



# IMPROVING IAQ IN THE NEW NORMAL: SMART QUESTIONS FOR BUILDING OWNERS

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This white paper is designed to help building owners, facility managers and engineers — no matter the age or condition of their HVAC equipment, controls or building automation systems — frame the questions related to assessing and optimizing indoor air quality (IAQ). Despite new obstacles created by COVID-19, the post-pandemic world has also created new opportunities to enhance building health and competitiveness in creating a healthy environment.

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## Background

Building owners and engineers recognize that the built environment is complex and evolving. Each building presents unique challenges that can vary from hour to hour and season to season. The outbreak of COVID-19 has added a new element to this complexity. Health experts agree that the risk of indoor disease transmission differs based on occupant density, work- and traffic flows, the presence of “hot spots” (such as food preparation areas), social distancing, hand-washing, disinfectant practices and the use of personal protective equipment. Contact, droplet, airborne and surface transmission are all possible vectors for spreading disease. Consequently, a “layered” strategy based on comprehensive planning and strengthened administrative controls can help to minimize disease transmission in the workplace.<sup>1</sup>

Of the several potential transmission vectors, the threat of infection from airborne transmission caused by droplet nuclei (or aerosols) that remain suspended in air over long distances and times has been the most difficult to assess. A letter signed in July 2020 by more than 200 scientists and engineers concluded that “there is every reason to expect” that SARS-CoV-2 transmission by airborne microdroplets is an important transmission pathway. The letter found that hand-washing and social distancing are insufficient to provide protection from virus-carrying respiratory microdroplets. The authors recommended additional focus on effective ventilation along with measures to enhance airborne infection control.<sup>2</sup>

The World Health Organization (WHO), which regularly updates its understanding of how COVID-19 is transmitted, responded to this information by concluding that short-range aerosol transmission in crowded and inadequately ventilated indoor spaces over a prolonged period of time with infected persons “cannot be ruled out.”<sup>3</sup> In addition, a recent evaluation of virus containment in air-handling systems recommends a number of measures that can improve an HVAC system's effectiveness in reducing transmission.<sup>4</sup>

While analysis is ongoing, these findings reinforce the role that buildings can play as an important piece of the first line of defense in reducing COVID-19 transmission. A renewed focus on IAQ is fundamental to this defense.

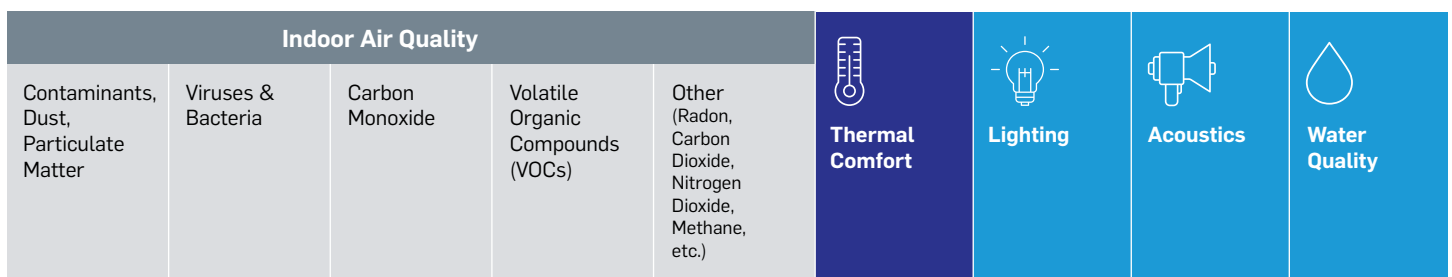
As building owners and engineers reopen their facilities, plans for occupant safety and wellness will vary as widely as the built environments to which they return. Some owners may seek specific actions designed to reduce the threat of disease transmission. Others may pursue a more holistic approach to improving IAQ, including energy efficiency, operational cost savings, code compliance, greenhouse gas reduction and occupant wellness — along with the slowing of virus transmission.

# The Importance of IAQ

IAQ measures the health and comfort of a building’s interior air, focusing on the presence of contaminants such as particulate matter (on which viruses such as SARS-CoV-2 are sometimes found), carbon monoxide and volatile organic compounds (VOCs). Particulate matter is a combination of solid particles and liquid droplets that may include dust, pollen and smoke. VOCs are ubiquitous (and often odorous), arising from cleaning agents, air fresheners and new carpets. HVAC strategies can have a significant impact on reducing these contaminants in the built environment.

IAQ is a subset of indoor environmental quality (IEQ), which also includes thermal comfort, lighting, acoustics and water quality. IEQ is an important component of the LEED® (Leadership in Energy and Environmental Design) rating system.

