Shaping Tomorrow's Built Environment Today

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December 5, 2022

Mr. Jonathan Edwards
Director
Office of Radiation and Indoor Air
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Sent Via Email to: *a-and-r-Docket@epa.gov*

RE: RFI: Better Indoor Air Quality Management To Help Reduce COVID-19 and Other Disease Transmission in Buildings: Technical Assistance Needs and Priorities to Improve Public Health (**Docket ID No. EPA-HQ-OAR-2022-0794)**

Dear Director Edwards:

ASHRAE is submitting this response to the U.S. Environmental Protection Agency's Request for Information on Better Air Quality Management to Help Reduce COVID-19 and Other Disease Transmission in Buildings. We are pleased the EPA is working to improve indoor air quality and reduce disease transmission. This is a goal ASHRAE shares as it is our vision to create a healthy and sustainable built environment for all.

ASHRAE, founded in 1894, is a technical society advancing human well-being through sustainable technology for the built environment. The Society and its more than 51,000 individual members – comprising engineers, academics and other professionals in the buildings industry – focus on building systems, energy efficiency, indoor air quality, refrigeration and sustainability. Through research, standards writing, publishing, certification and continuing education, ASHRAE shapes tomorrow's built environment today.

ASHRAE has a long history of developing technical tools and standards to promote healthy indoor environments. In 1895, the American Society of Heating and Ventilating Engineers (ASHVE), a predecessor of ASHRAE, produced its first ventilation standard with a required ventilation rate of 30 cfm per person. In 1973, ASHRAE created its Standard for *Natural and Mechanical Ventilation*,[1] which was subsequently adopted by reference into building codes. In addition, model code organizations used the standard to update their ventilation requirements.[2] The standard has been updated multiple times – and has been separated into standards for commercial (62.1) and residential (62.2) buildings since 2003.

These standards have benefitted building occupants in jurisdictions that have adopted them and through incorporation of some of their provisions in model building codes. However, it is mainly the prescriptive ventilation rates of ASHRAE Standard 62.1 that are adopted in building codes, not its very important provisions related to system design, construction, operation and maintenance. With no national model IAQ standard, building ventilation and IAQ requirements vary greatly from one jurisdiction to another and fall far short of achieving the impact of full compliance with ASHRAE's code-intended standards.

When the SARS-CoV-2 virus began to threaten global public health, ASHRAE stood up an Epidemic Task Force (ETF) that created hundreds of pages of guidance that was, and continues to be, used by government officials as well as the private sector to reduce health risks for building occupants. While motivated by COVID-19, ASHRAE's ETF guidance can also be useful for reducing the risk of other airborne viral transmissions and can form the basis for further development of consensus standards that address infection risk mitigation.

We hope the information provided by ASHRAE helps EPA promote and advance the widespread adoption of actions that lead to improvement in IAQ and help mitigate disease transmission.

Responses to Key Questions

3.1 In your opinion, what approach(es) could the Federal government consider deploying to move decision makers/owners/managers toward making and sustaining improved ventilation, filtration, and air cleaning practices to reduce the risk of disease transmission?

[1] ANSI/ASHRAE Standard 62-1973, *Standards for Natural and Mechanical Ventilation*

[2] Arthur E. Wheeler, P.E., Fellow ASHRAE, "A View of IAQ as the Century Closes," ASHRAE *Journal*, November 1999.

There are many ways in which Federal support could be helpful:

- Taking an active role in establishing procedures and for qualifying products used to improve IAQ that result in clear ratings for effectiveness and safety that are easy for the public to understand.
- Supporting the research necessary to reduce uncertainty in risk assessment so that more confidence can be reposed in the value of investments in improved IAQ
- Supporting the development of tools needed to assess risk and design energy efficient and cost-effective solutions.
- Developing guidance for different stakeholder groups (owner/operator, designer, tenant) on how to most effectively achieve good IAQ. An analogy might be made to ASHRAE's Advanced Energy Design Guides[3], developed in partnership with the Department of Energy that simplify design of low energy buildings.
- Developing or supporting development of IAQ rating systems for existing buildings, including the methods necessary to apply them.
- Support for IAQ standards development that address infection risk – technical and other.
- Support of a model national IAQ standard that could be adopted by state and local jurisdictions, and with federal government assistance for the adoption and enforcement of the standard.
- Education programs targeting designers, technicians, facilities engineers, code officials, and commissioning professionals.

ASHRAE and other non-governmental organizations can partner in some of these efforts as they have in the past in other areas related to the built environment.

3.2 In your opinion, what are the near-term indoor air quality related actions that could help schools respond to a COVID-19 disease surge?

Through the work of its Epidemic Task Force (ETF), ASHRAE has developed and disseminated extensive guidance on how HVAC-focused engineering controls can contribute to the mitigation of indoor transmission of COVID-19 as part of a program that incorporates a broad spectrum of non-pharmaceutical and pharmaceutical controls. ASHRAE guidance, which is posted on the ASHRAE web site (ashrae.org/covid19) is summarized concisely in the ETF Core Recommendations for Reducing Airborne Infectious Aerosol Exposure[4]. Implementation of the

[3] "AEDG - Advanced Energy Design Guides." www.ashrae.org/technical-resources/aedgs.
[4] ASHRAE Epidemic Task Force, "Core Recommendations for Reducing Airborne Infectious Aerosol Exposure," October 19, 2021. https://www.ashrae.org/file%20library/technical%20resources/covid-19/core-recommendations-for-reducing-airborne-infectious-aerosol-exposure.pdf

Core Recommendations is discussed in the ETF Building Readiness guidance[5]. A guidance document specifically for schools[6] was also developed.

