Ventilation Verification Senate Bill 414

Jeremy Zeedyk (NEMIC)– Representative / Northeast Region

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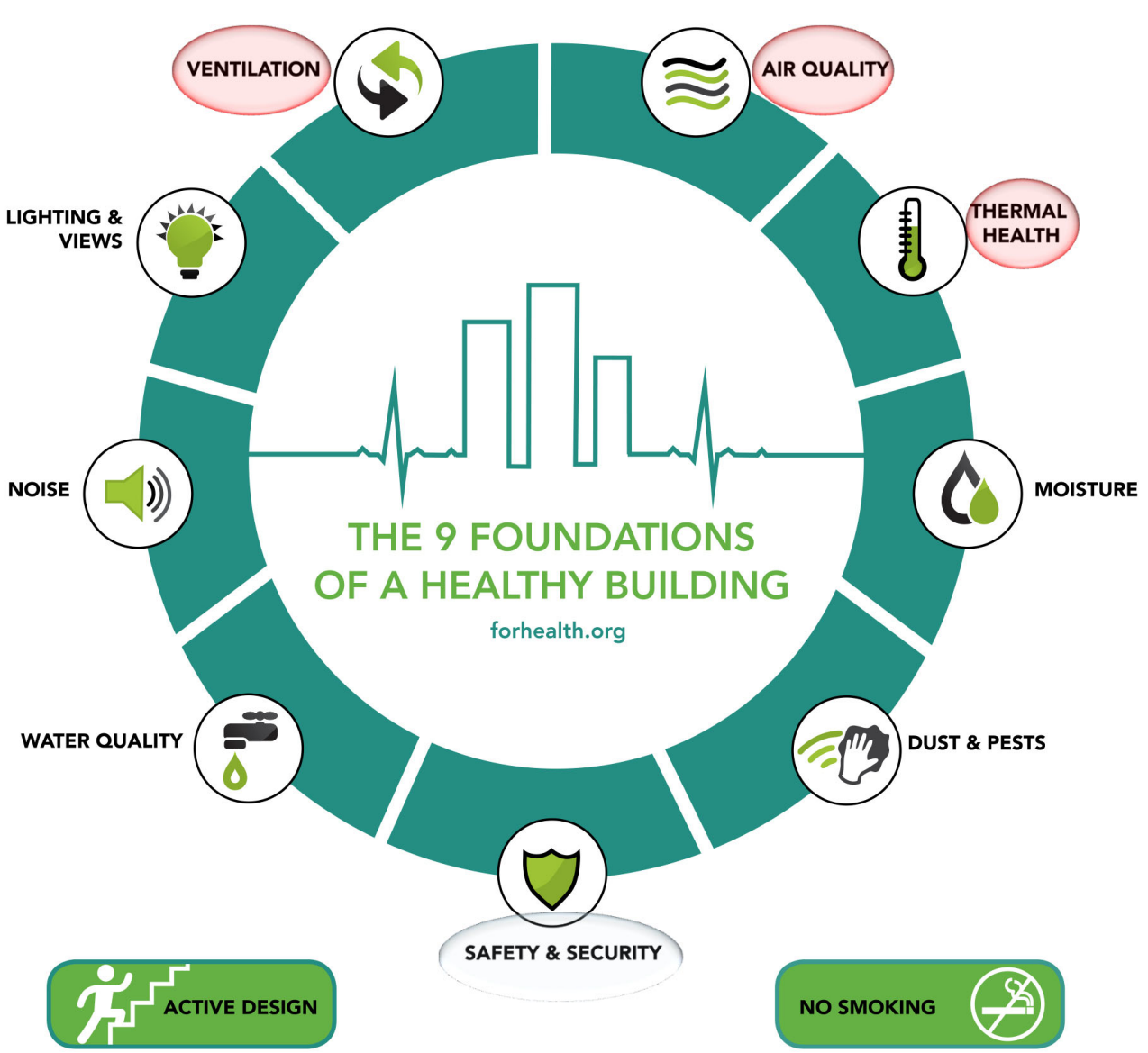

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Source: forhealth.org
https://9foundations.forhealth.org/

