



**EFFICIENT AND  
HEALTHY SCHOOLS**

# 2022 Efficient and Healthy Schools Webinar Series

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**Webinar 2 of 4: HVAC Inspection and Maintenance for Indoor Air Quality**

U.S. Department of Energy and Lawrence Berkeley National Laboratory

May 20, 2022

# Efficient and Healthy Schools Campaign Webinar

Welcome!

- Agenda is in the chat
- Webinar is being recorded
- All attendees are muted
- Please enter questions into the chat - they will be answered during the question and answer session toward the end
- We will send out the slides and presentation the week after the webinar



# Today's Webinar, Summary

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- Opening Remarks – Tracy Enger, U.S. Environmental Protection Agency
- Campaign Introduction – Rengie Chan, Berkeley Lab
- Campaign recognition program awardees presenting:
  - Best in Class – Rodney Williams, Newark Board of Education, NJ
  - Notable Achievement – Linda Mayfield, Mariposa County Unified School District, CA
- Ventilation Verification - HVAC Assessment – Christopher Ruch, National Energy Management Institute

# Tools and Resources for Taking Action in Schools







# KEY DRIVER: Assess Your Environments Continuously

## ASSESS

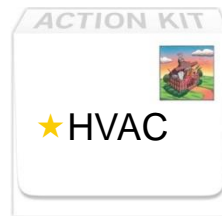
- Walk the Grounds
- Listen to Occupants
- Use Technology
- Determine a Baseline
- Keep Customers Satisfied
- Identify and Prevent Risks





## Quality HVAC

- Inspect HVAC systems regularly.
- Establish a maintenance plan.
- Change filters regularly and ensure condensate pans are draining.
- Provide outdoor air ventilation according to ASHRAE standards or local code.
- Clean air supply diffusers, return registers and outside air intakes.
- Keep unit ventilators clear of books, papers and other items.



## Integrated Energy Management Solutions

- Protect IAQ during energy efficiency upgrades and building renovations.
- Conduct regular HVAC maintenance and tune-ups.
- Install programmable thermostats.
- Consider performing post-construction commissioning for HVAC systems.
- Control moisture in building assemblies, mechanical systems and occupied spaces.



# EPA Resources to Get You Started!



**IAQ Tools for Schools  
Action Kit**



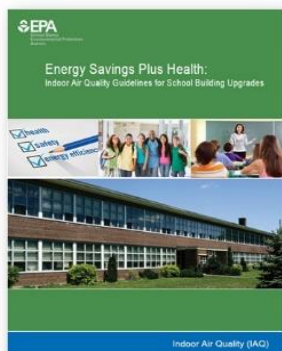
**IAQ Tools for Schools  
Mobile App**



**Framework for Effective  
IAQ Management**



**IAQ Master Class  
Professional Training  
Webinar Series**



**Energy Savings Plus Health Guide  
and Interactive Air Quality Planner**



**IAQ Tools for Schools:  
Preventive Maintenance  
Guidance**

[www.epa.gov/iaq-schools](http://www.epa.gov/iaq-schools)



# Efficient and Healthy Schools Campaign

The campaign aims to engage K-12 schools to improve energy performance and indoor air quality, with a focus on practical solutions involving HVAC and other technologies to reduce energy use and carbon emissions. This campaign is led by the U.S. Department of Energy with technical support from Lawrence Berkeley National Laboratory.



Organizing partners





# Recognition Program: 2021 Round One

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The Efficient and Healthy Schools Campaign aims to recognize schools and school districts that have implemented exemplary solutions involving HVAC upgrades and other approaches to reduce energy costs, and improve energy efficiency and indoor air quality.



# Areas for Recognition

- Schools and school districts that implement an inspection and maintenance policy to ensure adequate ventilation and effective filtration.



Opening windows, using portable air cleaners, and improving building-wide filtration are ways you can increase ventilation in your school or childcare program.

<https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/ventilation.html>

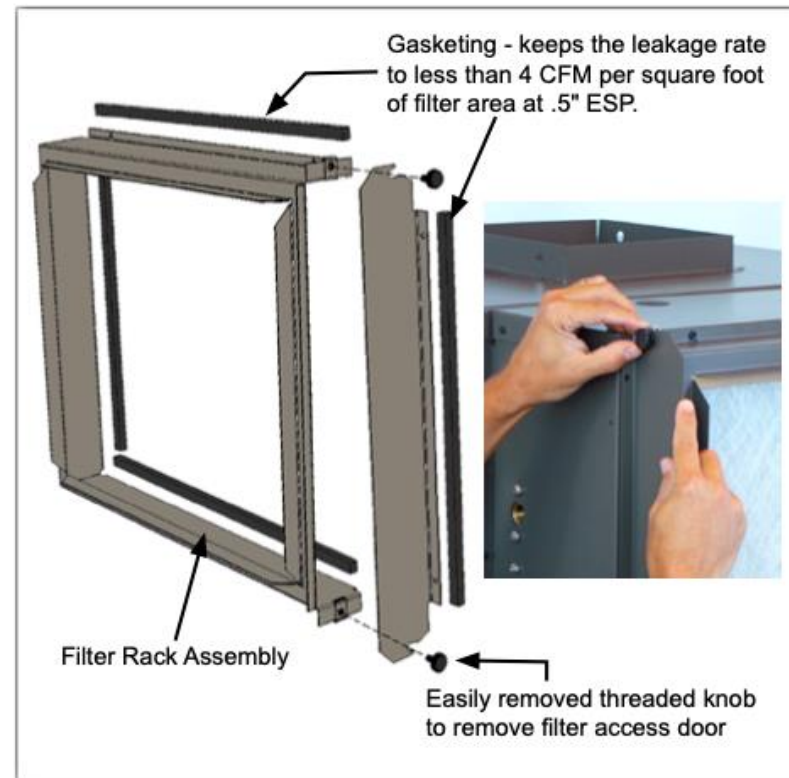


Good ventilation is important, especially in areas where students may not be able to wear masks. Eating meals outside is best. If you need to have students eat in a cafeteria, use methods such as opening windows, maximizing filtration as much as the system will allow and using portable HEPA air cleaners.

# HVAC Inspection and Maintenance for IAQ

- Perform periodic inspections of HVAC systems; utilize approaches to aid systemic inspection of equipment
- Perform testing, adjusting, and balancing (TAB) to verify HVAC performance
- Ensure effective filtration
- Provide ongoing workforce training

<https://www.ashrae.org/technical-resources/reopening-of-schools-and-universities>



# Recent Survey (Oct-Dec 2021) of 88 School Districts

- What are the overall costs/savings from changes related to ventilation, filtration, and other building controls, compared with the same period during a typical school year prior to the pandemic? Costs/savings may include energy, materials, and staffing.

