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Will Schools Be Ready?

From coast-to-coast, our second COVID summer has brought with it another frantic scramble to assess the indoor air quality needs of school buildings. But this time new federal funding is available to make more upgrades a reality.

A Special HPAC Engineering eBook

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Lessons Still Being Learned

This second anxious summer of the Coronavirus pandemic is distinct from the last in at least two very tangible ways: school districts across the U.S. now have ample federal funds available to assist in fall preparation efforts and the U.S. Dept. of Education is now unequivocal in recommending that ventilation improvements should be a top priority.

In July, echoing updated guidance from the Centers for Disease Control, the U.S. Dept. of Education stated, "School leaders across the country can act now to improve ventilation in their buildings." And specifically, the American Rescue Plan's $122 billion allocation to the Elementary and Secondary Schools Emergency Relief (ESSER) Fund will help make that possible.

This *HPAC Engineering* e-book offers our readers in the education market a handy reference guide to the latest industry guidance available, expert advice on making the most of new federal funding, and a look back on a tumultuous year of crisis learning and trial by fire.

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ROB MCMANAMY
HPAC Engineering

USGBC: HOW FEDERAL COVID-19 RELIEF FUNDS CAN ADVANCE GREEN SCHOOLS

Billions of dollars are still available to protect students and teachers from COVID-19 and to make schools more resilient to pandemic-related disruptions — if you know how to ask.

BY MICHAEL O'REILLY, USGBC
AUGUST 2021

Billions of dollars in aid are available to protect students and teachers from COVID-19 and to make schools more resilient to pandemic-related disruptions—if you know how to ask.

Since the COVID-19 pandemic spread throughout the United States, Congress passed three major packages of assistance: the Coronavirus Aid, Relief, and Economic Security Act (CARES Act); the Coronavirus Response and Relief Supplemental Appropriations Act (CRRSAA); and the American Rescue Plan (ARP). These combined to allocate a total of $176 billion in emergency relief funds for K–12 schools. Within the funding, there are opportunities to advance the objectives of green schools.

THE IMPORTANCE OF A SCHOOL'S INDOOR AIR QUALITY

When we think of pollutants, we often think about those found outdoors—such as plastic trash you see on a hike or an oil spill you hear about on the news. With so many visible sources to consider, it is common to overlook the conditions of the air inside your home, business or school as a concern. Indoor air

quality (IAQ), however, is vitally important to health and education. Human beings spend about 90% of our time indoors, and poor IAQ is contributing to a decline in immunity against disease because of increased incidence of respiratory health issues.

Additionally, IAQ is critical to student performance and is strongly connected to health and well-being. A strong body of evidence has linked deficient indoor air quality at school with poor health outcomes and performance on standardized tests. A recent American University study found that exposure to air pollution in middle childhood had a much larger effect on test scores in the state of Florida than exposure during later adolescence. Breathable air that is free from pollutants is not only wanted in our homes, schools and businesses, but is *needed* for a higher quality of life.

ADVICE FOR GREEN SCHOOLS ADVOCATES

The federal funding aimed at fighting the effects of COVID-19 can be used to advance healthy, green schools. The Center for Green Schools at USGBC, along with its partners in UndauntedK12, recently hosted a webcast to help green schools advocates to understand the common misconceptions and possible hurdles to overcome in using federal relief funding to advance school infrastructure projects.

What are the major differences between the CARES Act funds, CRRSAA funds and American Rescue Plan funds?

The CARES Act, passed in March 2020, was an initial emergency reaction to the pandemic to allow children to continue to receive an education, and the funding has almost been exhausted. CARES funding was focused on keeping teachers paid and offsetting losses in school budgets to sustain them for the rest of the academic year. CRRSAA and the American Rescue Plan are more holistic, and after advocacy by USGBC and other partners, include language to explicitly allow funding to be used on school facilities and on IAQ improvements. In terms of funding levels, the American Rescue Plan allocated around nine times the funding that was allocated in the CARES Act and over double what was allocated in CRRSAA to schools, so it is a much larger source of funding.

How would a school district use the funds available to them for a facilities project?

Many school officials have expressed uncertainty over whether these funds are available to be used on facilities improvements. This confusion may stem from their inexperience in using federal funds for school construction or from the various state interpretations of U.S. Department of Education's guidance. However, the U.S. Department of Education has been very clear that school districts can use this federal relief funding on construction (see FAQ on the funding, questions B-6 and B-7).

Let's say a school has an inefficient HVAC system that didn't allow the best air quality measures to be put into place, and it needed to be replaced. This type of improvement clearly falls within allowable uses of the federal COVID-19 relief funding, because it directly relates to following the Center for Disease Control and Prevention air quality recommendations regarding fresh air and filtration. It also assists school districts in increasing energy efficiency, which will yield a long-term benefit from this one-time funding. The school district would include the replacement in its plan for the relief funding, along with the other uses of funding it is considering.

How can I advocate for COVID-19 relief funding to be used to further green schools?

Formulate a clear and straightforward request for the school district leader you plan to speak to. Research who will be the most influential person to reach at the district, such as your elected school board member or the superintendent. Be ready to share any data or examples about what your specific needs are. You can gain a deeper understanding of how COVID-19 relief funding can be used from the resource documents below; ensure that you have done your research, so that you can answer questions as clearly as possible.

All three federal COVID-19 relief acts can advance the objectives of green schools, as well as improve IAQ and quality of life more generally. Whether you are a student, a parent, a school administrator or a concerned citizen, it is important that you encourage your district to invest in green facilities that provide long-term benefits for everyone.

ADDITIONAL RESOURCES

- Listen to the free recording of the Center for Green Schools' webcast, where we discuss the federal COVID-19 relief funding and how districts can use it;
- Read the resource Five Guiding Principles, co-released by the Center for Green Schools and UndauntedK12, to find research, ideas and resources to help you advocate to your school district leadership;
- Review the U.S. Department of Education FAQ for COVID-19 relief funding and FAQ for school construction projects;
- Read the U.S. Department of Education IAQ guidance for schools;
- Take a look at the U.S. Department of Education ESSER information for non-public schools.

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DEPT. OF EDUCATION RELEASES RESOURCE TO HELP SCHOOLS IMPROVE VENTILATION

To mitigate COVID-19 risks this fall, the new agency guide aims to help schools access federal funds for upgrading school infrastructure, including IAQ systems.

BY U.S. DEPT. OF EDUCATION
JULY 2021

Today, the Department of Education released a new resource to help schools, colleges, and universities improve their ventilation systems to prevent the spread of COVID-19 and provide healthy learning environments.

The resource outlines how American Rescue Plan (ARP) funds can be used to improve indoor air quality (IAQ) and is part of the Department's broader efforts to support schools as they prepare to welcome students back to in-person learning this fall and build back better. The release of the resource coincides with a visit by U.S. Secretary of Education **Miguel Cardona** to Kelley Lake Elementary School in Decatur, GA. The school will use ARP funds to invest in IAQ improvements that will allow it to offer in-person learning to all K-12 students for the 2021-2022 school year.

