

MAINE SCHOOL ENERGY PROJECTS GETTING STARTED GUIDE

VENTILATION



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Ventilation: Health & Energy

Schools upgrading their heating and cooling system to save energy and reduce greenhouse gas emissions should consider upgrading their ventilation at the same time. Ventilation involves the supply of fresh air and removal of stale air from indoor spaces. Proper ventilation in schools is essential to maintaining a comfortable learning environment and supporting the wellness of students, educators, and staff. Ultimately, ventilation improves indoor air quality (IAQ), offering numerous benefits for classrooms:

- ▶ Without sufficient ventilation, classroom air can become stuffy, carry unpleasant odors, and contain contaminants from cleaning products or other pollutants.
- ▶ Effective ventilation helps control moisture levels, reducing the risk of mold growth.
- ▶ Mold exacerbates asthma symptoms and can cause other health problems, such as sore throat and headaches.
- ▶ Proper ventilation reduces the spread of respiratory illness, thus [reducing student and teacher sick days](#).¹
 - ▶ One study found that there were [five fewer days with absences](#) for every two cubic feet per minute increase in ventilation rate per student in the classroom.²
- ▶ Healthier IAQ improves student and staff cognition. Too much carbon dioxide in the air can [cause headaches and lack of focus](#).³



While improving ventilation makes the classroom healthier, it can increase a building's energy use. The outdoor air needs to be heated in the winter and cooled and dehumidified in the summer. To keep energy bills low, schools should use heat recovery devices as described later in this guide. Schools should assess their building ventilation, especially if there are significant unwanted odors or other indicators like mold growth. Many older buildings use open windows for ventilation or have vents that have been accidentally shut or clogged. Upgrading heating systems, adding cooling, or making changes to other major building systems are great times to assess and address the school's ventilation system and integrate a heat recovery device.

Relationship Between IAQ and Performance

Numerous studies have demonstrated a clear link between improved IAQ and enhanced cognitive performance and productivity in children.^{4,5,6} Poorly ventilated, stuffy classrooms can make it significantly harder for students to concentrate and stay engaged.

For instance, higher ventilation rates have been associated with faster task completion among students and staff. Additionally, children in classrooms with higher outdoor ventilation rates [tended to score higher](#) on math and reading standardized tests compared to those in classrooms with lower outdoor ventilation rates.⁵

QUALITY PERFORMANCE

According to the [International WELL Building Institute](#), students in above-standard school buildings perform up to 17% better on tests than students in sub-standard buildings.⁷

Types of Ventilation

Schools typically use a combination of natural and mechanical ventilation.

Natural Ventilation

Natural ventilation refers to the movement of air through operable windows or doors. While this method is simple and free, it is limited by external conditions, such as weather, outdoor air quality, outdoor noise, and whether the air conditioning is running, making it unreliable as the sole ventilation strategy for Maine classrooms.

Mechanical Ventilation

Mechanical ventilation circulates fresh outdoor air and exhausts stale air through ducts and fans. Compared to natural ventilation, mechanical ventilation offers more control over incoming airflow and can condition and filter incoming air.