	Responses (N = 88)
<b>Cost a lot more</b>	<b>31 (35%)</b>
<b>Cost moderately more</b>	<b>36 (41%)</b>
No impact on overall costs	3 (3%)
Moderate savings	3 (3%)
Not sure	12 (14%)
NA / no changes	3 (3%)

<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

P. Jacob Bueno de Mesquita, Ph.D.  
Lawrence Berkeley National Laboratory

Wanyu Rengle Chan, Ph.D.  
Lawrence Berkeley National Laboratory

Anisa Heming  
Center for Green Schools at the U.S. Green Building Council

Caroline Shannon, AIA  
Center for Green Schools, MPH candidate at Harvard T.H. Chan School of Public Health

**THE CENTER  
FOR GREEN SCHOOLS**





## FOCUS GROUP INSIGHTS

“

*I had a conversation with our administration about the impact to our budget that we are going to have this year and next year because we get paid per student per day in the classroom. If all of a sudden we are short a bunch of students our budget shrinks. So if we have healthier kids because we have better ventilation, I don't know what the numbers are and I don't know that we can say what the numbers are, but we can certainly say they are linked. Ventilation keeps kids in the seats, which keeps the budget happy.*

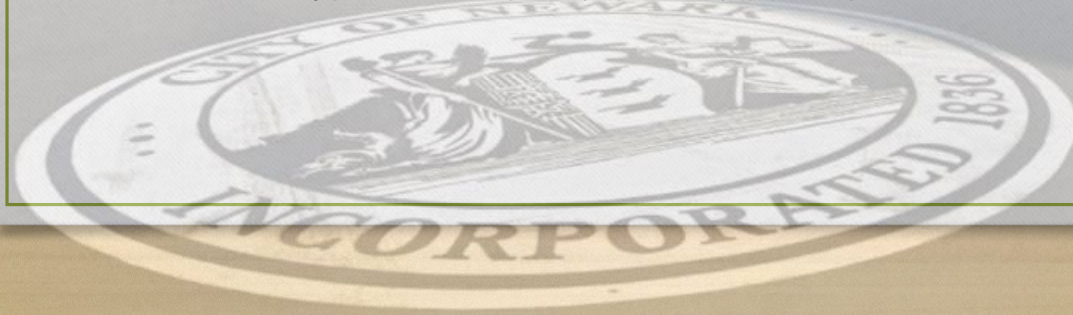
”

— Focus Group Participant

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

# Utilizing State Energy Saving Program for Excellence in IAQ

Rodney L. Williams, CEFM, SFP  
Director of the Energy and Sustainability  
Newark Board of Education



# Overview

The Newark Board of Education consist 39,900 students, 81 facilities (including Athletic complexes and warehouses) with approximately 7 million square feet of surface. We have buildings that are more than 150 years old, some building have full ventilation while others have little to no ventilation.

For the past couple of years we had been challenged with the onset of COVID-19 to provide an environment with limit exposure to the virus. The Board of Education used ESSER1 funding in a total of \$275,432.36 to purchase the recommended MERV-13 filters for our existing mechanical ventilation equipment.

# General Facilities Conditions

We reviewed each building to determine the basic types of mechanical systems we had running in the classrooms, findings as followed:

- 42% of the classrooms have only radiators with no mechanical fresh air
- 41% of the classrooms have univents with limited fresh air
- 15% of the classrooms have full mechanical ventilation in the entire building

HVAC Systems	Total # of Rooms
Radiators Only, No Fresh Air	1782
Mechanical Ventilation Univents, Limited Fresh Air	1718
Partial Mechanical System Portion of the Building	29
Full Mechanical Ventilation Entire Building	651



# Utilizing the “ESIP” Energy Savings Improvement Program

\***ESIP**, is a state program from the Board of Public Utilities. This program allows school districts to use the saving from the installation of Energy Efficient equipment upgrades along with other energy savings measures to pay off the purchase and installation of that equipment within 15/20 years.

\* **NBOE** is participating in this program and will receive over 100 million dollar of Energy Savings Measures. This will include **HVAC and Ventilation Equipment**

## Selected highlights of the ESCO ESIP RFP Process

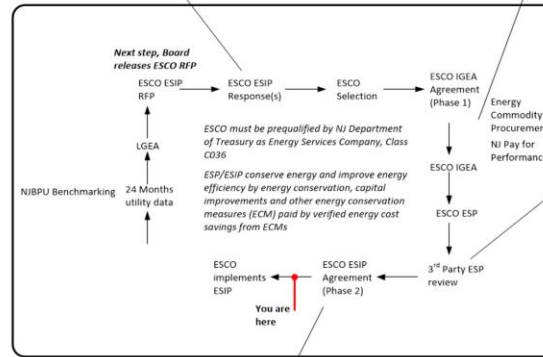
Energy Service Companies (ESCOs) assist Board to develop and finance Energy Savings Plan (ESP) via an Energy Savings Improvement Program (ESIP) to maximize energy and operational savings.

### ESCO ESIP RFP includes:

- Review potential ECMs from LGEA
- Provide utility cost and usage analysis
- Develop Baselines
- Provide preliminary ESP with savings
- Mandatory site inspection(s)
- Provide ESP proposal in respond to ESIP RFP
- Services in two phase, Provide ESP, After approval of ESP, implement the ESP

### IGEA includes:

- Detailed energy analysis
- Review of LGEA
- Conceptual engineering of ECMs
- Solicitation of Third Party Financing
- Project schedule
- Permits/Approvals
- State/Federal grant/rebate/incentives
- Procure plans for subcontractors as per ESIP and public bidding requirements



If ESCO and Board cannot in good faith agree on scope of work and financing, the IGEA Agreement can be terminated without financial obligation, otherwise Board must compensate ESCO for IGEA if they terminate IGEA agreement

Contract for 15 to 20 years (with CHP) commencing on completion of construction

ESCO costs cannot include maintenance contracts, energy savings guarantee or 3<sup>rd</sup> party verification.

After IGEA and determination by independent qualified 3<sup>rd</sup> party projected savings can be realized, Board adopts ESP as their ESIP, and executes a final ESIP agreement

Board may separately purchase energy savings guarantee to obligate ESCO to reimburse Board for shortfalls between actual energy savings and project payment costs.

All ESCO program development, conceptual engineering and permitting incurred pursuant to IGEA agreement shall be rolled forward and included in ESIP agreement. Final engineering for selected scope of work and ESIP program complete. Copy of executed ESIP agreement shall be submitted to BPU.

Selected ESCO will act as General Contractor (GC) and implement the ESP by expanding on LGEA, designing ECMs and improvements, preparing bid documents for public bid, solicit bids through a competitive bidding process from subcontractors, arranging for all necessary program financing, managing construction, overseeing commissioning and system startup, identify and apply for all grant/rebate/incentives, maintaining improvements (as per regulations) and providing training to staff.

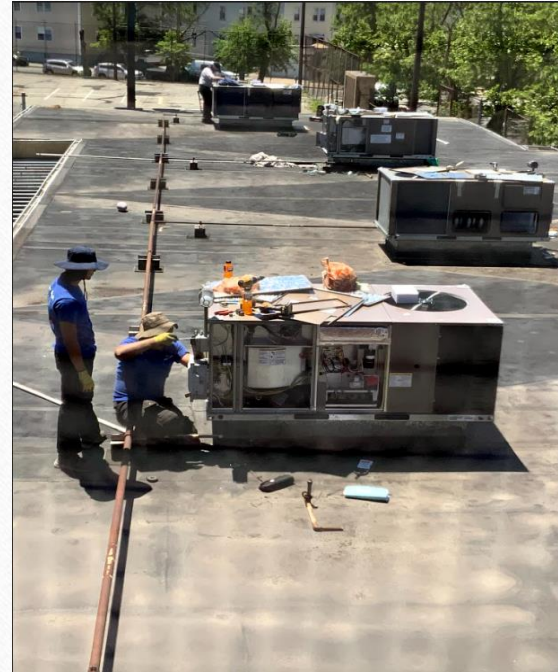
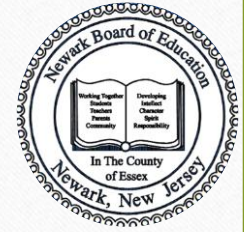
## Example of Updated classroom units

New Classrooms units with good ventilation. We replaced standard MERV 8/10 filter to the MERV-13 filter. Increasing the ability to filter out pollutants in the air.



