



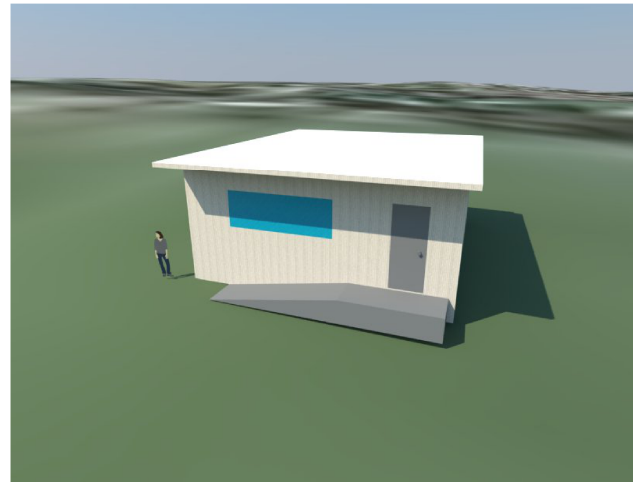
Reducing Power in Modular Classrooms (Portables)

Computer modeling matches measured savings of over 28%

Portable rooms are convenient and inexpensive. Once placed, they can be easily moved, removed or added, compared with fixed construction. They arrive nearly complete, and require only electrical and data connections to operate.

These units are typically heated and air conditioned with wall-packs manufactured by Bard Manufacturing, of Bryan, Ohio (www.bardhvac.com).

While these units, at 3 (typical) tons of effective cooling are quite fast at heating and cooling a space of 1000 square feet, the second stage in the heater element is a resistive coil heater, the most inefficient form of heating available. The first stages of the Bard wall pack are heat pumps, with a mechanical efficiency of about 3:1. This means they can supply the room with 10 kWh of heat with an electrical input of only 3.3 kWh, or less than \$0.60. When the second stage heat is invoked, there is no advantage, so the 10 kWh it puts into the room makes the meter add 10 kWh to the reading at a cost of \$1.80. This savings is multiplied by the average number of school days where heating is required, or roughly 90 out of 180 days.



Portable Classroom as modeled in Department of Energy eQuest simulation tool.

Only the Peak Demand Automation Energy Management System is currently capable of selectively eliminating the inefficient second stage heater from these systems while still leaving it available for teacher use on weekends and holidays.

In California, school is in session from late August through June. The cooling months generally are August, September, May and June, while the heating months are October, November, December, January, February, March and April. There are twice as many heating months as cooling months, so this inefficiency in heating can be reduced to substantially reduce costs during the school year. A typical portable classrooms costs \$2100 to heat and cool for a year, and this can be reduced (Northern California) to less than \$1500 with the proper controls.

An eQuest model of a typical portable classroom was built. eQuest is the industry standard energy simulation tool published by the United States Department of Energy (<http://www.doe2.com/equest/>). The model showed a 28% reduction in required energy in a typical year. Measured results of 35% are likely better due to improved behavior and lowered stratification, as the unit automatically shuts off every day, temperature distribution is improved, and holidays are accounted for by occupancy detection.

Air Quality can also be improved by decoupling the Bard fan and running it to reduce CO₂ levels whenever the room is occupied. This greatly improves the air quality for the students.