



# INSIGHTS INTO HEALTHIER INDOOR ENVIRONMENTS: COMMERCIAL BUILDINGS

The COVID-19 pandemic has increased the focus on the health and safety of building occupants in commercial offices around the world. Now, as businesses seek to safely bring back workers and confidently return to a sense of normal, there are also significant opportunities to make healthy building updates that can have a long-term impact on human health and productivity – and ultimately, the bottom line.

## THE NEED

While the COVID-19 pandemic has brought about increased urgency around health in commercial buildings, the renewed focus has also brought to light a long-standing need to address aging infrastructure, underperforming systems and air quality issues.



In a five-year building assessment survey and evaluation, **40% of the systems with design data available had measured outdoor airflows less than design.**<sup>1</sup>



**17% of outdoor air ventilation measurements were below** the American Society of Heating, Refrigerating and Air-Conditioning Engineers (**ASHRAE**) **minimum requirement** of 34 m<sup>3</sup>.<sup>1</sup>



**44% of buildings reported not performing HVAC testing and balancing.**<sup>2</sup>



**20% of the buildings surveyed had higher ratios of indoor to outdoor particulate matter concentration.**<sup>3</sup>



## THE QUANTIFIABLE BENEFITS OF COMMERCIAL BUILDINGS

Creating healthier indoor environments can help transform today's commercial buildings into valuable tools that drive health and progress for the people inside. And when you consider the costs associated with human resources, health and cognitive benefits can also lead to financial benefits for businesses. Salaries and benefits generally represent 90%<sup>4</sup> of a company's overhead, and therefore, investments in creating healthy workplaces can significantly impact the bottom line.



### HEALTH BENEFITS



**Sick building syndrome symptoms increased by 23% when ventilation was reduced** from approximately 34 m<sup>3</sup> to 17 m<sup>3</sup>/person. When the ventilation rates were increased from 34 m<sup>3</sup> to 85 m<sup>3</sup>/person, symptoms were reduced by 29%.<sup>5</sup>



**Employees exposed to high ventilation** (~41 m<sup>3</sup>/person) as opposed to lower ventilation (~20 m<sup>3</sup>/person) **had lower risk of short-term sick leave.**<sup>6</sup>



### COGNITIVE BENEFITS



**As the ventilation rate increased from 18 to 72 m<sup>3</sup>/person, performance in addition, text typing and memorization tests increased 4.7%, 5.2% and 8.0%, respectively.**<sup>7</sup>



For every 1°C increase in temperature in the range of 25°C to 30°C, there is a **2% reduction in occupant work performance.**<sup>8</sup>



### FINANCIAL BENEFITS



**Increasing ventilation rates** from 17 to 34 m<sup>3</sup>/person in a standard office building with standard occupancy would result in **\$1.4 million in annual benefits as a result of improved productivity** and reduced sick days and healthcare costs from respiratory infection.<sup>9</sup>



The operating costs of doubling ventilation rates from 34 to 68 m<sup>3</sup>/person were on the order of \$40 per person per year, in six U.S. climate zones. In contrast, the change in ventilation resulted in **workers' performance improvements by 8%, equivalent to \$6,500 in annual benefits per employee.**<sup>10</sup>



## ASSESSMENTS

There are a variety of IAQ and ventilation solutions to choose from — but not every solution fits every building's needs. To determine which solutions best meet your building's needs, Carrier provides **IAQ assessments**. Assessments can be customized to each building or follow a prescriptive assessment approach and include monitoring and testing.



## VENTILATION

### Strategies

- **Prioritize maximizing fresh air delivery rates to achieve 51 m<sup>3</sup>/person.** Occupancy loads can also be decreased to achieve recommended air delivery rates per person.
- **Eliminate or reduce air recirculation** (thus maximizing fresh outdoor air) to the extent possible.

### Solutions

- **Carrier i-Vu supervision** is the hub for intelligent integrations of technologies throughout a building.



From heating, ventilating and air-conditioning systems to security and access control to fire, lighting and more, i-Vu supervision enhances efficiency through greater visibility and control of all building systems.

- **Our air handling units (AHU)** provide a cost-effective improvement by inhibiting bacterial and microbial growth on the interior of the unit.



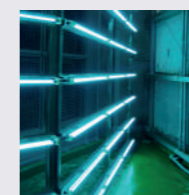
## FILTRATION

### Strategies

- In buildings with mechanical ventilation systems, **existing filters can be upgraded to filters with efficiency ratings of at least F7 (ePM2.5 >65%), and up to the highest fine particle classification or even HEPA filters,** if the available pressure drop of the system enables.
- **Portable air cleaners with high-efficiency particulate air (HEPA) filters may be useful to reduce exposures** to airborne droplets and aerosols emitted from infectious individuals in buildings.

### Solutions

- **Carrier filtration** technologies include various ePM filters and HEPA filters for particulate matter. Carrier also offers devices using UVC light, which are intended to target viruses,



and UV photocatalytic oxidation to help remove volatile organic compounds and improve indoor air quality (IAQ).