The overall approach is to flexibly combine dilution of contaminants with outdoor air, filtration of indoor air to remove fine particulate matter that may contain infectious particles, and use of air cleaners that inactivate infectious aerosols by various means. This approach allows solutions to be tailored to the conditions and risk management objectives of facilities with a range of system types, climate, and economic constraints by using an equivalent clean air delivery approach as a basis for combining controls. It also provides a framework for improving IAQ while continuing to reduce energy use and carbon emissions associated with the built environment. The ASHRAE ETF has produced a tool to assist in the calculation of the equivalent clean (non-infectious) air delivery rate from all sources in a building. It can be downloaded from the Building Readiness guidance at ASHRAE COVID-19 resources page.[7]

Specific recommendations based on the Core Recommendations are:

a) *Follow public health guidance*. HVAC systems are not the only control available, nor are they necessarily the most effective. Vaccination, use of masks/respirators, and distancing are examples of public health measures that can significantly reduce risk.
b) *Ensure that outdoor air supply meets minimum requirements found in codes and standards*. In general, systems should be recommissioned, which should include checking of outdoor air flows by qualified professionals. The Government Accountability Office (GAO) report on the condition of U.S. schools[8] found HVAC systems, which bring in outdoor air among their multiple environmental control functions, were the building system most commonly in need of repair or replacement, a problem affecting approximately 36,000 schools (Fig. 1). Exceeding code outdoor air minimums as an emergency measure is not always needed, or even very beneficial given that other good options for increasing risk mitigation are available in most cases and because in many systems increasing outdoor air reduces recirculated flow through central filters.

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[5] ASHRAE Epidemic Task Force, "Building Readiness," Updated May 17, 2022. https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-building-readiness.pdf

[6] ASHRAE Epidemic Task Force, "Schools & Universities," Updated May 14, 2021. https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-reopening-schools-and-universities-c19-guidance.pdf

[7] ASHRAE Epidemic Task Force, "Equivalent Outdoor Air Calculator" Version 1.3, May 9, 2022. Google Docs, docs.google.com/spreadsheets/d/1GUCcjAyhzrTATHD8SQvNcF7JnuWKpadSVT6LA_8SUII/edit.

[8] U.S. Government Accountability Office, "K-12 Education: School Districts Frequently Identified Multiple Building Systems Needing Updates or Replacement." 4 June 2020. www.gao.gov/products/gao-20-494.

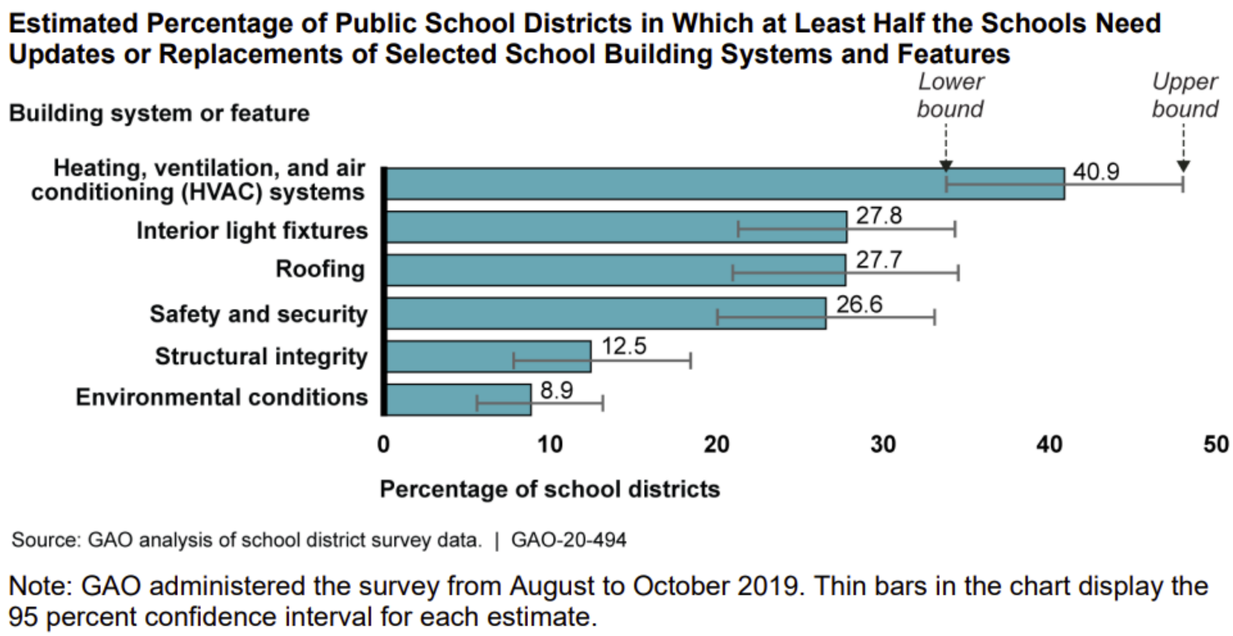

Fig. 1 Most common maintenance issues in US schools as reported by the Government Accountability Office

c) *For recirculated air, use filters or combinations of filters and other controls that achieve MERV 13 or better performance*. At the time of the beginning of the pandemic, the minimum filter efficiency used in most equipment was no higher than MERV 8, which has very little capability to remove particles in the size ranges that contain the bulk of the infectious load produced by respiratory emissions. By upgrading filter efficiencies in existing systems, infectious aerosol levels can be reduced without significant changes to system airflows.