# Additional HVAC Equipment

Ann Street built in 1885: Installed Rooftop Units under the  
State's Energy Program





## Training on Equipment

### SAFE SCHOOLS/VECTOR

**SOLUTIONS:** a Training Solution built with unique features and functionality to fit the training needs of School Districts.

- We use Safe Schools to train our staff on Indoor Air Quality issues which includes maintenance and operation of equipment.
- This module helps us to keep track of current policy and procedures as well as verify who has completed the training and who is scheduled for training.

The screenshot displays the Vector Solutions training platform interface. At the top left, the logo for Vector Solutions is visible, along with the text "Vector Training, K-12 Edition". In the top right corner, there is a language selection dropdown set to "English" and a user profile icon labeled "rwilliar". The main content area is a grid of 18 training modules, each represented by a small video thumbnail with a title. The titles of the modules are: "Hand and Power Tool Safety Overview", "Right To Understand (GHS)", "Hearing Loss Prevention", "Heat Illness Prevention", "Indoor Air Quality Awareness", "Integrated Pest Management", "Ladder Safety", "Lead Safety Awareness", "Lockout/Tagout: Energy Release", "Material Safety Data Sheets", "Mercury Spills", "Office Ergonomics", "Personal Protective Equipment (PPE)", "Playground Maintenance & Inspection", "Respirable Crystalline Silica Awareness", "Respiratory Protection", "Safety Committee Operations", and "Safety Data Sheets". A dark sidebar on the left contains navigation icons for home, search, and a menu.



# Keeping track on the Equipment and Maintenance

We use School Dude and Asset Essential.

This Online portal help us keeps tabs on the upkeep of the equipment by automatically sending PM workorders

Newark Board of Education

My Account(87575794) SchoolDude - Application Links - Logout

The Newark Public Schools

Home Calendar New Work Order Reports Services Account Setup

Search for GO Advanced Search Services | Help

Actions: Add | List | Graph | Report

### What's New?

#### WORK ORDERS BY STATUS

Last 10 Work Requests

Period All

#### Request Totals

- 24961 New Request
- 1022 UNASSIGNED
- 23491 In Approval Process
- 8008 Work In Progress
- 16652 Complete
- 253725 Closed Work Orders
- 9 Declined
- 39 Parts on Order
- 405 Duplicate Request
- 46357 Void
- 71 On Hold
- 22 Waiting More Information
- 1 Open Extended
- 2336 Pending
- 3 Waiting Funding
- 20339 Deferred
- 16 Forwarded

#### Work In Process

Forwarded  
Deferred  
Waiting Funding  
Pending  
Open Extended

#### WORK CENTER

CALENDAR

3/10/2021 WORK (Wednesday)

EMERGENCIES 3061

OPEN PM WORK 9951

OTHER OPEN WORK 45845

TOTAL OPEN WORK 55796

NJAC 6:24

- FAQ NJAC 6:24
- Comprehensive Maintenance Plan Documents
- Form W-1
- Form M-2

#### Information Analysis

Areas  
Budget  
Buildings  
Classifications  
Crafts  
Employees  
Equipment  
Equipment Usage  
Groups  
Locations  
Manufacturers  
Outstanding Work  
Priority  
Projects  
Purpose  
Saved Actions  
Status  
Suppliers  
Types  
Transactions  
Work Load/Assignment  
Work Order

Maint Category

#### Need Training?

Do you need a refresher course to learn some new helpful hints? Then click here to view our FREE training services.

#### Quick Launch

- New Request
- Print WO Batch
- Account Settings
- User Forum
- More Services
- My SchoolBuilding

#### LOGIN HERE

Hello Edward Brzezowski!  
If you are not Edward Brzezowski please click here.

#### Related Articles

Case Study #1: "Customer Service on Steroids" - Charlie McGinnis

#### Did you know?

The names of all the continents end with the letter they start with.

#### ASSIGNED WORK

Note: Action Taken is saved when Save button is clicked.

Sort by Request Age Ascending Descending

Filter -- Select Status --

1 - 0 of total 0 listed

No Work Orders yet.

# Utilizing State and Federal Programs

HOPE-LESS



HOPE-FULL!!!



\* We are living in historic times where there is great attention and financial resources giving towards IAQ, in- door air quality. Even if your district has equipment from the 1800's where air quality wasn't a priority, Utilizing the energy incentive programs will put your District in a better position to repair, replace and install efficient equipment that Leads to a Healthier School Facility.

# ANY QUESTION?



The background features a white central area with abstract, overlapping geometric shapes in various shades of pink and magenta on the left and right sides.

# Mariposa County Unified School District



# Small Necessary/Rural School District

Alternative Education: 133 students

Coulterville High/Greeley Hill Elementary: 66 students

Mariposa County High School: 430 students

Mariposa Elementary School: 383 students

Woodland Elementary School: 471 students

Lake Don Pedro Elementary School: 174 students

El Portal Elementary: 57 students

Yosemite Elementary: 38 students

Sierra Foothill Charter School: 136 students

Total Student Count = 1888

# AB 841

- ▶ I am utilizing AB 841 at our qualified school sites which will assist with HVAC Assessment, Maintenance, Filtration, and Monitoring.

# Bond Funding

- Our District was able to obtain Bond Funding in 2016. All of our school sites had units that were well over 25 years old, and had outlived their useful life cycle.
- Beginning June 2022 both of our Elementary schools (Woodland and Lake Don Pedro School) are scheduled for 50 HVAC unit replacement.



← 2000

# Thermostats & Filter Upgrades

- ▶ Pelican Thermostats are our districts choice due to their ease of use for the maintenance department. We began replacing our antiquated Honeywell thermostats in January 2021.



- ▶ Filter Upgrades



# Air Flow

- ▶ We asked that teachers open windows and doors (slightly) to allow for more air flow into the classrooms.
- ▶ HVAC economizers were utilized to allow as much fresh air into classrooms as possible.

# Carpet Replacement

- ▶ Changing from carpet to vinyl will all help towards air quality.

Old Carpet



LVT



A photograph of a classroom scene. A teacher, a woman with dark hair, is standing at the front of the room, looking towards the students. Several students are raising their hands, indicating an interactive or questioning session. The background shows a window with a view of greenery outside. The text is overlaid on a semi-transparent dark blue band across the middle of the image.