## Indoor Environmental Quality



Source: Carrier

HVAC strategies focused here can impact occupant safety, comfort, productivity and energy consumption

Poor IAQ can lead to headaches, fatigue, lack of concentration, and irritation of the eyes, nose, throat and lungs.<sup>5</sup> Conversely, IAQ optimized for VOCs, carbon dioxide and outdoor air ventilation has been shown to significantly improve cognitive functioning of office workers across nine measurements — including crisis response, information usage and strategy.<sup>6</sup>

As sensors have become more accurate and affordable, building owners are now able to measure nearly every important attribute of IAQ. Sensors for carbon monoxide, particulate matter, VOCs and other contaminants can be set to track conditions over time and programmed for threshold alarms.

The extraction of this rich data can help accurately describe the built environment and allow building owners gain the needed insights to balance optimum IAQ against energy consumption and occupant comfort. Applying these data insights and better managing the building will require close collaboration between the building owner’s engineering and operations team and their outside HVAC engineers.

## Smart Questions for Approaching IAQ

Regardless of the age of the building, the condition of the HVAC equipment or the complexity of the built environment and reoccupancy plans, optimizing IAQ and occupant safety begins with a common set of questions. Some of these questions can be answered by the building owner or engineer, while others must be determined in consultation with an HVAC-solutions engineer. These common questions include the following:<sup>7</sup>

1. How ready is the facility to reopen from a business need and from an occupancy status? That is: What are the tenant occupancy concerns? How secure does ownership feel? Does senior management have a comprehensive plan that has been reviewed, discussed and distributed to key stakeholders? (For additional guidance in preparing a plan, see the “Building Readiness” document<sup>8</sup> by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and Carrier’s “Air-Cleaning and Filtration: Addressing the Unseen in the ‘New Normal.’”<sup>9</sup>)
2. What goals has ownership set for IAQ and occupant safety at reentry? These goals may include reducing the chance for virus transmission, improving the IAQ of the built environment, increasing employee productivity, enhancing comfort, and others — or a combination of several of these goals.
3. Are there preexisting problems with the facility the ownership is trying to solve? What success have they had, and how are they measuring their progress? What steps, if any, have they already taken to improve the post-pandemic built environment?
4. How does ownership anticipate occupancy levels and workflows will change from pre-pandemic times? What new obstacles and opportunities do they need to address?
5. If achieving ownership goals requires capital investment or new operating expenses, do owners have the budget available?
  - a. Is there “low-hanging fruit” for energy savings that can help to fund any new solutions? (Often these opportunities can be identified in a low-cost, visual assessment of equipment.)
  - b. Are there tax incentives to assist with HVAC capital expenditures?
6. What is ownership’s timeframe? Are there actions that must be taken immediately and others that can be stages over time?
7. What are the next steps for moving forward?

For owners who may have already reopened their building, or for those who expect to reopen soon, the following questions may also apply:

8. Are there any steps listed above that ownership may have missed or postponed that should now be addressed?
9. What are the ongoing equipment service and maintenance plans to ensure optimum and sustainable building IAQ? Are there documented standard operating procedures in place to ensure this?
10. Are the owners current with all ASHRAE, federal, state and local guidance?

## Options to Assess IAQ and Occupant Safety

Often, the first step in preparing a building for reopening is to bring the HVAC system back to its original, commissioned state. ASHRAE suggests that the owner undertake a “tactical commissioning” of their building system to ensure that it is operating per design conditions and current operational strategies. This activity is usually accomplished with the assistance of a licensed and certified commissioning provider, a test and balance company and/or a building automation systems company.<sup>10</sup> The results of a tactical commissioning can create substantial energy savings or improvements to IAQ.

If the focus of a building operator is on reducing the risk of infectious aerosols, then recommendations for reoccupancy often key on improving ventilation, pressurization, airflow distribution and optimization, mechanical filtration, ultraviolet germicidal irradiation (UVGI) and humidity control.<sup>11</sup> In order to understand these opportunities, owners may be presented with several levels of review, each different in time, expense and comprehensiveness. These assessments can be greatly facilitated where there is a control system with suitable instrumentation.

**Basic Assessment.** Usually intended for single sites and smaller buildings, a basic assessment includes a limited site walk-through and a facility interview to help identify issues and solutions.

**Observational Assessment.** This level of review includes visual inspections; photographs; annotated floor plans; spot checks of indoor air and water quality, temperature and humidity; hand-washing support; and the observation of worker and patron flows. The resulting observational assessment identifies health and safety risks alongside possible solutions and next steps. The willingness of a building owner to provide unfettered access to their system can result in a variety of recommendations that have immediate health and energy-savings impact.

**Detailed Assessment.** This option expands on the observational assessment to provide a more thorough assessment of a facility, including interviews with occupants of the building that may surface concerns about pandemic-related policies and enforcement. Rigorous protocols are followed for testing procedures and locations. This assessment involves testing IAQ and water for contaminants; reviewing temperature and humidity trends; and assessing emergency preparedness, occupancy flow and physical distancing potential. A detailed report of findings will include documented test results (especially in areas of poor ventilation or with the greatest risk of contaminants) and actionable recommendations for health, wellness and energy consumption.

