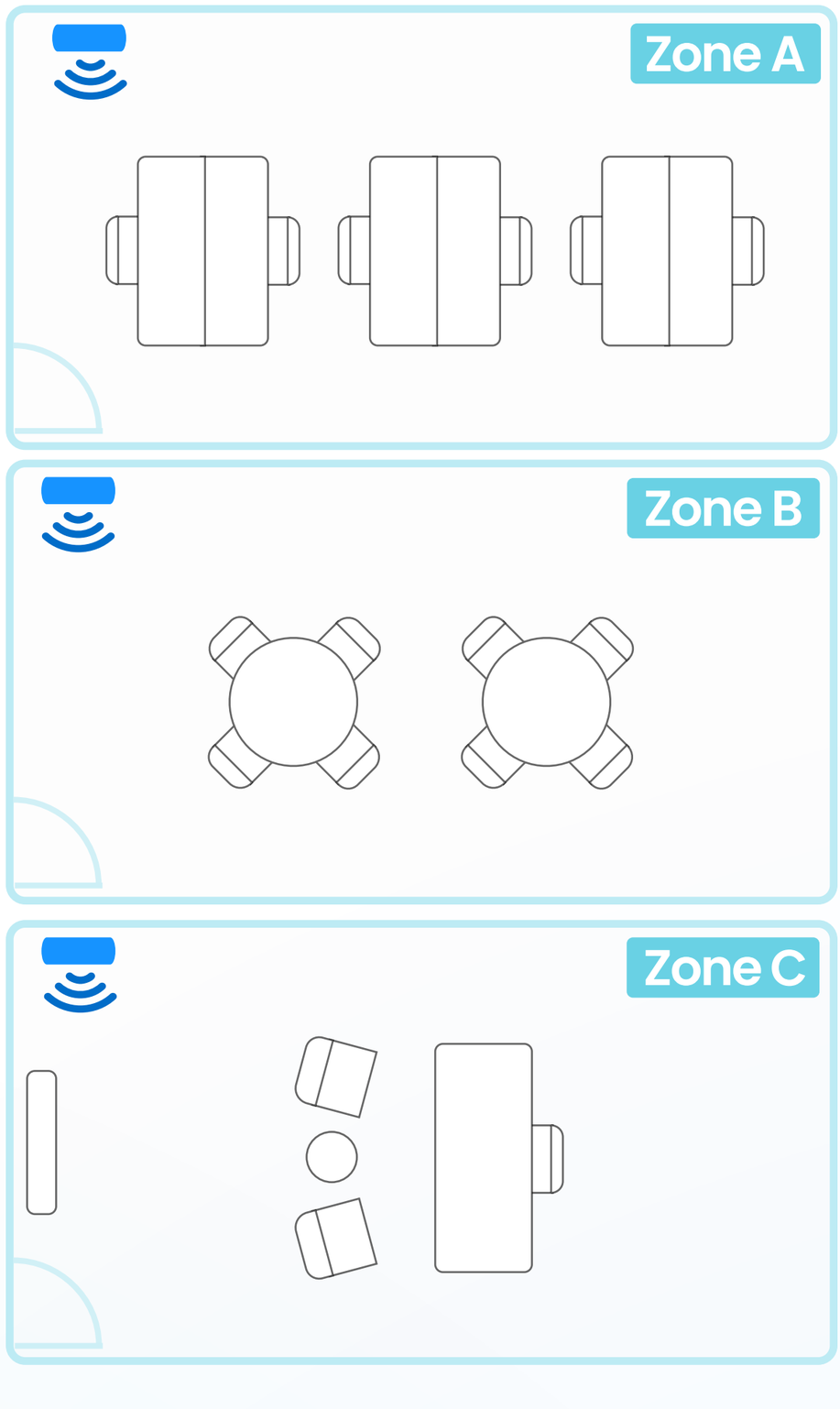
Using a BACnet/IP gateway or cloud integration, occupancy data is made available to the building's management system (BMS), enabling existing HVAC controls to adjust ventilation based on real-time conditions.