# Ventilation Verification -HVAC Assessment

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Christopher Ruch- Director of Education (NEMI)

# ASHRAE Technical Committee (TC) 9.7 Educational Facilities Working Group

- ASHRAE TC 9.7 is concerned with the application of heating, ventilating, air-conditioning, refrigeration, life safety, and energy conservation systems to educational facilities.
  - **Design Guidance For Education Facilities: Prioritization For Advanced Indoor Air Quality**

*\*ASHRAE is currently processing the document through its official review/publishing process to make it a permanent document*



## PRE-REQUISITE TASKS



- 1) Ventilation Verification and Testing, Adjusting, and Balancing (TAB) of HVAC airside components
- 2) Risk Tolerance Assessment – Wells-Riley or Equivalent

## VERY HIGH PRIORITY TASKS

- 1) HVAC Equipment Filtration Upgrades
- 2) HVAC for Wellness/Nurse Suites for Pre-K-12
- 3) Classroom and Assembly Space Air Distribution Effectiveness

## HIGH PRIORITY TASKS

- 1) IAQ Sensors with Data Aggregation Platform
- 2) New HVAC equipment to achieve recommended ASHRAE air change rates
- 3) Classroom Level Air Cleaning
- 4) Restroom Exhaust and Air Filtration Upgrades
- 5) Staff Training and Documentation Organizational Platform
- 6) UV-C/UVGI for Air handlers

## MEDIUM PRIORITY TASKS

- 1) Humidification systems
- 2) Energy Efficiency Offset Control Schemes for Advanced Indoor Air Quality
- 3) Operable Windows

# Section 1 - Overview

## Ventilation Verification Pre-Requisite Tasks

### Section 1 - Overview

#### Ventilation Verification and Energy Optimization Assessment

<b>Unit</b>	
<b>Model Number</b>	
<b>Serial Number</b>	
<b>SEER Rating</b> <small>Seasonal Energy Efficiency Ratio</small>	
<b>Refrigerant</b>	
<input type="checkbox"/>	<b>Filtration</b> - Review system capacity and airflow to determine the highest Minimum Efficiency Reporting Value (MERV) filtration for eliminating contagions, replace or upgrade filters where needed, and verify that such filters are installed correctly.
<input type="checkbox"/>	<b>Ventilation Rate</b> - Calculation of the required outside air rates for each occupied area based on the anticipated occupancy and physical verification that the ventilation rate meets or exceeds the minimum ventilation set forth by the local jurisdiction in all modes of operation. <ul style="list-style-type: none"><li>• Outside Air</li><li>• Exhaust Air</li></ul>
<input type="checkbox"/>	<b>Ventilation System Operation</b> - Physically test all ventilation components for proper operation. <ul style="list-style-type: none"><li>• Economizer</li><li>• Demand Control Ventilation</li></ul>
<input type="checkbox"/>	<b>Air Distribution</b> - Verify all ventilation is reaching the served zone, how air is distributed, and that there is adequate distribution. <ul style="list-style-type: none"><li>• Inlet Total</li><li>• Outlet Total</li></ul>
<input type="checkbox"/>	<b>Building Pressure</b> - Verify a slight positive building pressure and a negative pressure for contaminant rooms temporarily occupied by sick patrons.
<input type="checkbox"/>	<b>General Maintenance.</b> Verify coil condition, condensate drainage, cooling coil air temperature differential (entering and leaving dry bulb), heat exchanger operation,

maintenance, replacement or support

ces to verify systems will satisfy conditions during peak loads of building volume using

ained during building operation in each zone of the building.

**Applicable**) - In cases where the assessment would then be consistent with documentation and assumptions.

essment Report that includes:

f the HVAC Assessment to determine if upgrades can be made to the system, disinfection, and

the methods, procedures, and equipment used. It is the responsibility of the user to verify the methods, procedures, and forms used by Management Institute are current and to responsibly disclaim any liability or



Check off each Section of the Ventilation Verification assessment performed. All sections are not applicable to all units. Units may not have an economizer, Demand Control Ventilation (DCV), or even an outside air inlet.



You will likely need to alter Sections, add sections, or remove sections based on individual HVAC units.

# Section 2 - Filtration

## Ventilation Verification Pre-Requisite Tasks

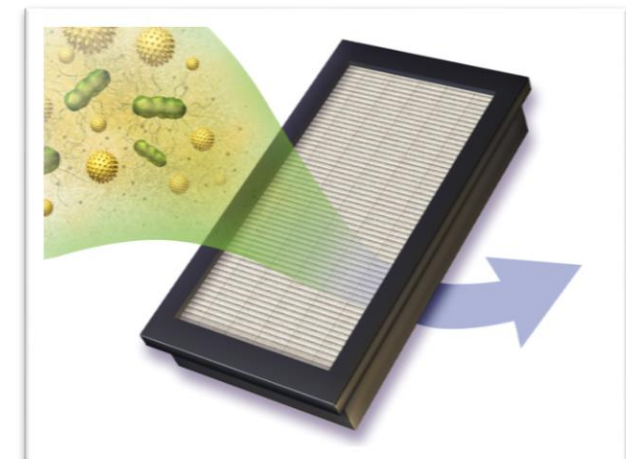
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Verify filters are installed correctly and replace if needed.



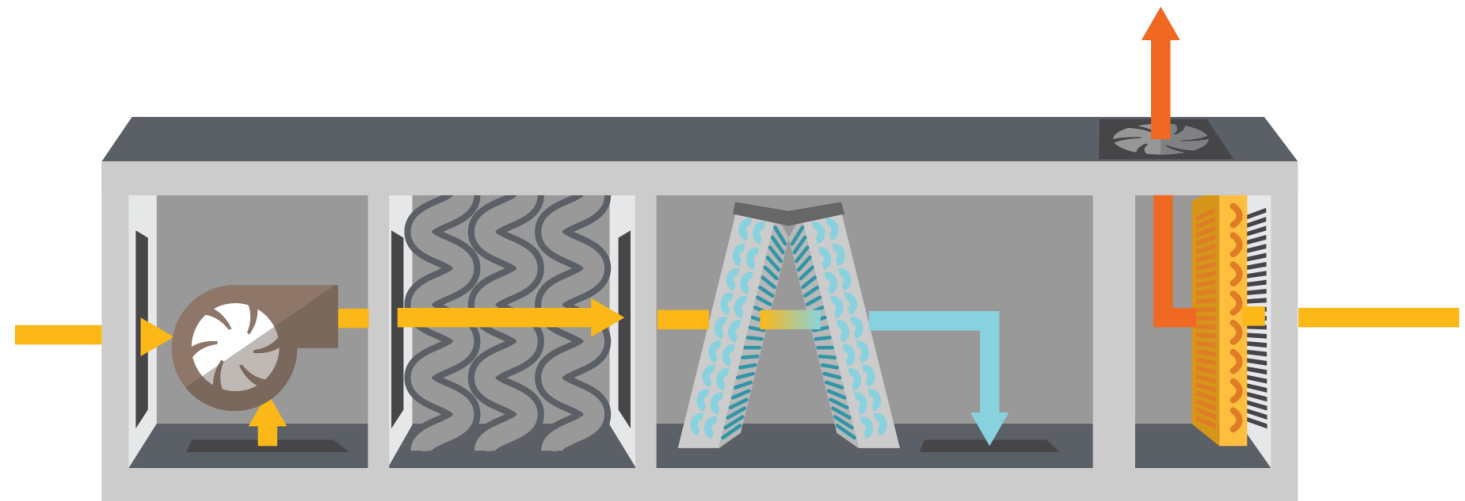
Apply the highest Minimum Efficiency Reporting Value (MERV) applicable for the HVAC units considering airflow and conditioning capabilities. MERV 13 or better is recommended.