**Comprehensive Assessment.** This study builds on the work done in the detailed assessment option but also includes the planning and execution of recommendations; the creation of an ongoing plan for health, safety and IAQ optimization; an energy analysis; and the identification of future goals related to WELL, LEED or other potential certifications. All costs and operational savings are shown so that building owners can estimate payback.

**Custom Assessment:** A building owner may opt for a custom assessment to establish a plan based on their unique occupancy requirements and built environment.

The HVAC industry has developed a menu of solutions — from increased ventilation and differential room pressurization to air-filtration and UVGI control — to address the findings of these reviews. The results can be substantially improved IAQ and reduced possibility of disease transmission.

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## Carrier's Capabilities

To help deliver healthy, safe, efficient and productive indoor environments, Carrier introduced its Healthy Buildings Program, a suite of advanced solutions for commercial buildings, healthcare, hospitality, education, retail and marine. The program draws from a comprehensive set of solutions designed to help improve IAQ by increasing outside air, improving temperature and humidity levels, managing occupancy density, optimizing energy efficiency and enabling touchless interactions. Carrier's services include but are not limited to:

- Safe Start Service to ensure building readiness through recommissioning of HVAC equipment and implementation of best practices
- Emergency assets, a variety of HVAC equipment on demand to meet building upgrade requirements for safe and timely reopening
- IAQ assessments to test air quality and ensure optimal filtration, ventilation, airflow and controls
- Remote airside management, providing continuous validation of IAQ
- Wellness services to evaluate and promote health and wellness, including help in achieving the International WELL Building Institute's WELL building standard certification
- Remote energy management for advanced cloud-based analytics to help optimize energy efficiency, equipment uptime, occupant comfort and operational productivity
- Advanced access services to enhance control site occupant density
- Security services that provide solutions including contactless management, temperature screening and video analytics, remote monitoring and remote diagnostics

Carrier's healthy buildings technologies include a variety of equipment and service options, many of which are available to enhance IAQ and occupant safety in existing buildings. These technologies include MERV filters, HEPA filters and Infinity™ electrostatic filters for airborne pathogens; devices using UVC light and UV photocatalytic oxidation; OptiClean™ dual-mode air scrubber and negative air machines to clean contaminated air and create negative pressure (if desired); ActivAir™ hybrid hydronic air terminals for increased ventilation and outside air; Environmental Index™ to manage temperature, humidity and CO<sub>2</sub> level in Carrier's Automated Logic building automation platform; DirectKey™ mobile access solutions; bipolar ionization technology to reduce particles, odor, bacteria and viruses; BlueDiamond™ touchless access; and the MyWay™ building services platform.

Carrier solutions range from fast and easily adopted solutions such as Carrier's OptiClean dual-mode unit, to more detailed and complex technologies.

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## Summary

Building owners and engineers seeking to prepare their facilities for reoccupancy and to meet the needs of a post-pandemic world may wish to prioritize indoor air quality. This white paper suggests questions related to monitoring and assessing IAQ and provides an overview of relevant third-party HVAC services. Once an assessment is completed, there are a range of affordable solutions available for optimizing IAQ.

For additional information, contact your local Carrier expert.

## References

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- <sup>3</sup> "Transmission of SARS-CoV-2: Implications for Infection Prevention Precautions," World Health Organization, July 9, 2020, Web July 13, 2020, <https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions>.
- <sup>4</sup> Renat Manassypov, "Evaluation Virus Containment Efficiency of Air-Handling Systems," *ASHRAE Journal*, July 2020, 17-23.
- <sup>5</sup> "Indoor Air Quality," United States Department of Labor, Web June 25, 2020, <https://www.osha.gov/SLTC/indoorairquality/>.
- <sup>6</sup> Joseph G. Allen et al., "Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments," *Environmental Health Perspectives*, June 1, 2016, Web June 25, 2020, <http://dx.doi.org/10.1289/ehp.1510037>.
- <sup>7</sup> These questions, the four assessment levels and the product solutions are adapted from "Carrier Commercial Service Sales Guide for Healthy Building Services and Solutions," July 2020, internal Carrier document.
- <sup>8</sup> "ASHRAE Epidemic Task Force, Building Readiness," May 21, 2020, Web July 13, 2020, <https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-building-readiness.pdf>.
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- <sup>11</sup> "ASHRAE Position Document on Infectious Aerosols," April 14, 2020, Web June 25, 2020, [https://www.ashrae.org/file%20library/about/position%20documents/pd\\_infectiousaerosols\\_2020.pdf](https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf), 4.