Pervasive Problem

- ✓ **Government Accountability Office (GAO) estimates that 41% of school districts need to update or replace the HVAC systems in at least half of their schools.** (1)

(1) K-12 Education School Districts Frequently Identified Multiple Building Systems Needing Updates or Replacement (Rep. No. GAO-20-494). (June 4th, 2020). United States Government Accountability Office. https://www.gao.gov/assets/710/707374.pdf

Ventilation Verification & Energy Optimization White Paper

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WHITE PAPER
Proposed Ventilation and Energy Efficiency Verification and Repair Program for Buildings

Prepared by
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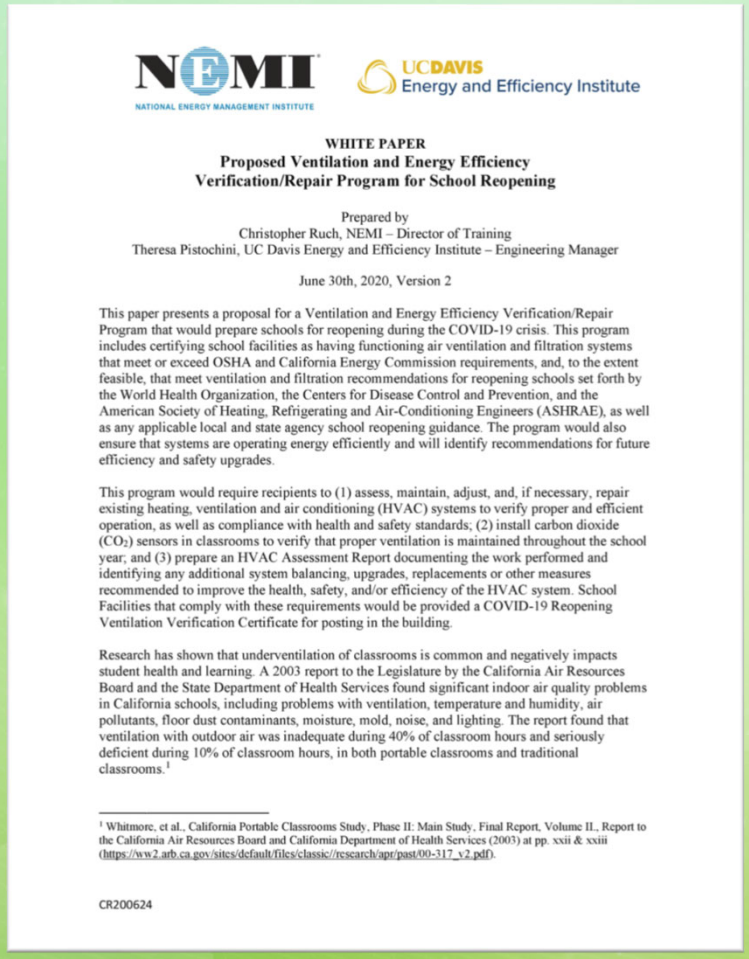
First published: June 30th, 2020
Current version: May 1st, 2021, Version 3

This paper presents a proposal for a Ventilation and Energy Efficiency Verification/Repair Program that would prepare buildings for operation during the COVID-19 crisis and provide lasting improvements in indoor air quality. This program includes a procedure to verify facilities have functioning heating, ventilation, and air conditioning (HVAC) and filtration systems that meet or exceed OSHA guidance[1], and, to the extent feasible, that meet ventilation and filtration recommendations for reopening buildings set forth by the World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC), and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), as well as any applicable local and state agency building reopening guidance. Providing adequate ventilation and filtration, however, can increase energy consumption. The program would also ensure that systems are operating efficiently and will identify recommendations for efficiency and safety upgrades.

This program would require buildings to (1) assess, maintain, adjust, and, if necessary, repair existing heating, ventilation and air conditioning (HVAC) systems to verify proper and efficient operation, as well as compliance with health and safety standards; (2) install carbon dioxide (CO_2) sensors in zones to verify that proper ventilation is maintained during occupied hours; and (3) prepare an HVAC Assessment Report documenting the work performed and identifying any additional system Testing, Adjusting and Balancing (TAB) requirements, upgrades, replacements or other measures recommended to improve health and safety, and/or efficiency of the HVAC system. Buildings that comply with these requirements can provide the final HVAC Ventilation Verification Report to building patrons and the public as a demonstration that adequate measures have been taken to ensure the HVAC system is operational and meets all applicable codes and standards.

