Efficient and Healthy Schools Recognition Program

Energy Efficiency + Health

February 14, 2023
EE+Health Recognition Webinar 2:

Understanding Your Building Stock: Energy Benchmarking and Ventilation Assessments for Schools
Today’s Presenters

David Landman
Lawrence Berkeley National Laboratory Affiliate
Building Technologies and Urban Systems

Chris Ruch
Director of Education
National Energy Management Institute
Today’s Agenda

• Introductions and Level Setting
• Using Baseline Data to Set Goals
• Energy Benchmarking & Assessment: David Landman
• Ventilation Verification & Assessment: Chris Ruch
• Discussion & Office hours
Let us know who is here!

Introduce yourselves in the chat with your name, title, and school district
$4.5 million in awards available for Energy Efficiency capacity building in public schools

Calling all local education agencies (LEAs) to apply for the Energy CLASS Prize. Through this prize, energy managers, or Champions, will receive training on ways to identify, plan, and implement energy upgrades in school facilities, so that students can learn in comfortable and healthy classrooms.

Energy CLASS Prize Office Hours will be held on February 16 at 6:00 p.m. ET to answer common questions about the $4.5 million prize, including what is required of a full application, eligibility rules, and upcoming deadlines.

Full applications are due on February 28, 2023, by 5 p.m. ET.

Check out the prize FAQs or watch the Energy CLASS Prize Informational Webinar to learn more. Follow the Energy CLASS Prize on HeroX to stay up to date on all prize-related news.

https://www.herox.com/energy-class
Recognition Implementation Track Submissions

**Preparation**
Interested schools and districts will fill out a recognition application and request assistance from the Campaign if needed.

**Final Submission**
Schools and districts will complete and send application together with supporting materials by March 1, 2023.

**Announcement**
Schools and districts receiving recognition will be invited to attend an in-person celebration in June 2023.

https://efficienthealthyschools.lbl.gov/20222023-recognition
Using Baseline Data to Set Goals
Key Approaches and Outcomes in Achieving Efficient and Healthy Schools
Assessing Building Stock

- Develop master facility list
- Benchmark energy and health data
- Set baseline data metrics
  - What metrics are you using?
  - What data year?
- How will you continue to track building data?
Goal Setting

- Identify any current goals
- How old are they?
- What do they measure or what metrics do they include?
- What year are they measuring from?
- Are energy and health considered?
- Do stakeholders know about these goals?
Goals

Specific

Measured
You can't improve what you don't measure.

Achievable
Challenging and attainable.

Relevant
Closely connected to the objective.

Timed
A completion date that holds accountable.
Energy Use Intensity (EUI)

Annual kBTU ÷ Building Area = kBTU/sf/year

“mpg for buildings”

- kBtu converts kWh (Electric) and Therms (Gas) to the same unit.
- Most common metric in use.
- Used across all commercial building types and normalizes energy use.
Documenting energy and carbon reduction goals in advance of events in a building lifecycle can save districts money.

Research has demonstrated that starting early with goals and clear energy targets is key to cost management. Decarbonization in new construction goes further, saving significant first costs by eliminating any extension to the gas infrastructure. Savings can be reinvested in the building’s exterior shell and more efficient systems.

**Portfolio Goals**

Goals require clear ways to measure progress. The baseline leverages benchmarking data and documents energy performance and carbon emissions in the school district’s facilities for a specific year. This baseline year is then used for future comparisons and to track changes over time. Ideally, it is a specified time in the past for which your district has a complete dataset on its buildings. For many of the example below we have suggested using a 2019 baseline.

**Individual Building Goals and Targets**

Having absolute energy goals measured as an EUI (as opposed to a percent better than code goal) in place early—before design even begins—is a helpful way to ensure buy in from the design team and manage costs. Use the [Advanced Energy Design Guide for Zero Energy K-12 Schools](https://www.newbuildings.org/guides/advanced-energy-design-guide-zero-energy-k-12-schools) (Table 3-1: Target EUI) to set climate-specific, new construction and major modernization EUI targets and goals. Appendix B in the [Advanced Energy Design Guide for Zero Energy K-12 Schools](https://www.newbuildings.org/guides/advanced-energy-design-guide-zero-energy-k-12-schools) can be utilized to identify the appropriate climate zone.
New Construction:
- Achieve LEED, CHPS, or another broad sustainability goal
- Be energy efficient and achieve a site energy use intensity of 17-25 kBtu/square foot/year
- Be all-electric and have no on-site fossil gas combustion
- Incorporate renewable energy sources to offset annual electricity use
- 5 total air changes per hour (ACH) for high indoor air quality
- Reduce life cycle impacts associated with high embodied carbon materials (like steel and concrete)
- Utilize low global warming refrigerants
- Integrate electric vehicle (EV) charging and fleet infrastructure
- Consider grid harmonization and battery storage