d) *Portable air cleaners can supplement existing ventilation and filtration systems to achieve overall clean air delivery rate targets*. Commercial units with HEPA filters are to be preferred, but there is ample evidence that do-it-yourself (DIY) air cleaners that use box fans to draw flow through moderately high efficiency filters may be an economic emergency measure. DIY filtration units have been studied previously as a means of mitigating wildfire smoke and have been tested for safety by EPA.[9] ASHRAE agrees with EPA that DIY air cleaners should not be viewed as a *permanent* alternative to products that have rated performance.

e) *If effective, safe, efficient, and economical, other air cleaner types can be considered*. Unfortunately, the availability of the testing protocols and certification programs needed to meet this bar is lacking. ASHRAE is developing standards such as Standard 185.3 *Method of Testing In-Room Devices and Systems for Microorganism Removal or*

[9] U.S. Environmental Protection Agency,"Research on DIY Air Cleaners to Reduce Wildfire Smoke Indoors." 31 Aug. 2022, www.epa.gov/air-research-diy-air-cleaners-reduce-wildfire-smoke-indoors

Inactivation in a Chamber. Among alternatives to filtration, germicidal ultraviolet disinfection has been studied extensively and applied for air disinfection since the 1930s and is permitted by the Centers for Disease Control and Prevention (CDC) as a secondary environmental control for tuberculosis control.[10]

ASHRAE's ETF guidance addresses other details of operation.

The question of what the non-infectious air delivery rate should be has been the subject of heated debate throughout the pandemic. The consensus of those who have looked critically at the literature on the relationship between ventilation and infection rates is that while there is conclusive evidence of a relationship, there is not conclusive evidence of what minimum rates for infection control should be.[11]

Recommendations for non-infectious air delivery rate endorsed by various sources during the pandemic have included six air changes per hour (ACH) based on analogy to rates in ASHRAE Standard 170 for healthcare facilities and 10 L/s-person (21 cfm/person) based on the effect on average indoor concentration distant from an infector, a level endorsed by the World Health Organization[12] for non-healthcare facilities. A recent report[13] proposed non-infectious air delivery rates in several forms, including both of the above and, in addition, a method that was reviewed by the ASHRAE ETF and found not to represent a sufficient improvement over the others to warrant endorsement. This third approach entailed adding the same amount of additional non-infectious air supply per unit area to whatever the minimum outdoor air requirement is in ASHRAE Standard 62.1.

Others[14,15] have used infection risk assessment based on the Wells-Riley model to develop custom targets based on the occupancy scenario and the user's definition of acceptable risk. The

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[10] Jensen, Paul A., L. Lambert, M. Iademarco, R. Ridzon, "Guidelines for Preventing the Transmission of *Mycobacterium Tuberculosis* in Health-Care Settings," Centers for Disease Control and Prevention, *Morbidity and Mortality Weekly Report.* 30 December 2005. www.cdc.gov/mmwr/preview/mmwrhtml/rr5417a1.htm

[11] Li, Y., Leung, G.M., Tang, J.W., Yang, X., Chao, C.Y., Lin, J.Z., Lu, J.W., Nielsen, P.V., Niu, J., Qian, H. and Sleigh, A.C., 2007. Role of ventilation in airborne transmission of infectious agents in the built environment-a multidisciplinary systematic review. *Indoor air*, *17*(1), pp.2-18.

[12] Roadmap to improve and ensure good indoor ventilation in the context of COVID-19. Geneva: World Health Organization; 2021.

[13] Task Force on Safe Work, Safe School, and Safe Travel, and Joseph Allen. "Proposed Non-infectious Air Delivery Rates (NADR) for Reducing Exposure to Airborne Respiratory Infectious Diseases." The Lancet COVID-19 Commission, Nov. 2022, static1.squarespace.com/static/5ef3652ab722df11fcb2ba5d/t/637740d40f35a9699a7fb05f/1668759764821/Lancet+Covid+Commission+TF+Report+Nov+2022.pdf.

[14] Kurnitski, J., Kiil, M., Wargocki, P., Boerstra, A., Seppänen, O., Olesen, B. and Morawska, L., 2021. Respiratory infection risk-based ventilation design method. *Building and Environment*, *206*, p.108387.

[15] Dai, H. and Zhao, B., 2023. Association between the infection probability of COVID-19 and ventilation rates: An update for SARS-CoV-2 variants. In *Building Simulation* (Vol. 16, No. 1, pp. 3-12). Tsinghua University Press.

range of recommendations for minimum ventilation rates resulting from these analyses spans several orders of magnitude. This is indicative of both how complex this issue is and the uncertainty inherent in them. At the low end, many systems are close to complying with little supplementary control. For example, placing an air cleaner sized to the Association of Home Appliance Manufacturers recommendation[16] will add about 4 ACH, which should bring most classrooms, especially those with mechanical ventilation that meets code up to 6 ACH of total non-infectious air delivery.

Given the current state of knowledge, ventilation rate recommendations should be treated as guidelines. The lack of well-validated, precise recommendations should not be taken as an excuse to do nothing. Bringing classroom spaces to at least 6 ACH should significantly reduce exposure compared with existing baselines for properly maintained and operated systems and is generally feasible. A recent study of the effect of mechanical ventilation on COVID-19 infection rates in Italian schools in the Marche region found that on average mechanical ventilation reduced rates by about 80% with mechanical ventilation rates of 10 L/s-pers or more. This is within the 4-6 ACH range sometimes suggested. However, this is surely a minimum, interim recommendation and not the last word.