# Section 3 – Ventilation Rate

## Ventilation Verification Pre-Requisite Tasks

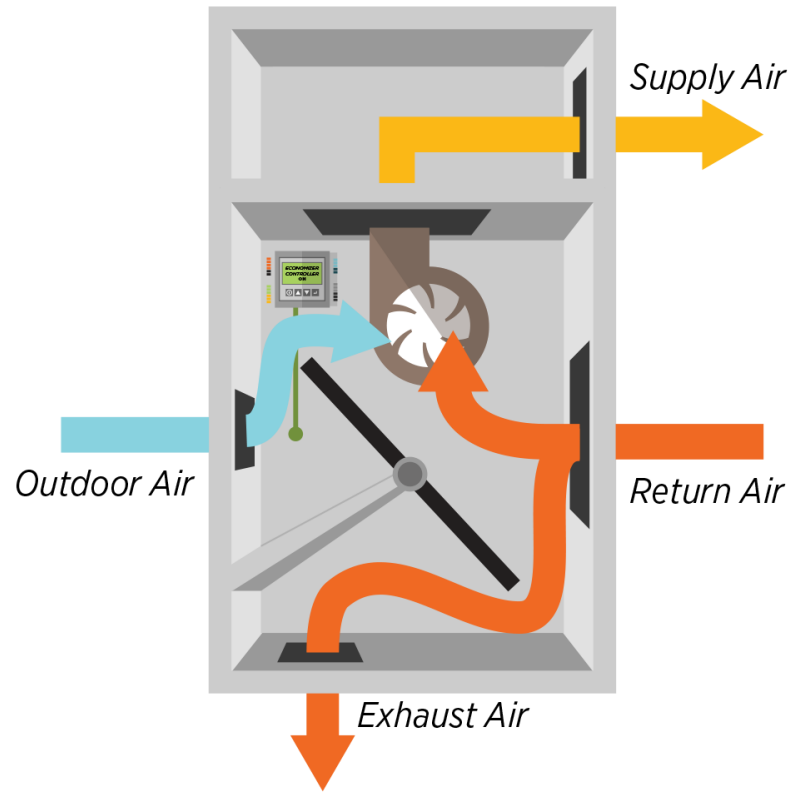
- ✓ Minimum Outside Air
- ✓ Can Outside Air be increased?
- ✓ Exhaust airflow





# Section 4 – Economizer Operation

## Ventilation Verification Pre-Requisite Tasks



### Section 4 – Economizer Operation

#### Ventilation Verification and Energy Optimization Assessment

<input type="checkbox"/>	Verify Economizer Operation
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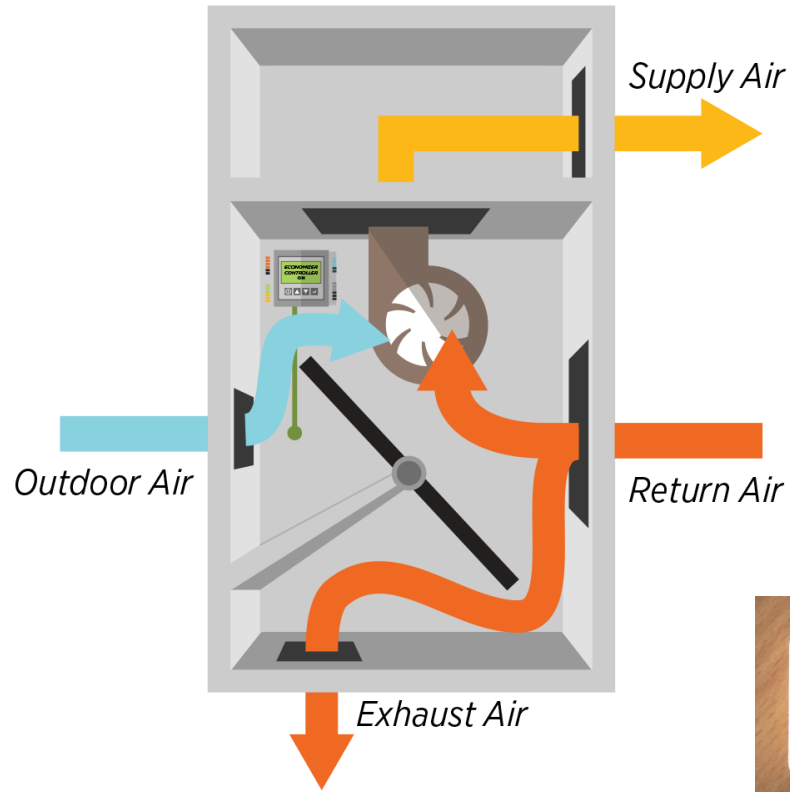
Step	Passing this test verifies the Economizer operates as designed.	Results
Step 1:	Disable demand control ventilation systems (if applicable)	
Step 2:	Enable the economizer and simulate a cooling demand large enough to drive the economizer fully open (record all of the following):	
	a. Economizer damper modulates 100% open and that the return air damper modulates 100% closed.	P/F
	b. All applicable fans and dampers operate as intended to maintain building pressure.	P/F
	c. The unit heating is disabled (if applicable).	P/F
Step 3:	Disable the economizer and simulate a cooling demand (record all of the following):	
	a. Economizer damper closes to its minimum position.	P/F
	b. All applicable fans and dampers operate as intended to maintain building pressure.	P/F
	c. The unit heating is disabled (if unit has heating capability).	P/F
Step 4:	If unit has heating capability, simulate a heating demand and set economizer so that it is capable of operating (i.e., actual outdoor air conditions are below lockout setpoint). (record all of the following):	
	a. Economizer is at minimum position.	P/F/NA
	b. Return air damper opens.	P/F/NA
Step 5:	Turn off the unit. Record if the Economizer damper closes completely.	P/F
Step 6:	Restore demand control ventilation systems (if applicable) and remove all system overrides initiated.	

Y/N	Economizer functions as designed
<input type="checkbox"/>	<p><b>If economizer does not function as designed and requires adjustment or repairs:</b></p> <ul style="list-style-type: none"> <li>• Document Required Repairs and Adjustments</li> <li>• Document information required for a repair or adjustment (i.e. measurements, model, serial, etc.)</li> </ul>
	<ul style="list-style-type: none"> <li>• Include relevant photographic documentation</li> </ul>

*This document is intended to be used solely as an aide when developing the methods, procedures, and forms used in the Ventilation Verification and Energy Optimization Assessment. It is the responsibility of each contractor, supervisor, and technician to ensure that the methods, procedures, and forms used*