"Protecting our schools and communities from the spread of COVID-19 is the first step in bringing more students back to in-person learning and reemerging from this crisis even stronger than we were before," said Secretary Cardona. "With the American Rescue Plan, schools and districts now have access to unprecedented resources that will enable them to ensure proper ventilation and maintain healthy learning and working environments. At the Department, we are committed to helping communities identify how to use these resources quickly and effectively as they prepare to welcome all students back to in-person learning this fall."

The resource outlines how schools can invest ARP funds, as well as previous rounds of relief funding, to take immediate action to improve IAQ, such as the inspection, testing, maintenance, repair, replacement, and upgrading of projects in school facilities. This can include system upgrades, filtering, purification, and other air cleaning fans, and window and door repair.

While these investments can provide an important foundation for schools to take action now to improve IAQ, more must be done to improve the infrastructure in schools across the country. That's why President Biden has proposed additional resources in his Build Back Better agenda to rebuild our nation's public schools.

Visit ed.gov/coronavirus to see how schools can use ARP funds to improve indoor air quality, and learn more about the infrastructure proposals in President Biden's Build Back Better agenda, so that they are safe and healthy places of learning, energy efficient, and have the technology and labs our students need to prepare for jobs in tomorrow's economy.

Click here to learn more about the infrastructure proposals in President Biden's Build Back Better agenda.

IMPROVING VENTILATION IN SCHOOLS, COLLEGES, AND UNIVERSITIES TO PREVENT COVID-19

Clean air is essential for living and learning, and effective ventilation is an important part of COVID-19 prevention. We know that even before the pandemic, some schools, colleges, and universities had indoor air quality challenges, which many school, district, and higher education leaders worked to address as they reopened schools for in-person learning over the course of the last year.

As we move into the 2021-2022 school year, ventilation continues to be a top concern for many communities. Proper ventilation is a key prevention strategy for maintaining healthy environments and, along with other preventive actions, can reduce the likelihood of spreading disease. Wearing a well-fitting, multi-layer mask helps keep virus particles from entering the air and protects mask wearers. Good ventilation is another critical step to help reduce the number of airborne virus particles.

The ARP provided $122 billion for the Elementary and Secondary Schools Emergency Relief (ESSER) Fund to help schools prevent the spread of COVID-19 and recover from its effects, including by improving indoor air quality, so school leaders across the country can act now to improve ventilation in their buildings. The ESSER funds and Governors Emergency Education Relief (GEER) funds provided under earlier appropriations can also support this work. In addition, Higher Education Emergency Relief (HEER) funds provided under the ARP and previous stimulus funds can support many ventilation improvements in institutions of higher education (IHEs). While these funds provide an important foundation, President Biden's Build Back Better agenda would tackle long-standing school infrastructure needs, including ventilation improvement.

ESSER, GEER, and HEER funds can support both immediate actions and longer-term projects, including the inspection, testing, maintenance, repair, replacement, and upgrading of projects to improve indoor air quality in school facilities. This can include system upgrades, filtering, purification and other air cleaning, fans, and window and door repair.

DID YOU KNOW?

You can use American Rescue Plan (ARP) education funds further described below to improve indoor air quality for in-person instruction, including through:

- Inspection, testing, and maintenance of current ventilation systems and approaches
- Purchasing portable air filtration units, such as HEPA air filters
- Purchasing MERV-13 (or higher) filters for your HVAC system and ACs
- Purchasing fans
- Repairing windows and/or doors so that they can open to let fresh air in
- Servicing or upgrading HVAC systems consistent with industry standards
- Purchasing equipment to run outdoor classes
- Purchasing carbon dioxide (CO_2) monitors, air flow capture hoods, and anemometers for custodians and building personnel to assess ventilation
- Paying for increased heating/cooling costs due to increased use of heating/cooling systems
- Other spending that supports inspection, testing, maintenance, repair, replacement, and upgrade projects to improve the indoor air quality in school facilities, including mechanical and non-mechanical heating, ventilation, and air conditioning systems, filtering, purification and other air cleaning, fans, control systems, and window and door repair.

STRATEGIES FOR IMPROVING VENTILATION

The following resources are based on current recommendations by the Center for Dis-

ease Control and Prevention (CDC) and the Environmental Protection Agency (EPA).

The Centers for Disease Control and Prevention (CDC) and the Environmental Protection Agency (EPA) outline ways that schools and IHEs can improve ventilation, including:

- **Bringing in as much outdoor air as possible.**
  - Open windows wherever it is safe to do so, including in classrooms and on school buses and other transportation. Where safe, opening doors can also improve airflow. Using child-safe fans in accordance with CDC guidance increases the impact of open windows and doors.
  - Hold classes, activities, and meals outdoors when safe and feasible.
- **Using heating, ventilation, and air conditioning (HVAC) settings to maximize ventilation.**
  - Service or upgrade HVAC systems consistent with current industry standards.
  - Set systems to bring in as much outdoor air as the system can safely support, including for 2 hours before and after occupancy.
  - Reduce or eliminate air recirculation in consultation with an HVAC expert.
  - Disable demand-controlled ventilation controls. In classrooms or buildings controlled at the thermostat, set the fan to the "on" position instead of "auto," which will operate the fan continuously, even when heating or air conditioning is not required.
  - Use a scheduled inspection and maintenance program for HVAC systems to allow repair, modification, or replacement of equipment.
  - In consultation with HVAC experts and health officials, consider changing HVAC system filters more often than recommended by normal maintenance requirements.
- **Ensuring exhaust fans** in restrooms and kitchens are working properly and use them during occupancy and for 2 hours afterward to remove particles from the air. Keep all fans and filters clean to maximize airflow.
- **Filtering and/or cleaning the air.**
  - Upgrade HVAC filters to minimum efficiency reporting value (MERV)-13, or the highest MERV rating a building's ventilation system can accommodate to improve air filtration as much as possible without significantly reducing airflow.
  - Ensure HVAC filters are sized, installed, and replaced at least as frequently as according to the manufacturer's instructions.
  - Consider using portable air cleaners that use filtration technology, such as high-efficiency particulate air (HEPA) filters. A July 2021 CDC report shows that HEPA filters can reduce exposure to the virus that causes COVID-19, particularly in combination with universal and correct mask wearing. Select air cleaners of appropriate capacity for the space in which they will operate. Portable air cleaners can go in any room of a school building to serve as an additional safety and mitigation layer, including in areas where airflow may be limited, and/or in areas where sick individuals may be present such as a nurse's office or sick/isolation room.
  - The CDC and EPA references listed under "Additional Resources" include valuable guidance on the selection of portable air cleaners. CDC guidance on ventilation in the home may be relevant for residential dormitories. Caution: Some products sold as air cleaners intentionally generate ozone and are not safe to use when people are present. Consumers should assess any claims about air disinfection devices to determine whether they have been tested in similar conditions to those where they would be used, including in schools, colleges, and universities.[1]
- **Considering the use of portable carbon dioxide (CO2) monitors** to verify how well air is circulating in classrooms and other spaces. School maintenance professionals may also use air flow capture hoods, anemometers, and qualitative tracer techniques to assess airflow. Additional information on using portable CO2 monitors is available in the CDC Ventilation FAQ related to CO2 monitors.
- **Communicating clearly to school communities, parents, students, faculty, and staff**, in a language they can understand and in accessible formats, including on district, school, college, or university webpages, how you are assessing and improving ventilation. For example, some districts have performed school building ventilation walk-throughs with community leaders to assess needs and share results and plans for how to improve ventilation. Walking through school or IHE buildings with custodial engineers, parent leaders, teacher or faculty leaders, students, and others is one way to educate your community on how ventilation works within your educational spaces and assess ways that you can target upgrades and updates. Some