3. Match ventilation to occupancy

Once occupancy data is available in the BMS, it can dynamically adjust HVAC operations in two key ways.

Mode Switching: Presence detection allows the BMS to shift individual zones, rooms, or entire floors between pre-configured HVAC operating modes in real time. For example, when occupancy drops in a conference room designed for 20 people, the BMS can switch that room from "occupied" to "standby," relaxing temperature set points and reducing ventilation to conserve energy, without compromising comfort.

Outside Airflow Adjustment: The BMS can also use real-time occupant counts to fine-tune the amount of outside air being introduced, minimizing the heating or cooling of unnecessary outside air when occupancy is low.

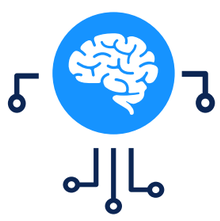


Real-Time Sensor Data

or third-party

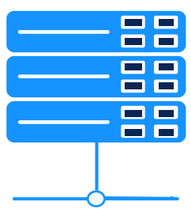
Real-time occupancy data is collected by sensors throughout your space footprint

R-Zero Gateway



Gateway maps individual sensors to HVAC zones and aggregates occupancy per zone

BACnet/IP Network

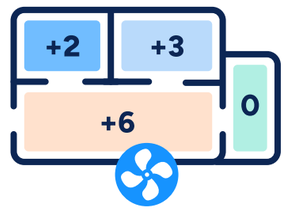


Gateway publishes HVAC zone occupancy to BACnet/IP

BMS

The building automation system (BAS) reads the signals and adjusts ventilation, temperature set points, or other controls accordingly

HVAC Control Adjustment



HVAC runs to match occupancy in every HVAC zone, saving energy and improving comfort

R-Zero's approach

Unlike traditional automation retrofits or HVAC upgrades that require costly overhauls, R-Zero enables buildings to implement O-DCV without major infrastructure changes and be up and running in a matter of weeks.

R-Zero's BACnet/IP integration:
Purpose-built for on-premises systems

On-premises data control

R-Zero uses a dedicated BACnet/IP gateway to keep occupancy, indoor air quality, and utilization data on-premises, addressing cybersecurity and latency concerns and ensuring seamless integration with existing building networks.

Indoor air quality backstop

In addition to occupancy and utilization data, R-Zero provides real-time indoor air quality monitoring, giving facility teams a reliable backstop to ensure healthy environments while optimizing ventilation.

Right sensors for the job

Battery-powered occupancy sensors eliminate the need to rewire and minimize installation complexity. R-Zero also supports third-party data ingestion, leveraging existing infrastructure without disruption.

All-in-one data platform

R-Zero unifies indoor air quality, occupancy, and utilization data in one platform, enabling facility teams to execute existing control sequences or write new ones, all without IT burden or risk to building operations.

Qualifying criteria for O-DCV in your building

Is your building a good fit for O-DCV? Ask the following questions:

- Can you control airflow at the floor or HVAC zone level of your building?
- Does your HVAC system use a variable fan drive AHU?
- Is your HVAC system connected to BACnet/ IP?
- Do you have permission to adjust set points and airflow in the relevant HVAC zones?
- Do you have permission to install and measure occupancy at the floor or HVAC zone level?
- Are your HVAC's key components (AHU, zonal airflow controls) in good working condition and connected to the BMS?
- Are you able to share HVAC data with R-Zero to calculate energy savings?

Fund an O-DCV project with the savings it generates

We designed our Efficiency-as-a-Service (EaaS) model to empower you to upgrade to smarter, more efficient ventilation controls without the need for upfront capital. Here's how it works:

No upfront costs

R-Zero installs all devices and implements the solution at no upfront cost to you.

Pay as you save

You pay a share of verified energy savings—nothing more.

Ongoing optimization

R-Zero provides continuous monitoring and optimization to maximize savings.