3.3 In your opinion, over the longer term, how can ventilation, filtration and air cleaning improvements be prioritized and made standard practices in building design, construction, commissioning, renovation, and operations and maintenance efforts (*e.g.*, building code adoption, training or other efforts to sustain proper practices such as operation and maintenance of HVAC systems as designed, weatherization and other retrofit programs)?

Although indoor air has been the subject of study for centuries, investment in the research needed to address important knowledge gaps has been lacking. A few of the key ones includes:

- A consensus operational definition of good indoor air quality in terms of specific contaminant exposures. (ASHRAE Standard 62.1-2022 does, through its Indoor Air Quality Procedure (IAQP), provide a list of contaminants and control levels, that represents the state of knowledge, but it does not address infection risk mitigation);
- Sufficient understanding of the relationship between clean air delivery rates (whether outdoor or filtered/disinfected air) and infection risk to accurately establish minimum requirements;
- Effectiveness and safety of air cleaners; and

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[16] Association of Home Appliance Manufacturers, "Air Filtration Standards." AHAM Verifide, 23 Mar. 2022, ahamverifide.org/ahams-air-filtration-standards.

- Effect of air distribution system design on IAQ.

Therefore, it is strongly recommended that the Federal government direct resources to improving the knowledge base needed to support management of IAQ.

There is a lack of practical tools for modeling of contaminant transport and exposure that are well-integrated with whole-building energy modeling. Software like the National Institute of Standards and Technology (NIST) CONTAMW[17] multizone model are in need of further development to make their extensive IAQ modeling capabilities more accessible and they should allow for estimation of health effects. Upgrading of CONTAMW was highlighted as a priority in the FY 2020 review of NIST laboratories by the National Academies: "The Engineering Laboratory should improve the CONTAM user interface and seek opportunities to demonstrate the interaction between indoor air quality and energy efficiency analyses." This is highly important as one of the most significant barriers to adoption of measures that improve IAQ is the perception that they have a significantly adverse effect on energy use. Tools that allow designers to develop low energy solutions will help to overcome it.

There has been limited national leadership on requirements for design or operation and building codes that almost exclusively focus on design. This has contributed to the deficiencies in delivered IAQ that are now front and center among public concerns. If existing buildings simply complied with the applicable ASHRAE air quality standards, 62.1 and 62.2, it would be a great improvement. ASHRAE believes that model national IAQ standards playing a role similar to that of ASHRAE Standard 90.1[18] for non-residential energy efficiency and the International Energy Conservation Code (IECC)[19] for residential buildings could have a similar impact. Since the adoption of ASHRAE Standard 90 as the national model for state energy codes in 1975, the normalized regulated energy use of the buildings to which it applies has fallen to less than 50% of what it was initially (Fig. 2) and most states have energy codes that comply with some version of the model codes (Fig. 3).

[17] National Institute of Standards and Technology, "CONTAM." 8 Jan. 2021, www.nist.gov/services-resources/software/contam.

[18] ANSI/ASHRAE/IES Standard 90.1, *Energy Efficiency Standard for Buildings Except Low-Rise Residential Buildings.*

[19] International Code Council, Inc., *International Energy Conservation Code.*

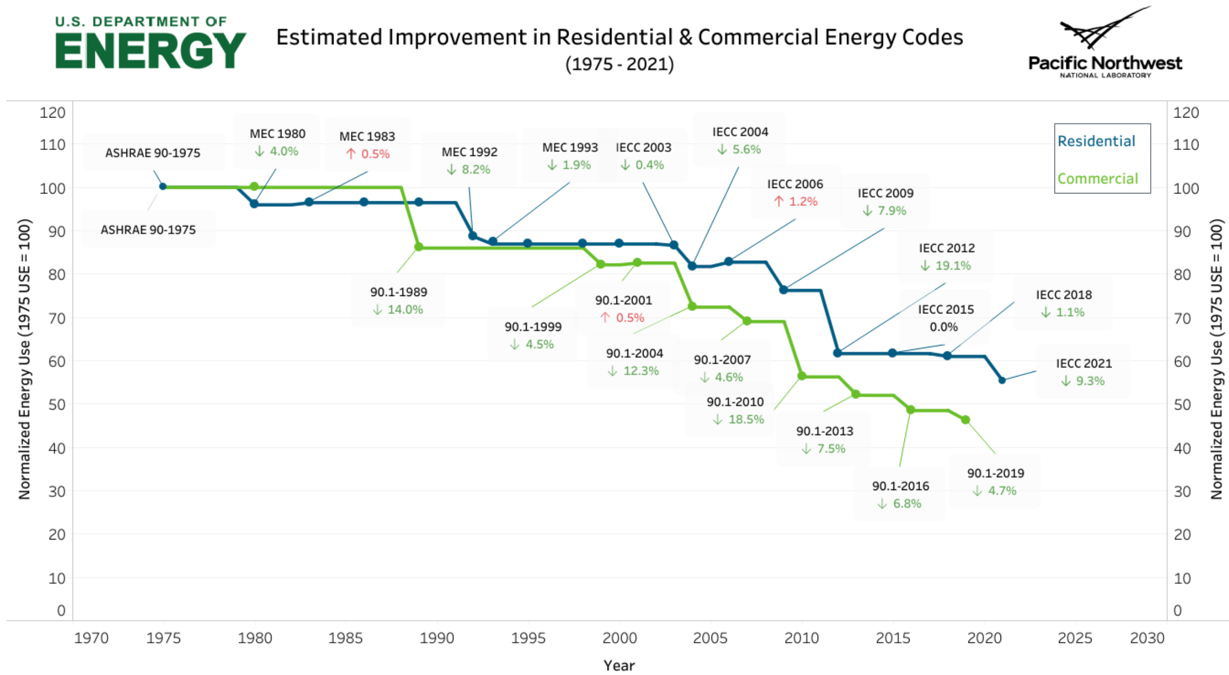


Fig. 2. Progress in stringency of national model energy codes (www.energycodes.gov/infographics)