AS WE MOVE INTO THE 2021-2022 SCHOOL YEAR, VENTILATION CONTINUES TO BE A TOP CONCERN FOR MANY COMMUNITIES. PROPER VENTILATION IS A KEY PREVENTION STRATEGY FOR MAINTAINING HEALTHY ENVIRONMENTS.

districts and school leaders have created videos touring the ventilation systems of school buildings and explaining the strategies deployed for effective ventilation in plain language to parents so they understand the school's approach. In all cases, school leaders can share the ways rooms have been prepared to maximize air flow for in-person learning.

For more information on how ESSER and GEER funds can be used to support these efforts, please see questions B-6 and B-7 of Frequently Asked Questions related to the program. For more information on using HEER funds, see question 24 of the ARP HEERF III FAQs. In addition, for ESSER and GEER, the U.S. Department of Education (Department) has provided supplementary information to States and districts to help them efficiently implement ventilation projects while following applicable requirements. If a district or IHE uses funds for HVAC systems, the Department's applicable regulations require the use of current American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) standards.

USE A SCHEDULED INSPECTION AND MAINTENANCE PROGRAM FOR HVAC SYSTEMS TO ALLOW REPAIR, MODIFICATION, OR REPLACEMENT OF EQUIPMENT.

LEGAL DISCLAIMER

Other than statutory and regulatory requirements included in the document, the contents of this guidance do not have the force and effect of law and are not meant to bind the public. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies. This document contains resources (including links to those resources) that are provided for the user's convenience. Inclusion of these materials is not intended to reflect their importance, nor is it intended to endorse any views expressed or products or services offered. These materials might contain the views and recommendations of various subject-matter experts, as well as hyperlinked text, contact addresses, and websites to information that other public and private organizations created and maintain. The opinions expressed in any of these materials do not necessarily reflect the positions or policies of the Department. The Department does not control or guarantee the accuracy, relevance, timeliness, or completeness of any outside information included in these materials.

ADDITIONAL RESOURCES:

- CDC information on improving ventilation in schools at https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/ventilation.html, in buildings at https://www.cdc.gov/coronavirus/2019-ncov/community/ventilation.html, and in homes at https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/Improving-Ventilation-Home.html.
- EPA resources on indoor air quality tools for schools at https://www.epa.gov/iaq-schools.
- Resources related to Lessons from the Field webinar featuring CDC, EPA, and U.S. Department of Education, along with district leaders at https://safesupportivelearning.ed.gov/events/webinar/lessons-field-indoor-air-quality-and-ventilation-america%E2%80%99s-k-12-schools-guidance-and.
- CDC Morbidity and Mortality Weekly report on the efficacy of HEPA filters and masking to reduce exposure to the virus that causes COVID-19 at https://www.cdc.gov/mmwr/volumes/70/wr/mm7027e1.htm?s_cid=mm7027e1_w.
- ASHRAE guidance for reopening schools at https://www.ashrae.org/technical-resources/reopening-of-schools-and-universities.
- National Energy Management Institute and U.C. Davis Energy and Efficiency Institute White Paper on Proposed Ventilation and Energy Efficiency Verification/Repair Program for School Reopening at https://ucdavis.app.box.com/v/ProposedVentilationProgram

OPEPD-IO-21-04

[1] Testing should validate both efficacy under as-used conditions and safety for all potential occupants, including those with compromising health conditions. (See the CDC FAQ related to air disinfection devices at https://www.cdc.gov/coronavirus/2019-ncov/community/ventilation.html.) Some indoor air filtration devices use ionization technology, including bipolar ionization technology, which has the potential to create ozone that can irritate the airways, unless specific precautions are taken in the product design and maintenance. (See https://www.epa.gov/coronavirus/air-cleaners-hvac-filters-and-coronavirus-covid-19.)

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K-12 SCHOOLS: CDC UPDATES GUIDANCE FOR COVID-19 PREVENTION

As we near the pandemic's second fall semester, U.S. health officials offer state and local officials strategies for keeping students, teachers, and buildings healthy.

BY CENTERS FOR DISEASE CONTROL
JULY 2021

This updated version of COVID-19 guidance for school administrators outlines strategies for K-12 schools to reduce the spread of COVID-19 and maintain safe operations.

Many schools serve children under the age of 12 who are not eligible for vaccination at this time. Therefore, this guidance emphasizes implementing layered prevention strategies (e.g., using multiple prevention strategies together) to protect people who are not fully vaccinated, including students, teachers, staff, and other members of their households. The guidance is intended to help administrators and local health officials select appropriate, layered prevention strategies and understand how to safely transition learning environments out of COVID-19 pandemic precautions as community transmission of COVID-19 reaches low levels or stops. This guidance is based on current scientific evidence

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

and lessons learned from schools implementing COVID-19 prevention strategies.

This CDC guidance is meant to supplement—not replace—any federal, state, local, territorial, or tribal health and safety laws, rules, and regulations with which schools must comply. The adoption and implementation of this guidance should be done in collaboration with regulatory agencies and state, local, territorial, and tribal public health departments, and in compliance with state and local policies and practices.

KEY TAKEAWAYS

- Students benefit from in-person learning, and safely returning to in-person instruction in the fall 2021 is a priority;
- Vaccination is currently the leading public health prevention strategy to end the COVID-19 pandemic. Promoting vaccination can help schools safely return to in-person learning as well as extracurricular activities and sports;
- Masks should be worn indoors by all individuals (age 2 and older) who are not fully vaccinated. Consistent and correct mask use by people who are not fully vaccinated is especially important indoors and in crowded settings, when physical distancing cannot be maintained;
- CDC recommends schools maintain at least 3 feet of physical distance between students within classrooms, combined with indoor mask wearing by people who are not fully vaccinated, to reduce transmission risk. When it is not possible to maintain a physical distance of at least 3 feet, such as when schools cannot fully re-open while maintaining these distances, it is especially important to layer multiple other prevention strategies, such as indoor masking;
- Screening testing, ventilation (see below), handwashing and respiratory etiquette, staying home when sick and getting tested, contact tracing in combination with quarantine and isolation, and cleaning and disinfection are also important layers of prevention to keep schools safe;
- Students, teachers, and staff should stay home when they have signs of any infectious illness and be referred to their healthcare provider for testing and care;
- Many schools serve children under the age of 12 who are not eligible for vaccination at this time. Therefore, this guidance emphasizes implementing layered prevention strategies (e.g., using multiple prevention strategies together consistently) to protect people who are not fully vaccinated, including students, teachers, staff, and other members of their households.
- COVID-19 prevention strategies remain critical to protect people, including students, teachers, and staff, who are not fully vaccinated, especially in areas of moderate-to-high community transmission levels;
- Localities should monitor community transmission, vaccination coverage, screening testing, and occurrence of outbreaks to guide decisions on the level of layered prevention strategies (e.g., physical distancing, screening testing).