1. Build EaaS Model

Estimate cost savings over a period based on inputs:

- **$/kWh**
- **Energy intensity**
- **Project cost**
- **Hours of operation**

2. Measure & Validate

Measure & validate energy saved based on:

- **Air temp (supply, outside), OA damper, fan speed**
- **Validate against power draw (when present) & utility bills**
- **No submetering or other hardware required**

3. Shared Savings

Deploy R-Zero with no upfront cost. It pays for itself through energy savings, and after that, you keep saving while also benefiting from:

- **Cost reduction**
- **Carbon reporting**
- **Rich IAQ & utilization data**

Real-World Implementations

Case studies

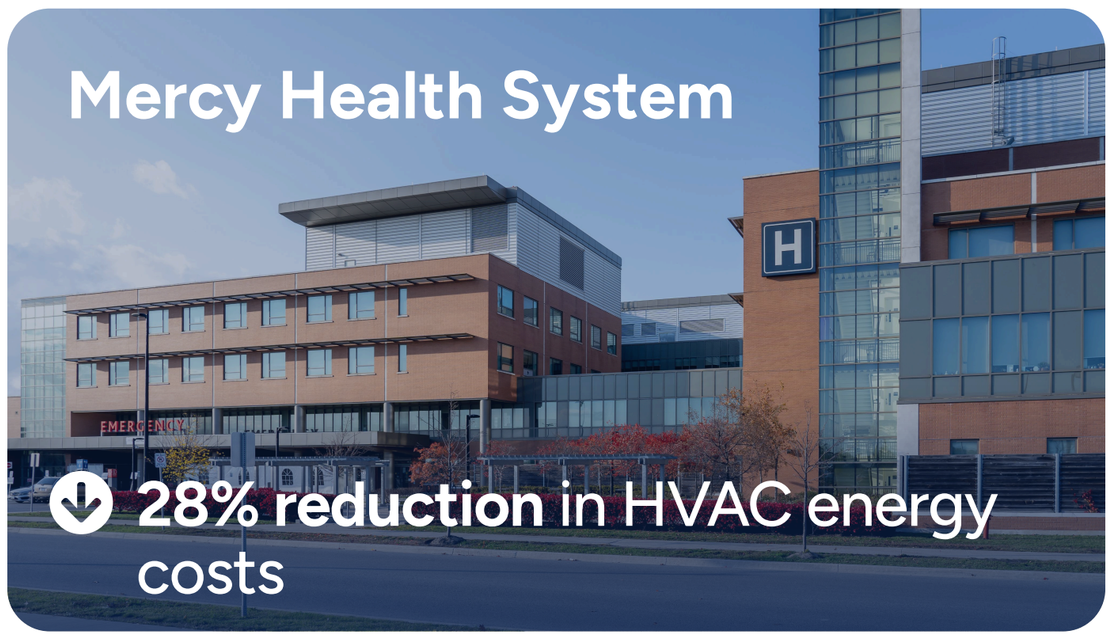
8-story office building

200,000 sq. ft.

150 Holborn, a 200,000 sq. ft. office building in London, found that applying occupancy-based controls in meeting rooms **reduced operational energy use and carbon emissions by 22%.**

By using real-time occupancy detection to optimize HVAC, lighting, and plug loads, meeting rooms were at minimum air delivery 76% of the time, cutting unnecessary energy consumption without compromising air quality and occupant comfort.

The study estimated a two-year payback period for implementing these controls, with even greater savings possible at scale.



17 hospitals

500,000 sq. ft.