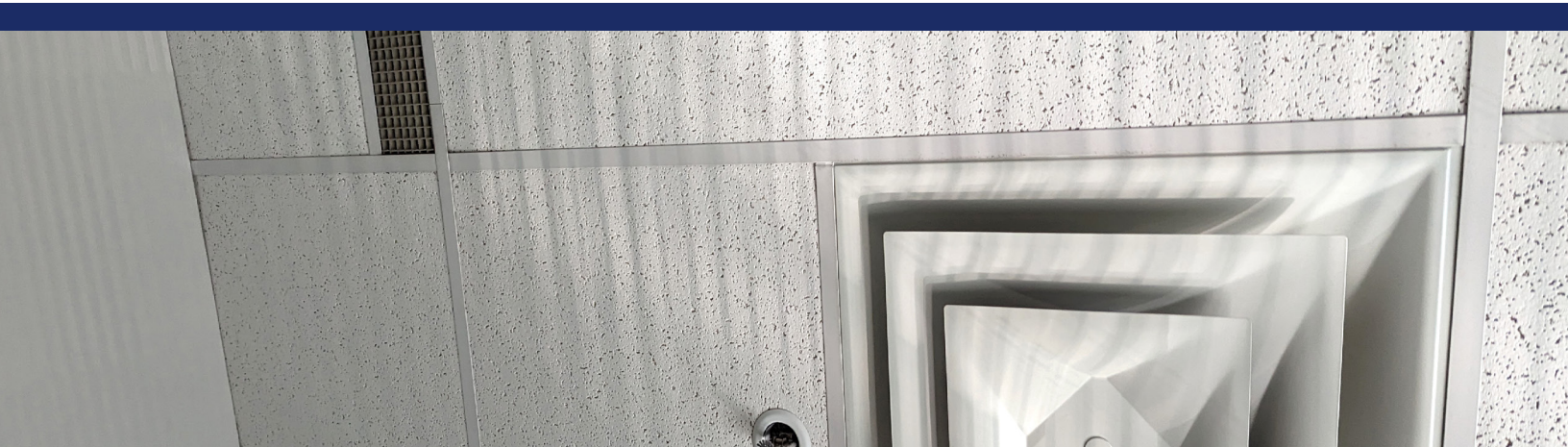
KEYS TO GOOD VENTILATION

- ▶ Sufficient flow rate per the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) 62.1 per [Maine Public School Standards & Guidelines for New School Construction and Major Retrofit Projects](#).
- ▶ A 1,000 square foot classroom with 25 students would need 380 cubic feet per minute of outdoor air.
- ▶ Filtration of outdoor air to capture dust, pollen, airborne pathogens, or other particles.
 - ▶ Filter efficiency is rated with a number called a Minimum Efficiency Reporting Value (MERV). A higher MERV means the filter is better at removing particles and contaminants. Use at least a MERV 8 filter in schools, and as high as MERV 13 for the best filter efficiency.
- ▶ Exhaust stale air and pollutants, especially in dirty spaces such as locker rooms, kitchens, and bathrooms.
- ▶ Ensure balanced airflow by exhausting the same amount of air that is brought in.
 - ▶ Difficulty opening or closing entryway doors can indicate an imbalance between supply and exhaust airflow.
- ▶ Condition air to room temperature.

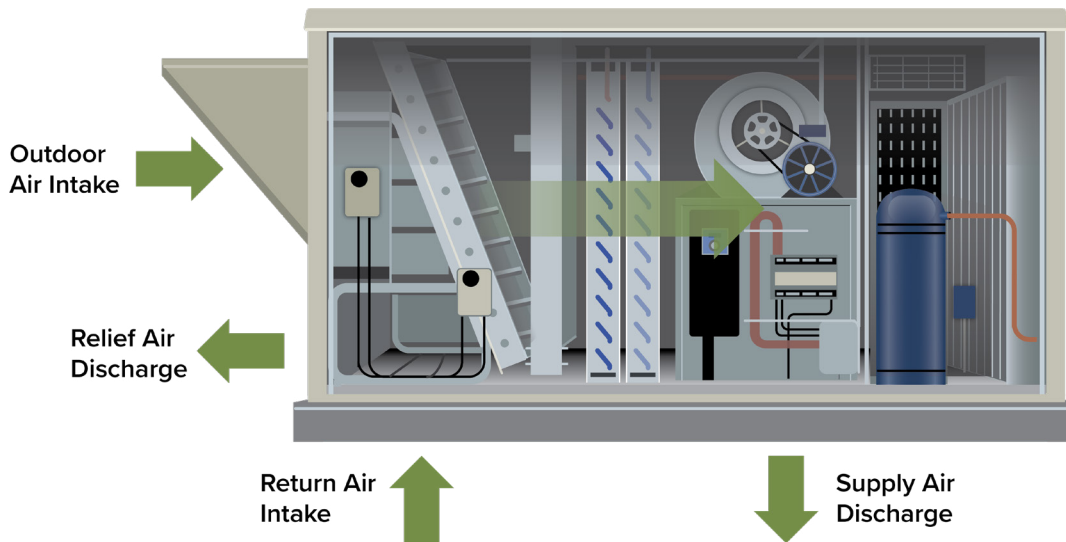
For more detailed school ventilation practices and Maine standards for schools refer to the latest standards from ASHRAE found in the [Maine Public School Standards and Guidelines for New School Construction & Major Renovation Projects](#).

Types of Mechanical Ventilation Systems

- ▶ Older schools with unit ventilators in classrooms have **single room ventilation systems**. These bring outdoor air into each classroom and filter and condition it. While unit ventilators serve this purpose, older models might not supply sufficient air to meet current ventilation standards. To save energy, a single room solution should be paired with a residential-size heat recovery ventilator, as described later in this guide.



- ▶ Schools with rooftop units (RTU) are examples of **central heating, ventilation, and air conditioning (HVAC) systems** that have built-in ventilation to serve multiple rooms or wings. Schools should consider pairing an RTU with a heat recovery device to improve energy efficiency.



- ▶ Many heat pump systems require **separate ventilation systems**, such as a dedicated outdoor air system (DOAS). These units can heat, cool, filter, and dehumidify the air and serve multiple rooms or school wings. DOAS units are required by code to have heat recovery devices to improve energy efficiency.

