

Maine High School Transforms Learning Environment with Multi-Function Classroom Air Handlers



If teachers at Madison Area Memorial High School in Maine are looking for interactive lessons in physics, sustainability or even economics, they need not look any further than the school's HVAC system. This new high efficiency heat pump system embodies lessons in all three.



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It uses solar energy stored in the earth to heat and cool the school; it reduced the school's overall carbon footprint; and it continues to deliver an impressive return on investment. All this, and students and teachers have never been more comfortable.

There was plenty of room for improvement. Prior to the renovation, there was no air conditioning or even adequate ventilation at the 25-year-old school. And the original central boiler system was costing the school a fortune in oil and maintenance.

"The existing system was on its last leg. The school had to do something, but they didn't want to spend \$800,000 on the same kind of limited system. Also, the superintendent recognized that they needed something more sustainable and less costly than oil," said Tim Weber, formerly of NextEnergy, the company hired to design a new HVAC system for the school.

In 2012 NextEnergy teamed up with Pine State Drilling and ABM Mechanical to design and install a new decentralized solution that uses geothermal technology and water source heat pump air handlers installed in each of the 25 classrooms. These dedicated units from Changeair provide heating, cooling, dehumidification and ventilation to each classroom.

The Changeair units are fed by a geothermal heat transfer loop consisting of 35 boreholes at 500 ft of depth. The supply and return lines were brought into the school's mechanical room and integrated into the existing distribution system so the school was able to use most of the piping from the old boiler system.

An All-Inclusive Solution

Not only do the Changeair air handlers incorporate heating

and cooling, they also include fresh air ventilation with built-in energy recovery capable of reclaiming nearly 70% of the energy from the exhausted air. It's a vast improvement over the old ventilation system, which merely dumped hot or cold air (depending on the season) into the classroom. This method not only created hot and cold spots within the space, it significantly increased the load on the old boiler system – so much so that the school actually disabled the ventilation in order to conserve oil.

The new system affords much more comfort and precise control. Each Changeair unit is equipped with a CO2 sensor that controls fresh air intake based on classroom occupancy. When the classroom is empty, fresh air intake is minimized resulting in maximum efficiency and energy conservation. Additionally, each teacher has the ability to adjust the temperature set point within 2 degrees for heating and cooling needs within the individual classroom.

"It's a pretty unique piece of equipment. I'm surprised more of this isn't happening in schools," remarked Chad Grignon of Pine State Drilling, the company that designed the overall geothermal system and installed all of the outdoor components.

Combined with the geothermal loop, the Changeair units are able to direct heating and cooling where it is needed – simultaneously. The system can actually transfer excess heat from one side of the building to the colder side of the building where it is needed. Because the system is able to effectively shift energy around, Grignon said the actual geothermal loop temperature never gets below 37 or 38 degrees during the heating season.

Many might argue that a New England school doesn't even need cooling, but the installation of this system has proved differently. According to Grignon, cooling actually kicks in as

early as January on the south side of the building. There's no energy penalty because that heat is basically transferred to the north side.

Comfort AND Savings

Mike McHugh of AB Mechanical, the lead mechanical contractor on the project, agreed that the system has delivered an extraordinary boost to comfort while reducing energy cost.

"To my knowledge we saved them in range of \$40K in energy the first year. And they went from having 85 degrees on second floor to a comfortable 72 degrees," said McHugh.

McHugh credits the versatility of the Changeair units with bringing the whole system design together.

"There's nothing else out on the market would have provided us this much functionality. It's a great unit for retrofits – and a lot of schools in our state need retrofits."

The improvements to the indoor environment at Madison have been nothing short of remarkable. McHugh, Grignon, and Weber have all spoken directly with teachers who have reported that attention spans are up while absenteeism is way down.

"I talked to one teacher who said everybody is more vibrant. There are no more bad smells. To me there is no better option for learning environment," said Grignon.

Along with the bad air, much of the fuel cost has also disappeared. Tim Weber reported that as of Spring 2014, the school had consumed only 224,000 kWh for heating, cooling, fans and pumping since the new system was commissioned in October 2012. That included energy consumed by separate systems that heat and cool certain common

areas like the cafeteria and auditorium. The Changeair equipment consumed a mere 104,391 kwh which equates to \$12,400.00 total for two heating seasons and one cooling season with full ventilation in each of the 25 classrooms.

Not bad for a 50,000 sq. ft. school that was built over two decades ago.

What About Noise?

Noise is quite often the one factor that holds schools back from decentralized HVAC solutions like the one installed at Madison Area High School. It was a concern for Mike McHugh of ABM Mechanical, Inc. as well. But the sound ratings on the Changeair units installed at Madison were actually well below what is required for a classroom setting.

"Once we got the units installed we could tell that they are actually very quiet," said McHugh.

This whisper quiet operation is largely due to Changeair's Intelligently Quiet (IQ) technology. Through the use of an AMCA accredited sound lab, Changeair has been able to develop a product that supports the most stringent acoustic requirements, including those defined under the Indoor Environmental Quality (IEQ) section of LEED.

As recommended by ASHRAE, Changeair equipment with IQ technology has been tested in accordance with AHRI 260 in an accredited reverberant laboratory, and meet ANSI/ASA Standard S12.60-2010, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools. The AHRI 260 test method is recommended because it eliminates much of the uncertainty present in other common methodology.

The end result is a product that performs far and above conventional equipment in terms of acoustics.



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