THE CENTER FOR GREEN SCHOOLS

U.S. GREEN BUILDING COUNCIL
USGBC

WHO WE ARE: Global leader in advancing green schools, providing school districts and education leaders with resources and training to create sustainable, healthy, resilient and equitable learning environments.

WHAT WE DO: We support and train those implementing sustainability within school systems to be the most effective change agents they can be, through professional development, peer networks, research, and advocacy.





Through our growing School Sustainability Leaders Network, we equip powerful voices for change within school districts in the U.S.

Geographic distribution of School Sustainability Leaders Network participants

NETWORK PARTICIPANTS:
approx. 300

SCHOLARSHIPS GIVEN:
36 districts

STUDENTS SERVED in DISTRICTS:
8 million +

IN THIS PRESENTATION:

1 What we know about environmental health in schools

2 How school districts are acting on IAQ in their schools

3 Federal resources to support environmental health in schools

4 Examples of state action

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FEELING WELL

BIOLOGICAL AND PHYSICAL HEALTH

THINKING WELL

SHORT-TERM COGNITIVE AND MENTAL WELL-BEING

PERFORMING WELL

LONG-TERM ACADEMIC SUCCESS AND ACHIEVEMENT

SCHOOLS

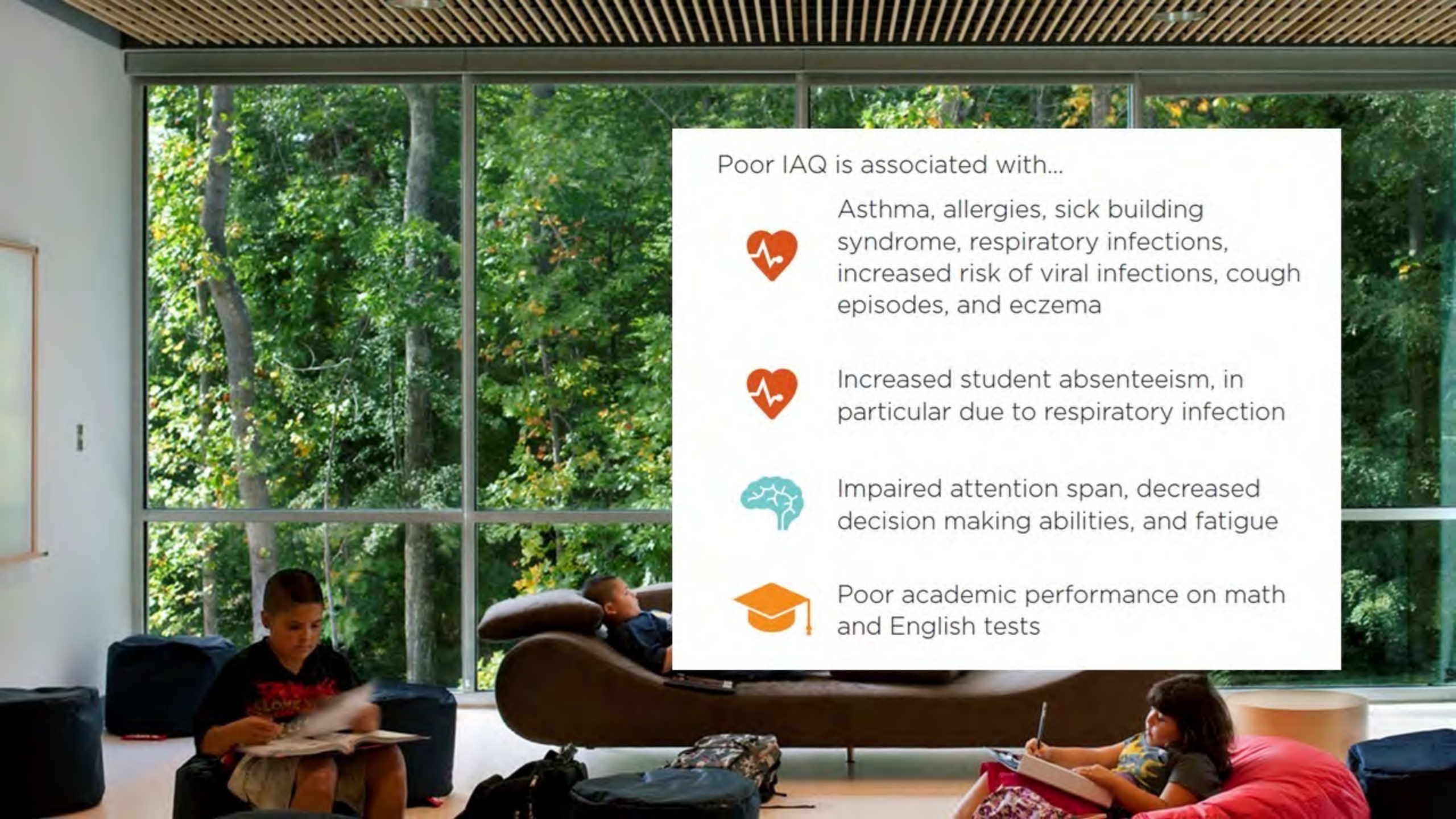
FOR HEALTH

FOUNDATIONS FOR STUDENT SUCCESS

HOW SCHOOL BUILDINGS INFLUENCE
STUDENT HEALTH, THINKING AND PERFORMANCE

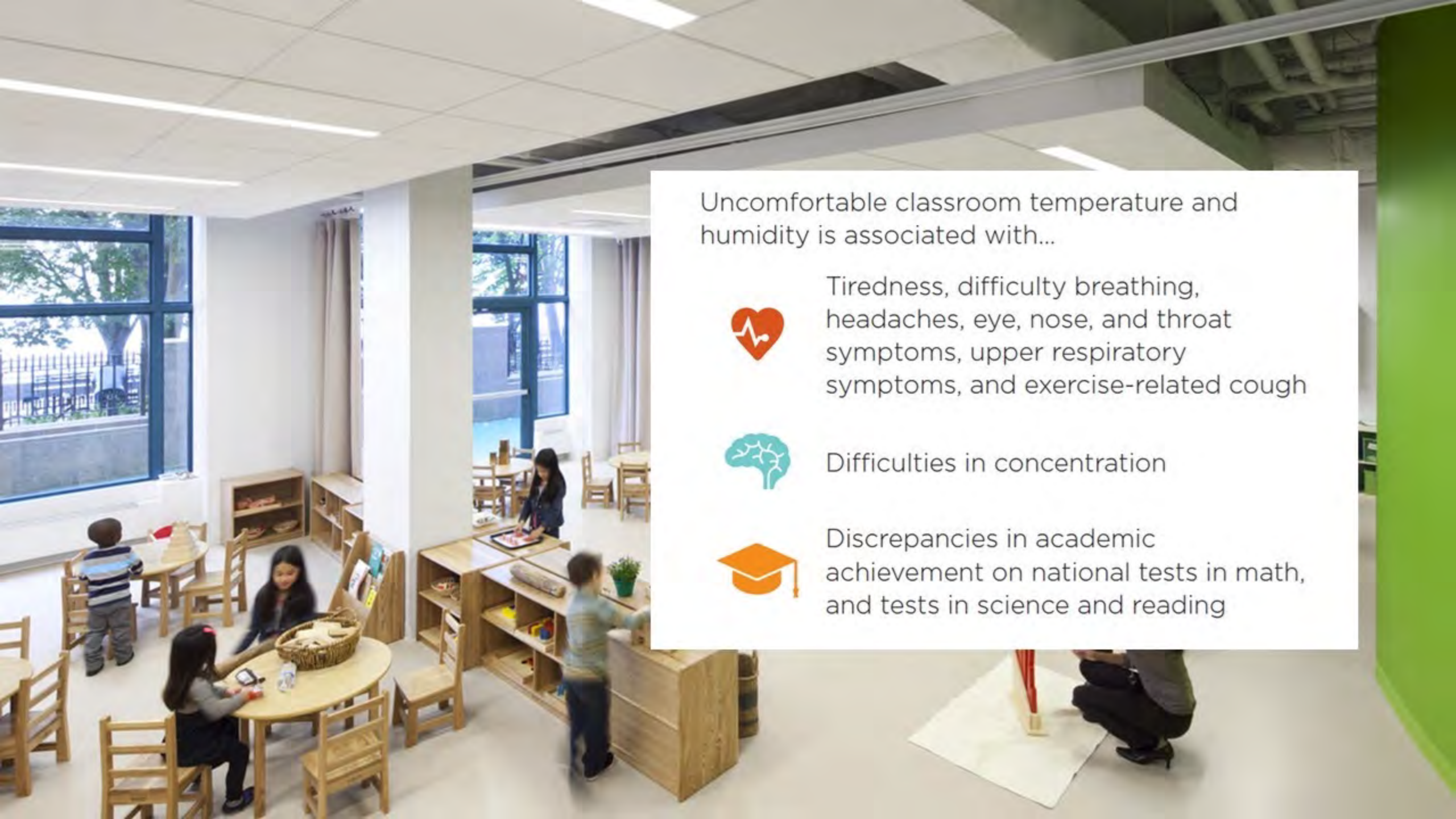
HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

FOR HEALTH
forhealth.org



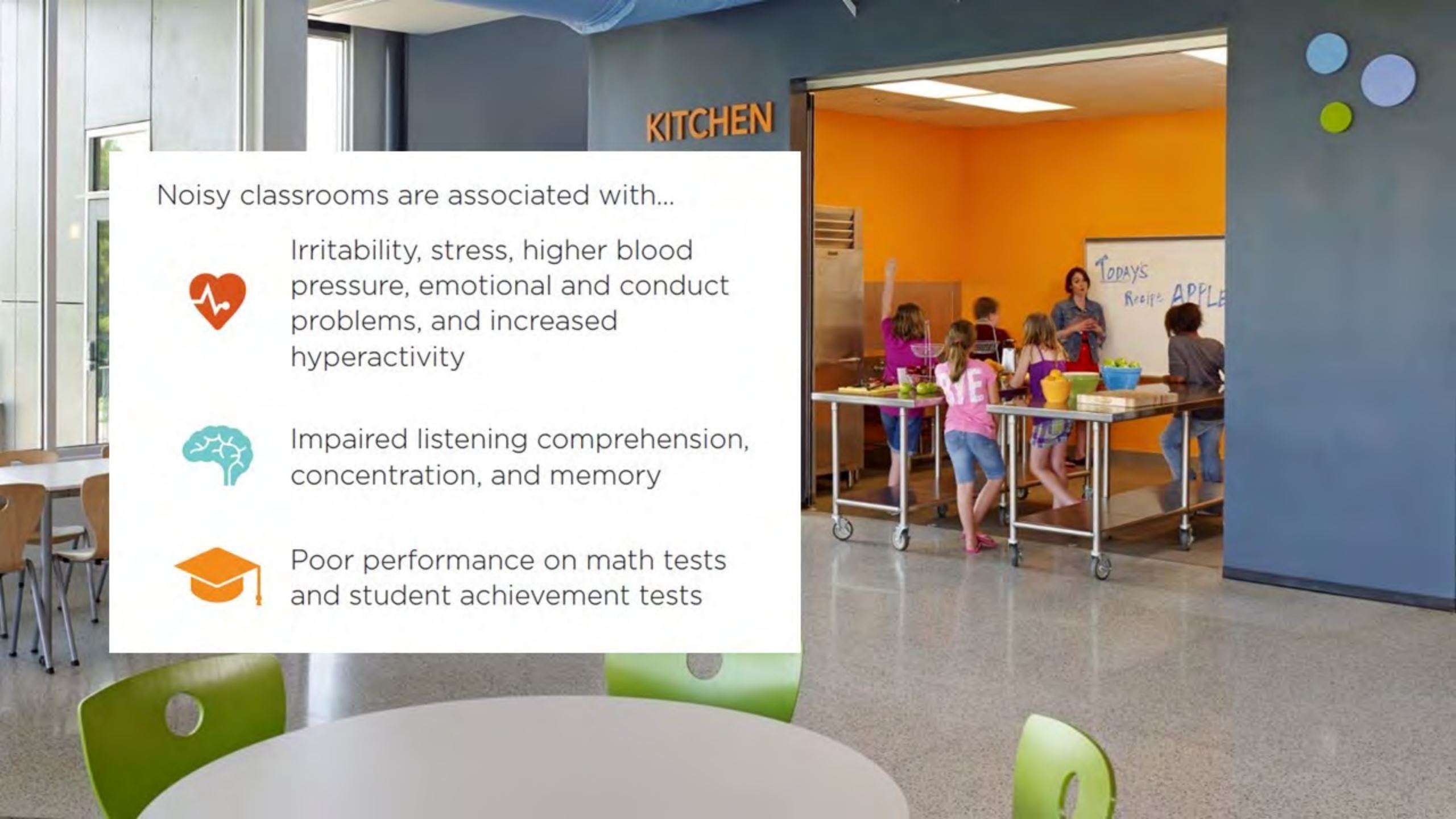
Poor IAQ is associated with...