Major Modernization:
- Achieve LEED, CHPS, or some other sustainability goal
- Achieve a site energy use intensity of 25-35 kBtu/square foot/year or better
- 5 total air changes per hour (ACH) for high indoor air quality
- Eliminate on-site gas combustion or have a plan to eliminate gas by a target year signed off by the department director
- Reduce life cycle impacts associated with high embodied carbon materials (like steel and concrete)
- Utilize low global warming refrigerants

Retrofits:
- Improve the site energy use intensity by a minimum of 20%, targeting 50% from a
  year from benchmarking data. 2019 or 2018 suggested)
- Include a written plan for future removal of all gas-combusting equipment, specify low global warming potential equipment and low embodied carbon materials

System Replacement:
- Phase out gas infrastructure where possible incorporate efficient, all-electric systems.

2045 Carbon Neutral School Building Portfolio
Table 7: Building-Related Sustainability Goals

Before developing new goals, it is important to document the goals your district may already have. In the table below note any current building-related goals in your district, when they were passed, and where they are formalized or documented. An additional two examples from districts are included below. These goals might cover green building, energy, carbon, electric vehicle infrastructure, or any other sustainability goals. This might be in a facility master plan report, in a school board resolution, or elsewhere.

<table>
<thead>
<tr>
<th>Date</th>
<th>Sustainability, Green or Energy Goal</th>
<th>Goal, Resolution or Document Name</th>
<th>Link to Documentation of Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 2020</td>
<td>1. To use 100 percent clean, renewable energy in its electricity sector by 2030</td>
<td>SLCSD Resolution to Establish Goals for Sustainability, Clean Energy, and Carbon Neutrality</td>
<td><a href="https://www.slcschools.org/departments/auxiliary-services/sustainability">https://www.slcschools.org/departments/auxiliary-services/sustainability</a></td>
</tr>
<tr>
<td></td>
<td>2. To meet 100% of all district operations energy needs with carbon neutral energy by 2040.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. 100% zero-carbon electricity, with the combined use of energy from Seattle City Light and renewable energy sources installed on District property, no later than 2027.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Energy Benchmarking & Assessment

David Landman, dslandman@lbl.gov
Lawrence Berkeley National Laboratory Affiliate

February 14, 2023
Are you currently benchmarking your building energy use?
Energy Benchmarking and Assessment

- What is Benchmarking?
- Ordinances
- Energy Star Portfolio Manager
- Assessments/Next Steps
What is Benchmarking?

When applied to building energy use, benchmarking serves to measure energy performance of a single building over time, relative to other similar buildings, or to modeled simulations of a reference building built to a specific standard (such as an energy code).

https://www.energy.gov/scep/slsc/building-energy-use-benchmarking
Why? Energy Benchmarking Ordinances/Laws & more
Energy Star Portfolio Manager

- Identify underperforming buildings to target for efficiency improvements
- Identify best practices from efficient buildings
- Set investment priorities
- Verify savings and prevent snapback
- Share and report performance
- Earn recognition
- Benchmark more than energy — Cost, CO2, water
- Implement a comprehensive management program

https://www.energystar.gov/buildings/benchmark
## Energy Star Portfolio Manager—Data Collection

### Required:
- Data Collected for All Properties
- Property Name
- Property Address
- Total Gross Floor Area of Property
- Irrigated Area
- Year Built/Planned for Construction Completion
- Occupancy
- Number of Buildings
- 12 consecutive months of energy data

### Additional required to get an ENERGY STAR score (if eligible):
- Gross Floor Area
- High School
- Number of Workers on Main Shift
- Weekend Operation
- Cooking Facilities
- Percent That Can Be Heated
- Percent That Can Be Cooled

### Optional:
- Student Seating Capacity
- Months in Use
- Number of Computers
- Gross Floor Area Used for Food Preparation
- Number of Walk-in Refrigeration/Freezer Units
- Gymnasium Floor Area
- School District
- School District

