

A Sustainable and Holistic Approach to Design and Construction



Northern Guilford Middle School in Greensboro, N.C., is a two-year-old \$20.7 million facility with 1,030 students. The school is beginning to show the long-term benefits of energy efficiency with lowered electric bills and a reduction in water use. The building uses 43% less energy than a school of comparable size and saves about \$77,000 in energy costs each year. This equals big savings for Guilford County Schools.

By Leo Bobadilla

Building energy-efficient school facilities is not just about being “green.” It is about providing high-performance facilities that are safe, healthy, and conducive to learning. It is also about building facilities that are cost-effective from their inception and in the long term.

Many school districts are working under ever-tightening budgets, so reduced operating costs are welcomed. With careful planning, facilities and construction departments can build schools that encourage learning, reduce long-term operating costs, and lessen the effect on the environment while controlling up-front construction costs. The keys are including staff as active participants in the process and using a holistic approach to facility design.

Guilford County Schools in North Carolina is an example of a district that was able to build a high-performance school that continually saves money.

School districts can construct efficient buildings and lower energy expenses without greater up-front costs.

Northern Guilford Middle School is a \$20.7 million facility serving 1,030 students. At two years old, it is beginning to show the long-term benefits of energy efficiency with lower electric bills and reduced water use. The building uses 43% less energy than a school of comparable size and saves about \$77,000 in energy costs each year based on Energy Star data. This achievement equals big savings for the school district.

The building uses 43% less energy than a school of comparable size.

The school district wanted to use taxpayer dollars wisely while building a sustainable facility and creating a three-dimensional learning experience for students. During the planning and construction of Northern Guilford, the district's facilities staff worked with the architects to develop a holistic design for the school, detailing how the lighting, heating, cooling, and other systems would work together in the building. Since the design of each system would influence other decisions, the team worked to optimize the systems concurrently.

The architects designed a new daylighting system for the school to maximize the amount of natural light used in the building and to lower the energy needed to light the facility. Under the design, natural daylight is the primary lighting source in the school during two-thirds of

Northern Guilford Middle School's daylighting system maximizes the amount of natural light used in the building. It includes revolutionary curved, translucent interior light shelves. Natural daylight is the primary lighting source in the school during two-thirds of the daylight hours, which cuts the energy used by light fixtures in half. Since daylight produces less heat than fluorescent lighting, the facility can accommodate a heating and air conditioning system that is 20% smaller than is typical for a building of similar size.



the daylight hours, which cuts the energy used by lights in half. Since daylight produces less heat than fluorescent lighting, the facility could accommodate a heating and air-conditioning system that is 20% smaller than is typical for a building of similar size, therefore reducing construction costs.

While developing each of the school's systems, the team conducted extensive energy modeling to understand how the systems would work together and to balance the building's heating and cooling needs. Through this process, the expected energy use of each system could be predicted up front and could be used as the school district monitored the facility after it opened.

Ongoing Improvements

The school district's quest to develop a high-performance building did not stop when the building opened. Guilford County Schools continued to improve the efficiency of the building—and lower its bills—by carefully monitoring the facility and comparing its energy use with the predictions found through modeling. Modeling predicted that the school would use about half the energy required by a typical school of its size; however, initial monitoring after the building opened found that it was using more energy than expected. A typical school





About 75% of Northern Guilford Middle School's hot water is provided by solar power from 10 compound parabolic collector panels. The school also gathers energy for a road sign and wetland aerators from three photovoltaic solar power systems.

uses about 79,500 Btus per square foot annually based on Energy Star data, but Northern Guilford was using 85,166 Btus.

After studying the building carefully, the design team found that a natural gas leak and a malfunctioning carbon dioxide monitor were causing higher energy consumption. Through monitoring, they also determined that some of the building's controls were not working properly. By addressing these issues and continuing to monitor the facility, Northern Guilford's energy consumption is now about 45,000 Btus per square foot annually—50%–60% lower than a typical school.

In addition to the energy and money saved, Northern Guilford's design provides students with valuable learning opportunities. For example, students learn firsthand the importance of conserving natural resources by observing the school's natural water cycle. A 360,000-gallon tank collects rainwater that is first used in the school's toilets. After it is flushed, it travels to an on-site cleansing wetland and then into the school's underground irrigation system. Teachers at Northern Guilford can incorporate the water cycle and the school's system monitoring into the science curriculum. Since the sys-

tems are monitored in real time, the data are readily available for use.

Guide for Green

Guilford County Schools has made a commitment to achieving energy efficiency in its schools by developing its own outline of standards for new construction projects. The "Guilford Green Guide," the first of its type in North Carolina, includes the district's requirements for the processes and materials that builders should use in school construction. (View the guide at www.gcsnc.com/construction/pdfs/G3.pdf)

The district also developed design guidelines and educational specifications to ensure as much consistency as possible across all projects. In developing its standards, the school district looked for guidance from organizations like the U.S. Green Building Council; the American Society of Heating, Refrigerating and Air-Conditioning Engineers; the Council of Educational Facility Planners International; and the U.S. Department of Energy.

The school district also plans to make its existing facilities more energy efficient. Implementation of a districtwide energy master plan is currently under way, which includes a system to monitor energy con-

sumption at each of the district's 120 schools and to develop energy conservation measures for each facility.

Toward High-Performance Schools

School districts can construct efficient buildings and lower energy expenses without greater up-front costs. Here are some points school districts should remember as they develop plans to build high performance schools:

- Define clear goals for energy efficiency and share them with architects and design teams during the design process.
- Work with architects to design systems holistically to achieve energy efficiency and save on construction costs.
- Use modeling throughout the design process to balance heating, ventilating, and air-conditioning needs with the lighting and air distribution systems. After the building is complete, compare the modeling analysis with the actual energy consumption of the building.
- Follow through with periodic monitoring after the facility opens to detect issues that may be interfering with energy efficiency. Continue to make adjustments until peak performance is achieved.

School districts that are interested in building high-performance facilities have a number of resources available. School districts can consult the Websites of the American Society of Heating, Refrigerating and Air-Conditioning Engineers; the U.S. Green Building Council; the Council of Educational Facility Planners International; the U.S. Department of Energy; and the Association of School Business Officials International, among others.

Leo Bobadilla is chief operations officer for Guilford County Schools in North Carolina and a member of ASBO's School Facilities Management Committee. Email: bobadil@gcsnc.com