- Asthma, allergies, sick building syndrome, respiratory infections, increased risk of viral infections, cough episodes, and eczema
- Increased student absenteeism, in particular due to respiratory infection
- Impaired attention span, decreased decision making abilities, and fatigue
- Poor academic performance on math and English tests



Uncomfortable classroom temperature and humidity is associated with...

- Tiredness, difficulty breathing, headaches, eye, nose, and throat symptoms, upper respiratory symptoms, and exercise-related cough
- Difficulties in concentration
- Discrepancies in academic achievement on national tests in math, and tests in science and reading



Noisy classrooms are associated with...

- Irritability, stress, higher blood pressure, emotional and conduct problems, and increased hyperactivity
- Impaired listening comprehension, concentration, and memory
- Poor performance on math tests and student achievement tests

Daylight exposure is associated with....

Improved sleep duration, lower blood pressure, improved mood

Access to outside views is associated with...

Faster recovery from stress and mental fatigue, and higher attentional functioning

Bright light and blue light exposure is associated with...

Reduced daytime sleepiness, improved alertness, better attention, faster cognitive processing

Faster reading speed and increased oral reading fluency performance


EPA United States Environmental Protection Agency
Environmental Topics
Laws & Regulations
About EPA
Search EPA.gov
CONTACT US
Healthy Schools: Environmental Factors, Children's Health and Performance, and Sustainable Building Practices
EPA awarded seven universities to inform school building (K-12 educational facilities) design, construction and operation practices in order to foster safe and healthy school environments and maximize student achievement and teacher/staff effectiveness.
Request for Applications closing date: October 8, 2013
View RFA Text
Related Information
Research Grants
P3: Student Design Competition
Research Fellowships
Small Business Innovation Research (SBIR)
Grantee Research Project Results Search
Abstracts
Publications
Download .csv file
Check All
Help
#
Add/ Remove Selection
Identifier
Abstract
Principal Investigator
Institution
Project Period
State
<< STAR GRANTS AND STAR CENTERS >>

RESULTS from the RESEARCHERS (~2018)

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- Our schools are not keeping up with CO2 levels: Studies found that half or fewer of classrooms had CO2 measurements above recommended levels.

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- Sources of VOCs can be surprising: One study found elevated VOCs only in classes with air fresheners and scented candles.
- Filtration is effective in preventing asthma incidence: Statistical models seem to indicate that asthma incidence is being caused by large particulates.

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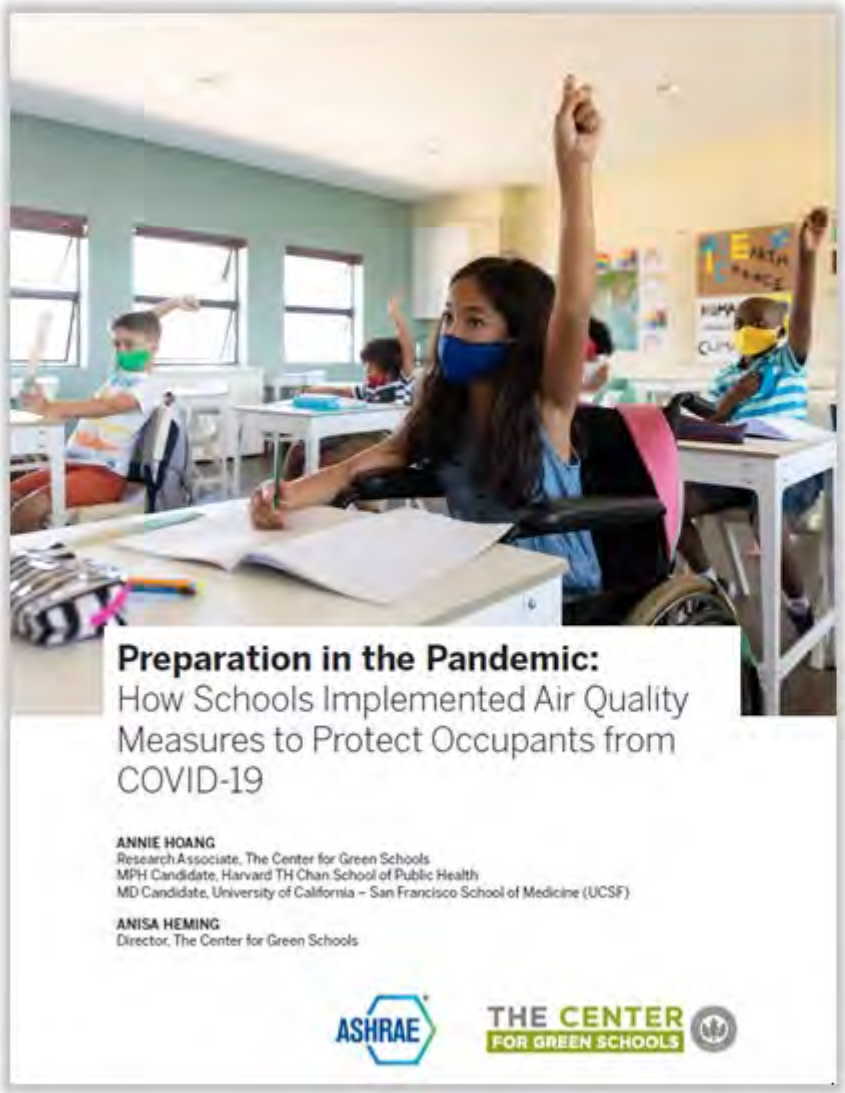
Building the Case

The 2022 report builds on previous research, published in April 2021, which helped to make the case for increased COVID-19 funding for schools, including for use on facilities-related expenditures.



Preparation in the Pandemic:
How Schools Implemented Air Quality Measures to Protect Occupants from COVID-19

ANNIE HOANG
Research Associate, The Center for Green Schools
MPH Candidate, Harvard TH Chan School of Public Health
MD Candidate, University of California – San Francisco School of Medicine (UCSF)

ANISA HEMING
Director, The Center for Green Schools

ASHRAE

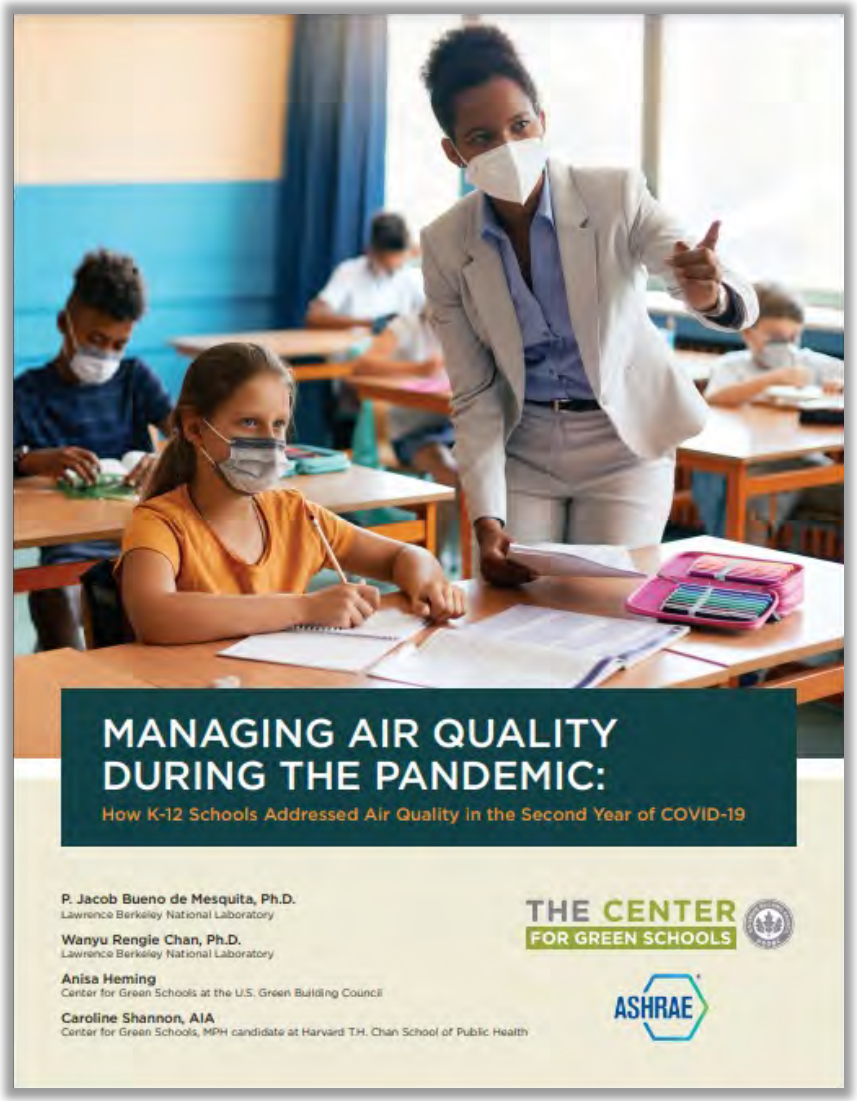
THE CENTER FOR GREEN SCHOOLS

The new survey builds on previous research, published in April 2021.

2022 National IAQ Survey for School Districts

New report, released in early May 2022:

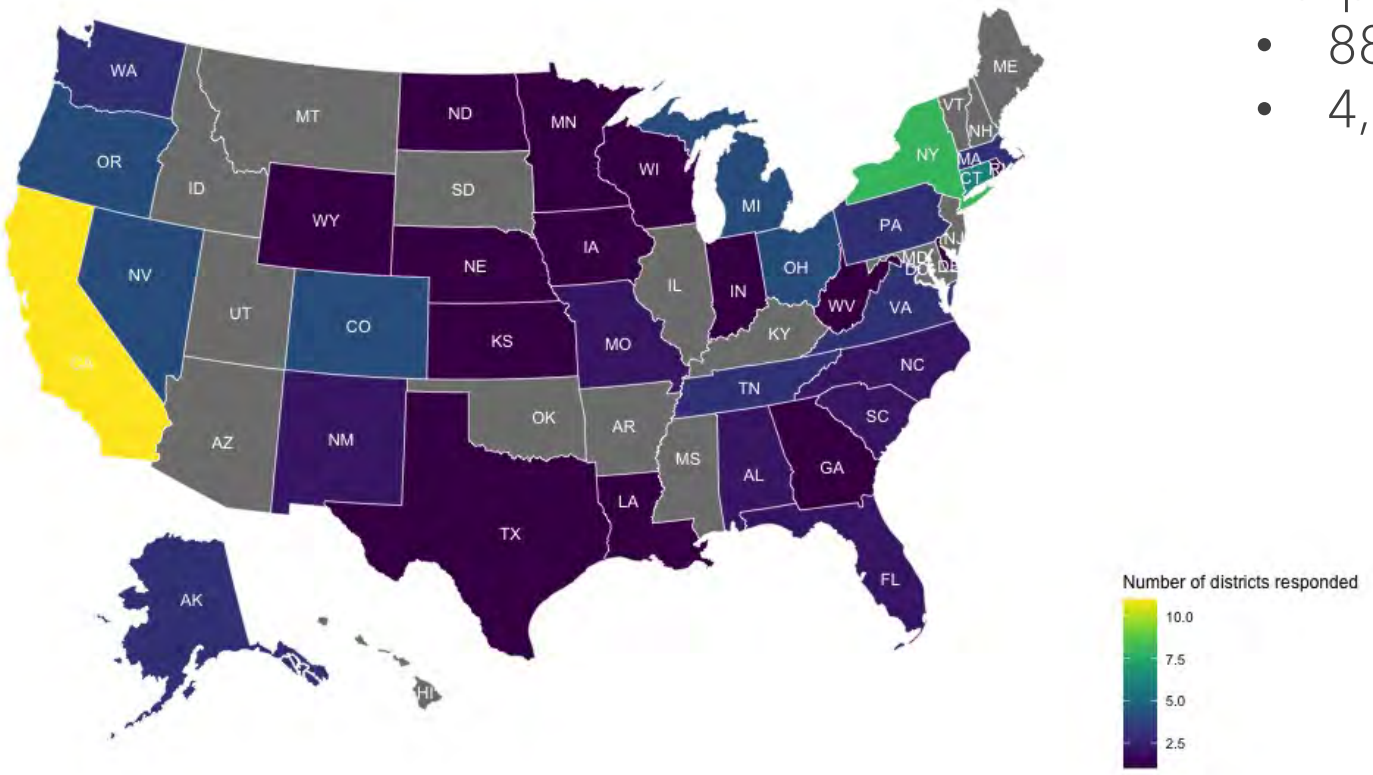
- Contributes to a national understanding of IAQ implementation in schools
- Helps local, state, and federal policymakers understand what is needed on the ground
- Gives NGOs, researchers, and government officials an understanding of the decision-making process that school districts are going through related to IAQ, COVID relief funding, and facilities upgrades



https://www.usgbc.org/resources/managing-air-quality-during-pandemic-how-k-12-schools-addressed-air-quality-second-year