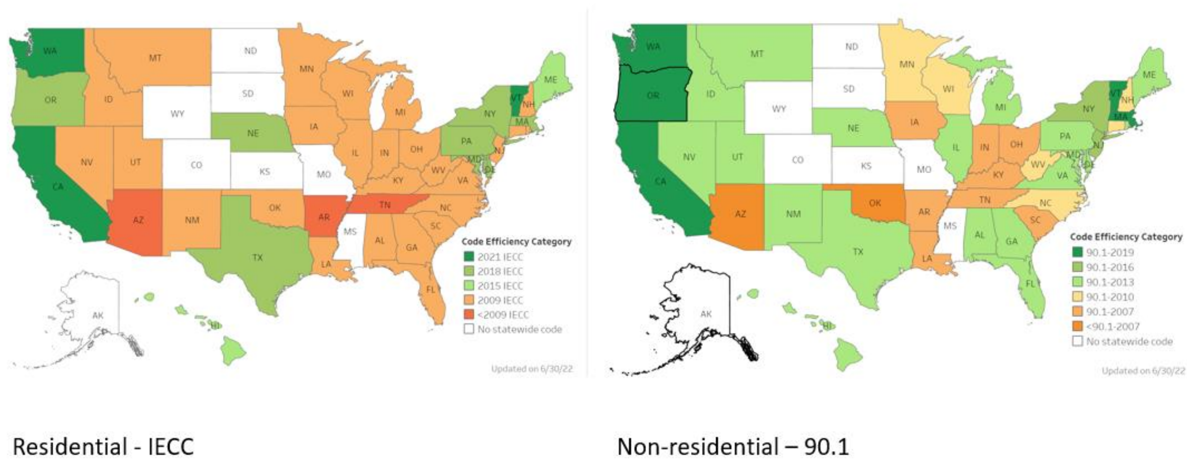


Fig. 3. Status of state energy code adoption. (www.energycodes.gov/state-portal)

ASHRAE has shared with the White House that it is committed to developing a consensus-based, code enforceable standard to mitigate risk from respiratory pathogens that could serve as a national model code. Federal support for national standards would positively impact future changes in building codes and could begin immediately by using ASHRAE's existing standards as the starting point. Future developments could address not only infection risk, but also broader concerns about the impact of indoor environments on productivity and health, which have huge national economic implications. It will be essential that guidance and requirements for IAQ are coordinated with standards for energy use and emissions that are needed to address climate change. They must also be economically feasible for the owner. If energy use and cost are not properly addressed, the likelihood of the paradigm shift[20] in IAQ standards that is envisioned is low.

However, improved design standards are not sufficient. As previously noted, IAQ deficiencies frequently have their root cause in operational issues. Unless there is encouragement to maintain performance over time, even the most ambitious design standards will fail to achieve their intent. Consideration should be given to developing IAQ disclosure programs analogous to energy disclosure programs. A growing number of jurisdictions require reporting of energy use data and display of the results (Fig. 3). A similar approach to quantifying IAQ based on appropriate metrics could stimulate voluntary improvements by owners or be the basis for requirements to remediate. Federal leadership could take the form of both establishing guidelines for performance and providing resources to implement them through building assessments and upgrades.

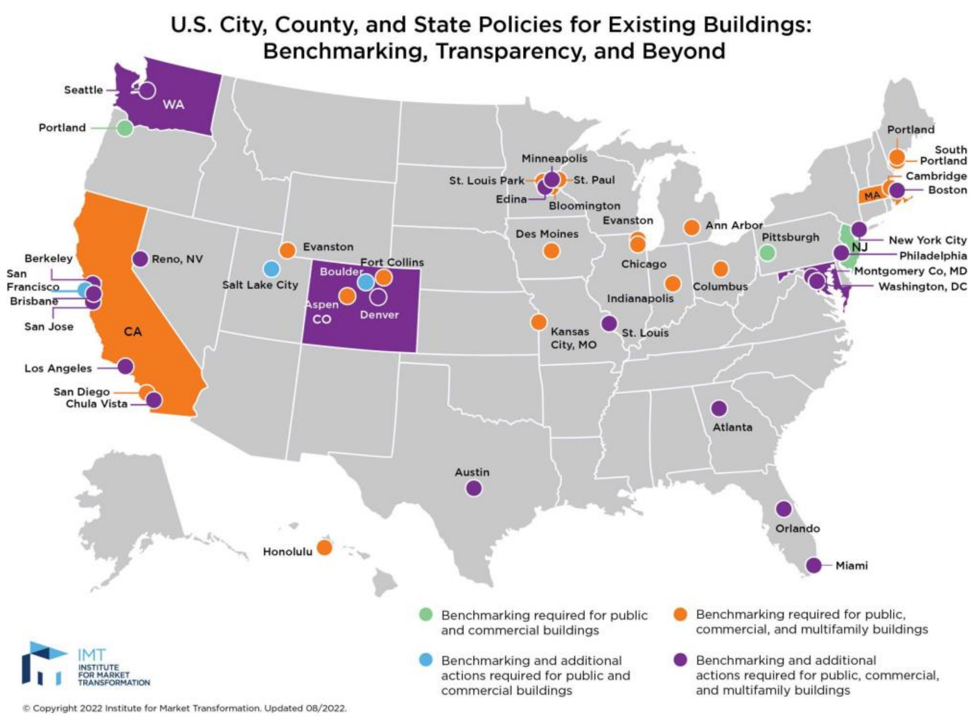


Fig. 4. Status of state and municipal energy benchmarking. (www.imt.org/resources/map-u-s-building-benchmarking-policies/)

