Energy Case Study: Henderson County Public Schools

Hillandale and Mills River Elementary Schools exemplify a comprehensive approach to managing energy costs.

Background

Hillandale and Mills River Elementary Schools share a common design built on two different sites in Henderson County, North Carolina. Opening in August 2009, the two schools provide learning space for up to 722 students each, with core spaces sized to accommodate as many as 800 students through future classroom additions. Designed by Moseley Architects with 32 classrooms, a gymnasium, media center, art room and cafeteria, the two schools are the first facilities in Henderson County to earn LEED and ENERGY STAR certifications.

“We have been very happy with the design and its functionality. The design is very simple but meets a lot of needs. I think it lends itself to being very cost effective.”

Todd Murphy, Mills River Principal

Energy Performance Trends

According to ratings received by the U.S. Environmental Protection Agency’s ENERGY STAR program for buildings, both Hillandale and Mills River have nationally ranked in the 90th percentile of K-12 building energy performance in each of their three years of operation. Dave Lyons, Energy Manager for Henderson County Public Schools (HCPS), indicates that “Hillandale and Mills River continue to have the best energy performance of any school in our district”—an accomplishment that is impressive considering that all 23 schools in Henderson County are now ENERGY STAR designated.

Given the differences in fuel types and utility rates that are found throughout the U.S., a measurement of energy performance known as Energy Use Intensity (EUI) is becoming commonplace. As a measure of the amount of energy consumed per square foot of building space each year (kBtu/SF/yr), EUI allows building owners to compare their facilities’ energy performance on a per square foot basis against national and regional benchmarks.

Recently created benchmarking studies by the U.S. Department of Energy (DOE) indicate that schools designed within the same climate zone (4A) and energy code requirements (ASHRAE 90.1-2004 equivalent) as Hillandale and Mills River should operate at an EUI of approximately 73.0 kBtu/SF/yr. As depicted on the following page, these two schools are consuming roughly 50-60 percent less energy than this DOE benchmark.
Henderson County Public Schools’ primary energy goal for the design of these schools was to minimize utility costs while obtaining a reasonable payback period on any investment made to achieve an improved performance. The county’s total investment in energy efficiency features for these two facilities amounted to roughly 2.4 percent of their total construction cost, representing a total of only $3.87 per square foot. Based on the savings already accumulated in the first three years of operation, it is anticipated that the payback on this investment will be realized in less than five years.

“In today’s dollars, Hillandale and Mills River are saving $60,000 to $70,000 per year in energy costs over a normal design. As energy rates continue to escalate over the life of these two buildings, these savings add up to millions of dollars.”

John Nichols, Moseley Architects’ Senior Sustainability Coordinator

Although a wide variety of HVAC, lighting, and building envelope improvements were included in the schools’ design, three main strategies played a central role in delivering energy use reductions:

1) INTEGRATED DAYLIGHTING APPROACH

As daylighting relies on a complex interaction of many different components, Moseley Architects’ designers undertook significant steps to bring these parts together in the right way. Large windows and tubular skylights are utilized to provide high quality natural daylight throughout each school, with clerestory glazing added to high volume spaces such as the dining and multi-purpose rooms. As a key component of passive solar design, exterior sunscreens were installed at each south-facing window and sized to block out the direct summer sun, while allowing in sunlight during the winter months for free heating. Interior light shelves are also present to reflect light deeper into each space.
Most importantly, perhaps, the overall orientation of each building on its site follows an east-west (E-W) axis to allow all classrooms to face north or south. Despite different site constraints at each school, both buildings were able to be oriented within 15 degrees of this ideal E-W axis.

Daylight sensors are linked to classroom lighting controls to reduce energy use through on/off switching. Through conversations between HCPS and the project’s engineering team, Optima Engineering, the school district also agreed to a 35 footcandle illumination level for classroom lighting, which provides a substantial savings in lighting energy compared to the 50 footcandles often targeted by other school districts.

It’s striking how much light comes through the schools’ Solatube skylights. The different light levels provided by their dimmer switches allows teachers a good bit of control, and I’ve seen many teachers operate their classrooms with the electric lights completely off.

David Lyons, HCPS Energy Manager

2) DEMAND-CONTROLLED VENTILATION AND DEDICATED OUTSIDE AIR SYSTEMS

To promote further reductions in energy use, Optima Engineering utilized a combination of Demand-controlled Ventilation (DCV) and Dedicated Outside Air Systems (DOAS) in conjunction with the schools’ water source heat pumps. In spaces with variable occupancy loads, such as the schools’ dining areas and gymnasiums, DCV saves energy by restricting the amount of ventilation air (and thus the need for heating and cooling) when fewer people are occupying a space.

DOAS is most effective in spaces that are either full or empty throughout the typical occupied period, such as classrooms and media centers. Total energy wheels were used in the design to capture energy from the schools’ exhaust air stream. This use of energy recovery cuts down on installed tonnage and hence the operating energy of the DOAS. Because much of the school year occurs during the “shoulder seasons” of spring and fall, the DOAS unit is often able to satisfy space conditions without energizing the heating or cooling mode of individual heat pumps.
3) ENERGY MANAGEMENT AND A CULTURE OF CONSERVATION

Extending beyond the features inherent in Hillandale and Mills River’s design, principals and staff at both schools are taking an active role in keeping their utility costs in check. HCPS Energy Manager David Lyons conducts monthly energy audits at each school in the district, which combine the utility reports for the month with the results of a walk-through to check for any items that are wasting energy.

“In many ways, the widespread participation of school staff in these efforts and the friendly competition between different schools in the district has fostered a culture of conservation at Hillandale and Mills River. Mills River’s Principal Todd Murphy concurs. “These are brand new facilities that we’re proud of and we obviously want to take care of them. We look at them as our homes. With our facilities being green schools, we work on incorporating that theme into the classroom as well.”

Denise Montgomery, Hillandale Principal