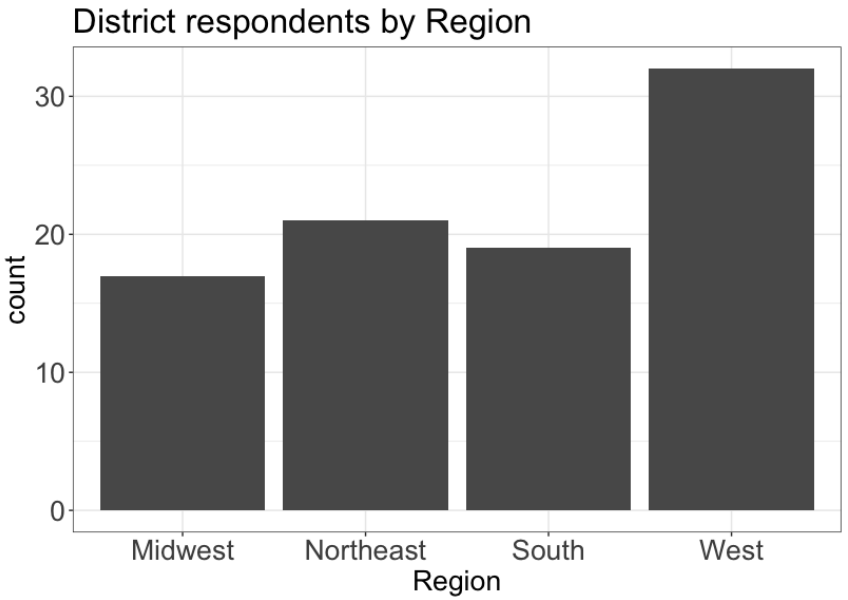
Managing Air Quality During the Pandemic:

How K-12 Schools Addressed Air Quality in the Second Year of COVID-19



Respondents:

- 88 school districts (complete entries)
- 4,000+ schools represented



Managing Air Quality During the Pandemic:

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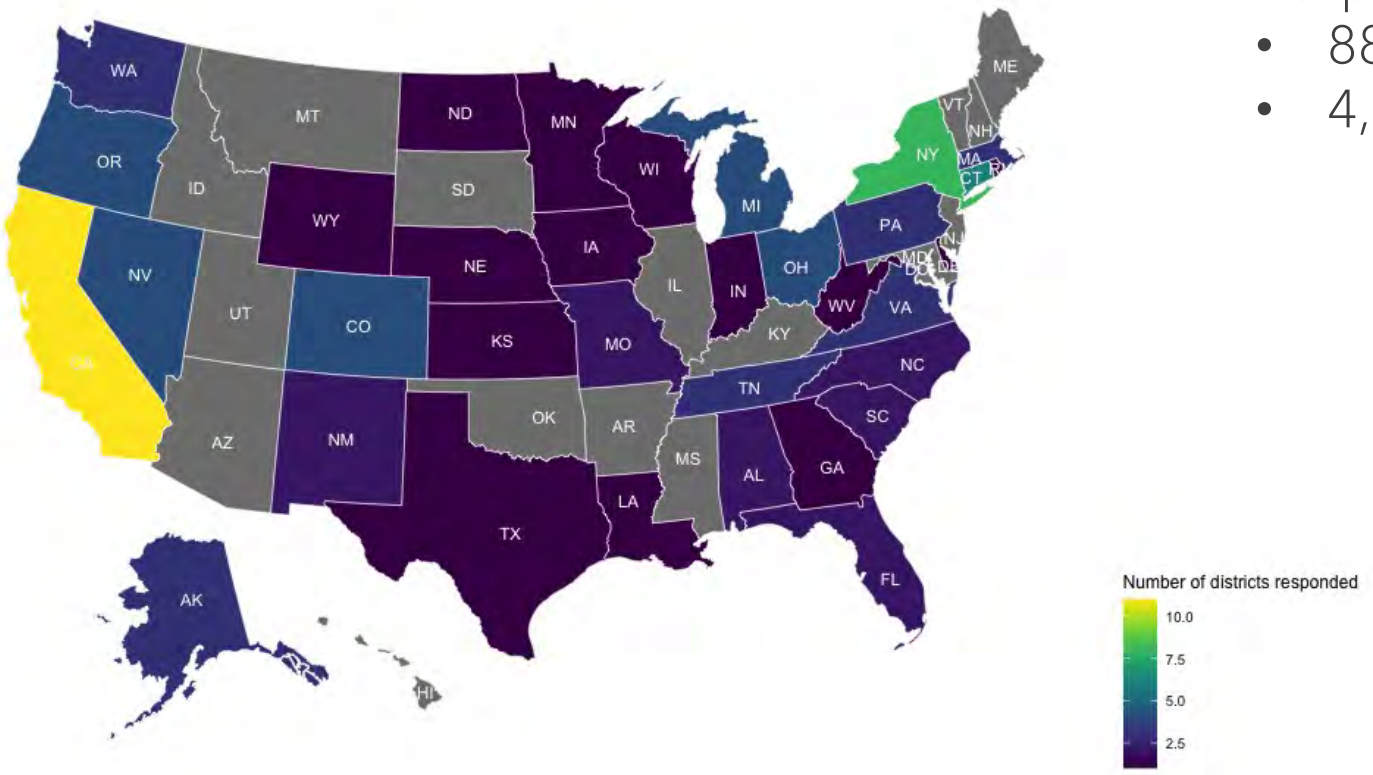

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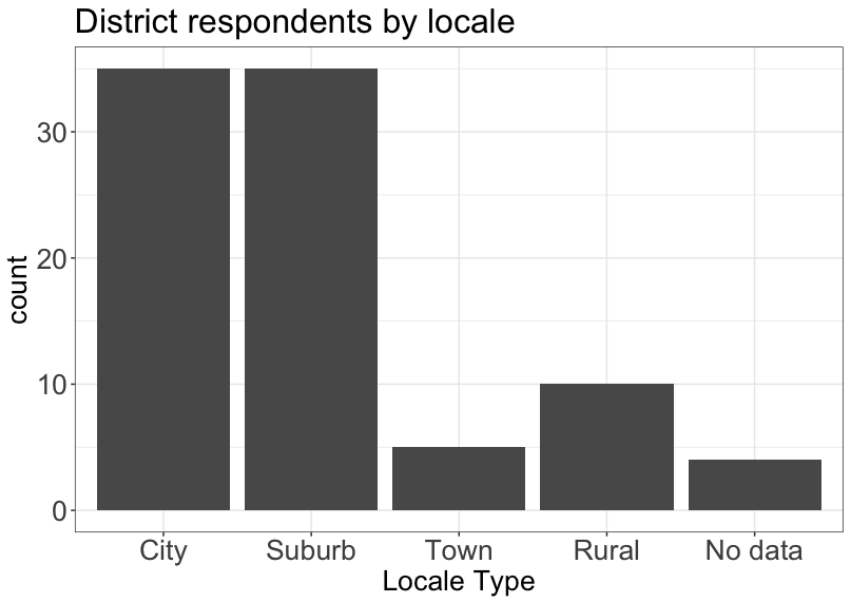

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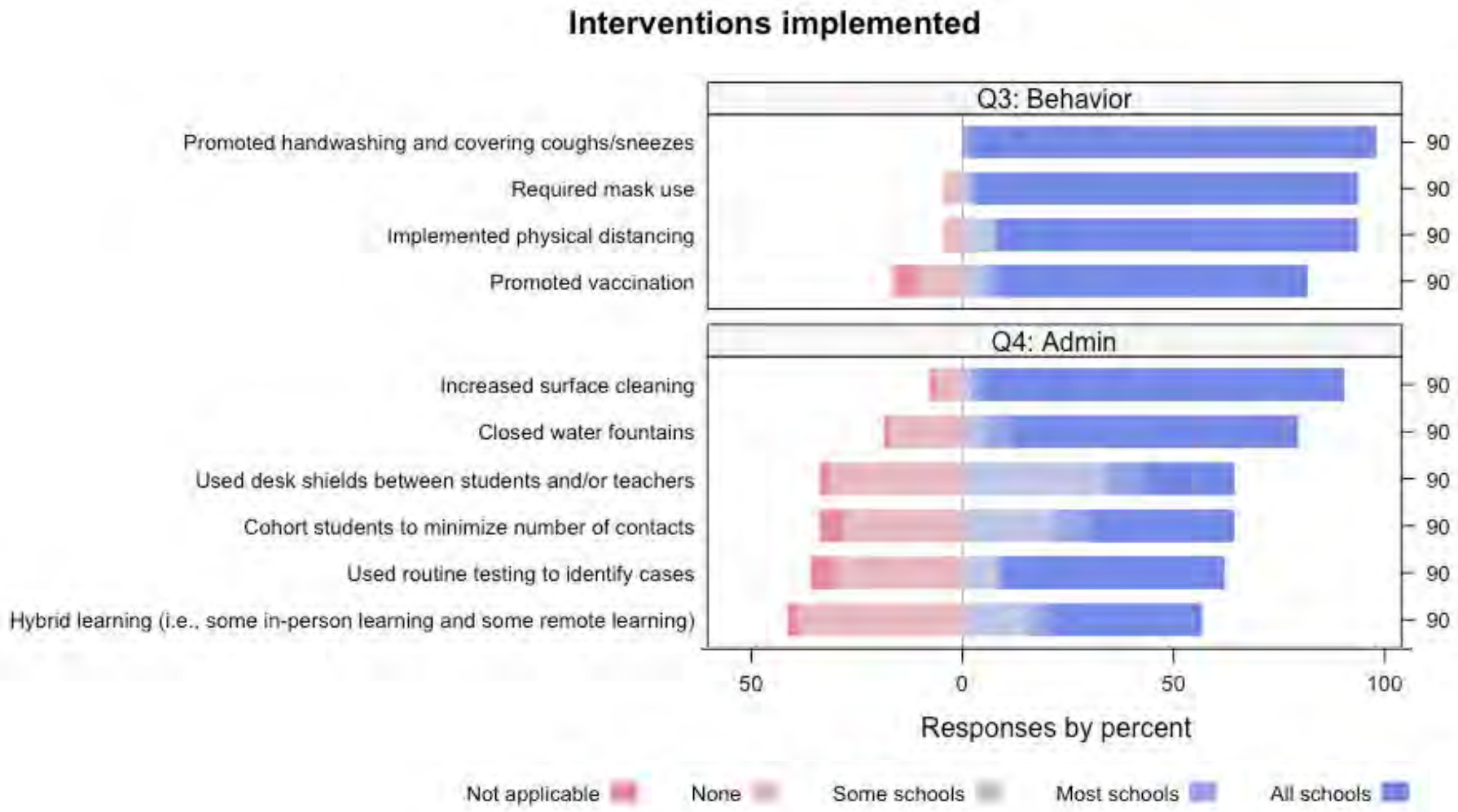