The persistence of underperforming HVAC systems and inadequate ventilation rates in the buildings is of particular concern as states and provinces look to reopen buildings during the COVID-19 pandemic. An April 2020 paper by ASHRAE found that viruses such as COVID-19 can spread through the air in two ways. Larger droplets travel between 6 and 7 feet before dropping to the ground, but smaller droplets can evaporate and become aerosolized, remaining

[1] Protecting Workers: Guidance on Mitigating and Preventing the Spread of COVID-19 in the Workplace. (n.d.). Retrieved January 29, 2021, from https://www.osha.gov/coronavirus/safework



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WHITE PAPER
Proposed Ventilation and Energy Efficiency Verification/Repair Program for School Reopening

Prepared by
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June 30th, 2020, Version 2

This paper presents a proposal for a Ventilation and Energy Efficiency Verification/Repair Program that would prepare schools for reopening during the COVID-19 crisis. This program includes certifying school facilities as having functioning air ventilation and filtration systems that meet or exceed OSHA and California Energy Commission requirements, and, to the extent feasible, that meet ventilation and filtration recommendations for reopening schools set forth by the World Health Organization, the Centers for Disease Control and Prevention, and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), as well as any applicable local and state agency school reopening guidance. The program would also ensure that systems are operating energy efficiently and will identify recommendations for future efficiency and safety upgrades.

This program would require recipients to (1) assess, maintain, adjust, and, if necessary, repair existing heating, ventilation and air conditioning (HVAC) systems to verify proper and efficient operation, as well as compliance with health and safety standards; (2) install carbon dioxide (CO_2) sensors in classrooms to verify that proper ventilation is maintained throughout the school year; and (3) prepare an HVAC Assessment Report documenting the work performed and identifying any additional system balancing, upgrades, replacements or other measures recommended to improve the health, safety, and/or efficiency of the HVAC system. School Facilities that comply with these requirements would be provided a COVID-19 Reopening Ventilation Verification Certificate for posting in the building.

Research has shown that underventilation of classrooms is common and negatively impacts student health and learning. A 2003 report to the Legislature by the California Air Resources Board and the State Department of Health Services found significant indoor air quality problems in California schools, including problems with ventilation, temperature and humidity, air pollutants, floor dust contaminants, moisture, mold, noise, and lighting. The report found that ventilation with outdoor air was inadequate during 40% of classroom hours and seriously deficient during 10% of classroom hours, in both portable classrooms and traditional classrooms.[1]

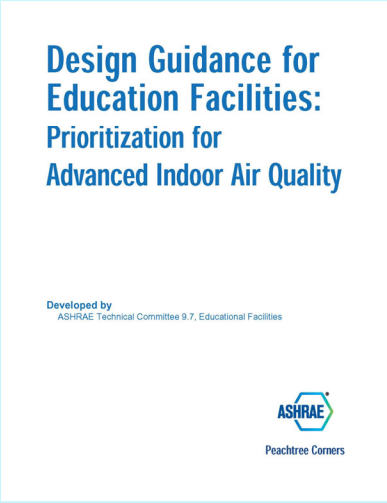
[1] Whitmore, et al., California Portable Classrooms Study, Phase II: Main Study, Final Report, Volume II., Report to the California Air Resources Board and California Department of Health Services (2003) at pp. xxii & xxiii (https://ww2.arb.ca.gov/sites/default/files/classic//research/apr/past/00-317_v2.pdf).

Design Guidance For Education Facilities: Prioritization For Advanced Indoor Air Quality

Developed by the ASHRAE Technical Committee 9.7, Educational Facilities.

The Design Guidance for Education Facilities is a tool for contractors and design professionals to sit down with school districts and go through the options to increase energy efficiency and Indoor Air Quality (IAQ).

The first prerequisite is to perform a "*Ventilation verification and testing, adjusting, and balancing (TAB) of HVAC airside components*."