- **The Carrier OptiClean™ air scrubber** helps clean contaminated air and removes airborne particles with HEPA filtration.\* An easy way to supplement an HVAC system without replacing or modifying existing equipment, OptiClean plugs into a standard outlet and can be easily rolled into place in offices and other meeting areas.



\*HEPA filter is 99.97% effective for particles that are 0.3 microns or larger.

## ACTIONABLE STRATEGIES AND SOLUTIONS

There is no single strategy for creating healthier indoor environments in today's commercial buildings.

**Carrier can help inspire confidence in returning to normal with a layered defense approach, implementing all levels of control strategies,** which can help reduce risk and maximize benefits. For engineering controls, the healthy building experts at Carrier can support commercial building customers with solutions and services for the entire lifecycle.



## CONTROLS AND SERVICES

### Strategies

- **Buildings should not shut off or reduce their mechanical ventilation** during or before regular business hours while there still may be people in the building.
- **Businesses can ensure that there is adequate ventilation and filtration through a process of commissioning and testing.** Commissioning and testing should be performed by trained individuals and should be performed at regular intervals.
- **Testing can be done through the use of low-cost IAQ monitors.** If CO<sub>2</sub> concentrations are measured at levels below 1,000 ppm while facilities are occupied, then the outdoor air ventilation is likely performing according to acceptable minimum standards. Higher CO<sub>2</sub> concentrations may indicate that other strategies for increasing outdoor air ventilation are necessary.
- To promote healthy indoor environments, real-time monitoring for a variety of pollutants and IAQ parameters, including (but not limited to) carbon monoxide, ozone, volatile organic compounds, formaldehyde and other aldehydes, temperature, humidity, noise and light, is recommended.

### Solutions

- **Remote Airside Management** provides continuous validation of IAQ parameters, periodic checks of equipment health and continuous airside commissioning, enabled by a command center.
- **Remote Energy Management** connects HVAC and other building systems to provide advanced



cloud-based analytics that help optimize energy efficiency, equipment uptime, occupant comfort and operational productivity. Carrier's digital services are based on actionable insights by the EcoEnergy Insights CORTIX™ building IoT platform.

- **Carrier's best-in-class BluEdge® service platform** offers IAQ assessments, wellness services, retro-commissioning and more. As a result, buildings can operate at their peak performance, providing lower energy and maintenance costs and a more productive, healthier building environment.
- Businesses should implement **multi-parameter IAQ monitoring** to baseline performance, identify deficiencies and enable demand control ventilation for specific contaminants of concern.

- By integrating with the Automated Logic WebCTRL building automation system, **zone occupancy sensors** can detect occupant presence to help increase ventilation, report alarms and track real-time occupancy. Additionally, **security-based occupancy sensing** provides real-time integration to access control systems to determine building occupancy based on access card swipes.





### PREDICTIVE MAINTENANCE

- Remote connection through BMS manages IAQ and ventilation in line with best practices
- Make changes and fix issues remotely
- Optimize maintenance and operational costs
- 24 x 7 command center



### HVAC EUROPEAN BLUEEDGE DIGITAL PORTAL

- Provide advanced remote analytics
- Optimize energy efficiency, equipment uptime, occupant comfort and operational productivity
- Actionable insights by different communication protocols
- Optimize autonomously or through a remote application



### RETROFIT SPARE PART SOLUTIONS

#### INNOVATIVE TECHNOLOGIES

- M5 filters
- New filtering media technologies
- High filtration efficiency of PM2.5 particles

#### ADD-ON RETROFIT ALTERNATIVES

- AHU-UVC add-on kits
- Carbon surface & F7 filtering technology options
- Add-ons are easy to install in the universal frames of existing AHUs
- Effective against viruses, bacteria, small particles and VOCs

#### RANGE OF FILTRATION SOLUTIONS

- High-efficiency filtration solutions
- A large variety of air filters
- Solutions for our full product range (AHU, RTU, TFCU)
- More than 1300 references of air filters to cover all sizes / filtration needs

## THE BOTTOM LINE

Providing the best possible environment for health and productivity has never been more important. With the right solutions and strategies in place, building owners and operators can safely welcome occupants back into buildings while creating healthy indoor environments that maximize health, cognitive and financial benefits for workers and businesses. To learn more about healthy building solutions and strategies for commercial buildings, [connect with a Carrier expert today.](#)

<sup>1</sup> Building Assessment Survey and Evaluation (1998)

<sup>2</sup> Persily and Gorfain (2008)

<sup>3</sup> Burton, Womble and McCarthy (1999); Macher, Tsai, Burton and Liu (2002)

<sup>4</sup> Allen and Macomber (2020)

<sup>5</sup> Fisk et al. (2009)

<sup>6</sup> Milton (2000)

<sup>7</sup> Park and Yoon (2011)

<sup>8</sup> Seppanen, Fisk and Faulkner (2003); Seppanen et al. (2004)

<sup>9</sup> Fisk and Rosenfeld (1997)

<sup>10</sup> MacNaughton et al. (2015)