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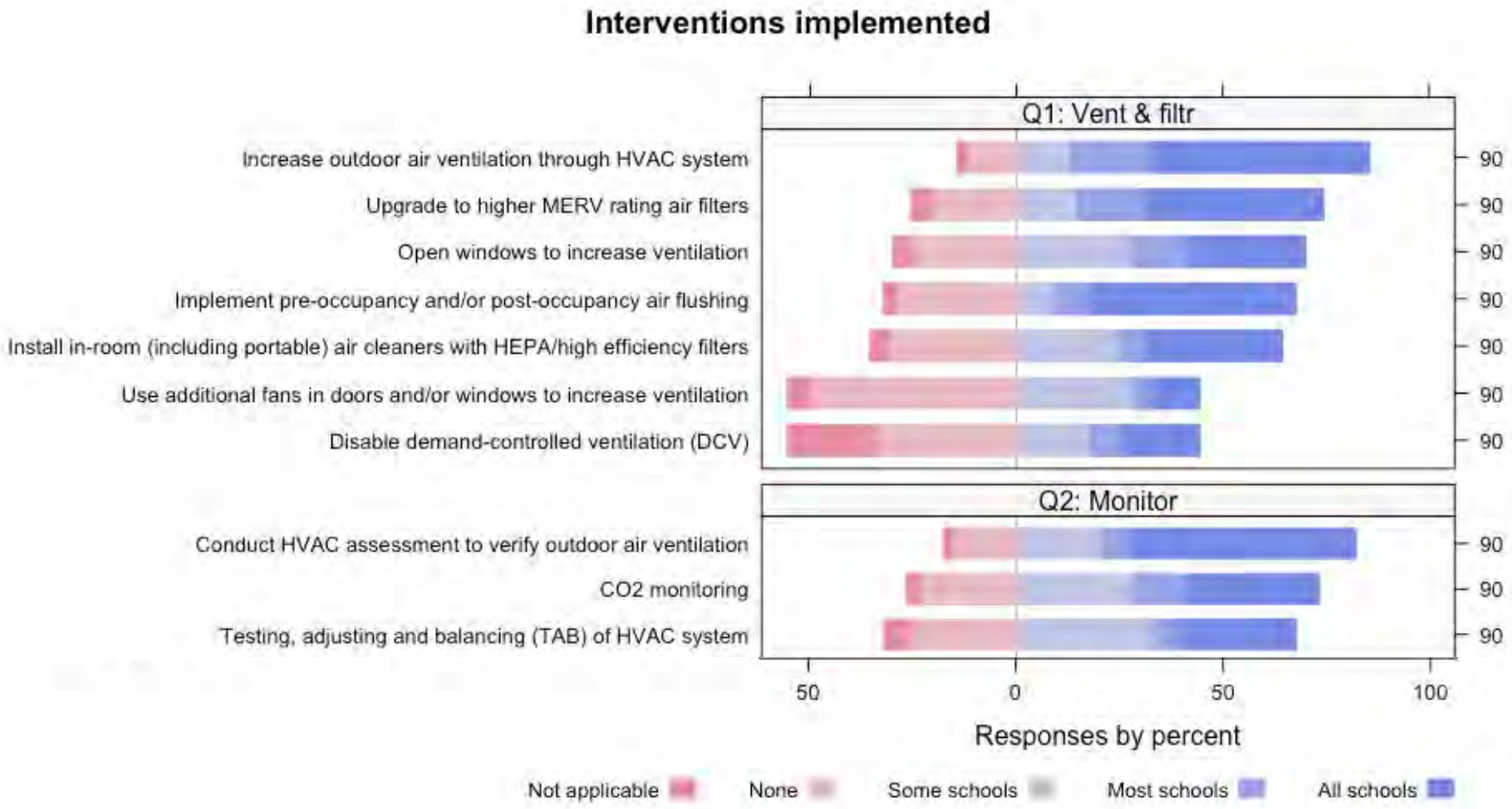
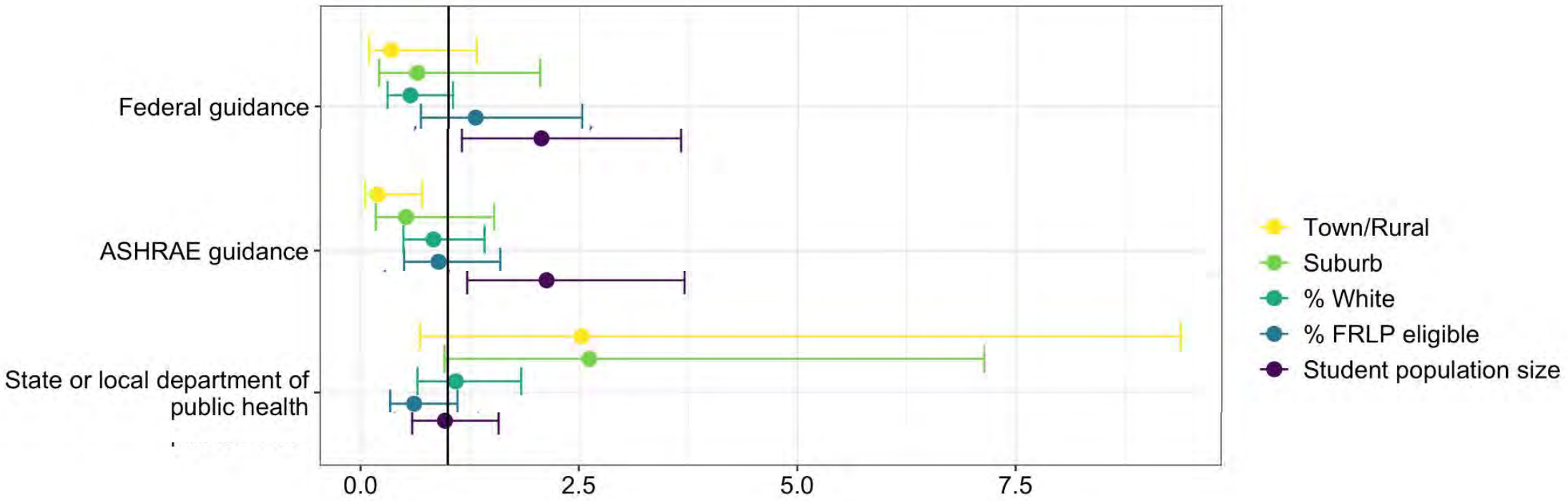


Managing Air Quality During the Pandemic:

How K-12 Schools Addressed Air Quality in the Second Year of COVID-19

Guidance utilized in determining strategy for IAQ measures



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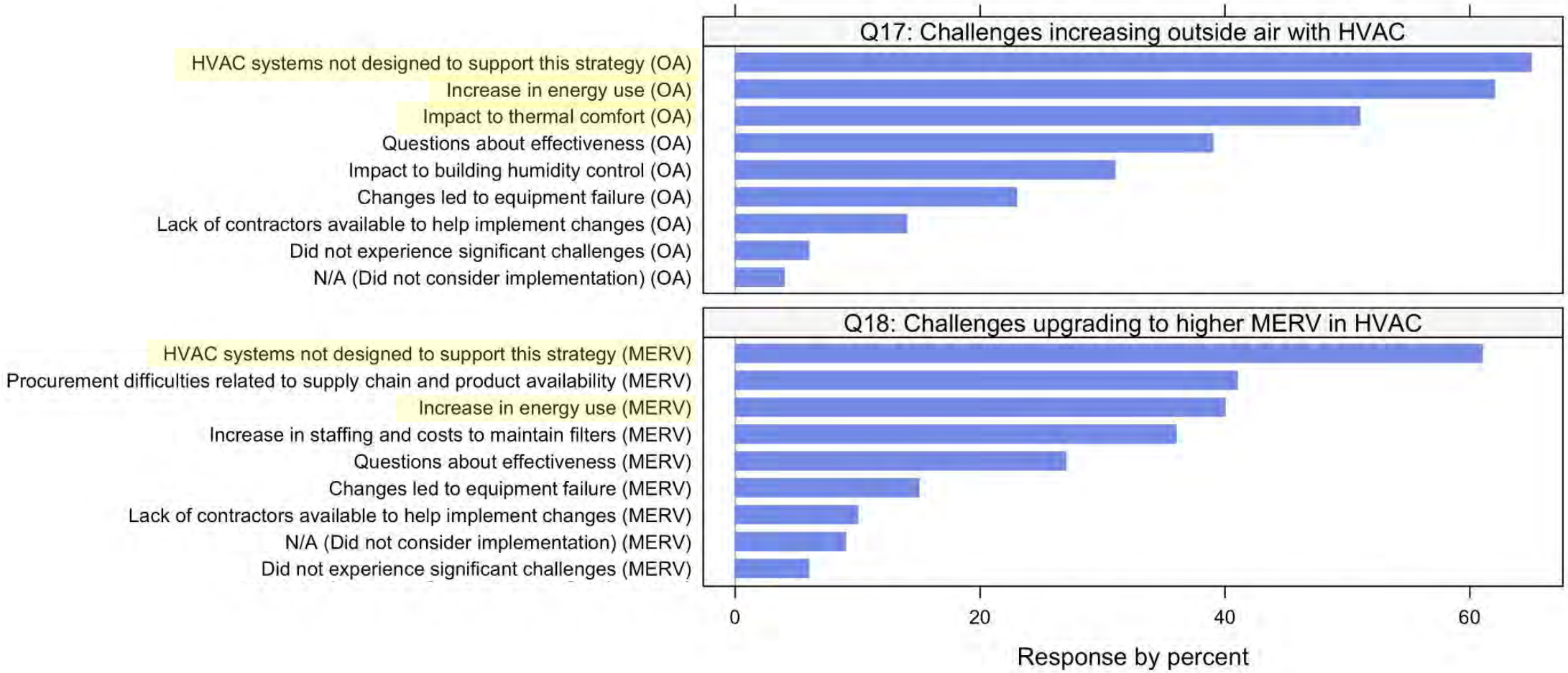

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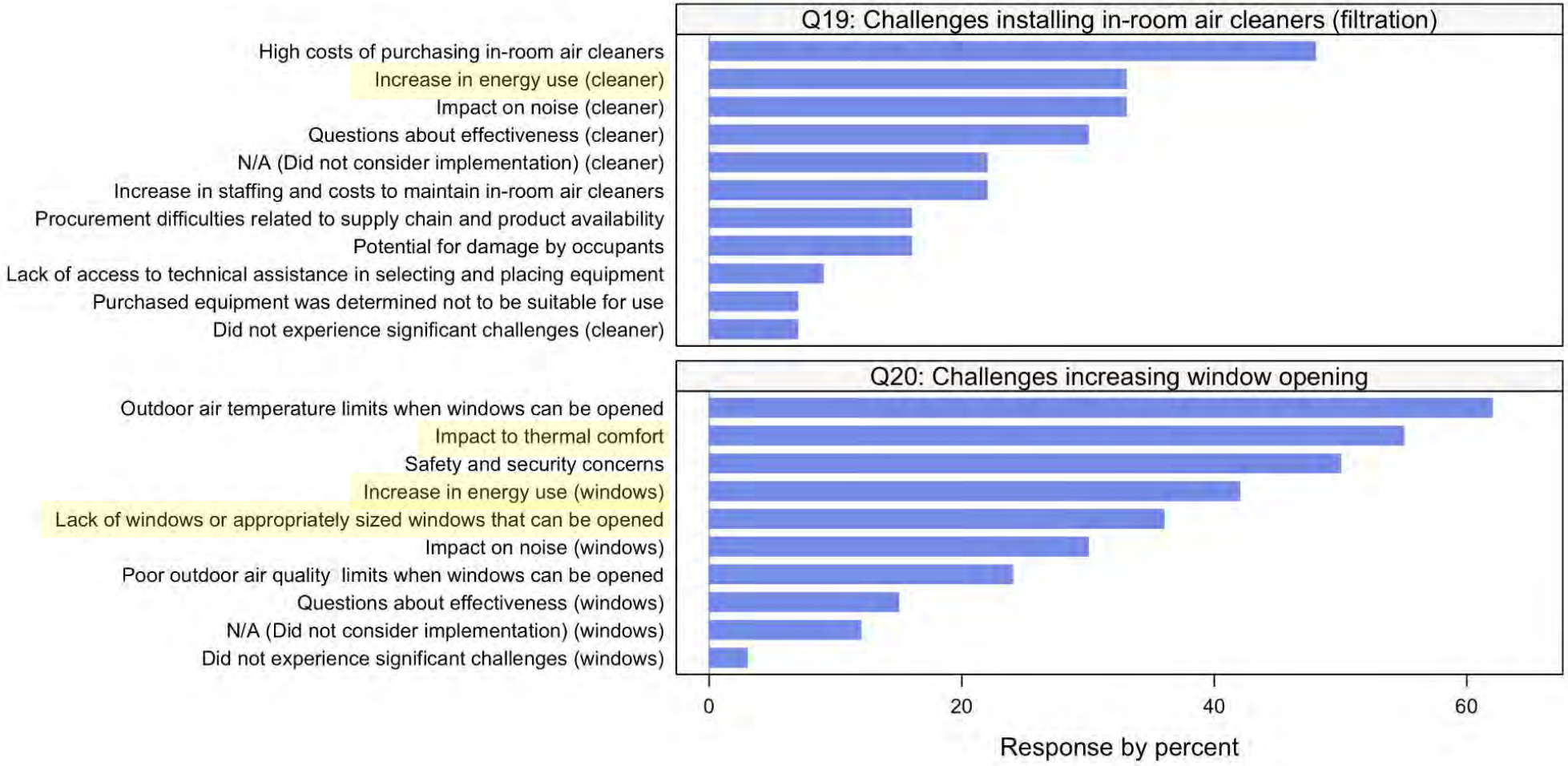

