

# ClimaVision Indoor Air Quality Management

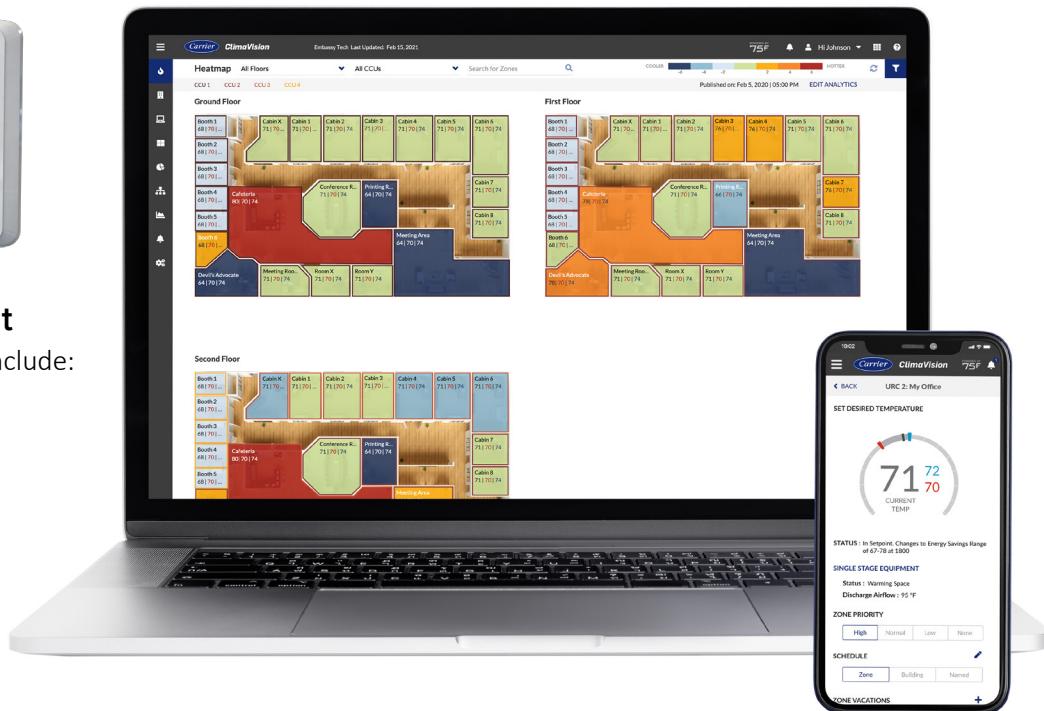
Save energy, provide comfort and improve indoor air quality



## ClimaVision HyperStat

Available onboard sensors include:

- Temperature
- Humidity
- Light
- Occupancy
- CO<sub>2</sub>
- VOC
- Sound
- Particulate Matter



## APPLICATION OVERVIEW

Indoor Air Quality Management (IAQM) is an essential process to determine the level of contaminants present in indoor air and predictively and proactively optimize airflow while minimizing wasted energy costs via occupancy sensors, modelling and air quality data, demand control ventilation, outside air economizing, and other tools.

The average person spends 90% of their day indoors. Given the proven negative effects of poor IAQ, installing an IAQM system is one of the easiest investments a building owner or facility manager can make. Buildings with poor IAQM tools are prone to sick building syndrome, occupant complaints, high occupant turnover rates, and illness. Poor indoor air quality has also been shown in repeated studies to limit cognitive performance—as anyone who has felt sleepy on a stuffy airplane can attest—and workplace productivity as a result.

ClimaVision's wireless IAQ sensors and building management system deliver over a million data points daily per fifty thousand square feet of space, including temperature, humidity, volatile organic compound (VOC), CO<sub>2</sub>, light, sound, and particulate matter levels taken every 60 seconds. This data flows to the cloud where ClimaVision uses machine learning algorithms and outside weather forecasts to optimize indoor air quality over time and send decisions in real time to building HVAC controls. Built-in occupancy sensors adjust ventilation to make partially occupied spaces more efficient and direct outside air where it is needed via Dynamic Airflow Balancing, while Outdoor Air Optimization uses free heating and cooling to maximize fresh air and minimize system costs.