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https://portfoliomanager.energystar.gov/pm/dataCollectionWorksheet?dcw.data=%7B%22country%22:%22US%22,%22propertyUses%22:{{%22propertyUse%22:%22K12_SCHOOL%22,%22useType%22:%22K12_SCHOOL%22}}

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Energy Star Portfolio Manager Statistics

![Histogram of Source EUI (kBtu/ft²)]

** Portfolio Manager Median = 114 kBtu/ft²

** 95th percentile = 208

** 5th percentile = 56

** Range of Values

<table>
<thead>
<tr>
<th>Property Characteristic</th>
<th>5th percentile</th>
<th>Median</th>
<th>95th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square Feet</td>
<td>23,211</td>
<td>74,519</td>
<td>284,599</td>
</tr>
<tr>
<td>Computers per 1,000 ft²</td>
<td>0.7</td>
<td>2.1</td>
<td>5.2</td>
</tr>
<tr>
<td>Walk-in Refrigeration</td>
<td>0.00</td>
<td>0.01</td>
<td>0.04</td>
</tr>
<tr>
<td>Units per 1,000 ft²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooking Facilities?</td>
<td>79% say yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School?</td>
<td>19% say yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating Degree Days</td>
<td>1,021</td>
<td>4,710</td>
<td>7,860</td>
</tr>
<tr>
<td>Cooling Degree Days</td>
<td>227</td>
<td>1,108</td>
<td>3,432</td>
</tr>
</tbody>
</table>
Energy Star Portfolio Manager – Common Questions

Q: How do I enter fuel that comes as a delivery? (oil, propane, coal)


As a bulk shipment based on the actual delivery dates or monthly estimates

When you select “Enter as Delivery” for energy meters, Portfolio Manager assumes that all the fuel was used in the month it was received/entered. For some users that will be most accurate. For others, using a monthly estimate will be more accurate.
Enter a zip code to find utilities that provide their customers with better access to the data needed to benchmark properties in Portfolio Manager.

https://www.energystar.gov/buildings/owners_and_managers/existing_buildings/use_portfolio_manager/find Utilities/provide_data/benchmarking
Energy Star Portfolio Manager

EPA Sample K-12 School

Basic Information
- Construction Status: New property that is one single building
- Property GFA - Self-Reported: 75,000 Sq. Ft.
- Occupancy: 100%

Unique Identifiers (IDs)
- Portfolio Manager ID: 2474559
- Custom ID(s): None
- Standard ID(s): None

Property Uses and Use Details

<table>
<thead>
<tr>
<th>Name</th>
<th>Property Use Type</th>
<th>Gross Floor Area</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Use</td>
<td>K-12 School</td>
<td>75,000 ft²</td>
<td></td>
</tr>
</tbody>
</table>

- Gross Floor Area: 75000 ft²
- High School: No
- Number of Workers on Main Shift: 70
- Student Sequencing Capacity: 300
- Months in Use: 12
- Weekend Operation: No
- Number of Computers: 120
- Cooling Facilities: Yes
- GSA Energy Star Award: No

Property GFA (Buildings): 75,000
Property GFA (Parking): 32,000
Energy Star Portfolio Manager

EPA Sample K-12 School
221 Education Way, Phoenix, AZ 85005

Portfolios Manager Property ID: 24745281
Year Built: 1960

Saved to this PC

Not currently eligible for ENERGY STAR Certification

ENERGY STAR Score (1-100)
Current Score: 85
Baseline Score: 85

Metrics Summary

<table>
<thead>
<tr>
<th>Metric</th>
<th>Dec 2017 (Energy Baseline)</th>
<th>Dec 2018 (Energy Current)</th>
<th>Change [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY STAR Score (1-100)</td>
<td>85</td>
<td>85</td>
<td>0.00 (0.00%)</td>
</tr>
<tr>
<td>Source EUI (kBtu/ft²)</td>
<td>104.0</td>
<td>100.6</td>
<td>3.32 (-3.00%)</td>
</tr>
<tr>
<td>Site EUI (kBtu/ft²)</td>
<td>55.2</td>
<td>53.3</td>
<td>1.96 (-3.40%)</td>
</tr>
<tr>
<td>Energy Cost ($)</td>
<td>Not Available</td>
<td>Not Available</td>
<td>N/A</td>
</tr>
<tr>
<td>Total GHG Emissions Intensity (kgCO2eq/ft²)</td>
<td>6.2</td>
<td>4.5</td>
<td>-0.80 (-11.20%)</td>
</tr>
<tr>
<td>Water Use (All Water Sources) (gal)</td>
<td>627.8</td>
<td>609.7</td>
<td>-18.10 (-2.90%)</td>
</tr>
<tr>
<td>Total Wastes (Disposed and Diverted) (Tons)</td>
<td>56.73</td>
<td>70.51</td>
<td>1.78 (2.60%)</td>
</tr>
</tbody>
</table>
# Energy Star Portfolio Manager—School Results