DEMAND CONTROL VENTILATION

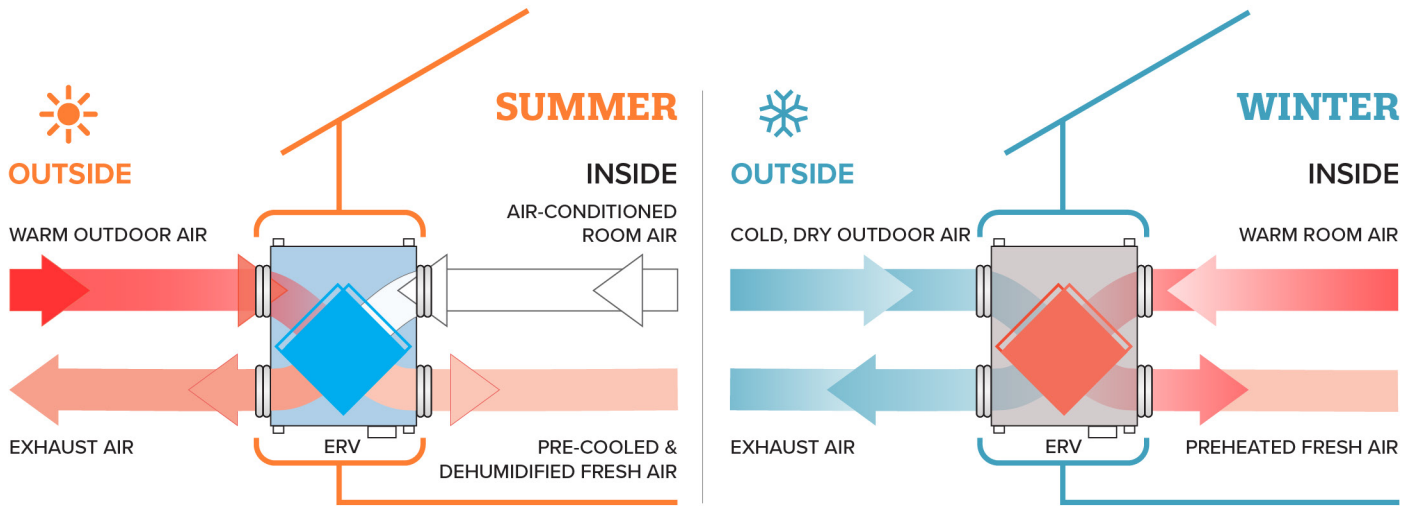
Schools can also install demand-controlled ventilation (DCV), a control strategy that uses carbon dioxide sensors to measure occupancy and then raise and lower ventilation in the building.

Energy-Efficient Solutions

Ventilation can increase energy consumption because the incoming outdoor air needs to be conditioned and either humidified or dehumidified to room conditions. Heat recovery devices integrated into HVAC ventilation systems can significantly reduce this energy demand. Therefore, incorporating these devices is strongly recommended to offset increased energy use and help lower energy bills. Per the [National Renewable Energy Laboratory \(NREL\) Advanced Energy Retrofit Guide](#), heat recovery devices can lower a school's site energy by 28%.⁸

Heat Recovery Devices

Heat recovery devices are HVAC systems that recover heat or cold from the exhaust air and transfer it to the incoming outdoor air. Energy Recovery Ventilators (ERVs) transfer heat and moisture, while Heat Recovery Ventilators (HRVs) only transfer heat. There are individual residential-style ERVs and HRVs or larger commercial options. Schools should talk to their HVAC contractor to help determine which option is best for the building. Many of these solutions are eligible for [incentives from Efficiency Maine](#).



Maintenance

To ensure that all ventilation systems are working effectively, filters should be changed or cleaned as needed, often every few months. Specific maintenance instructions vary by manufacturer, so schools should check their equipment manual.

Finding a Contractor

Schools should hire an [Efficiency Maine Qualified Partner](#) to ensure quality equipment and installation.



BETTER VENTILATION = BETTER ATTENDANCE

A [study by the University of New York at Albany](#) found that improving ventilation, heating, and cooling increased attendance by 2% and reduced suspensions by 7% across schools in upstate New York.⁹

Ventilation Funding Resources

- ▶ [Efficiency Maine's education webpage](#) lists current funding opportunities.
- ▶ [Efficiency Maine](#) offers commercial HVAC incentives.
- ▶ The [Community Resilience Partnership](#) offers grants and technical assistance.

Additional Resources

- ▶ The [State of Massachusetts](#) offers simple steps for educators to improve ventilation.
- ▶ The [New Jersey Healthy Schools Now Coalition](#) offers a school ventilation fact sheet.
- ▶ The [International WELL Building Institute](#) released a 2021 report on the state of PK-12 public school facilities.
- ▶ The [Environmental Protection Agency \(EPA\)](#) gathered scientific evidence on IAQ and improved academic performance.
- ▶ The [Harvard Kennedy School's The Journalist's Resource](#) offers a collection of research on IAQ in U.S. schools.

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