VENTILATION

Improving ventilation is an important COVID-19 prevention strategy that can reduce the number of virus particles in the air. Along with other preventive strategies, including wearing a well-fitting, multi-layered mask, bringing fresh outdoor air into a building helps keep virus particles from concentrating inside. This can be done by opening multiple doors and windows, using child-safe fans to increase the effectiveness of open windows, and making changes to the HVAC or air filtration systems.

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WEBINAR ON DEMAND:

Make the Most of Federal COVID Funds for School IAQ Upgrades

Recorded this summer, our one-hour event was led by veteran IAQ experts Paul Tseng and Ed Light, aiming to help anxious school districts prepare their facilities for the safe return of students this fall.

BY ROB MCMANAMY
JUNE 2021

In June, *HPAC Engineering* held its first hour-long, Members-Only Webinar that is now available to you On Demand.

Everyone in the HVAC industry knows that this summer is an absolutely crucial period for trying to prepare schools at every level for the safe return of students, teachers, and in-person instruction this fall, as the effects of the pandemic finally start to fade. New federal COVID relief funding is now available to help with related indoor air quality (IAQ) projects. But there is considerable debate in the engineering community about how best to proceed with these types of projects and which approaches offer the most effective responses to reduce the known risks.

Two veteran IAQ experts, **Paul Tseng**, P.E., and **Ed Light**, CIH, each with more than 40 years of industry experience, took a deep dive into this topic for our new webinar: **Make the Most of Federal COVID Funds for School IAQ Upgrades**. Following are some of the urgent issues they addressed:

- How much ventilation / filtration is needed to minimize COVID spread in buildings?

• What other O&M procedures can also help minimize COVID spread?

• What role, if any, should measures involving ultraviolet light, bipolar ionization, increased open windows, and more, possibly play?

In addition to the subjects presented, the speakers also fielded several questions from webinar attendees in a lively Q&A that reflected the ongoing debate nationally about how school districts should allocate their dollars most effectively to ensure occupant safety. With multiple expensive IAQ "solutions" now flooding the market, boasting near-100% effectiveness, the recommendations called for sober and thoughtful decision-making that will both stand the test of time, and fit the individual schools.

UPDATE: ON AUGUST 12, PRESENTER ED LIGHT ADDED THIS COMMENT:

"The scientific evidence continues to support our position that the most effective use of COVID funds is to:

• Repair existing equipment to provide intended ventilation & filtration, and...

• Address areas with very poor ventilation or air distribution, starting with an evaluation of current systems.

This approach will not only minimize the chances of airborne transmission for the short-term, but will also provide ongoing IAQ and energy efficiency benefits. The research is still clear that COVID is primarily spread by close contact which is unaffected by HVAC systems. The proven ways to minimize COVID transmission in buildings are therefore masking, social distancing, and occupant testing/case isolation. In contrast, there is no scientific evidence establishing that either maximizing ventilation and filtration or providing supplemental air treatment reduces COVID transmission.

Unfortunately, the focus of many school COVID programs continues to be the purchase of supplemental air cleaning equipment, upgrading filter ratings and maximizing ventilation. If this trend continues, we will be missing a unique opportunity to restore school HVAC systems to an effective level of operation."

All in all, a compelling kick off to our *HPAC Engineering* Members-only Webinar series, and this on-demand version is well worth your time.

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Survey Assesses IAQ Measures in 4,000+ U.S. Schools

ASHRAE.org

ASHRAE, USGBC Center for Green Schools report polled school districts serving over 2.5 million students in 24 states on steps taken to mitigate COVID-19 spread.

BY ASHRAE & USGBC
MAY 2021

With technical support from **ASHRAE**, the **Center for Green Schools** at the **U.S. Green Building Council** (USGBC) has published a new report on indoor air quality (IAQ) measures that schools have taken in response to the pandemic.

The report titled **"Preparation in the Pandemic: How Schools Implemented Air Quality Measures to Protect Occupants from COVID-19,"** presents the survey responses of school districts representing more than 4,000 schools serving over 2.5 million students in 24 states, on the protocols and operations plans implemented to mitigate the spread of COVID-19.

"Maintaining proper ventilation and good indoor air quality are vital in keeping school buildings healthy and operating as energy efficiently as possible," said 2020-21 ASHRAE President **Charles E. Gulledge III**, P.E. "This report provides a wide-scale, foundational framework to school leaders and lawmakers alike towards the imple-

mentation of new building design guidelines and to advance health and sustainability goals, while instilling confidence in the places where people learn."

The report is the only known national view of air quality measures implemented in schools during the pandemic. It highlights what school districts have prioritized, which actions they have taken, how they have made decisions and what the consequences have been. The results of the survey show that schools have implemented some protective measures to improve IAQ, prioritizing ventilation and filtration to reduce the transmission of the virus. However, school districts still have unmet needs and face numerous challenges related to costs and outdated building infrastructure.

"Indoor air quality continues to be a critical concern as more teachers and students are returning to the classroom," said **Anisa Heming**, Director of The Center for Green Schools at USGBC. "Increasing clean air circulation for our teachers and students is vital to promoting public health and is a key green building strategy for school buildings. Our aim with this report is to inform policymakers and nonprofits that support our schools of the challenges that our education institutions face in combatting the spread of COVID-19, particularly given the deficient state of many school buildings across the country."

Additional findings from the survey include:

The most-frequently cited challenge to implementing protective air quality measures at schools was that school buildings were not designed to support the strategies that were being recommended;

- School districts that have been able to act have leaned heavily on their mechanical systems, such as increasing air supply through HVAC systems or upgrading filters to implement protective air quality measures for students and teachers;
- Only two-thirds of respondents were regularly monitoring IAQ before the pandemic, indicating that providing time, staff, and funding for regular monitoring and data collection has not been a priority for many districts in the past;
- Respondents want to continue the measures implemented during the pandemic, citing student and teacher health. Seventy percent of school districts plan to continue some or all of the strategies they've implemented.

"As schools re-open and develop health and safety plans to mitigate airborne transmission of COVID-19, many are prioritizing and upgrading current HVAC systems to provide the highest indoor air quality for building occupants," said **Corey Metzger**, ASHRAE Epidemic Task Force Schools team lead. "We know that improved indoor air quality has a positive impact on student performance and general well-being and I'm hopeful that more schools will consider and implement the guidance provided by ASHRAE."

To download the full report, please visit ashrae.org/COVID19.