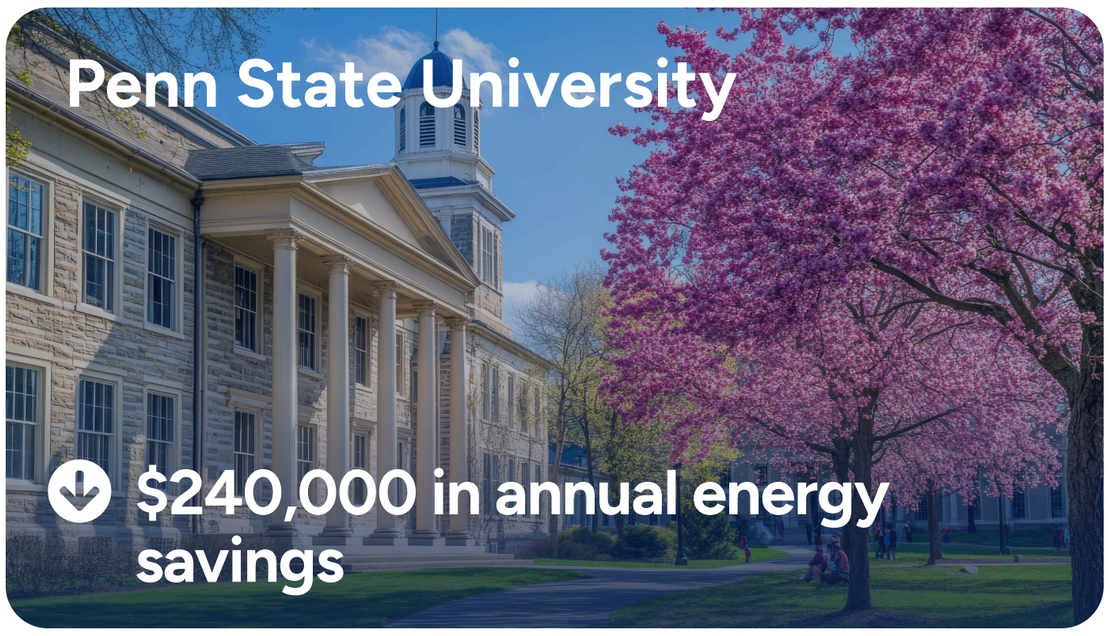
Mercy Health, a major healthcare provider with 17 hospitals across four states, implemented occupancy-based controls as part of a plan to improve efficiency and reduce HVAC costs.

By integrating sensors and automation software, Mercy **optimized ventilation in 500,000 sq. ft. of hospital space**, prioritizing critical patient areas and sterile supply rooms to ensure precise climate control and regulatory compliance.

This modernization resulted in a **28% reduction in HVAC energy** costs, **$200K in annual peak demand charge savings**, and enhanced air quality compliance, demonstrating how intelligent ventilation control can drive measurable savings while maintaining healthcare standards.

Real-World Implementations

Case studies



25 buildings

2,000,000+ sq. ft.

Penn State improved HVAC efficiency across 25 academic buildings totaling over 2 million sq. ft. by integrating class scheduling data with its building automation system.

Each classroom was already equipped with occupancy sensors, ensuring HVAC systems operated only when rooms were in use.

By combining real-time occupancy data with scheduling inputs, the system cut unnecessary heating, cooling, and ventilation, **resulting in $240,000 in annual energy savings**.

This strategy delivered measurable efficiency gains without infrastructure overhauls, using both sensor data and existing operational systems.

Adopt O-DCV with R-Zero

Since 2020, commercial real estate margins have been squeezed by high vacancy rates and rising operational costs. Despite traditional energy efficiency measures, cost pressures remain high. R-Zero helps CRE leaders achieve measurable financial impact through occupancy-driven automation.

Why R-Zero?

Guaranteed Savings – Pay only when you save, reducing financial risk.

Seamless integration

No expensive retrofits or disruptions.

High upside

Implement for energy savings and capture valuable utilization & IAQ data as a result.

Stay compliant

Save energy while confidently complying with modern ASHRAE standards.

Portfolio-wide impact

Scalable solutions for single buildings or entire portfolios.

Cut energy costs and optimize portfolio performance with R-Zero

Only R-Zero optimizes HVAC use dynamically to cut energy waste, enhances HVAC efficiency with high-performance filtration, validates air quality, and delivers lease intelligence in one risk-free solution that seamlessly integrates with existing building systems. For a complete assessment of how our solutions can help you drive reductions in OpEx, contact us at marketing@rzero.com.