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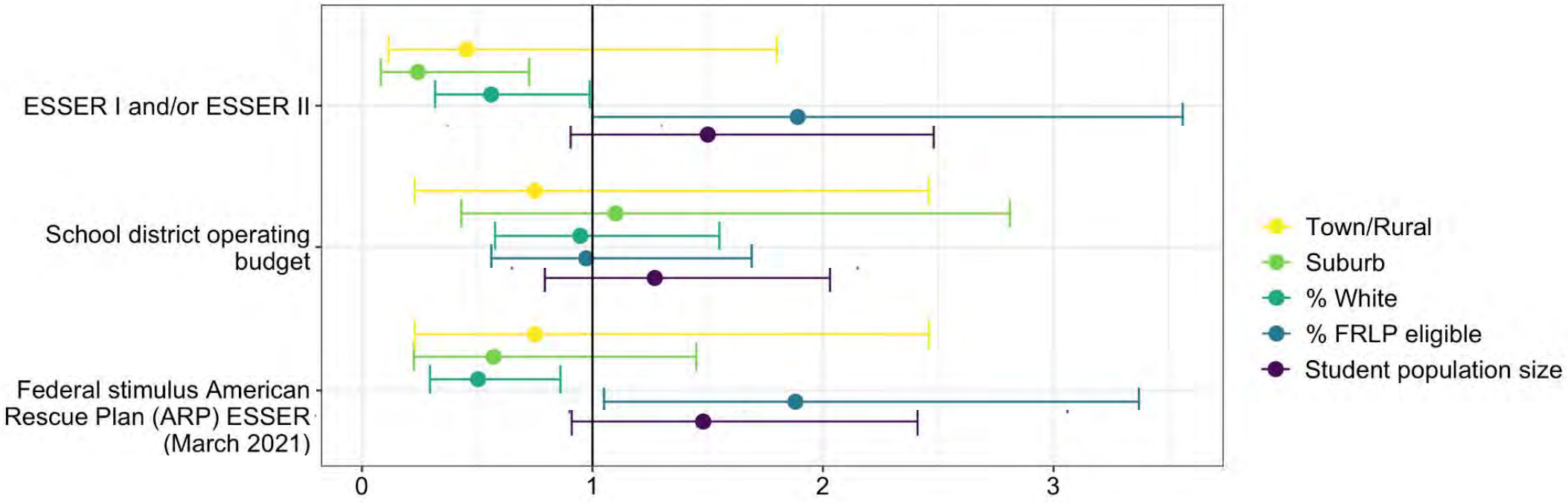
Odds of using funding sources for IAQ-related improvements



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COVID-19 RELIEF

Bill	Passed	TOTAL Appropriation	PK-12 Public Education Allocation	% Funds to LEAs	Must obligate by
CARES Act (ESSER 1)	March 27, 2020	$2.2 Trillion	$13.5 Billion	90%	December 30, 2021*
CRRSAA (ESSER 2)	December 27, 2020	$900 Billion	$54.3 Billion	90%	September 30, 2022*
American Rescue Plan Act (ESSER 3)	March 11, 2021	$1.9 Trillion	$122.0 Billion	87.5%	September 30, 2023*

* The Tydings Amendment allows for one additional year for expenditure, making these dates September 30, 2022; September 30, 2023; and September 30, 2024

FIVE GUIDING PRINCIPLES

How Districts Can Use COVID Relief Funds
to Advance Healthy, Green Schools

THE CENTER FOR GREEN SCHOOLS

UNDAUNTEDK12
Climate-resilient schools and future-ready students

INVESTING IN HEALTHY, GREEN SCHOOLS IS CENTRAL TO ADVANCING EQUITY

"In less-resourced districts, i
communities that were most
are the places where we see
issue of equity for me in term
have a safe learning environm

THE TAKE-AWAY

Using federal COVID relief funds to advance healthy, g
access to high-quality learning environments and to en
and promote climate justice.

THE LANDSCAPE

As recent history has underscored, the challenges o
global pandemic or changing climate do not land in t
same way on all of us. Just as the COVID pandemic h
exacerbated existing inequalities in health, housi
financial security, and working conditions, the chang
climate is a present and heightened threat to vulnera
populations. The concept of climate justice acknowledg
the unequal burdens of climate change and recognizes t
linkages with other forms of social justice, including rac
justice. The Biden Administration is advancing clima
justice through its government-wide Justice40 Initiati
which aims to deliver 40% of benefits from releva
investments to disadvantaged communities and ma
environmental justice a part of the mission of every fede
agency.

District leaders have powerful opportunities to put equ
at the center as they guide the use of a monumen
federal investment in our K-12 sector. The Department
Education has expressly directed states and districts
advance spending plans that will meet the needs of
pandemic, including students from low-income families
students experiencing homelessness, children in foster c

Center for Green Schools and UndauntedK12

Understand financial benefits.

In engaging private sector partners who offer clean energy solutions, schools are likely to develop an understanding of the financial resources required to transition to clean energy as well as the financial benefits. In fact, evaluating the available funding structures and sources for energy efficiency and renewable energy improvements are likely to yield options for schools to access these improvements with no upfront cost and no new debt obligations. For example, over 7,300 schools across the US have installed solar, mostly through a power purchase agreement, which requires no upfront capital. Since many stakeholders mistakenly assume that clean energy technologies operate at a premium, incorporating this financial analysis into school planning processes can invite new thinking and reveal attractive opportunities.

Plan for a clean energy future.

Given the flexibility for COVID relief funds to fun
operation of schools to reduce risk of virus transmiss
support student health needs," many schools will lik
operation of schools. Schools and districts with exist
of how buildings can be healthy, efficient, and resi
Schools without these plans are at higher risk of spe
that do not take advantage of long-term opportuni
and space heating systems with high performance, g
indoor air quality, reducing operating costs, and red
HVAC systems that rely on fossil fuels are unlik
regulations with associated financial penalties emer
DC and New York City, have already started to regul

Embrace a role in resilience.

Schools are well-positioned in their communities t
extend beyond school day instruction. By engaging
schools can play an important role in providing eme
and continuity of their own operations.

Long-term facilities planning is the crucial foundation to achie
across the nation's school facilities. Communities benefit, w
student and teacher health and reduce energy use and emiss
navigating replacement of failed systems and engaging private

INSPIRATION FROM THE FIELD

At Parkway School District (Missouri), Erik Luebers has been leading change toward sustainability through many years of stakeholder engagement, development of policy and procedures, planning, and goal setting. Parkway has a clear set of goals that include quantitative metrics and activities, aiming to reduce water usage by 20%, energy usage by 35%, and achieve 70% landfill diversion by 2025. The district also aims to regularly increase opportunities for hands-on student learning with sustainability topics, engage students and staff in sustainable outdoor environments, and connect students and staff to more health and wellness activities. Metrics are tracked and shared publicly in an online dashboard. In order to solidify their sustainability goals and processes, Parkway has drafted policies that they aim to have adopted by their Board of Education. Procedures governing energy, indoor environmental quality, waste, water, and sustainable sites (e.g. landscaping) have continued to evolve throughout time as their experience with the work grows.

Center for Green Schools and UndauntedK12

LEADERS AND ADVOCATES: QUESTIONS TO ASK

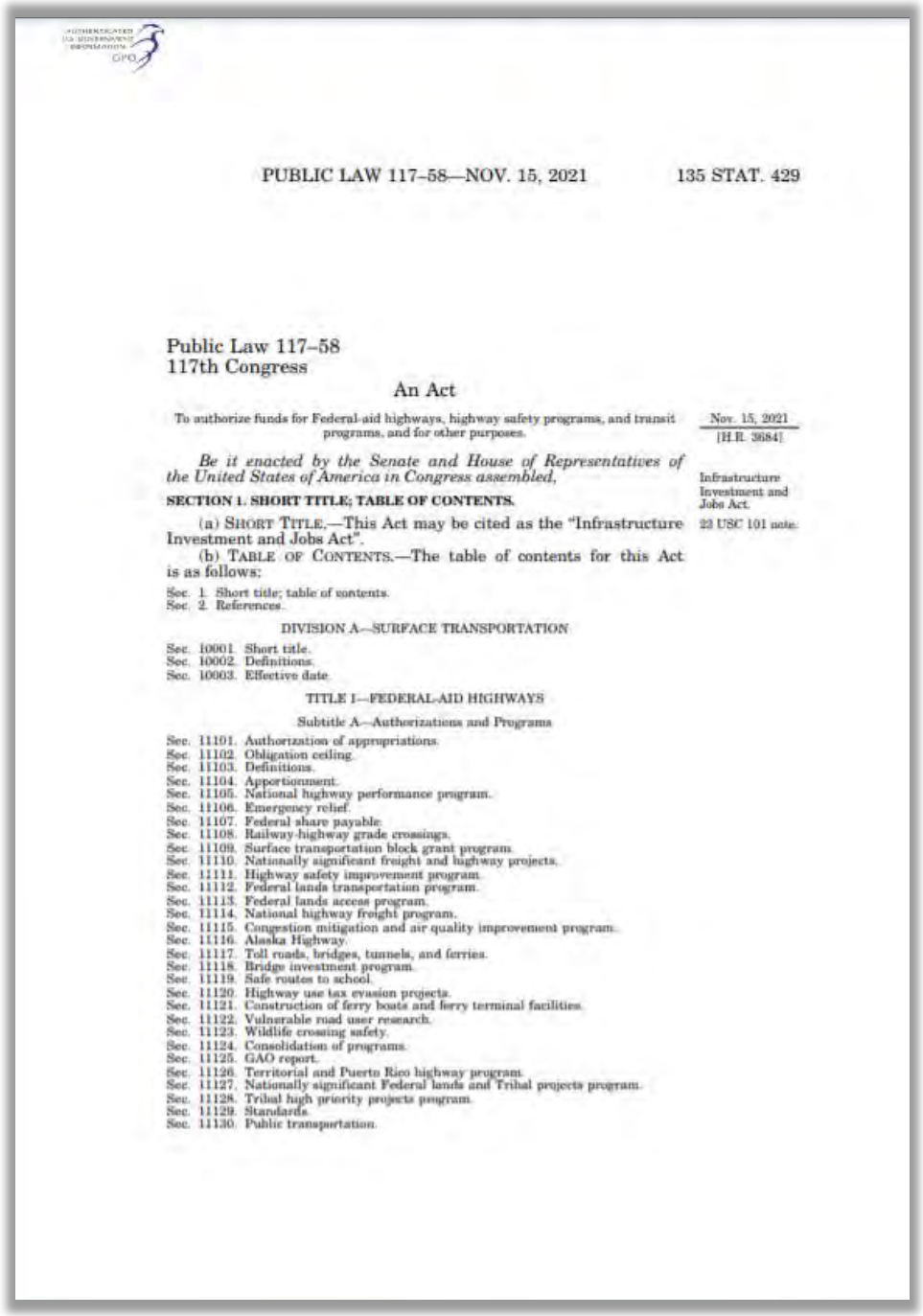
- Is providing access to environmental and climate literacy an explicit goal of the school district, with appropriate support for professional development and teaching resources?
- Are there resources allocated to support professional learning for all educators in the area of environmental and climate literacy, including establishing relationships with community-based partners?
- Do district and school leaders understand how sustainability education is currently being addressed at every grade level and in every subject area? Is there a plan to integrate sustainability?
- As industry embraces the green economy, what are the costs of inaction for students if climate change education is not equitably and reliably delivered? In other words, what are the risks to students' future education and career pathways of failing to provide climate change education?
- How do various stakeholders view the urgency of addressing the environment and climate change in the curriculum? Are there forums for adults and youth to exchange perspectives around climate change?
- How is the school district developing relationships with local clean energy and sustainability businesses to provide internships and work-based learning opportunities for students?
- How is the district considering the role of sustainability and environmental education in supporting students' social-emotional well-being as they reopen schools?

