

# Remote Control for Portable Classroom HVAC

Portable classrooms are a focus of much concern because of their poor energy efficiency. In Maryland, a school system has solved at least part of the problem. The district is saving very large sums of money and keeping a better eye on comfort levels by using remote control – via internet and radioed messages – for the heating, ventilation and air conditioning (HVAC) in its portable classrooms.

Electric utilities, the U.S. military and at least one entrepreneurial company have tried remotely controlling residential air conditioning to shed load during times of high power demand. Working with suggestions from Montgomery County Public Schools, Carrier Electronics took that idea to the next step – devising software and hardware to allow remote control of HVAC in portable classrooms. Now it is paying off for the school district, a large district with almost 700 portable classrooms in the Washington suburbs of Maryland.

“Every time I check the performance of this strategy, the payback just gets better,” says the school district’s Energy Manager Ron Balon.

Based on measured data and simulations, the new system is saving the school district more than \$500,000 per year, versus an installed cost of \$350,000, Balon says. Because he is dealing with extrapolations, he is being conservative in his savings estimate. The final number for a year of savings may very well exceed \$650,000.

## A Path-Breaking System

The system may be the first of its kind. Balon says he could not find any other company even claiming to do this sort of thing for portable classrooms. Rebuild America specialists have not heard of such a system being tried in another school district.

Before the new system was installed, portable classroom HVAC in the school district was controlled by teachers with a simple inexpensive mercury-bulb thermostat that had no automatic setback feature. Teachers tended not to set back the heat themselves at the end of a day, nor did they usually alter settings for air conditioning in the cooling months. Maintenance crews similarly tended not to change settings after their work was done.

The result was an average electricity cost of \$3.40 a square foot per year in the portable classrooms, that number including all lighting and other plug loads, not just HVAC. The average portable was 800 square feet, bringing the electricity cost for approximately 700 portables to about \$1.9 million a year. By contrast, Montgomery County schools were paying \$1.10 a square foot per year for electricity in normal classrooms.



*Energy Manager Ron Balon with a test unit for HVAC controls.*

To reduce the economic burden of the portable classrooms, Balon worked with Carrier Electronics, a division of HVAC company Carrier Corp. The new system allows Balon to send from his computer a message that travels via SkyTel messaging system – essentially a paging network – to each portable. Each of the classrooms has a thermostat and separate communications panel with a small antenna, plus wiring from the panel that goes through the wall to the packaged air-conditioning unit outside. Carrier charges a small monthly fee of roughly \$1.25 per thermostat, which includes the SkyTel cost element.

Balon programs heating for 70 degrees Fahrenheit starting at 5 a.m., easing back to 68 degrees at 8 a.m. – because peak electric rates start, and occupants are unlikely to notice the slight drop – stepping down to 64 degrees during 4-6 p.m. when teachers may be working late, then dropping back to 50 for the night. During cooling season, Balon sets the temperature at 76 degrees during primary occupied hours, 80 for 4-6 p.m. and an off-hours cap of 90.

## Flexibility for Savings

A single broadcast message can reschedule the system. During holidays, school breaks, emergency closings and the six-week summer break, the portables can be quickly and remotely rescheduled to full setback 24/7, which saves about \$4,000 a day systemwide.

Another big advantage is the mobility of the system, requiring no rewiring or reprogramming when a portable is moved. Each thermostat also sends status reports back to Balon, allowing him to spot problems requiring maintenance. A broadcast test typically reveals 30 to 40 HVAC units malfunctioning at the start of each heating or cooling season.

The school district’s electricity expenses for portable

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# Heat Studied in Hawaii's Portable Classrooms

There are more than 1,700 portable classrooms in Hawaii, some dating back to the 1960s. Although some newer units are insulated and air conditioned, many share a problem with the older models: uncomfortable indoor air temperatures.

"We'd heard anecdotal evidence and news reports that the classrooms were too hot and uncomfortable," says Steve Meder, assistant professor with the University of Hawaii's (UH) School of Architecture.

To investigate these concerns, the UH School of Architecture used a State Energy Program/Rebuild America Special Projects grant to study conditions in portable classrooms used by public schools in the state.

The study focused primarily on measuring both indoor and outside temperatures using data loggers at three K-12 campuses. Light levels and air movement were recorded as well. The portable classrooms varied from wood construction to concrete, some with insulation. The data loggers measured temperatures around 100 degrees Fahrenheit near the ceiling and up to 89 at desk level in some locations. According to the study's authors, "the conditions that these students are enduring are conditions that most adults would not tolerate in their workplace."

The study's results prompted meetings with the Hawaii Department of Education, Department of Accounting and General Services and state energy office. Presentations were given at Rebuild America peer forums in Santa Monica and Phoenix.

After the initial study was completed, UH School of Architecture and its students teamed up with Hawaiian Electric Co. and the American Institute of Architects' Honolulu Chapter to develop better designs for portable classrooms. Using a grant from Group 70 International, a local architecture firm's charitable foundation, the team developed the following recommendations that should be used in concert:

- Minimize solar radiation by using double roofs, reflective roofs and paints, and reduce conductive heat gain by using insulation
- Increase natural ventilation by orienting buildings to take advantage of predictable, natural breezes
- Minimize internal heat gain by using more efficient lighting and daylighting strategies

Using window air conditioning units is discouraged because it is not a cost-effective solution in Hawaii's portable classrooms, which tend to have leaky building envelopes. The design recommendations concluded that window air conditioning units should only be used when other strategies

cannot keep temperatures in a comfortable range. If air conditioning units are installed, each should be controlled by a dedicated thermostat. Teachers and other staff should be trained to properly operate the controls to maximize efficiency.

The study also highlighted a design challenge for portable classrooms: some teachers close windows to minimize distractions, while students close them so their schoolmates will not see them taking special education courses. These preferences need to be taken into account when designing new portable classrooms.

The researchers concluded that retrofitting existing portable classrooms is not cost-effective. Instead, the design recommendations should be applied to new, replacement portable classrooms. "We're not against the idea of portable classrooms, just the thoughtless design and site orientations," explains Meder.

For more information on the Hawaii portable classrooms study, contact Steven Meder at [smeder@hawaii.edu](mailto:smeder@hawaii.edu).

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## Portable Classroom HVAC



*McChell Jackson coordinated installation work at portable classrooms.*

classrooms now are about \$2.20 a square foot per year, a big drop from the earlier \$3.40.

Teachers are allowed to override settings for two hours at a stretch, after which the temperature reverts to the programmed setting. That is an important factor for winning teacher

acceptance of new control systems. Balon adds that when teachers do override, they appear to be more likely to do so in a way that saves energy rather than wasting it, possibly because of the energy awareness and education efforts of Montgomery County Public Schools, which is a Rebuild America community partnership.

For more information, contact Karen D. Anderson, 301-279-3475, email [Karen\\_D\\_Anderson@mcpsmd.org](mailto:Karen_D_Anderson@mcpsmd.org), or Anja S. Caldwell, same phone number, email [Anja\\_S\\_Caldwell@mcpsmd.org](mailto:Anja_S_Caldwell@mcpsmd.org). Or contact Rebuild America program coordinator Charles Young, 252-459-6822, email [charlesyoung@aspensys.com](mailto:charlesyoung@aspensys.com).