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School IAQ Rehabs Poised to Lead Mid-Year Turnaround


Getty Images

Federal stimuli for national HVAC upgrades in schools should fuel eventual rebound, according to our new monthly Market Focus feature.

BY ROB MCMANAMY, JANUARY 2021

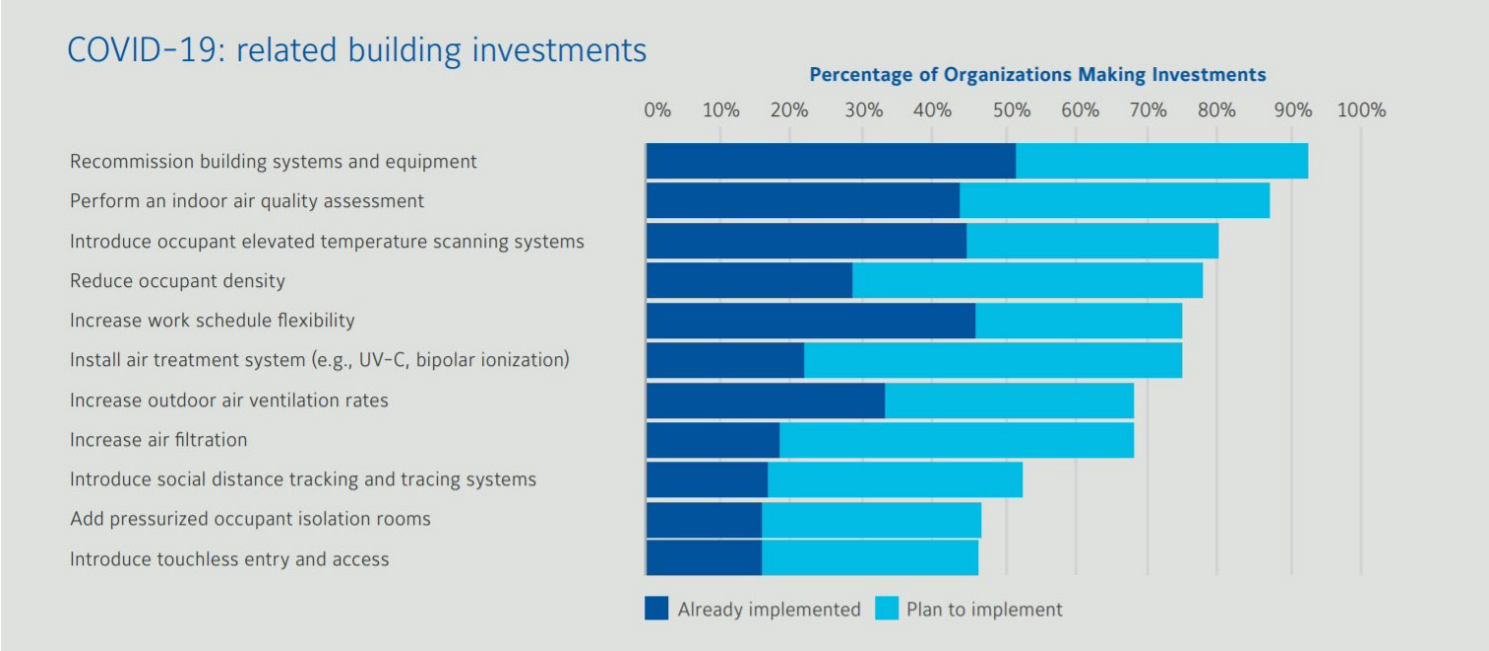
Among the flurry of new pandemic-related Executive Orders issued by President Biden in his first week in office, this one may have the most immediate impact on our industry:

• **Supporting the Reopening and Continuing Operation of Schools and Early Childhood Education Providers** — It directs a national strategy for safely reopening schools, including requiring the Departments of Education and HHS to provide guidance on safe reopening and operating, and to develop a Safer Schools and Campuses Best Practices Clearinghouse to share lessons learned and best practices from across the country. GOAL: Getting a majority of K-8 schools safely open in 100 days.

Yes, schools are a big part of the new, national, '100 Days' Strategy, and whether or not this ambitious initial goal is achieved, one thing seems certain. School ventilation upgrades will dominate the 2021 education construction market as never before.

Already, the $900-billion federal stimulus bill that was signed into law in December had set aside $54 billion in funding for K-12 school projects and $22 billion for colleges and universities. Most of those funds were expected to be poured into HVAC work to improve indoor air quality enough to allow public schools safely to welcome back more socially distanced students into their buildings, as soon as possible. Now, the Biden Administration's new proposed stimulus package would more than double those allotments, adding another $130 million for K-12 schools, and $35 billion for higher education. And those funds would go well beyond bricks and mortar projects.

• "The Administration will release a handbook that helps schools and local leaders implement the precautions and



Johnson Controls

strategies necessary for safe reopening. It will also work with states and local school districts to support screening testing in schools, including working with states to ensure an adequate supply of test kits."

As more and more COVID vaccinations increase across the U.S., particularly among teachers and school staff, it now seems that there is genuine cause for optimism, even as the grim news continues in our nation's hospitals. Schools have been a particular point of contention in the last year, as administrators, teachers, parents, custodians, unions, and politicians have clashed repeatedly, often with valid health and safety concerns on multiple sides of multiple issues.

And not surprisingly, IAQ experts have been drawn into the controversy, as well. Indeed, Dr. **Joseph Allen**, Harvard University's leading expert on healthy buildings Tweeted this blunt message earlier this month:

Last summer, we published a summary of that report here.

For its part, ASHRAE's Epidemic Task Force has been even more immersed in the debate, determined to let the science lead decision-making. *HPAC Engineering* advisory board member Dr. **William Bahnfleth**, P.E., an architectural engineering professor at Penn State University, has led the task force since it was formed last spring. On K-12 schools, he has expressed concern for the psychological toll of facility shutdowns on students forced into remote learning, but he has been equally adamant about the need to create safe buildings.

Toward that end, the Task Force's updated recommendations for schools can be found here.

In a recent webinar hosted by IAQ specialists enVerid Systems, Bahnfleth said, "ASHRAE's Core Recommendations are based on an equivalent clean air supply approach that allows the effects of filters, air cleaners other removal mechanisms to be added together to achieve an exposure reduction target."

Reviewing the current crop of economic prospects for the U.S. education construction market, the latest American Institute of Architects Consensus Industry Forecast was released Jan. 13. Aggregating the eight

How Much Will Congress Spend to Shore Up Schools?

The Covid-19 relief plans before Congress all dedicate billions to stabilizing education budgets amid deep losses in state revenue. But the amounts vary from bill to bill.

FutureEd Georgetown University	CARES Act Signed into Law March 2020	Covid Relief Package Signed into Law December 2020	Biden Stimulus Package Newly Proposed January 2021
Education Total	$30.7 billion	$82 billion	$170 billion
K-12	$13.2	$54	$130
Higher Ed	$14	$22	$35
Governors	$3	$4	$5

Future-Ed.org

forecasting firms that it follows, AIA's consensus outlook expects a 3.9% decline in the roughly $100-billion market for school construction contracts this year, before a rebound of 2.7% in 2022. Admittedly, all predictions were made before any new Biden Stimulus package has been enacted. So passage of that legislation in some form this spring *should* boost those numbers.