ADDITIONAL RESOURCES

The Brookings Institution: A New Green Learning Agenda
San Mateo County Office of Education: Green Economy Overview for K-12 Educators
U.S. Green Building Council: Green Careers Resource and Center for Green Schools at USGBC: Learning Lab
Strategic Energy Innovations: Energize Schools Curriculum Library
National Oceanic and Atmospheric Administration: Climate Science and Information for a Climate-Smart Nation
North American Association for Environmental Education (NAAEE): EeePRO
National Energy Education Development
Paleontological Research Institution: Climate Change and Energy Education
The California Environmental Literacy Initiative
National COVID-19 Outdoor Learning Initiative

Center for Green Schools and UndauntedK12 24

https://www.usgbc.org/resources/five-guiding-principles



PUBLIC LAW 117–58—NOV. 15, 2021 135 STAT. 429

Public Law 117–58
117th Congress

An Act

To authorize funds for Federal-aid highways, highway safety programs, and transit programs, and for other purposes.

Nov. 15, 2021
[H.R. 3684]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Infrastructure Investment and Jobs Act.

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the "Infrastructure Investment and Jobs Act".

23 USC 101 note.

(b) TABLE OF CONTENTS.—The table of contents for this Act is as follows:

2021 Bipartisan Infrastructure Law

School districts can benefit from many elements of the IIJA. Several opportunities include schools as eligible entities, but schools may not be informed about the resources available.

Funding specifically for schools:

- $5 B for clean school buses (EPA)
- $500 M for energy efficiency and renewable energy (DOE)
- $200 M for lead in school drinking water (EPA)

Funding that schools may be eligible to receive:

- $1.25 B in community grants for EV charging stations (DOT)
- $550 M in Energy Efficiency and Conservation Block Grants (DOE)

https://www.usgbc.org/articles/2021-infrastructure-investment-and-jobs-act-resources-schools

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State action on school air quality since the start of COVID-19

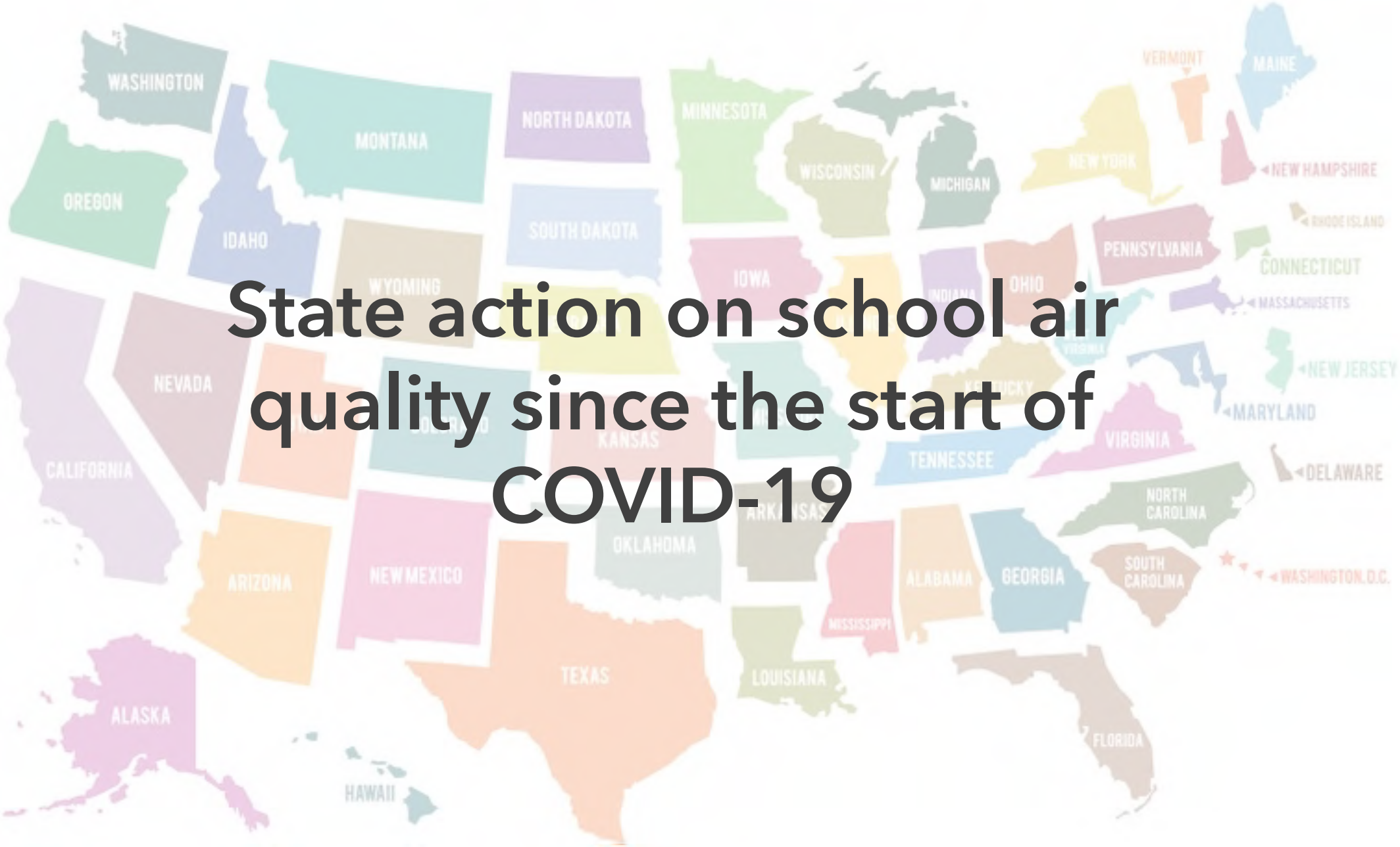


Image credit: Saskatoon Graphics

States have allocated American Rescue Plan funds (SLRF) to schools for IAQ

Vermont: Act 9, 2021

Massachusetts: Chapter 102, 2021

Virginia: Senate Bill 1303, 2021

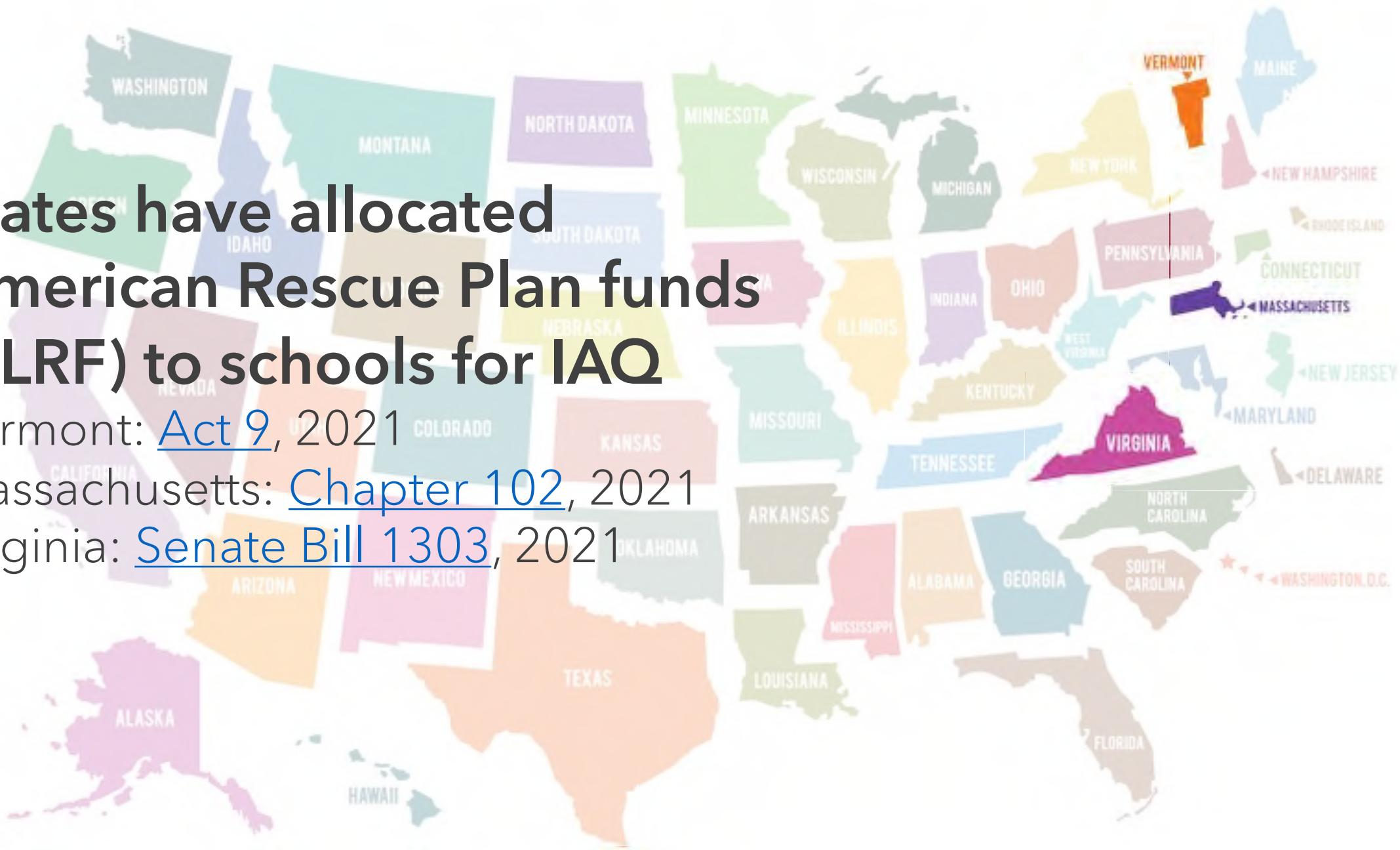
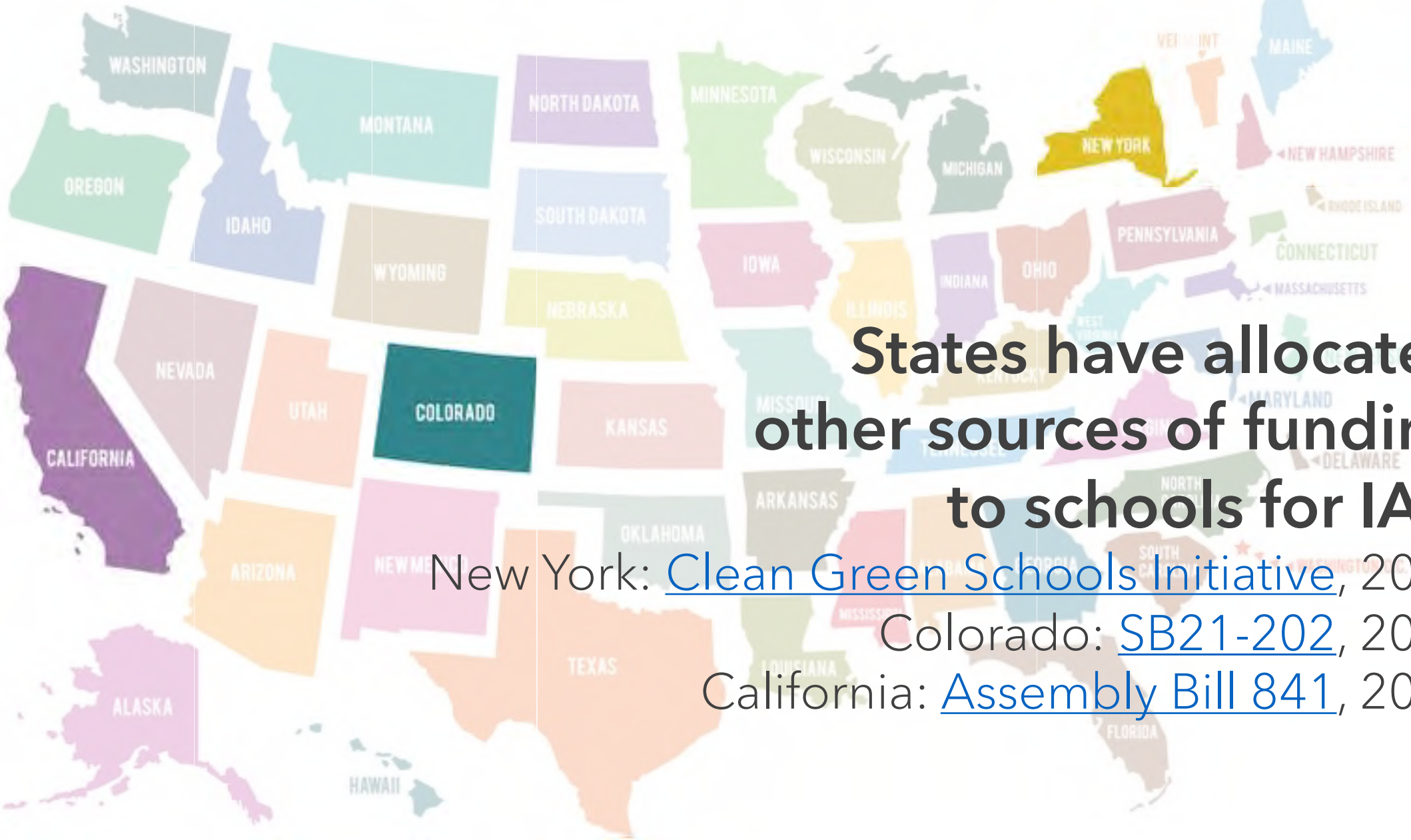