Ventilation Verification and Energy Optimization Process

HVAC Assessment Report Template

Section 1:	**Overview**
Section 2:	**Filtration**
Section 3:	**Ventilation Rate**
Section 4:	**Economizer Operation**
Section 5:	**DCV Operation**
Section 6:	**Air Distribution and Building Controls**
Section 7:	**General Maintenance**
Section 8:	**Operational Controls**
Section 9:	**CO_2 Monitoring**
Section 10:	**Limited or No Existing Mechanical Ventilation**

Source: UC Davis WCEC

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Filtration

- Verify filters are installed correctly and replace if needed.
- Apply the highest Minimum Efficiency Reporting Value (MERV) applicable for the HVAC units considering airflow and conditioning capabilities. MERV 13 or better is recommended.

I was told our units cannot handle MERV 13…

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"A review of manufacturer specifications of existing filters and of available MERV-13 filters found that almost all buildings had options to upgrade with similar or even lower initial pressure drops."

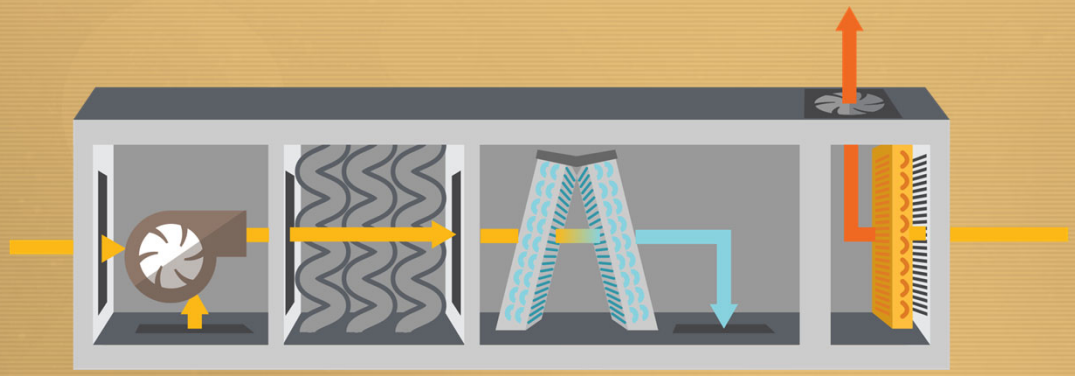
- ***Only one of the 95 buildings were mechanically unable to upgrade to MERV 13***

MERV 13 filters typically cost more and will need to be replaced more often. However, MERV 13 filters provide the highest infection risk reduction at the lowest cost of all filtration levels and various ventilation rates.[2]

[1]McNulty, M. K., Kono, J., & Abramson, B. (2022 ASHRAE Winter Conference). From Guidance to Implementation: Applying ASHRAE Epidemic Task Force Building Readiness Strategies in 95 Commercial Office Buildings.

Ventilation

- Minimum Outside Air
- Can Outside Air be increased?
- Exhaust airflow



Source: UC Davis WCEC

Has Your Classroom size changed since the HVAC unit was installed?

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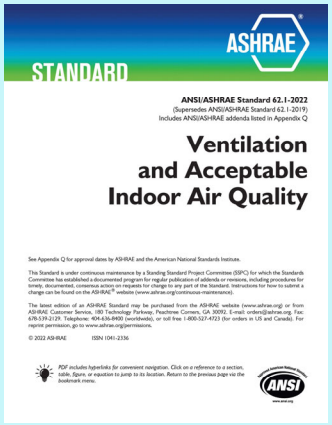
Sample requirement for a 900 square foot meeting room or assembly area