## ASHRAE STANDARDS FOR IAQ

Without air quality monitoring and management, the built environment poses a health risk for those who spend most of their day indoors. Some of these risks are invisible – VOCs are emitted as chemical gases into the air from commonplace structures such as building materials, furniture, office equipment, paints, cleaners, cosmetics, glues, plastics, and aerosol sprays. Overnight or on weekends, or in unused or partially occupied rooms or spaces, VOC buildup occurs. For CO<sub>2</sub> the opposite is true: High occupancy inside a zone or conference room without proper ventilation spikes CO<sub>2</sub> levels. These high occupancy areas also benefit from higher ventilation rates to reduce virus transmission.

To ensure air quality then, building codes have standards that must be met. For CO<sub>2</sub>, ASHRAE standards 62.1 and 62.2 are the recognized guidelines for acceptable indoor air quality and health.

Standard 62.1 outlines minimum ventilation rates and procedures, and specifies 1,000 ppm as the ceiling for acceptable levels. However, it's important to note that CO<sub>2</sub> levels indoors change based on the number of people inside a structure. Because of this, ASHRAE further specifies a 500 ppm difference between outdoor and indoor CO<sub>2</sub> levels as the standard acceptable level for human-created CO<sub>2</sub>.

Section 6.2 of ASHRAE Standard 62.1, Ventilation for Acceptable Indoor Air Quality, prescribes the quantity of air that must be delivered to each zone based on expected use and occupancy, with calculations for system-level intake. The ClimaVision system updates with each ASHRAE standard revision and uses the formula

$$V_{bz} = (R_p \cdot P_z) + (R_a \cdot A_z)$$

To determine outdoor airflow requirements for any building where

$V_{bz}$  = Outdoor airflow to any given zone or office

equals

$R_p$  = outdoor airflow required per person

multiplied by

$P_z$  = The number of people measured or estimated by the system during typical usage

Plus

$R_a$  = Outdoor airflow per volume of the space

multiplied by

$A_z$  = The occupiable floor area of the zone

$V_{bz}$  is then divided by air distribution effectiveness data (E<sub>z</sub>) create a zone specific calculation (or V<sub>oz</sub>) if a VAV profile is not being used. These and thousands of other increasingly complex calculations are run and repeated continuously by ClimaVision's cloud based IAQM system to optimize airflow and keep CO<sub>2</sub> in check.

The problem with typical ventilation systems is that they do not take human occupancy into consideration, and instead vent air into a building at a fixed rate based on peak expected occupancy. When occupancy levels are low or buildings have partial occupancy and reduced foot traffic, fixed ventilation can be the leading source of energy waste in a building and massively increase heating and cooling costs as well as equipment maintenance and replacement expense. As spaces become more dynamic and partial occupancy or low occupant density and distancing become more common, ventilation needs to be dynamically managed based on real time indoor air quality patterns, outside air quality, temperature, and humidity, and indoor occupancy sensors.



## CLIMAVISION'S SENSORS AND OAO APPLICATION

When occupancy in a building is unknown, ASHRAE standards call for assuming the worst case — maximum occupancy — to set the minimum position of the OA damper. Most spaces are not occupied at maximum, and the result is that most indoor spaces are over-ventilated at the cost of much greater mechanical conditioning and energy cost.

OAO from ClimaVision delivers an ASHRAE-approved method to derive occupancy, allowing for adjustments of the OA damper according to IAQ instead of assuming the worst case. The result is energy savings during low occupancy and improved system performance during high occupancy. This is achieved thanks to demand-controlled ventilation (DCV), a controls strategy that allows the reduction or increase of outdoor air use proportional to occupancy.



ClimaVision uses smart sensors that can capture IAQ data to determine the amount of outside air required. If there are no IAQ sensors in the space, then the system uses the return air sensor to provide an average level of CO<sub>2</sub> and other contaminants in the mixed air.