Image credit: Saskatoon Graphics



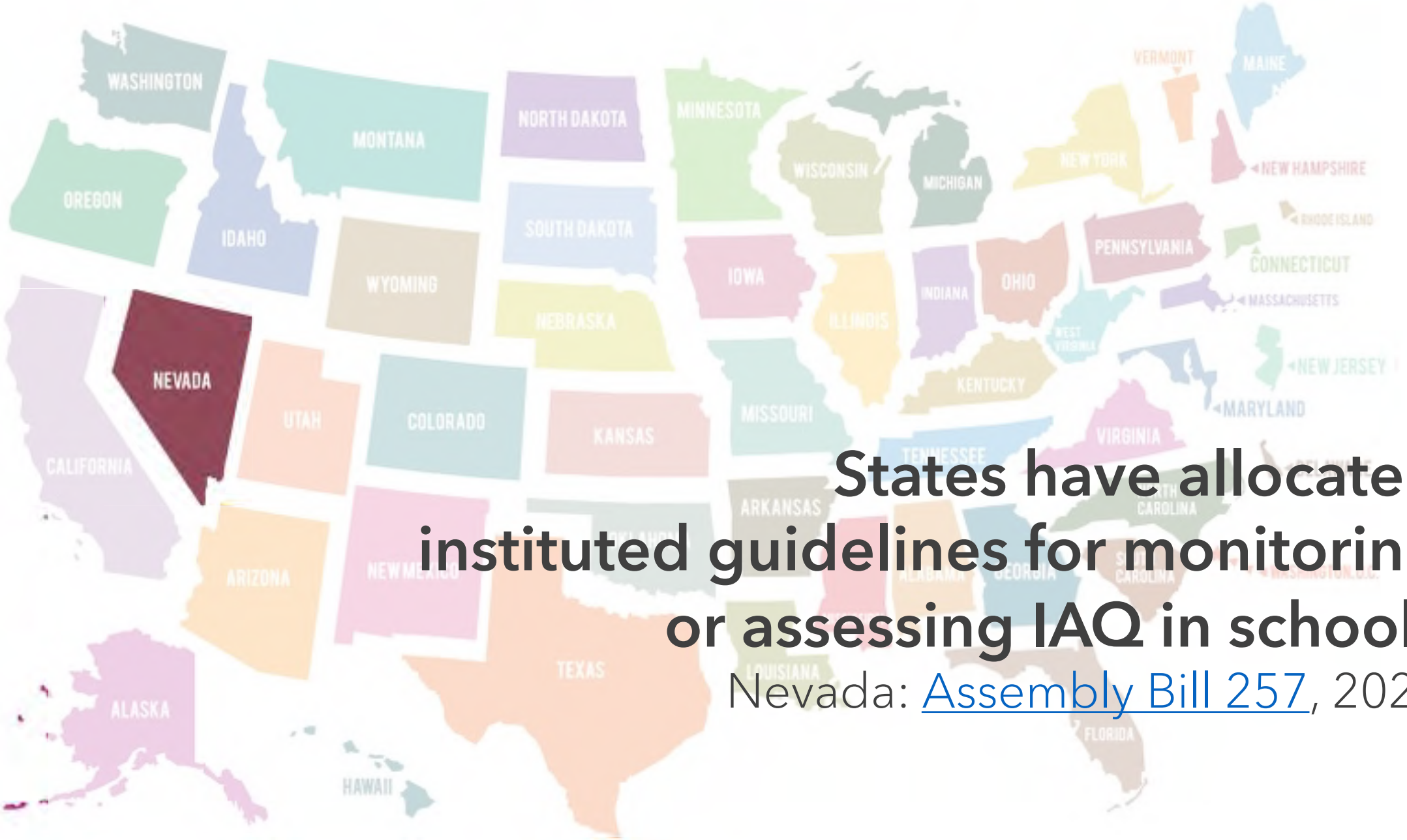
States have allocated other sources of funding to schools for IAQ

New York: Clean Green Schools Initiative, 2022

Colorado: SB21-202, 2021

California: Assembly Bill 841, 2020

Image credit: Saskatoon Graphics

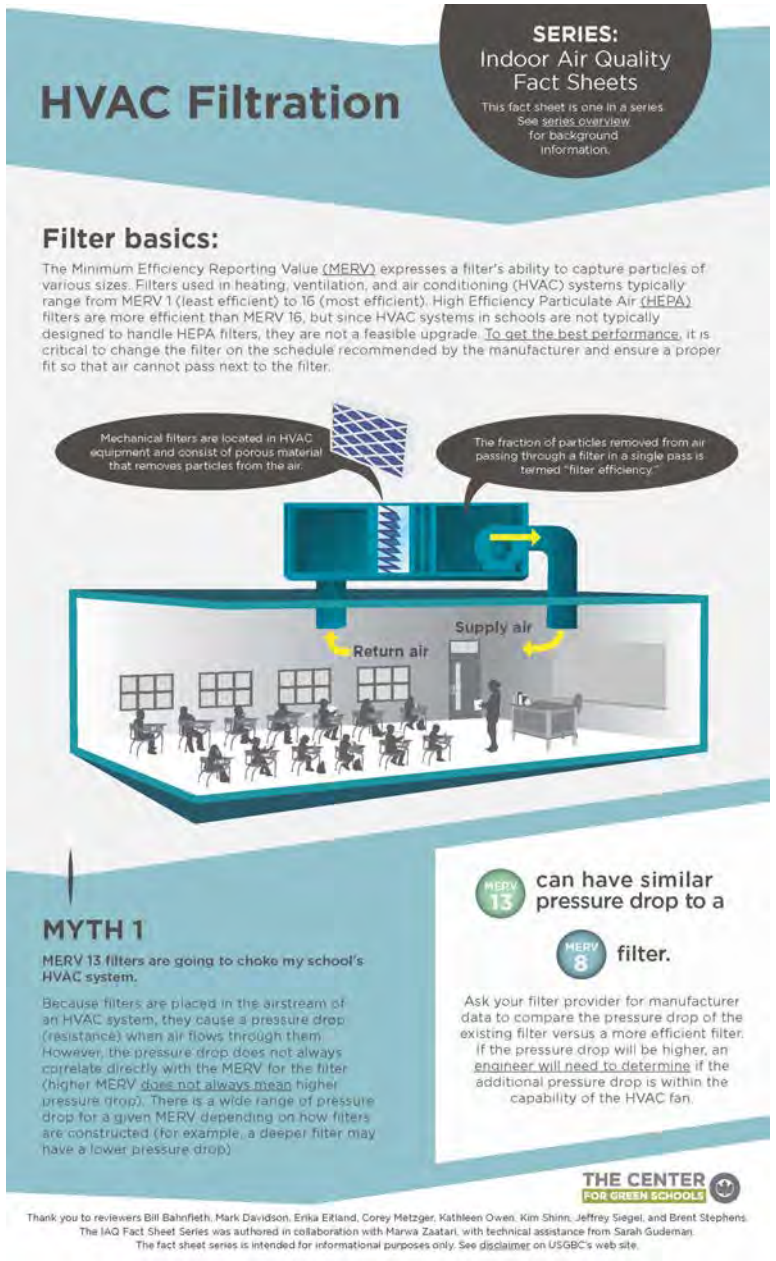


States have allocated instituted guidelines for monitoring or assessing IAQ in schools

Nevada: Assembly Bill 257, 2021

Image credit: Saskatoon Graphics

RESOURCES
for you and your constituents



HVAC Filtration

SERIES: Indoor Air Quality Fact Sheets

This fact sheet is one in a series. See series overview for background information.

Filter basics:

The Minimum Efficiency Reporting Value (MERV) expresses a filter's ability to capture particles of various sizes. Filters used in heating, ventilation, and air conditioning (HVAC) systems typically range from MERV 1 (least efficient) to 16 (most efficient). High Efficiency Particulate Air (HEPA) filters are more efficient than MERV 16, but since HVAC systems in schools are not typically designed to handle HEPA filters, they are not a feasible upgrade. To get the best performance, it is critical to change the filter on the schedule recommended by the manufacturer and ensure a proper fit so that air cannot pass next to the filter.

MYTH 1

MERV 13 filters are going to choke my school's HVAC system.

Because filters are placed in the airstream of an HVAC system, they cause a pressure drop (resistance) when air flows through them. However, the pressure drop does not always correlate directly with the MERV for the filter (higher MERV does not always mean higher pressure drop). There is a wide range of pressure drop for a given MERV depending on how filters are constructed (for example, a deeper filter may have a lower pressure drop).

MERV 13 can have similar pressure drop to a MERV 8 filter.

Ask your filter provider for manufacturer data to compare the pressure drop of the existing filter versus a more efficient filter. If the pressure drop will be higher, an engineer will need to determine if the additional pressure drop is within the capability of the HVAC fan.

THE CENTER FOR GREEN SCHOOLS

Thank you to reviewers Bill Bahnfleth, Mark Davidson, Erika Erland, Corey Metzger, Kathleen Owen, Kim Shinn, Jeffrey Siegel, and Brent Stephens. The IAQ Fact Sheet Series was authored in collaboration with Marwa Zaatari, with technical assistance from Sarah Gudeman. The fact sheet series is intended for informational purposes only. See disclaimer on USGBC's web site.

IAQ Fact Sheets

For school district administrators, school board members, community stakeholders, and anyone else who wants to be well-informed about IAQ but doesn't have a technical background.

Fact Sheet Topics:

- Overview of strategies
- HVAC filtration
- HEPA in-room air cleaners
- Ventilation
- Germicidal Ultraviolet (GUV, or UVGI)
- Disinfection (i.e., "fogging")
- Electronic Air Cleaners

https://www.usgbc.org/resources/school-iaq-fact-sheets-entire-series

Ventilation

SERIES:
Indoor Air Quality
Fact Sheets

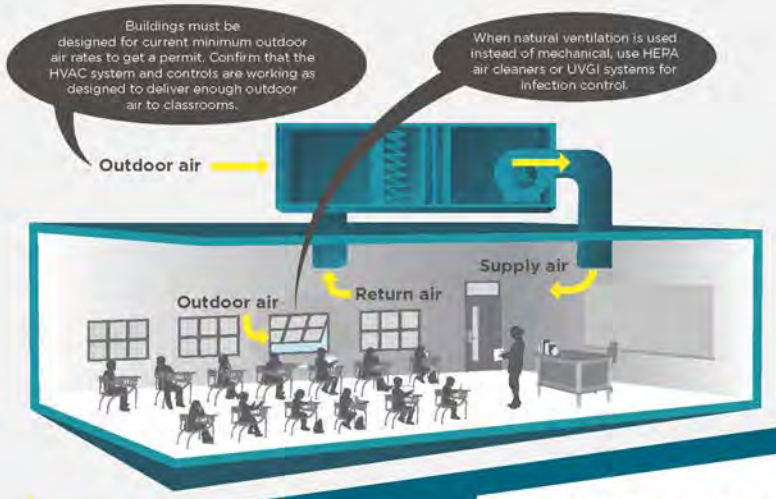
This fact sheet is one in a series. See series overview for background information.