# Section 5 – Demand Control Ventilation (DCV) Operation

## Ventilation Verification Pre-Requisite Tasks



### Section 5 – Demand Control Ventilation (DCV) Operation

#### Ventilation Verification and Energy Optimization Assessment

<input type="checkbox"/> Demand Control Ventilation (DCV) systems shall be verified for proper operation		
Step	Passing this test verifies the DCV and associated CO <sub>2</sub> sensor operates as designed.	Results
1	Prior to functional testing, record the following:	
a.	Disable economizer controls.	
b.	Record outside air CO <sub>2</sub> concentration from dynamic measurement <i>or</i> Assume outside air concentration if dynamic measure is not include with the system	ppm 400 ppm
c.	Record interior CO <sub>2</sub> concentration setpoint (may not exceed Step 1b + 600 ppm) <sup>1</sup>	ppm
2	Simulate a signal at or slightly above the CO <sub>2</sub> concentration setpoint required.	
a.	Apply CO <sub>2</sub> calibration gas at a concentration at or slightly above the setpoint to the sensor.	ppm
b.	For single zone units, verify that the outdoor air damper modulates open to satisfy the total required ventilation air, called for in the Mechanical Schedule.	P/F/NA
c.	For multiple zone units, the zone damper (or outdoor air damper when applicable) modulates open to satisfy the zone ventilation requirements.	P/F/NA
3	Simulate signal well below the CO <sub>2</sub> setpoint.	
a.	Apply CO <sub>2</sub> calibration gas at a concentration well below the setpoint to the sensor or ventilate the sensor as necessary.	ppm
b.	For single zone units, outdoor air damper modulates to the design minimum value.	P/F/NA
c.	For multiple zone units, the zone damper (or outdoor air damper when applicable) modulates to satisfy the reduced zone ventilation requirements.	P/F/NA
4	Verify DCV operation with economizer	
a.	Restore economizer controls and remove all system overrides initiated during the test.	
b.	Apply CO <sub>2</sub> calibration gas at a concentration slightly above the setpoint to the sensor.	ppm
c.	Verify that the outdoor air damper modulates open to satisfy the total ventilation required air.	P/F
5	Remove all system overrides initiated during the test and return system to normal operation.	

Y/N	DCV functions as designed with the established setpoint (1b)
<input type="checkbox"/>	<b>If No, and the DCV requires adjustment or repairs:</b> <ul style="list-style-type: none"> <li>• Document Required Repairs and Adjustments</li> <li>• Document information required for a repair or adjustment (i.e. measurements, model, serial, etc.)</li> </ul>
<input type="checkbox"/>	<b>Disabled DCV During Pandemic:</b>

<sup>1</sup> Or as required by applicable local, state, or provincial guidance.

# Section 6 – Air Distribution and Building Pressure

## Ventilation Verification Pre-Requisite Tasks

- 
- ✓ 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.



# Section 7 – Maintenance

## Ventilation Verification Pre-Requisite Tasks



### Section 7 – General Maintenance

#### Ventilation Verification and Energy Optimization Assessment

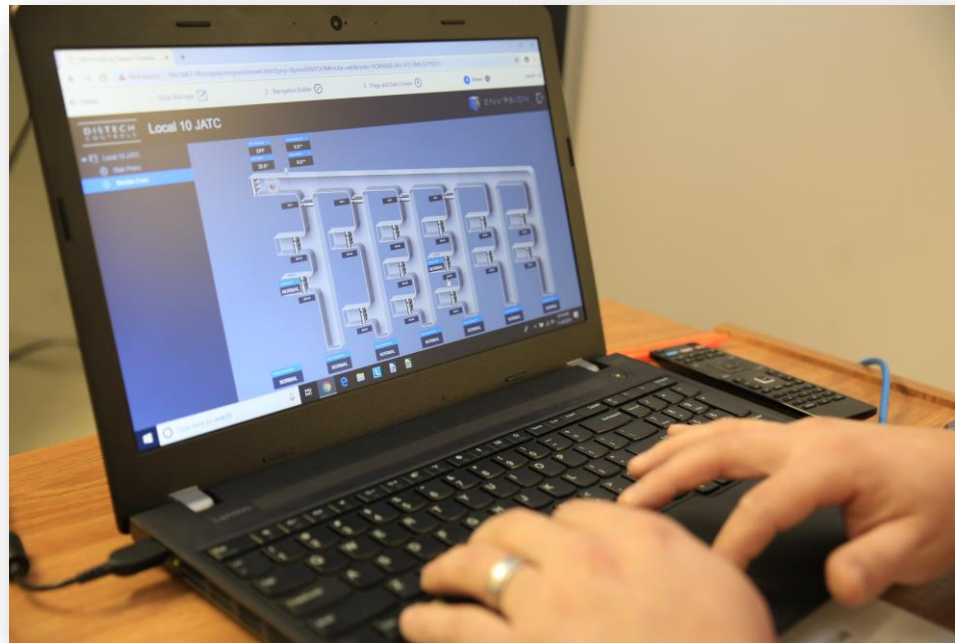
Verify General Maintenance	
<input type="checkbox"/>	<b>Verify coil condition</b> - Note downstream and upstream condition
<input type="checkbox"/>	<b>Verify condensate drainage</b>
<input type="checkbox"/>	<b>Temperature Differential (Cooling Mode)</b> - Measure and Document cooling coil air temperature differential (entering and leaving dry bulb) <ul style="list-style-type: none"><li>• If applicable, measure GPM on hydronic systems.</li></ul>
<input type="checkbox"/>	<b>Temperature Differential (Heating Mode)</b> – Measure and document air temperature differential (entering and leaving dry bulb) <ul style="list-style-type: none"><li>• If applicable, measure GPM on hydronic systems.</li></ul>
<input type="checkbox"/>	<b>Verify condition of drive assembly.</b> (if applicable)
<input type="checkbox"/>	<b>Deficiencies</b> - Document deficiencies, general condition of unit, and make recommendations for additional maintenance, replacement, or upgrades.
<input type="checkbox"/>	<b>Repairs and Adjustment.</b> <ul style="list-style-type: none"><li>• Document Required Repairs and Adjustments</li></ul>
<input type="checkbox"/>	Include relevant photographic documentation

*This document is intended to be used solely as an aide when developing the methods, procedures, and forms used in the Ventilation Verification and Energy Optimization Assessment. It is the responsibility of each contractor, supervisor, and technician to ensure that the methods, procedures, and forms used meet the requirements of the local mechanical codes. The National Energy Management Institute Committee makes no representations, whatsoever, that drafting procedures or forms based on this document will meet that requirement of local mechanical codes and expressly disclaims any liability or responsibility regarding the use of this document.*



# Section 8 – Operational Controls

## Ventilation Verification Pre-Requisite Tasks



### Section 8 – Operational Controls

#### Ventilation Verification and Energy Optimization Assessment

<b>Review control sequences to verify systems will maintain intended conditions during building operation.</b>	
<input type="checkbox"/>	<b>Temperature</b> – Setpoints match design.
<b>Setpoint</b>	<b>Design</b>
<input type="checkbox"/>	<b>Humidity (if applicable)</b> – Setpoints match design. <ul style="list-style-type: none"> <li>Design professional to determine if setpoint should be adjusted to maintain a relative humidity between 40% and 60%.</li> </ul>
<b>Setpoint</b>	<b>Design</b>
<b>Ventilation Schedule Operation</b>	
<input type="checkbox"/>	<b>Ventilation operates continuously during occupied hours.</b> <ul style="list-style-type: none"> <li>Occupied hours to include <b>all</b> hours building is occupied by staff or patrons (i.e. teachers, security, janitorial staff, night shift, etc.).</li> <li>Includes all exhaust fans and fans used to distribute outside air.</li> </ul>
<input type="checkbox"/>	<b>Daily Flush</b> <ul style="list-style-type: none"> <li>Verify a daily flush is scheduled for 3 changes of building volume using outdoor air as demonstrated by a calculation of flush times per ASHRAE Guidance for Building Readiness<sup>1</sup> or otherwise applicable local or state guidance</li> </ul> <p style="text-align: center;"><b>Calculated Flush Time =</b></p>
<input type="checkbox"/>	<b>Deficiencies</b> - Document deficiencies, options for adjustment (i.e. Humidity) and recommendations for additional maintenance, replacement or upgrades.
<input type="checkbox"/>	Include relevant screenshots and photographic documentation