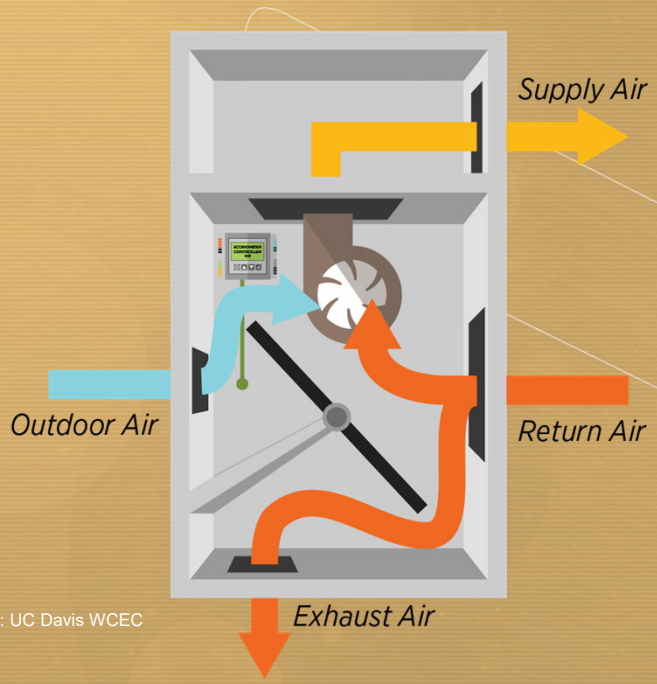
Standard	Method	15 People	25 People	35 People
ASHRAE 62.1 2022	$10\ CFM/person + \ 0.12\ CFM/ft^2$	258 CFM	358 CFM	458 CFM



CFM = Cubic Feet per Minute

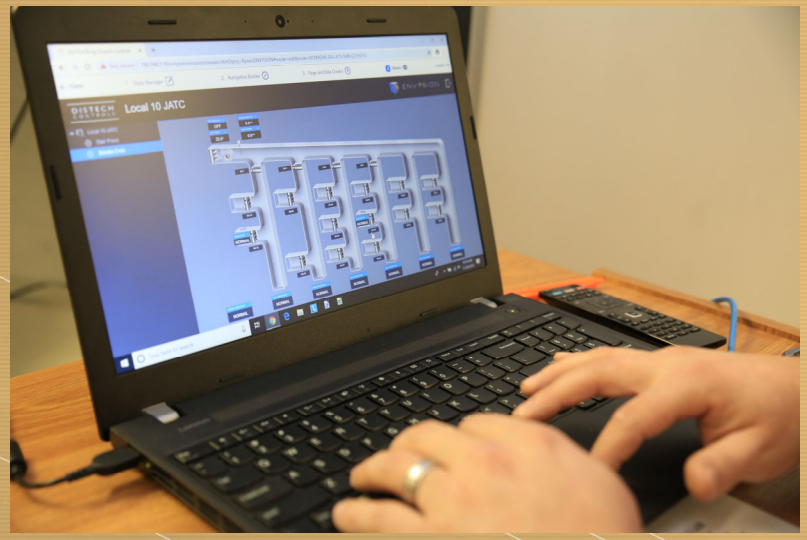
American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2022). *Ansi/Ashrae Standard 62.1-2022, Ventilation and Acceptable Indoor Air Quality*. https://www.ashrae.org/technical-resources/bookstore/standards-62-1-62-2

Economizer/DCV Operation



Source: UC Davis WCEC

Operational Controls



Airflow & Pressure

- Ensure airflow patterns are measured, verified, and documented to provide maximize distribution and mixing but minimize occupant exposure to particles.
- Room pressure differentials and directional airflow help control airflow between zones.

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General Maintenance

Has the system been maintained?

- Coil Condition
- Condensate Drainage
- Heating and Cooling
- Drive Assembly
- Note Deficiencies

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CO^2 Monitoring

The canary in the coal mine…

- Alert building occupants to high CO^2 levels
- Indicates where ventilation systems may be malfunctioning
- Assessment can identify missing or broken monitors