Ventilation basics:

Ventilation is outdoor air brought into a building intentionally, to control air contaminants. The required rate of outdoor air is based on occupancy and floor area. Since 1990, the minimum rate for typical classrooms has been approximately 15 cubic feet per minute (CFM) per person, set by ASHRAE Standard 62.1. There are two forms of ventilation: mechanical and natural.

Mechanical ventilation brings in outdoor air via a forced air delivery system, such as a heating, ventilation, and air conditioning (HVAC) system.

Natural ventilation allows in outdoor air via open windows and/or doors that are designed to serve the space's ventilation needs. Natural ventilation is most effective on windy days or when there is strong temperature difference between indoors and outdoors, but its effectiveness can vary based on many factors. For infection control, use High Efficiency Particulate Air (HEPA) cleaners or Germicide Ultraviolet Air Disinfection (GUV, also known as UVGI) systems during periods of low natural ventilation.



Costs and benefits of outdoor air

Outdoor air, particularly humid air, needs to be treated before it can be introduced inside, which takes energy. The annual cost of outdoor air ranges from a few dollars to a max of $10 per person per year. The benefits are enormous; studies show that under-ventilated schools are associated with increased transmission of infection, asthma exacerbation, and other cognitive and health impacts.

School ventilation in the U.S.:

Research has demonstrated that classroom under-ventilation in the U.S. is far too common.

Researchers hypothesize several reasons for low ventilation rates, including lack of verification when systems were installed, deferred maintenance, or attempts to save energy.

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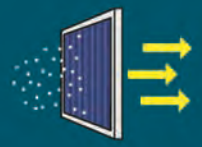
Carbon dioxide:

CO_2 concentration can be an indicator of ventilation effectiveness. Lower rates mean that exhaled air is being appropriately diluted.

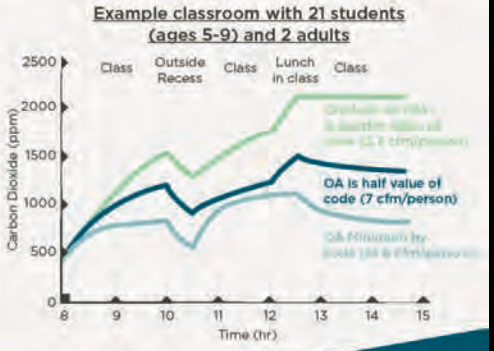


CO_2 does not directly indicate risk of exposure to COVID-19 because it cannot capture the impact of filtration strategies.

Monitoring CO_2:

The best use of carbon dioxide monitors in classrooms is to identify issues with the HVAC system or to indicate insufficient ventilation.

To interpret the data correctly, CO_2 levels must be logged throughout the school day in a typically occupied classroom. CO_2 spot checks will not give you the maximum CO_2 or the general trend of the values. For example, at typical occupancy and outdoor air that is below code, a reading could be 800 ppm at 8:30am or 2,200 ppm at midday.



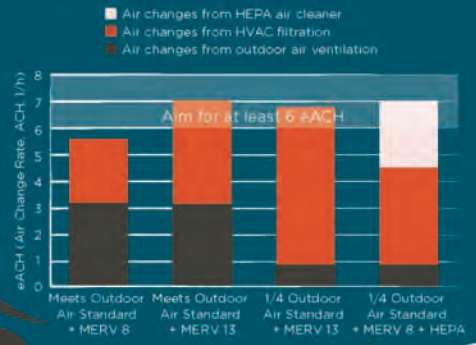
Using ventilation to reach your air change rate goal:

eACH is equivalent air change rate. It is calculated by adding all ventilation and air cleaning strategies. A reasonable target for air change rate in a classroom is at least 6 eACH.

Example eACH for a typical 1,000 ft² classroom

This eACH calculation may vary based on factors such as the amount of air supplied from an HVAC system. The graph is provided as a general comparison between strategies and as an example of how strategies can be combined for infection control.

Imagine measuring contaminants in a space and then starting a stopwatch. At 6 eACH, at the end of 30 minutes, 95% of the original contaminants would have been removed. At a lower eACH, it would take longer to get the same result. At a higher eACH, it would take less time.



Minimum outdoor air is governed by ASHRAE standard 62.1. However, older buildings may not meet this standard, and even newer buildings may not work as intended.

Even with limited outdoor air, a combination of strategies can achieve 6 eACH or higher.

Benefits of ventilation beyond COVID

1. Reduced incidence of respiratory illness, including asthma, common cold, and influenza.
2. Reduced stale air and odors and prevention of headaches and drowsiness.
3. Contributes to better air quality, which is linked to improved cognitive function and higher academic achievement.

In-Room Air Cleaners

SERIES:
Indoor Air Quality Fact Sheets

This fact sheet is one in a series. See series overview for background information.

Air cleaner basics:

In-room air cleaners are installed within an occupied space and work by pulling in air and filtering it before sending it back out into the space. They are independent from a heating, ventilation, and air conditioning (HVAC) system. In-room HEPA air cleaners contain high efficiency particulate air (HEPA) filters, which are certified to meet their stated efficiency.

In-room air cleaners come in several types and sizes, including miniature desktop units, portable units operated on the floor or tabletop, and larger fixed units that can be installed on or above ceilings, walls, or floors.

Where no HVAC system is being used (only natural ventilation is available), HEPA air cleaners can provide additional infection control.

If a school's HVAC system meets ASHRAE recommendations, in-room HEPA air cleaners should still be used for higher-risk locations (nurse's suites, music rooms, cafeterias).

Tips for selecting air cleaners:

- **IDENTIFYING HEPA FILTERS:** Filters that are HEPA will have their factory test reports easily accessible, either on the filter packaging or by request. HEPA filters will not be called "better than HEPA," "HEPA-type," or "HEPA-like." These terms are misleading.
- **PLACEMENT:** Place air cleaner 3 ft away from walls or open windows and doors. Do not block the unit's air inlet or outlet. Place it as close as possible to the teacher and between the teacher and the students.
- **NOISE:** Check manufacturer's data for noise levels, and choose one that meets the recommended 35-50 dBA for classrooms. If a unit is too noisy at its highest fan speed, consider running two units at a lower speed to keep noise down.
- **COST:** Look for the price, availability, and expected lifetime of replacement filters, and incorporate this cost into planning.
- **COMPONENTS:** Check for add-ons you do not want or need. HEPA filters are the most effective method for removing particles that may contain the virus, and additional technologies are often more problematic than helpful.
- **MAINTENANCE:** Clean prefilters and replace filters as recommended by the manufacturer.

What is CADR?

An in-room air cleaner should be chosen so that its clean air delivery rate (CADR) meets the needs of the room. The CADR is usually given for the highest fan speed, so if the unit runs at lower speeds, the CADR will be lower. Look for a unit with a CADR at least 2/3 your room's area. For example, a 20' x 30' room (600 ft²) would require CADR of at least 400. Multiple air cleaners can be added to get the total required CADR (e.g., two units with 200 CADR would meet the 400 CADR requirement).

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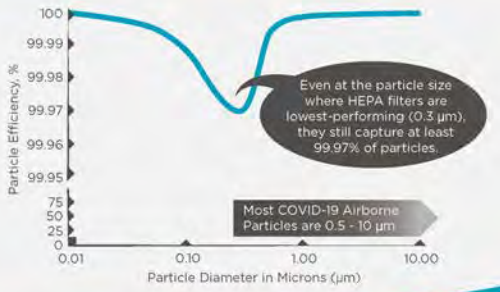
DIY in-room air cleaner:

A cheaper alternative to purchasing an in-room air cleaner is the DIY Corsi-Rosenthal filter box, made with a box fan, MERV 13 or MERV 11 filters, cardboard, and duct tape.

MYTH

Viruses are too small to be captured by filters.

HEPA filters are more than 99.97% efficient at capturing particles of all sizes, including those that carry the COVID-19 virus. Using HEPA in-room air cleaners correctly is the most effective way to increase clean air delivery in schools.



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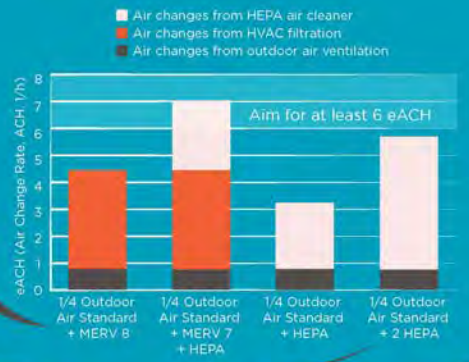

Even with limited outdoor air and MERV 8 filters, air cleaners can help reach 6 eACH.

The effectiveness of natural ventilation (usually through windows) can vary. Where windows are the only outdoor air available, air cleaners are an important strategy to remove contaminants.

Benefits of air cleaners beyond COVID

1. Air cleaners can be used as supplemental filtration when outdoor air quality is poor, such as during wildfires.
2. HEPA filtration is the most effective method at reducing particles like allergens in the air and can reduce respiratory symptoms like asthma.
3. Continuous use of air cleaners is associated with respiratory and heart health benefits for both healthy and at-risk populations.

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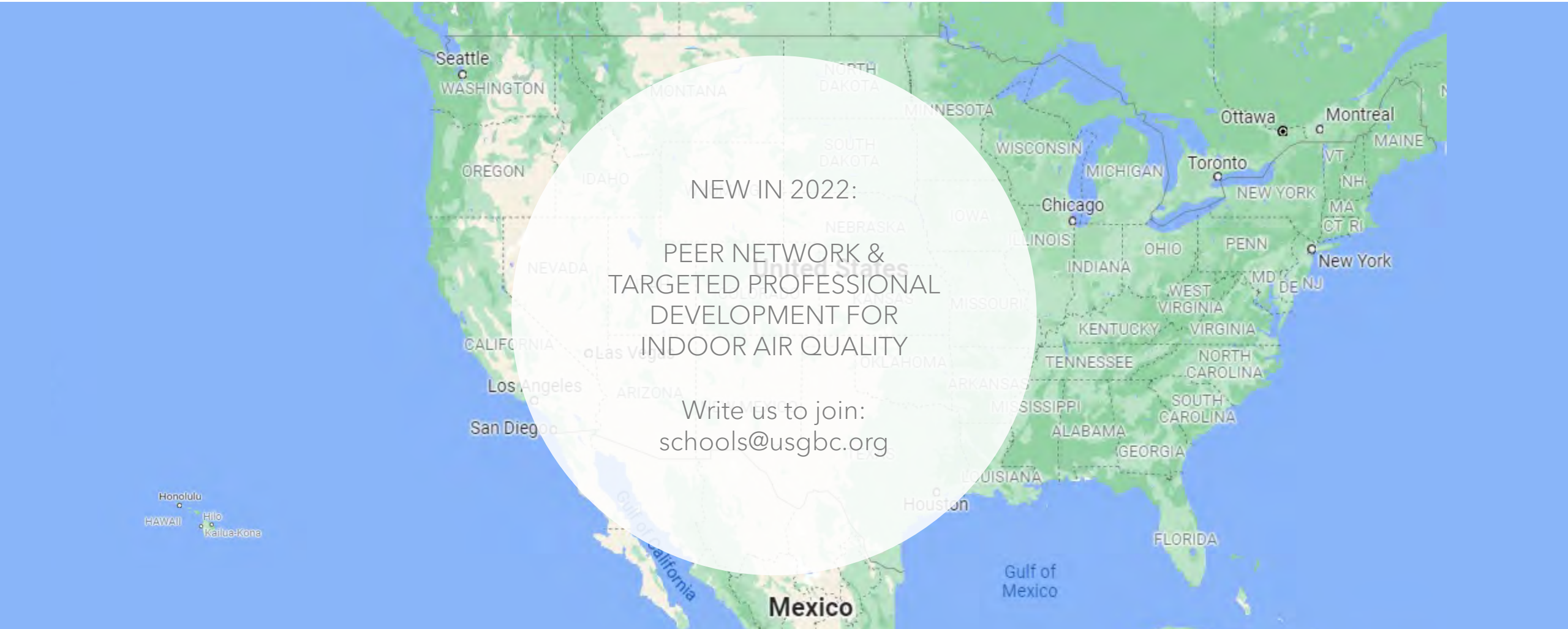

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