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<sup>1</sup> ASHRAE, ASHRAE Epidemic Task Force: Building Readiness (February 1, 2021) (<https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-building-readiness.pdf>)

# Section 9 – CO<sub>2</sub> Monitoring

## Ventilation Verification Pre-Requisite Tasks



### Section 9 – CO<sub>2</sub> Monitoring

#### Ventilation Verification and Energy Optimization Assessment

<input type="checkbox"/>	<p><b>Verify installation or install a CO<sub>2</sub> monitor.</b></p> <ul style="list-style-type: none"> <li>All classrooms shall be equipped with a CO<sub>2</sub> monitor.</li> <li>General Buildings – At least one CO<sub>2</sub> monitor shall per installed in each zone of the building (where a zone is defined by an area of the building with temperature controlled by a thermostat). The number of CO<sub>2</sub> monitor must also meet or exceed at least one CO<sub>2</sub> monitor per 10,000 square feet of occupied floor space.</li> </ul> <p><b>CO<sub>2</sub> monitors shall:</b></p>
<input type="checkbox"/>	Be hard-wired or plugged-in and mounted to the wall between 3 – 6 feet above the floor and at least 5 feet away from the door and operable windows.
<input type="checkbox"/>	Display the CO <sub>2</sub> readings to the occupants through a display on the device or other means such as a web-based application or cell-phone application.
<input type="checkbox"/>	Notify the building operator through visual indicator on the monitor (e.g. indicator light) or other alert such as e-mail, text, or cell phone application, when the CO <sub>2</sub> levels have exceeded 1,100 ppm.
<input type="checkbox"/>	Maintain a record of previous data which includes at least the maximum CO <sub>2</sub> concentration measured.
<input type="checkbox"/>	Have a range of 400 ppm to 2000 ppm or greater;
<input type="checkbox"/>	Be certified by the manufacturer to be accurate within 75 ppm at 1,000 ppm CO <sub>2</sub> concentration and is certified by the manufacturer to require calibration no more frequently than once every five years.

Y/N	<b>Is a CO<sub>2</sub> monitor installed that meets the required features listed above?</b>	
<input type="checkbox"/>	If installed but lacking required features, what features are missing?	
<input type="checkbox"/>	If installed, document CO <sub>2</sub> monitor nameplate data.	
	Manufacturer:	Model:
	Serial:	
<input type="checkbox"/>	Include relevant photographic documentation	

# Section 10 – Limited or No Existing Mechanical Ventilation

## Ventilation Verification Pre-Requisite Tasks

### 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.	
<input type="checkbox"/>	<b>Existing HVAC Infrastructure</b> – Verify the functionality and document nameplate data on any existing HVAC equipment (i.e., heating only units, exhaust fans, etc.)
<input type="checkbox"/>	Verify and document the location of windows and doors that can be opened. <ul style="list-style-type: none"> <li>Verify if windows have any switches or controls that initiate exhaust fans, motorized dampers or other devices that operate to provide free cooling.</li> </ul>
<input type="checkbox"/>	Verification or installation of the $CO_2$ sensor as detailed in Section 9.
<input type="checkbox"/>	<b>Collection the following information, in addition to any information requested by a design professional to evaluate options for adding mechanical ventilation.</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Verify existing mechanical, architectural, structural drawings match current conditions.</li> <li><input type="checkbox"/> Provide a sketch of actual roof penetrations, penetration type (i.e., vent pipe) and approximate locations if different from drawings.</li> <li><input type="checkbox"/> Document locations of any vents could contaminate Outside Air (OSA) intake locations.</li> <li><input type="checkbox"/> Photograph existing building, existing mechanical equipment (if applicable) and potential locations for mechanical ventilation equipment.</li> <li><input type="checkbox"/> Document roof and wall type/material to the best of the technician's ability.</li> <li><input type="checkbox"/> Document if existing mechanical equipment can be altered to provide outside air (OSA) or if a Dedicated Outside Air System (DOAS) is required.</li> <li><input type="checkbox"/> Obtain information on central plant capacity (if applicable)</li> <li><input type="checkbox"/> Document whether outside air conditions may make reliance on windows or other sources of non-filtered outside air potentially hazardous to occupants.</li> <li><input type="checkbox"/> 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.</li> </ul>
<input type="checkbox"/>	Include relevant screenshots and photographic documentation. <ul style="list-style-type: none"> <li>Include existing building and potential locations for mechanical ventilation equipment.</li> </ul>

# HVAC Assessment Report

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- Preparation of an HVAC Assessment Report that includes documentation of all verifications and deficiencies.

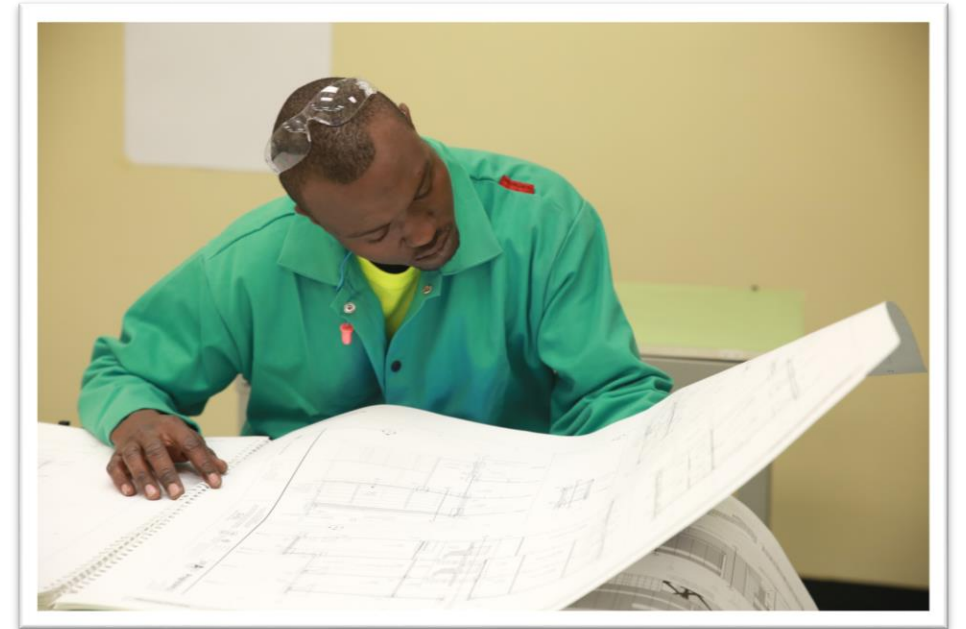




# Design Professional Ventilation and Energy Evaluation

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Upon completion of the HVAC Assessment Report, a **Design Professional** 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

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All work completed by **Skilled, Trained, and Certified Workforce.**





# Thank you!

Questions...