There is valid concern that the workforce to design, operate, and maintain buildings that maintain a high level of IAQ does not exist. Programs to educate, train, and certify a range of specialists

[20] Morawska, L., Allen, J., Bahnfleth, W., Bluyssen, P.M., Boerstra, A., Buonanno, G., Cao, J., Dancer, S.J., Floto, A., Franchimon, F. and Greenhalgh, T., 2021. A paradigm shift to combat indoor respiratory infection. *Science*, *372*(6543), pp.689-691.

are needed. This presents an excellent opportunity for public private partnership with the Federal government working together with professional and technical organizations to develop targeted curricula to obtain credentials that are required or preferred in order to practice as an IAQ specialist.

3.4 In your opinion, what is an effective approach for a building recognition program (*e.g.*, pledge campaign, performance tiers, certification program)?

The most important thing to note regarding recognition programs is that they must include, and perhaps emphasize, existing buildings. Recognition for new buildings as designed may have a beneficial effect, but only on a small fraction of the building stock. It is also important that recognition programs have a renewal period. As noted several times in this response, failure to maintain the condition of existing buildings is the most important factor contributing to poor IAQ in many buildings. For existing buildings, *progress* toward goals should be recognized, not only the absolute level achieved. A rating can incorporate both a continuous scale and levels, as is already done for energy efficiency. A national model standard for IAQ could be the baseline level for recognition with additional recognition for exceeding it.

3.5 In your opinion, what are key characteristics of a building recognition program that would be needed to document credible efforts toward improved ventilation, filtration, and air cleaning in buildings?

A recognition program should have a combination of prescriptive and performance requirements. Prescriptively, bringing outdoor air up to or beyond code, installing higher efficiency filters, adding air cleaners, and installing continuous monitoring for important indoor pollutants could be credited. Some control system upgrades might also be included, for example, improved demand control ventilation that is driven by levels of multiple key parameters such as PM2.5, formaldehyde, ozone as well as more conventional carbon dioxide control (which controls outdoor air flow rate per person).

It is critically important, if a recognition program is to have a real impact, that it require a physical assessment of a facility, not merely a paper review. Conducting regular assessments and maintaining a plan for ensuring ongoing good IAQ should be mandatory. ASHRAE has extensive experience in this type of recognition program for building energy efficiency through its Building EQ certification[21]. A similar program could be developed that focuses on IAQ and a combined rating that credits both IAQ and energy performance actually achieved.

[21] https://www.ashrae.org/technical-resources/building-eq

ASHRAE is an authority for development of procedures for evaluating and remediating HVAC systems. Its standards and guidelines related to commissioning (Standard 111 *Testing, Adjusting, and Balancing of Building HVAC Systems*, Standard 202 *Commissioning Process for Buildings and Systems*, forthcoming Standard 230 *Commissioning for Existing Systems and Assemblies*, Guideline 0 *The Commissioning Process*, and others) are widely used by commissioning professions.

3.6 In your opinion, what quantifiable metrics or targets could be helpful in evaluating or assessing ventilation, filtration, and air cleaning parameters in a building?

This question was partially answered in the response to 3.5. Summarizing, there are both asset characteristics (outdoor air flow compliance with standards, filter efficiency, automatic control of IAQ) and outcomes (measured levels of PM2.5, formaldehyde, and other contaminants) that could be measured. Other metrics such as trends in absenteeism, academic performance of students, performance on cognitive function, would shed light on the effect of IAQ interventions, but their measurement may not be practical and is subject to various confounding factors.

3.7 In your opinion, what changes would you recommend to the Clean Air in Buildings Challenge best practices document to improve public engagement and participation by a broad set of stakeholders?

The Clean Air in Buildings Challenge, in concept, is an excellent tool to convey key recommendations about how to achieve better IAQ to a broad audience in a concise way. The use of the document in application requires the assistance of qualified professionals. Some parts of the document are less clear than they could be, and the document includes some questionable recommendations. The simplest way to point out these issues is via a mark-up, which is attached[22]. The focus of the document shifts from overall IAQ to infection control. It would be stronger to emphasize the need for better IAQ with infection risk mitigation being one aspect of improving IAQ. This would emphasize that there is a national IAQ problem that needs to be fixed and that it will not go away when the pandemic ends.

3.8 In your opinion, how might lessons from the COVID pandemic be useful for long-term efforts to improve ventilation, filtration, air cleaning and other indoor air quality parameters in the nation's building stock?

Some of the most important lessons of the pandemic include:

1. Public health and building science have not been well connected and the importance of HVAC-based infection controls was not emphasized for far too long. Efforts to better

[22] Attachment: U.S. EPA, "Clean Air in Buildings Challenge," March 2022, with ASHRAE comments.

connect the two spheres of expertise are needed. There was little consensus regarding requirements for building operations from government agencies with public health and IAQ responsibilities. This should be addressed as soon as possible in support of possible changes to IAQ standards so that new and renovated buildings will have systems that are better prepared for operation during respiratory disease outbreaks.