Among the eight economists included, Moody's Analytics is the most optimistic about 2021, forecasting $104.6 billion in school construction contracts this year, up 4.8 % over 2020. And Moody's sees another 5.6% increase slated for 2022. On the flip side, Wells Fargo Securities is by far the most pessimistic in the group, predicting that education work will slip 12% this year to $97 billion, before recovering mildly in 2022 with an expected gain of 2.5%.

"As we move into 2021, we do expect that the economy will recover, and it will move in lockstep with the vaccine rollout," said **Richard Branch**, Chief Economist for Dodge Data & Analytics. For its part, Dodge Data has been predicting a 5% decline for education work this year, with a 1.4% rebound set for 2022.

In November, Johnson Controls surveyed 100 facility executives at K-12 schools across the U.S. as part of its new OpenBlue Healthy Buildings initiative. The report found that 21% had already used prior federal economic stimulus funds from last spring to help pay for building improvements. Overall, air treatments and ventilation represented the top COVID-19 building investments.

"Industry, trade, and public health organizations have recommended various changes to buildings to help control the spread of the virus," said the report. "In addition to increasing work schedule flexibility and reducing occupancy density, more than half of organizations have performed indoor air quality assessments, introduced elevated temperature scanning systems, and increased air filtration."

Again, as this recovery year progresses, and the virus deals us likely setbacks along the way, look for more school HVAC renovation activity to grow exponentially into the summer. Frustrated

stakeholders from every corner will be determined to make the 2021-22 school year that starts next fall as normal as possible in the post-COVID-19 era.

And HVACR engineers will be absolutely essential to creating that reality.

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REOPENING SCHOOLS: RISK REDUCTION STRATEGIES

As debate rages nationally on how best to reopen schools in a pandemic, here's what Harvard's public health experts are recommending to maintain safe indoor air quality.

BY HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

JULY 2021

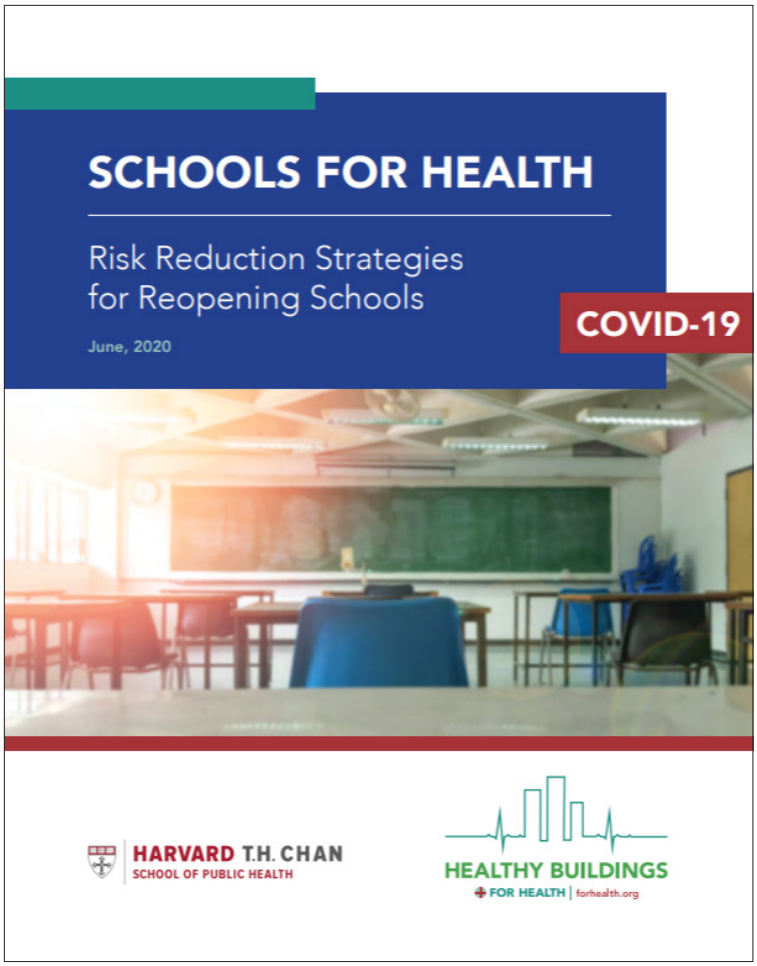
The following excerpts are from a 60-page report released in June 2020 by the Harvard T.H. Chan School of Public Health. Entitled, "Risk Reduction Strategies for Reopening Schools," the document was written specifically to address public health concerns surrounding COVID-19, and to suggest how schools can safely mitigate risks ahead of the approaching start of the new term. Passages were chosen specifically for the HPAC Engineering audience. The full report can be downloaded here.

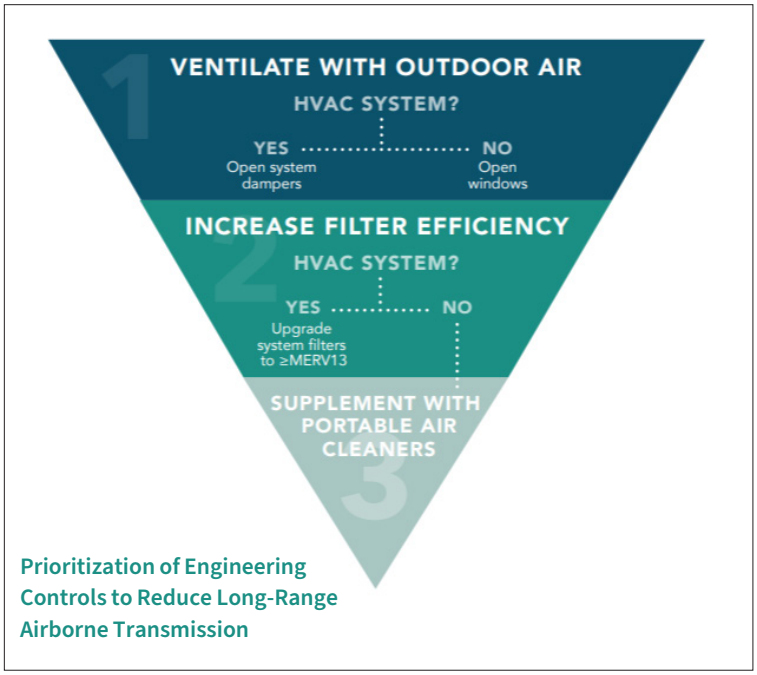
EXECUTIVE SUMMARY

Schools will eventually need to reopen.

Keeping schools closed comes with massive, long-term individual and societal costs. Many children cannot effectively learn, grow, engage, socialize, be active, eat healthy food, or get support until schools reopen. Parents and caregivers cannot go back to work until children go back to school. Knowing that schools will reopen at some point, we set out to answer this question: what strategies should schools consider to reduce risk of COVID-19 transmission? Note that a risk reduction strategy is different from a goal of achieving zero cases. There is no such thing as 'zero risk', in anything we do, and certainly not during a pandemic.