## ENRGY STAR® Energy Performance Scorecard

### C Elementary School

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>For Year Ending</td>
<td>August 31, 2022</td>
</tr>
<tr>
<td>Property Address</td>
<td>Nebraska</td>
</tr>
<tr>
<td>Primary Function</td>
<td>K-12 School</td>
</tr>
<tr>
<td>Gross Floor Area (ft²)</td>
<td>57,662</td>
</tr>
<tr>
<td>Year built</td>
<td>1992</td>
</tr>
<tr>
<td>Energy Use per sq. ft.*</td>
<td>48.3 kBtu</td>
</tr>
</tbody>
</table>

**Score:** 65 out of 100

### H Elementary School

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>For Year Ending</td>
<td>August 31, 2022</td>
</tr>
<tr>
<td>Property Address</td>
<td>Nebraska</td>
</tr>
<tr>
<td>Primary Function</td>
<td>K-12 School</td>
</tr>
<tr>
<td>Gross Floor Area (ft²)</td>
<td>52,472</td>
</tr>
<tr>
<td>Year built</td>
<td>1992</td>
</tr>
<tr>
<td>Energy Use per sq. ft.*</td>
<td>64.8 kBtu</td>
</tr>
</tbody>
</table>

**Score:** 42 out of 100
Energy Star Portfolio Manager—Set Target

You can establish the same performance baseline and target for all of your properties. Be careful! Selections here will overwrite any baseline or targets you have already made for your individual properties. Changes you make below will change all properties where you are the PDA, you have Full Access, or you have Full Access to Goals tab. If you prefer to set baselines and targets for each property individually, you can do that on each property’s Goals tab.

### Selecting Baselines

A baseline is made up of 12 full calendar months of use information as well as meter entries (either energy, water, or waste/materials). It is defined by selecting the last month in the time frame (also known as the Year Ending Date). You can choose to select the same baseline date for all your properties or Portfolio Manager can automatically determine the baseline for each individual property by calculating the earliest eligible year ending date. If you have set specific baselines for individual properties, make sure to choose the option to leave them alone, or they will be overwritten.

### Baselines

**Energy Baseline:**
- Select a baseline year: Month ▼ Year ▼
- Let Portfolio Manager automatically set my baselines
- Leave property-specific baselines as currently set

**Water Baseline:**
- Select a baseline year: Month ▼ Year ▼
- Let Portfolio Manager automatically set my baselines
- Leave property-specific baselines as currently set

**Waste Baseline:**
- Select a baseline year: Month ▼ Year ▼
- Let Portfolio Manager automatically set my baselines
- Leave property-specific baselines as currently set

### Energy Target

**Target Metric:** Leave property-specific targets as set ▼

**Target Value:**

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Be Careful

Setting baselines and targets using this form will re-set any targets or baselines you have set for your properties individually.
Energy Star Portfolio Manager Results

- Identify underperforming schools/buildings in your district to target for efficiency improvements
- Identify best practices that are replicable across schools
- Set investment priorities to compare savings across buildings in your district to decide how to allocate capital and maximize financial returns in energy efficiency
- Verify savings through continuous tracking of energy over time
- Share and report performance, educate classes and the town/city about how the schools are performing
- Earn recognition by best performing school in the district or energy star certification (75 or higher)
- Benchmark more than energy, include water, waste, greenhouse gas emissions—
  *More about GHGs in next weeks webinar*
**Energy Star Portfolio Manager—Lessons Learned**

- Controls not working in schools requiring updates in software and hardware
- Economizers not working
- Air cleaners left on 24/7

- Next step—Assessment
Energy Star Portfolio Manager—Next Gen Certification

- **Demonstrate Top Energy Efficiency.** The building must achieve a 1–100 ENERGY STAR score of 75 or higher and meet all criteria associated with ENERGY STAR certification.

- **Use Renewable Energy.** The building must obtain at least 30% of the total energy it consumes from renewable sources.