2. Although the hierarchy of controls and the Swiss cheese model of risk management are well known, integrated risk assessment based on those models was not sufficiently well-developed to be helpful. As a result, there is little agreement today on what role building systems need to play in the future in the overall infectious disease transmission risk mitigation strategy both for established diseases like influenza and for future novel pathogens like SARS-CoV-2.
3. Too many buildings do not perform as intended due to inadequate maintenance. This is perhaps the most significant IAQ deficiency of all. It is critically important to take steps to ensure that performance is maintained over the life of a building.
4. Existing buildings are generally not resilient with respect to challenges like the COVID pandemic. Design practices today do not require that buildings be able to adapt to severe infectious disease outbreaks even though they must be designed, where applicable, for earthquake and flood resistance. Standards and best practices should consider who to cost-effectively and efficiently make it possible for buildings to shift to a protective mode when needed. This applies also to buildings in wildfire regions.
5. Underinvestment in IAQ research has left major gaps in understanding that have made response to the pandemic more difficult. Much of this research needs to be done by infectious disease transmission experts to help the building science community understand what it needs to do.
6. Many technologies that *might* be helpful to mitigate infection risk lacked needed testing and certification programs. ASHRAE is helping to address this deficiency with several new standards such as 185.3 *Method of Testing In-Room Devices and Systems for Microorganism Removal or Inactivation in a Chamber* and others are also considering action. The work of EPA during the pandemic to improve understanding of air cleaning technologies and develop appropriate test methods is greatly appreciated.

3.9 What else would you like to note about opportunities and issues that could improve indoor air quality in the nation's building stock?

Consider extending the Clean Air Act to address Indoor Air

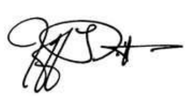
The Clean Air Act (CAA) has had a profound effect on the quality of outdoor air in the United States during the 50 years that it has been in force. Currently, there are no comparable Federal regulations for indoor air. In its 50th anniversary report, the Clean Air Act Advisory Committee (CAAAC) devoted an entire section to indoor air. The committee noted that:

Through the CAA and OSHA, the public is protected from hazardous levels of outdoor air pollution and industrial workers are protected from hazardous levels of indoor air pollution. However comprehensive public health standards for indoor air quality, in residences, schools, community buildings or commercial spaces, do not yet exist at the federal level. This gap in public health and safety is not negligible: indoor air generally contains more air pollutants than outdoor air and many of those pollutants occur at higher concentrations than outdoor air… This report recommends that the EPA build on the success of the CAA by developing a strategy exploring the viability of the federal government establishing national indoor air quality guidelines and/or standards.

ASHRAE encourages EPA to consider the overall recommendation and nine specific related recommendations in the CAAAC report.

Thank you for the opportunity to provide recommendations to EPA to support indoor air quality and reduce disease transmission inside buildings. Please do not hesitate to contact me for more information, or have your staff contact GovAffairs@ashrae.org. Thank you again for your consideration of our comments.

Sincerely,



Jeff H. Littleton
Executive Vice President

Attachment: U.S. EPA, "Clean Air in Buildings Challenge," March 2022, with ASHRAE comments.

Clean Air in Buildings Challenge

U.S. ENVIRONMENTAL PROTECTION AGENCY MARCH 2022

This document provides basic principles and general actions recommended to improve [indoor air quality](#) (IAQ) in buildings and reduce the risk of airborne spread of viruses and other contaminants. These actions, as well as technical assistance and tools provided through the links, are intended to support building owners and operators, as well as organizational leaders and decision makers, to make ventilation and other IAQ improvements.

Infectious diseases like COVID-19 can spread through the inhalation of airborne particles and aerosols. In addition to other layered prevention strategies, taking actions to improve IAQ can reduce the risk of exposure to particles, aerosols, and other contaminants, and improve the health of building occupants. None of these actions will eliminate risk completely, and building owners and operators may not need or be able to take all actions listed below. The best combination of actions for a building will vary by space and location. When determining which actions to take to help protect occupants, building owners and operators should consider, for example, public health guidance, who and how many people are in the building, the activities that occur in the building, outdoor air quality, climate, weather conditions, and the installed heating, ventilation, and air conditioning (HVAC) equipment. Some actions may increase energy consumption and may be more appropriate as temporary measures when disease transmission is higher. Building owners and operators should engage experts, facilities managers, and others who are skilled, trained, and/or certified in HVAC work to develop and implement plans to improve IAQ and manage air flows. Individual actions and layered prevention strategies remain important measures for reducing the spread of viruses.

American Rescue Plan and Bipartisan Infrastructure Law funds can be used to supplement investments in ventilation and IAQ improvements in public settings.

1. CREATE AN ACTION PLAN FOR CLEAN INDOOR AIR IN YOUR BUILDING(S) that assesses IAQ, plans for upgrades and improvements, and includes HVAC inspections and maintenance.

- Determine how clean outdoor air is brought into the building and distributed to all occupied spaces. Understand and document how HVAC systems work for your building.
- Work with an HVAC expert to assess and inspect systems for ventilation, filtration, and air cleaning. Verify through commissioning, testing, and balancing that building systems are functioning as designed.
- Implement other IAQ assessment approaches such as carbon dioxide (CO2) monitors as needed.
- Determine how much clean air (outdoor air + filtered HVAC recirculation air) is needed and verify or measure air delivery for each room or space.
- Assess if you need to manage the direction of air flows in higher risk areas of your building (e.g., in a school nurse's office).
- Create an IAQ action plan that includes regular inspections and maintenance, including filter replacements, and HVAC system upgrades or improvements, as needed.
- Support the people who operate or help with building and air distribution systems by providing continuing education and training.

2. **OPTIMIZE FRESH AIR VENTILATION** by bringing in and circulating clean outdoor air indoors.