However, scientific evidence indicates that risks to students and staff can be kept low if schools adhere to strict control measures and dynamically respond to potential outbreaks. We recognize there are immense challenges. There is no perfect plan to reopen schools safely, only 'less bad' options. There is no 'one size fits all' strat-





Prioritization of Engineering Controls to Reduce Long-Range Airborne Transmission

egy that works for every school. Schools have limited budgets and staff. Compliance will be imperfect. Learning will be different. There will be disruption. Schools may need to re-close unexpectedly depending on local conditions. No one knows with certainty what the fall will bring in terms of this pandemic.

Despite these challenges, the enormous individual and societal costs of keeping schools closed compels us, a team focused on Healthy Buildings and exposure and risk science, to present a range of control strategies that should be considered in discussions of school reopenings: Schools should adopt and adapt these recommendations to best fit their unique situation, depending on available personnel, resources, finances, school demographics, and building attributes.

HEALTHY BUILDINGS

Healthy building strategies that improve air quality and clean surfaces should be incorporated as part of a layered defense against COVID-19. For improving indoor air quality, we recommend prioritizing control strategies — ventilation, filtration, supplemental air cleaning – and verifying system performance regularly. For more detailed and technical guidance, we recommend reviewing the materials produced by the ASHRAE Epidemic Task Force. Schools should work with facilities managers and outside professionals to tailor these recommendations for their unique building systems.

INCREASE OUTDOOR AIR VENTILATION

- Bring in more fresh outdoor air;
- Follow the decision-tree for ventilation type and corresponding strategies.

SARS-CoV-2 present in the coughs, sneezes, and exhaled breath of an infectious person can be transported in the air to disperse throughout a room and can remain aloft for hours. This long-range airborne virus can infect even people who haven't had close contact with the infectious person if they inhale a sufficient amount of virus. Bringing fresh outdoor air into a room can dilute and/or displace any present airborne virus, which thus reduces the probability that someone breathes enough infectious aerosol to become infected. As an ideal, holding class outdoors provides the freshest air and most effective dilution of any infectious airborne SARS-CoV-2.

As the next best solution, mechanical ventilation systems in buildings can forcibly bring outdoor air inside and then distribute that fresh air to different areas of the building. Some fraction of the indoor air is usually recirculated and mixed with the outdoor air coming in to save on cooling and heating energy costs. However, during a pandemic, when long-range airborne viral transmission can occur, air re-circulation can lead to a buildup of airborne viral particles indoors and also potentially spread the virus to other areas of the building.

Therefore, buildings should eliminate or minimize air re-circulation (thus maximizing fresh outdoor air) to the extent pos-

sible during this period. In addition, buildings should not shut off or reduce their mechanical ventilation during before-school or after-school hours when there still may be people in the building, including students, staff, and custodians during any student programs, cleaning times, teacher class preparation, sports (e.g., if students are returning to lockers), or other activities. Finally, mechanically ventilated schools should evaluate any potential contaminant source near the outdoor air intake duct. For example, the outdoor air inlet should not be located too close to the exhaust air outlet or contaminated indoor air that is exhausted out of the building could renter (refer to local building codes on minimum required distance, generally 10 feet).

Schools that do not have mechanical ventilation systems can increase the amount of natural ventilation via a) open windows, doors, or skylight, b) roof ventilators, c) stacks, and d) specially designed inlet or outlet openings. Opening windows can help bring in fresh outdoor air and dilute and exhaust contaminants in the indoor air. Natural ventilation through windows can be effective but is dependent on factors that drive pressure differentials between outdoors and indoors, like wind pressure and stack (or buoyancy) effects.

Therefore, airflow into the building, even with open windows, is not guaranteed. To help address this, schools can consider using window fans or box fans positioned in open windows to blow fresh outdoor air into the classroom via one window and indoor air out of the classroom via another window. Note that devices that simply recirculate the same indoor air without filtering it or replacing it with fresh air are not helpful in reducing any airborne virus present in the room (including most window air conditioning units, fans used in rooms with closed windows, and fan coils and radiators)

In some cases, it is not reasonable to bring in additional outdoor air. For example, on very hot summer days or very cold winter days it may not be impossible to maintain a comfortable temperature in the classroom if the windows are open. Mechanical ventilation systems, similarly, may need to recirculate more indoor air and bring in less fresh outdoor air when extremely hot or cold outdoor air cannot be sufficiently cooled or heated before it is blown into classrooms.

Other factors may also impact the ability to increase outdoor air ventilation, particularly for naturally ventilated buildings, including but not limited to, security concerns, high outdoor air pollution or pollen levels, or high outdoor noise levels. In these cases, the highest tolerable amount of outdoor air ventilation should still be used, even if students, teachers, and administrators have to adjust their clothing to be comfortable (e.g., wear a jacket indoors in the winter).

In cases where there cannot be adequate outdoor air ventilation, other strategies such as enhanced filtration and air cleaning can be used to reduce airborne SARS-CoV-2 concentrations.

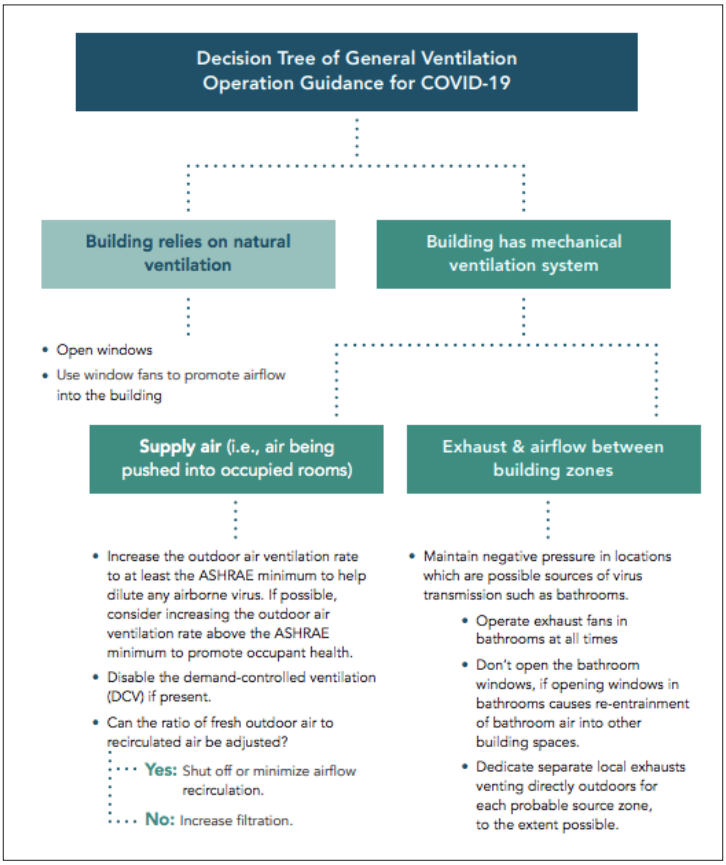
FILTER INDOOR AIR

- Increase the level of the air filter to MERV 13 or higher on recirculated air;
- Inspect filters to make sure they are installed and fit correctly;
- Check that sufficient airflow can be maintained across the filter;
- Maintain and change filters based on manufacturer's recommendation.