- **Meet a Direct Emissions Target.** The building’s direct (i.e., onsite) greenhouse gas emissions intensity must be within a specified level, normalized for both the type of building and the climate/weather.

*EPA plans to make ENERGY STAR NextGen certification available in late 2023/early 2024.*
Next Steps—Assessments

Quick Building Assessment Form and Tool
- This tool provides identification of energy improvement opportunities, recommendations for energy efficiency measures, and associated health and safety benefits for various projects

DOE Asset Score
- This tool allows users to generate energy retrofit measure recommendations and energy savings estimates
- [https://buildingenergyscore.energy.gov/](https://buildingenergyscore.energy.gov/)

Third Party Needs Assessment
- Use of a site audit or energy efficiency measure identification and impacts analysis as provided by a contractor (i.e., Energy Service Companies [ESCOs] or consultant).

School Prototype and Retrofit Package
Next—BETTER

Plan for change by using additional software and resources:

Use software like BETTER to streamline energy efficiency audits

https://better.lbl.gov/static/pdf/BETTER_Portfolio%20Case%20Study_ERI_v7_FINAL.1e5c7b8525dc.pdf
Next—Energy Management Information Systems (EMIS)

Data Sources
- Utility Bills
- Interval Meters
- Weather Stations
- Building Automation System (BAS)
- IoT Devices
- Distributed Energy Resources

Data Warehouse

EMIS Capabilities
- Monthly Data Analytics
  - Energy Information System
    - Interval Meter Data Analytics
    - Advanced M&V (Measurement and Verification)
  - Fault Detection and Diagnostics
  - Automated System Optimization
# Summary of EMIS Tools

<table>
<thead>
<tr>
<th>EMIS Capability</th>
<th>Data Scope</th>
<th>Key Uses</th>
<th>Costs</th>
<th>Whole-building Energy Savings</th>
</tr>
</thead>
</table>
| Whole-building  | Monthly data analytics | Monthly utility bills | ▪ Peer-to peer comparison  
▪ Utility bill data acquisition & analysis  
▪ Budgeting  
▪ Tenant billing | $$-$-$ | 2.4% median |
| Whole building & submeters | Energy information system (EIS) | Hourly or 15-min energy meter data | ▪ Benchmarking & energy dashboard  
▪ Building load analysis  
▪ Energy anomalies alert  
▪ Peak demand reduction  
▪ Automated M&V | $$ | 3% median, portfolio-level $0.03/sq ft |
| System          | FDD | 15-min or less interval data from BAS and meters | ▪ System-level performance tracking (KPIs)  
▪ Automated fault detection & notification  
▪ Fault causes identification  
▪ Issues tracking | $$$ | 9% median, portfolio-level $0.24/sq ft |
|                 | ASO | 15-min or less interval data from BAS and meters  
Supervisory control to BAS | ▪ Optimal HVAC settings prediction | $$$$$ Higher than FDD | Field validations in progress |
Questions?
Ventilation Verification

Are your classrooms meeting the minimum requirements?
THE 9 FOUNDATIONS OF A HEALTHY BUILDING
forhealth.org
But my system is new...

✓ 2020 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

✓ Poor Quality Installation Is Pervasive. A Study By The California 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. (2)

ASHRAE Core Recommendations
(American Society of Heating, Refrigerating and Air-Conditioning Engineers)

1. Public Health Guidance – Follow all current regulatory and statutory requirements and recommendations

2. Ventilation, Filtration, Air Cleaning

3. Air Distribution

4. HVAC System Operation

5. System Commissioning – Verify that HVAC systems are functioning as designed.

ASHRAE Epidemic Task Force - Core Recommendations for Reducing Airborne Infectious Aerosol Exposure. 19 Oct. 2021,
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\(^2\), 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 owners 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

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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, MERV 13 or better is recommended.
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.

Ventilation Rate

- Outside Air (OSA) Volume
- Can OSA be increased?
- Exhaust Airflow

Source: UC DAVIS WCEC
Has Your Classroom size changed since the HVAC unit was installed?

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

<table>
<thead>
<tr>
<th>Standard</th>
<th>Method</th>
<th>15 People</th>
<th>25 People</th>
<th>35 People</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 62.1 2022</td>
<td>10 CFM/person + 0.12 CFM/ft²</td>
<td>258 CFM</td>
<td>358 CFM</td>
<td>458 CFM</td>
</tr>
</tbody>
</table>

*CFM = Cubic Feet per Minute*

Ventilation System Components

- **Economizer**
- **Demand Control Ventilation (DCV)**

Source: UC Davis WCEC
General Maintenance

Has the system been maintained?