- Ensure outdoor air is acceptably clean or is adequately filtered as it is brought into the building.
- Properly use economizers, which are devices that supplement mechanical cooling with fresh air, to efficiently and cost effectively increase fresh air ventilation.
- Run HVAC systems during all occupied hours to ensure clean air enters and is distributed throughout the building.
- Ensure that exhaust fans in bathrooms are functioning, and set fans to run during occupied hours.
- Increase volume of clean, outdoor air at times of higher risk (e.g., at times of elevated risk of COVID-19):
  - Adjust HVAC settings while considering thermal comfort, humidity, outdoor air quality, and energy use.
  - Consider running the HVAC system to refresh air before arrival and/or remove remaining particles at the end of the day (e.g., 1-2 hours before/after the building is occupied), as needed.
  - Check with an HVAC expert to understand the maximum outdoor air your system can support.
- Open operable windows, as weather, outdoor air quality, occupant safety, and HVAC systems permit. To the extent possible, enable cross ventilation by opening windows and doors at opposite sides of the room or building. (Note: Opening windows while running HVAC systems may increase energy costs or introduce other air contaminants.)

3. **ENHANCE AIR FILTRATION AND CLEANING** using the central HVAC system and in-room air cleaning devices.

- Install properly sized MERV-13 air filters or the highest rated MERV filters that the HVAC system can accommodate.
- Close off any gaps around air filters to minimize air moving around them instead of through them.
- Use portable air cleaners to increase air cleaning rates in areas where air flow and central filtration are insufficient:
  - Select devices that are appropriately sized for the space in which they will be used. Consider ENERGY STAR certified products. If noise is a consideration, look for a product with lowest perceived sound levels.
  - As a temporary measure, do-it-yourself air cleaners can also be built from HVAC filters and box fans.
- Increase ventilation and/or filtration in areas with higher emission of airborne particles and aerosols (e.g., gyms, cafeterias, or choir/music rooms at schools). You can make adjustments for these areas by:
  - Increasing the volume of clean, outdoor air delivery.
  - Using portable air cleaners.
  - Setting up extra exhaust ventilation to move air directly to the outside.
- Consider an upper-room Ultraviolet Germicidal Irradiation (UVGI) system to clean the air. (UVGI systems require professional design and installation, in consultation with experts.)

4. **GET YOUR COMMUNITY ENGAGED IN YOUR ACTION PLAN** by communicating with building occupants to increase awareness, commitment, and participation in improving indoor air quality and health outcomes.

- Communicate to affected people (e.g., building occupants, workers, students, teachers, and parents) about how the action steps you are taking will improve indoor air quality and reduce disease transmission in your building.
- Show your work by hosting building walkthroughs, posting descriptive signage, or communicating on social media. Demonstrate the importance of individual actions to ensure facility operations are optimal (e.g., keeping ventilation systems clear of clutter).
- Provide feedback mechanisms such as maintenance requests to identify repair issues and surveys to gather perspectives from your community.
- Remember individual actions and layered prevention strategies remain important measures for reducing the spread of viruses like COVID-19.

ADDITIONAL RESOURCES

Clean Indoor Air Resources

Indoor Air Quality
https://www.epa.gov/indoor-air-quality-iaq

Indoor Air and Coronavirus (COVID-19)
https://www.epa.gov/coronavirus/indoor-air-and-coronavirus-covid-19

Ventilation and Coronavirus (COVID-19)
https://www.epa.gov/coronavirus/ventilation-and-coronavirus-covid-19

Air Cleaners, HVAC Filters, and Coronavirus (COVID-19)
https://www.epa.gov/coronavirus/air-cleaners-hvac-filters-and-coronavirus-covid-19

Interactive Ventilation Tool
https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/interactive-ventilation-tool.html

Indoor Air Quality Scientific Findings Resources Bank
https://iaqscience.lbl.gov/

Ventilation in Buildings
https://www.cdc.gov/coronavirus/2019-ncov/community/ventilation.html

Ventilation in the Workplace
https://www.osha.gov/ventilation

Improving Indoor Ventilation During Cold Weather
https://www.osha.gov/sites/default/files/publications/OSHA4172.pdf

COVID-19 Guidance on Ventilation in the Workplace
https://www.osha.gov/sites/default/files/publications/OSHA4103.pdf

ASHRAE Epidemic Task Force, Core Recommendations
https://www.ashrae.org/file%20library/technical%20resources/covid-19/core-recommendations-for-reducing-airborne-infectious-aerosol-exposure.pdf

Resources for Schools

Creating Healthy Indoor Air Quality in Schools
https://www.epa.gov/iaq-schools

Efficient and Healthy Schools Campaign
https://efficienthealthyschools.lbl.gov/

Efficient and Healthy Schools Website
https://www.energy.gov/eere/buildings/efficient-and-healthy-schools

ASHRAE Epidemic Task Force Guidance for Schools and Universities
https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-reopening-schools-and-universities-c19-guidance.pdf

Resources for Building Professionals

Indoor Air Quality Master Class Professional Training Webinar Series
https://www.epa.gov/iaq-schools/indoor-air-quality-master-class-professional-training-webinar-series

Indoor Air Quality in Offices and Other Large Buildings
https://www.epa.gov/indoor-air-quality-iaq/indoor-air-quality-offices-and-other-large-buildings

Better Buildings Resource Center: Building Operations during COVID-19
https://betterbuildingssolutioncenter.energy.gov/covid19

ASHRAE Indoor Air Quality Guide
https://ashrae.org/iaq

ASHRAE Epidemic Task Force Guidance for Commercial Buildings
https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-commercial-c19-guidance.pdf