Filtration in school buildings can help mitigate long-range airborne viral transmission by removing SARS-CoV-2 from any air that is recirculated through the building. In buildings with mechanical ventilation systems, existing filters can be upgraded to filters with efficiency ratings of at least MERV 13 or the highest MERV rating the system can handle. MERV ratings, developed by ASHRAE, indicate the percentage of particles and the sizes of particles that filters can remove from air passing through them. Filters with higher MERV ratings remove higher percentages of particles and more effectively remove small particles than filters with lower MERV ratings. Filters with MERV ratings of 13 or higher are recommended for SARS-CoV-2 by ASHRAE. Filters need to be periodically replaced and inspected to make sure they are sealed and fitted properly, with no gaps or air bypass. In some cases, if the airflow distribution system is not designed to handle a higher MERV filter, air could leak around the filter edges, compromising any benefit that might have even been gained from a lower MERV filter.

SUPPLEMENT WITH PORTABLE AIR CLEANERS

- Supplement with air cleaning devices;
- Select portable air cleaners with HEPA filters;
- Size devices carefully based on the size of the room.



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. Portable air cleaners are typically most effective in smaller spaces, and care must be taken when choosing a device to ensure it is the correct size for the room where it will be used. One metric to consider is the clean air delivery rate (CADR). The CADR reflects both the amount of air that a unit can process per unit time and the particle removal efficiency of the filter. A helpful rule of thumb is that for every 250 square feet of space, a CADR of about 100 cfm is desirable. CADR is not the only factor to consider. Portable air cleaners vary in their ability to circulate air in the room, so not all devices with the same CADR rating are equivalent. Devices that provide better mixing of the indoor air can capture particles from more of the room's airspace and are therefore preferred.

Because potential viral sources could be in various locations within a room, it may be beneficial to have several units that meet the target CADR values rather than a single larger unit. In larger spaces, industrial-sized supplemental ventilation and filtration units are available and should be considered. Furthermore, room airflow patterns and the distribution of people in the room should be considered when deciding on air cleaner placement that maximizes source control and prevents airflow from crossing people. Since air cleaners should be operated while people are present, it may be important to compare different models to find one that does not generate disruptive noise.

VERIFY VENTILATION AND FILTRATION PERFORMANCE

- Verify through commissioning and testing;
- Work with an expert to evaluate building systems, ventilation, filtration, and air cleaning;
- Measure carbon dioxide (CO_2) as a proxy for ventilation.

Mechanical heating, ventilation, and air conditioning (HVAC) systems in buildings tend to get out of tune. Within several years of construction, ventilation airflows may change from how they were designed. Schools can ensure that there is adequate ventilation and filtration through a process of commissioning and testing. Commissioning is the process of checking HVAC performance to ensure that systems are operating as designed. Commissioning and testing should be performed by trained individuals and should be performed throughout the school year.

In between commissioning events, there are several ways to test whether a classroom's ventilation delivers sufficient outdoor air. In addition to working with trained experts, a school could quickly evaluate ventilation performance using carbon dioxide (CO_2) as a proxy for ventilation using low-cost indoor air quality monitors. In an unoccupied classroom, background CO_2 would be approximately equal to the concentration of CO_2 in the atmosphere: 410 ppm. When students and teachers are present in a classroom, they exhale CO_2 into classroom air at a relatively constant rate causing CO_2 to rise above the background concentration. At some point, the concentration of CO_2 reaches an equilibrium based on the amount generated indoors, and the amount diluted by ventilation. This is called 'steady-state' and can be used as a quick indicator of ventilation performance. If the measured CO_2 concentrations while students are present are mostly below 1,000 ppm, then the outdoor air ventilation is likely reaching acceptable minimums. Lower CO_2 concentrations while students are present mean there is acceptable outdoor air ventilation rates; higher CO_2 concentrations suggest other strategies for increasing outdoor air ventilation are needed.

It is important to note that CO_2 measurements are only useful when a full class of students is present; otherwise, ventilation will be overestimated. Also, while CO_2 measurements are a good indicator of overall ventilation, they will not indicate whether other air cleaning interventions are effective. For example, if a classroom is operating portable air cleaners to remove the virus from air, viruses and other pollutants will be removed even if CO_2 remains high because cleaners with HEPA filters are not designed to remove CO_2 .

CONSIDER ADVANCED AIR QUALITY TECHNIQUES

- Attempt to maintain indoor relative humidity between 40-60%;
- Consider advanced air cleaning with ultraviolet germicidal irradiation (UGVI).

Additional air quality controls can be considered, including maintaining higher humidity and air cleaning with ultraviolet germicidal irradiation (UVGI). Because these controls require great care in imple-

mentation, they are listed in this separate section as advanced considerations. Schools that consider these approaches should consult with outside technical experts.

People's physiological defenses against respiratory viral infection function best in mid-range humidity levels. Humidity also impacts environmental quality: dry environments are associated with higher incidence of some viral infections, such as influenza, but too much humidity can increase the presence of mites and lead to mold growth. While positive impacts of humidification on COVID-19 have not been determined, avoiding dry conditions in buildings is generally thought to be effective as a risk reduction strategy in buildings. ASHRAE suggests that maintaining relative humidity between 40% and 60% may help reduce COVID-19 infection rates.

For more information on indoor relative humidity and temperature combination set-points within this relative humidity range that are aimed at providing a healthy as well as a comfortable environment for occupants, for winter and summer operation, refer to the ASHRAE's Pandemic Task Force's reopening plan for schools and universities.

UVGI is an air cleaning technology that is sometimes used in buildings. UVGI uses low-wavelength ultraviolet light (UVC light) to destroy viruses. UVGI has been shown to be effective in disinfecting surfaces and air from bacteria and viruses such as influenza. In buildings, this technology is usually deployed as upper room UVGI to destroy airborne virus in the upper airspace of a room or as UVGI in supply air ducts to destroy airborne virus present in recirculated air. UVGI may be able to reduce exposures to airborne COVID-19.

In order for UVGI to be effective, there must be sufficient contact time between the virus and the UV light; this often presents a challenge for installing an effective in-duct UVGI system. Similarly, upper room UVGI works best when the air in a room is well mixed so that airborne virus emitted by people in the lower portion of the room is lofted into the upper airspaces where it can be treated. Other potential issues with UVGI in schools include cost, maintenance, and potential health concerns of inadvertent UV exposures. In general, UVGI should be further discussed with an expert before consideration for use in a school.

To access the full report, click here.

Thirteen authors contributed to this special report, led by Joseph G. Allen, Asst. Prof. of Exposure Assessment Science; Director, Healthy Buildings Program, Harvard T.H. Chan School of Public Health, jgallen@hsph.harvard.edu.

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