- Coil Condition
- Condensate Drainage
- Temperature splits
- Drive Assembly
- Note Deficiencies
Air Distribution

- Measure airflow distribution throughout building
- Compare measured values with design values
Operational Controls

- Setpoints
- Scheduling
  - Continuous Operation
  - Building Flush
$CO^2$ 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

- Help design professionals make well informed decisions
- Will identify existing equipment and how it’s performing
- Identifies optional ventilation/filtration options

Source: UC DAVIS WCES
Step Two: Design Professional Review

- Licensed design professional reviews
- Makes recommendations for next course of action:
  - Adjustments
  - Repairs
  - Upgrades
- Building authorities receive report
Step Three: Repairs, Adjustments, and Upgrades

- Work with licensed design professional to address deficiencies:
  - Recommend upgrades
  - Adjustments (balancing)
  - Increase filtration

Importance of a Skilled, Trained, and Certified Workforce.
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.”
Improperly selected equipment, lack of commissioning, incorrect fan control settings and maintenance issues (heavily loaded filters) were all associated with under-ventilation in classrooms.

“Proper installation, operation, and maintenance of HVAC are all necessary in order to provide adequate ventilation in classrooms.”

“replacing aging equipment with new equipment does not guarantee adequate ventilation in classroom.”

Better Air in Buildings Webpage

- [https://www.betterairinbuildings.org/](https://www.betterairinbuildings.org/)
- Links Building Owners with contractors offering Ventilation Verification services.
- Shared by the White House as a Resource
NEMI – Ventilation Verification webpage

- https://www.nemionline.org/
- Informational Videos (English and Spanish)
- UC Davis/NEMI Videos – Ventilation and Filtration
- Sample Test Sheets
- Sample Methods of Procedure
- White Papers
- Sample Specifications
Questions?
For those that are tracking energy, ventilation, etc....

- What tool are you using and why?
- How are you using the data?
How do you successfully implement benchmarking and ongoing energy/ventilation monitoring?

• For those that already have... how have you implemented this?

• For those that haven’t yet, what might you do?
Resources
Resources

Benchmarking Resources:

Energy Star Portfolio Manager About Benchmarking: https://www.energystar.gov/buildings/benchmark


Education toolkits and courses:

Additional Resources for Schools


DOE About Benchmarking: https://www.energy.gov/scep/slsc/building-energy-use-benchmarking

DOE Building Energy Asset Score: https://www.energy.gov/eere/buildings/building-energy-asset-score

BETTER Tool: https://better.lbl.gov/

Energy Efficiency Programs in K-12 Schools: https://www.epa.gov/sites/default/files/2017-06/documents/k-12_guide.pdf

Energy Star Portfolio Manager Webinars: https://www.energystar.gov/partner_resources/energy_star_webinars
Ventilation Assessment Resources

Better Air in Buildings Website – Contractor Listing
- The Better Air in Buildings website has a contractor listing where potential clients can find a contractor offering Ventilation Verification services.

Ventilation Verification Resources
- The following resources are available at https://www.nemionline.org/
  - Informational Videos (English and Spanish)
  - UC Davis/NEMI Videos – Ventilation and Filtration
  - Sample Test Sheets
  - Sample Methods of Procedure
  - White Papers
  - Sample Specifications

Design Guidance for Education Facilities: Prioritization for Advanced Indoor Air Quality
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). This document was developed by ASHRAE Technical Committee 9.7, Educational Facilities and has been approved by ASHRAE as a free download. The document lists a ventilation verification assessment as a prerequisite to the other recommendations.
Click Here to Download the Full Report
School Funding Resources

Federal and State Resources for Schools:
https://www.energy.gov/eere/buildings/federal-and-state-resources

Public School Facility Upgrades – Financing and Incentives:
Next Steps
Submitting for Planning Recognition

Plans will be tailored to school district needs and may evolve over the course of this series.

**Goal: an actionable plan that is not extra busywork for your district.**

**Plans can be:**
- Focused on a particular topic (energy, IAQ, IEQ, etc.)
- Focused on a particular action (ex. building assessment)
- Be part of an existing plan or a larger plan focused on whole district sustainability
- In any format! PPT, word doc, one pager, infographic, etc.
Office Hours