If IAQ readings in a space move below a threshold, DCV has no effect. If readings move above threshold, the ClimaVision system will automatically and proportionately open an OA damper to bring in outside air. In other words, DCV essentially sets the minimum damper opening level at any given time and is calculated based on either the return air readings or data from individual spaces using a Trim and Respond system.

Other ClimaVision IAQ sensors such as CO and NO<sub>2</sub> can be added to this sequence for spaces like parking garages or other applications. When combined with the ClimaVision HyperStat or Hyperstat, VOCs are also monitored.

## MANAGING VIRAL TRANSMISSION WITH OAO AND HUMIDITY CONTROL

ClimaVision's IAQM solution can address research-supported methods of slowing the dispersal of viral particles in the built space. Studies show that incorporating high outside air volumes and maintaining a higher target relative humidity indoors are both critical strategies every business should use to mitigate the spread and survival of viral particles indoors.

According to a paper published in the American Society for Microbiology, maintaining relative humidity as high as 40 to 60 percent indoors can reduce the spread and survival of viral particles. The society's latest paper on the topic indicates that relative humidity above 40 percent is detrimental to CoVs, or coronaviruses, and can slow down airborne dispersal of a virus by encouraging larger droplet formation and infected particles, which are weighed down onto floors or surfaces more quickly and reduce aerosolization and spread distance.

ClimaVision users have portfolio-wide control over all parameters remotely via ClimaVision's building intelligence suite of web and mobile apps – relative humidity is one of the controllable parameters provided.

Maintaining relative humidity between 40 and 60 percent is both within the current ventilation standard for health care and residential care facilities (20 to 60 percent) and is within a safe range regarding mold growth. Relative humidity below 80 percent, according to the paper, avoids the respiratory dangers and operational hazards of mold growth.

One way commercial and residential buildings try to prevent viral particles and potentially equipment-damaging debris from entering air delivery systems is through filters. Different facility types will have varying degrees of filtration requirements, with critical health care facilities having among the strictest. While viral particles are often contained inside droplets large enough for high-efficiency filters to catch, viral particles alone are typically between 0.004 to 1.0  $\mu\text{m}$ , rendering them too small for filtration systems to be entirely effective against them. "Proper filter installation and maintenance can help reduce the risk of airborne transmission, but it is important to understand that filters should not be assumed to eliminate airborne transmission risk," the paper says. "Higher outside air fractions and higher air exchange rates in buildings may help to dilute the indoor contaminants, including viral particles, from air that is breathed within the BE."

## IAQ AND SICK BUILDING SYNDROME

Ample industry research supports superior IAQ as a contributing factor to healthy, productive building occupants. Results from a study facilitated through The Healthy Buildings Team at Harvard's T.H. Chan School of Public Health reveal compelling data about cognitive function in environments that fulfill or exceed industry standards.

The study measured participants from 10 high-performing buildings surpassing ASHRAE Standard 62.1 ventilation requirements and with low total volatile organic compound concentrations.

Researchers administered a cognitive function test of higher order decision-making performance twice during the same week. Results showed that employees working in green-certified buildings scored 26.4 percent higher on those tests compared to those working in non-green-certified buildings. Additionally, these employees showed 30 percent fewer sick building symptoms, which include symptoms such as eye, nose, and throat irritation; mental fatigue; nausea; headaches; dizziness; and skin irritation. Finally, the study linked thermal comfort in the workplace with higher sleep quality at home and the performance and cognitive benefits that result.

"Cognitive function scores were significantly better under Green+ building conditions than in the Conventional building conditions for all nine functional domains," the study concludes. "These findings have wide-ranging implications because this study was designed to reflect conditions that are commonly encountered every day in many indoor environments."

In short, meeting – or exceeding – IAQ standards has far reaching benefits in the spaces where we work, eat, shop, learn, play, and relax. It also can dramatically increase the efficiency of buildings with any partially occupied floors or offices and can slow the dispersal of airborne particles or viruses in areas with higher occupancy by redirecting outside air into areas that need it most.