Source: UC DAVIS WCEC

Limited or No Existing Mechanical Ventilation

Source: UC DAVIS WCES

Section 10 – Limited or No Existing Mechanical Ventilation

Ventilation Verification and Energy Optimization Assessment

	Collect and document existing HVAC infrastructure to assist the Design Professional in determining ventilation options.
☐	**Existing HVAC Infrastructure –** Verify the functionality and document nameplate data on any existing HVAC equipment (i.e., heating only units, exhaust fans, etc.)
☐	Verify and document the location of windows and doors that can be opened. • Verify if windows have any switches or controls that initiate exhaust fans, motorized dampers or other devices that operate to provide free cooling.
☐	Verification or installation of the CO^2 sensor as detailed in Section 9.
☐	**Collection the following information, in addition to any information requested by a design professional to evaluate options for adding mechanical ventilation.** ☐ Verify existing mechanical, architectural, structural drawings match current conditions. ☐ Provide a sketch of actual roof penetrations, penetration type (i.e., vent pipe) and approximate locations if different from drawings. ☐ Document locations of any vents could contaminate Outside Air (OSA) intake locations. ☐ Photograph existing building, existing mechanical equipment (if applicable) and potential locations for mechanical ventilation equipment. ☐ Document roof and wall type/material to the best of the technician's ability. ☐ Document if existing mechanical equipment can be altered to provide outside air (OSA) or if a Dedicated Outside Air System (DOAS) is required. ☐ Obtain information on central plant capacity (if applicable) ☐ Document whether outside air conditions may make reliance on windows or other sources of non-filtered outside air potentially hazardous to occupants. ☐ Document recommendations for adding mechanical ventilation and filtration where none currently exists or for replacing a mechanical ventilation system where the current system is non-operational or is unable to provide recommended levels of ventilation and filtration.
☐	Include relevant screenshots and photographic documentation. • Include existing building and potential locations for mechanical ventilation equipment.

Mechanical Engineer
Ventilation and Energy Evaluation

Upon completion of the **HVAC Assessment Report**, a Mechanical Engineer shall review and determine if adjustments, repairs, or upgrades can be made to the HVAC system to increase energy efficiency, filtration, disinfection and ventilation.

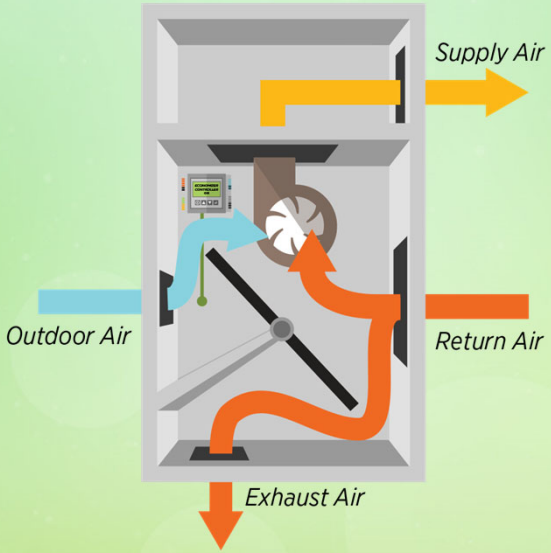
Repairs, Adjustments, and Upgrades

If installed HVAC systems or system components are broken, fail to meet minimum ventilation requirements, or are unable to operate to the original design and intent, corrective work must be completed.

- Upgrades, as determined by the licensed professional, to increase ventilation, filtration, disinfection, or increase energy efficiency.
- All work completed by **Skilled, Trained, and Certified Workforce**.

But my system is new…

- ✓ **2019 Report by UC Davis and Lawrence Berkely National Labs reviewed HVAC system replaced within the last 3 years.** [1]
  - **Only around 15% of the classrooms had a median Ventilation rate of 15 CFM per person**

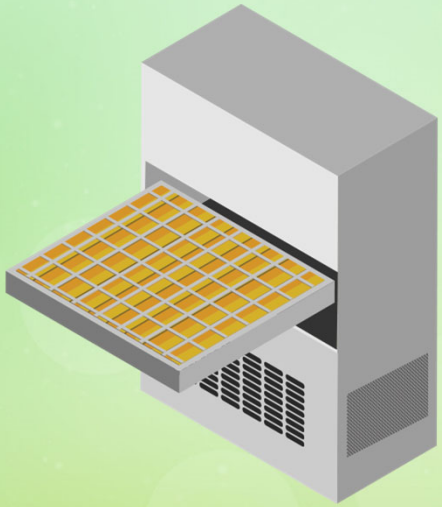


UC Davis WCEC

(1) Chan, et al, Ventilation rates in California classrooms: Why many recent HVAC retrofits are not delivering sufficient ventilation, Building and Environment Journal 167 (2020) (https://www.sciencedirect.com/science/article/pii/S0360132319306365).