Christopher Ruch

*Director of Education*

National Energy Management  
Institute

3180 Fairview Park Drive, Suite 400

Falls Church, VA 22042

(C) 916-280-6281

[Cruch@nemionline.org](mailto:Cruch@nemionline.org)



## Q&A

Contact us at [EHSC@lbl.gov](mailto:EHSC@lbl.gov)



# Become a Participant or Supporter

- Access technical assistance and resources on best practices, guidance, case studies, and webinars
- Campaign prioritize schools serving low-income communities and in rural areas
- Campaign participants can receive recognition for their exemplary efforts to improve energy efficiency and indoor air quality
- Campaign supporters are encouraged to share and promote goals and benefits of efficient and healthy schools

## Engaging K-12 Schools to Improve Energy Efficiency and Indoor Air Quality

The Efficient and Healthy Schools campaign will engage schools—especially those serving low-income student populations—to reduce energy costs and improve energy efficiency and indoor air quality. The campaign aims to connect schools with practical solutions to heating, ventilation and air conditioning (HVAC) systems and other technologies. Its goal is to reduce energy use, lower carbon emissions and promote a healthy learning environment by enabling good indoor air quality.

### PARTICIPANT

As participants, schools will:

- Stay informed by receiving newsletter.
- Engage in peer-to-peer learning.
- Participate in the development of technical resources to simplify and scale solutions that improve energy performance and indoor air quality.

Participating schools can receive recognition for their exemplary efforts to improve energy efficiency and indoor air quality through operation and maintenance, HVAC upgrades and replacement, ongoing monitoring and data analytics, and support for a culture for efficient healthy school buildings.



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### SUPPORTER

The campaign plans to engage supporters such as designers, engineers, consultants, program implementers, and others that work with K-12 schools.

As supporters, organizations will:

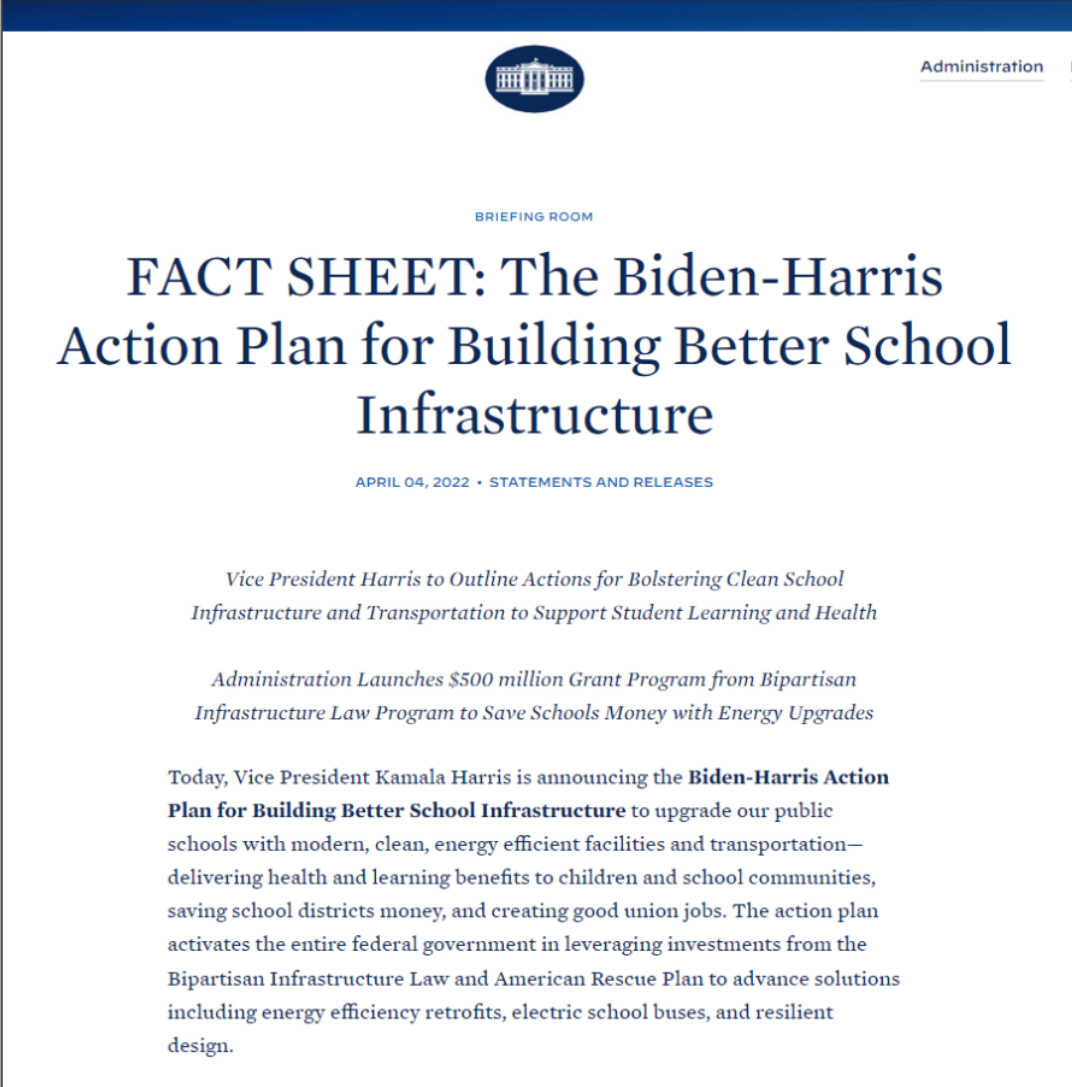
- Help us share the benefits of efficient and healthy school buildings.
- Partner with the campaign team to promote improvements in K-12 schools.
- Receive public recognition for your support.
- Share and promote existing resources, programs and tools.

To learn more, please visit  
[efficienthealthyschools.lbl.gov](http://efficienthealthyschools.lbl.gov)  
or contact us at [EHSC@lbl.gov](mailto:EHSC@lbl.gov)

# DOE at Center of Building Better Schools Action Plan

The Biden-Harris Action Plan for Building Better School Infrastructure will:

**Invest in More Efficient, Energy-Saving School Buildings:** The Department of Energy (DOE) is launching a \$500 million grant program through President Biden's Bipartisan Infrastructure Law to make public schools more energy efficient. This new program will lower energy costs, improve air quality, and prioritize schools most in need, enabling schools to focus more resources on student learning.



The screenshot shows a document header with the DOE seal and the word 'Administration' in the top right. Below the seal is the text 'BRIEFING ROOM'. The main title is 'FACT SHEET: The Biden-Harris Action Plan for Building Better School Infrastructure'. Below the title is the date 'APRIL 04, 2022' and the category 'STATEMENTS AND RELEASES'. There are two sub-headers: 'Vice President Harris to Outline Actions for Bolstering Clean School Infrastructure and Transportation to Support Student Learning and Health' and 'Administration Launches \$500 million Grant Program from Bipartisan Infrastructure Law Program to Save Schools Money with Energy Upgrades'. The main body of text begins with 'Today, Vice President Kamala Harris is announcing the Biden-Harris Action Plan for Building Better School Infrastructure to upgrade our public schools with modern, clean, energy efficient facilities and transportation—delivering health and learning benefits to children and school communities, saving school districts money, and creating good union jobs. The action plan activates the entire federal government in leveraging investments from the Bipartisan Infrastructure Law and American Rescue Plan to advance solutions including energy efficiency retrofits, electric school buses, and resilient design.'

# Upcoming webinars summer 2022

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- June: Team approach to support strategic investments in efficient and healthy schools
- July: Efficient HVAC for improving indoor environmental quality