But my system is new…

- ✓ **Poor Quality Installation Is Pervasive.** **A Study by a state Energy Commission Found That Over 50% Of New HVAC Systems And 85% Of Replacement HVAC Systems That They Evaluated Were Not Performing Correctly Due To Poor Quality Installation.** [1][2]



UC Davis WCEC

(1) California Energy Commission, *Strategic Plan to Reduce the Energy Impact of Air Conditioners* (June 2008), CEC-400-2008-010, at p. (v) (https://docplayer.net/6285926-Staff-report-strategic-plan-to-reduce-the-energy-impact-of-air-conditioners-california-energy-commission-june-2008-cec-400-2008-010.html);

(2) Zabin, et. al, Workforce Issues and Energy Efficiency Programs: A Plan for California's Utilities, Don Vial Center for Employment in the Green Economy (2014), at pp. 32-34 and Appendix 2B (http://laborcenter.berkeley.edu/workforce-issues-and-energy-efficiency-programs-a-plan-for-californias-utilities/).

Health Concerns

- ✓ **CDC study of 3,000 individuals across 40 buildings found that 57% of sickness can be attributed to poor ventilation. (1)**

(1) Allen, Joseph and Macomber, John. “What Makes an Office Building “Healthy””. Harvard Business Review. April 2020. https://hbr.org/2020/04/what-makes-an-office-building-healthy

Wildfire IAQ Concerns

Problem

- Wildfire smoke contains fine, inhalable particles called PM2.5, as well as dangerous levels heavy metals and other toxins It may be as much as 10 times more dangerous for kids than other forms of air pollution."[1]

Solution

Stanford Center for Innovation and Global Health

- Measure your Indoor Air Quality
- Conduct baseline assessment
- Improve HVAC Systems

1) Stanford Center for Innovation in Global Health. "Wildfires and Health." *Global Health*, 21 July 2022, https://globalhealth.stanford.edu/planetary-health/wildfires-and-health.html/.

ASTHMA IAQ CONCERNS

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Problem

- Poor Indoor Air Quality can trigger or exacerbate Asthma Symptoms.
- Asthma, which is the most common childhood chronic disease in the United States, now affecting more than 6 million children.[1]
- Asthma is a leading cause of absenteeism (13.8 million missed school days annually).[2]

Solution

EPA – Managing ASTHMA in The School Environment [3&4]

- Action Plan to develop an Indoor Air Quality program to identify, solve, and prevent IAQ problems.

1) "The Links Between Air Pollution and Childhood Asthma," US Environmental Protection Agency, 2018, https://www.epa.gov/sciencematters/links-between-air-pollution-and-childhood-asthma.
2) "Standard 55- Thermal Environmental Conditions for Human Occupancy," ASHRAE, 2020, https://www.ashrae.org/technical-resources/bookstore/standard-55-thermal-environmentalconditlons-for-human-occupancy; "Moisture Control, Part of Indoor Air Quality Design Tools for Schools," US Environmental Protection Agency, 2022, https://www.epa.gov/iaq-schools/moisturecontrol-part-indoor-air-quality-design-tools-schools; "Standards 62.1 & 62.2," ASHRAE, 2022, https://www.ashrae.org/technical-resources/bookstore/standards-&2-1-62-2; and Jose Guillermo Cedeno Laurent, et al., "Reduced Cognitive Function During a Heat Wave Among Residents of Non-Air-Conditioned Buildings: An Observational Study of Young Adults in the Summer of 2016,"PLOS Medidne 15, no. 7 (2018): e1002605, https://doi.org/10.1371/joumal.pmed. 1002605.
3) EPA, Environmental Protection Agency, https://www.epa.gov/iaq-schools/managing-asthma-school-environment.
4) Centers for Disease Control and Prevention. (2022, August 11). Hierarchy of controls. Centers for Disease Control and Prevention. Retrieved September 17, 2022, from https://www.cdc.gov/niosh/topics/hierarchy/default.html

Educational Benefits
Student Performance

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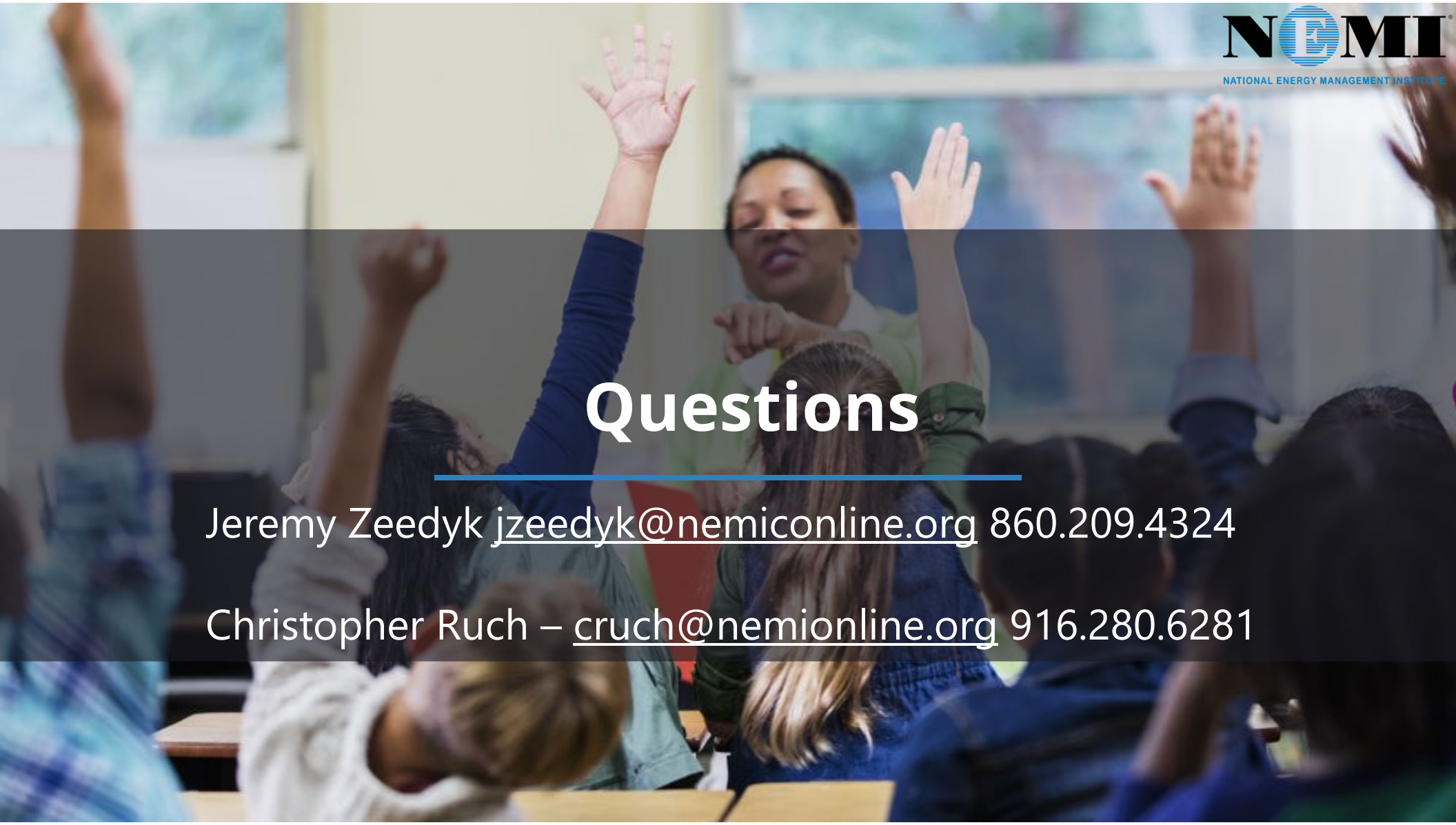
- ✓ **8 studies reported statistically significant improvements in some measures of student performance associated with increased ventilation rates or lower CO_2 concentrations, with performance increases up to 15%.** (1)

(1) Fisk, W. J., The ventilation problem in schools: literature review, Indoor Air. 2017;27:1039–1051 https://onlinelibrary.wiley.com/doi/epdf/10.1111/ina.12403



Questions

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