Energy-Smart Building Choices

How school administrators and board members are improving learning and saving money

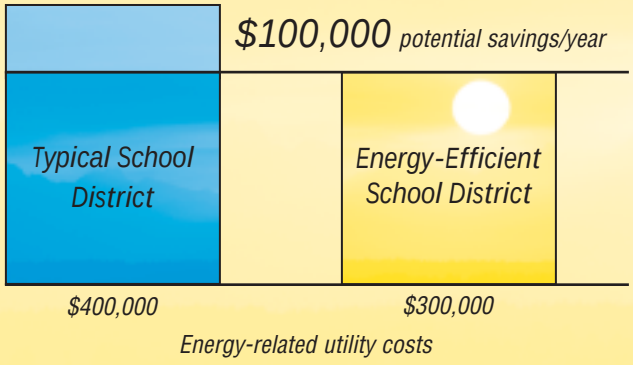
School Districts Are Challenged to Provide More with Less

Most school administrators and board members today must perform a tough juggling act. You're challenged to fulfill increasingly complex educational missions, meet rising community expectations, and serve growing student populations...all with constrained operating budgets. As districts consider renovating their facilities or building new schools, many have found that smart energy choices can have lasting benefits for their schools, their communities, and the environment.

The difference between a well-designed, energy-efficient school district and a typical school district can be seen in their utility bills. An energy-efficient district with approximately 4,000 students can save as much as $100,000 per year in energy costs. Over a 10-year period, the savings can reach $1,000,000 and, over the lifetime of the facilities, millions of dollars.

Spending less on operating costs enables school districts to redirect dollars to more critical needs. Energy savings can be used to hire additional teachers, purchase new computers and instructional materials, or pay for necessary capital improvements.

How much can you save?



A typical school district with 4,000 students pays over $400,000 for energy-related utilities each year. Incorporating energy-efficient design improvements could potentially save that district over $100,000 annually, enough to pay for three maintenance positions; replacement of gym bleachers; all roof maintenance, repair, and replacement needs over the life of the facilities; or annual requirements for instructional supplies.

Smart Energy Choices Reduce Operating Costs and Create Better Learning Environments

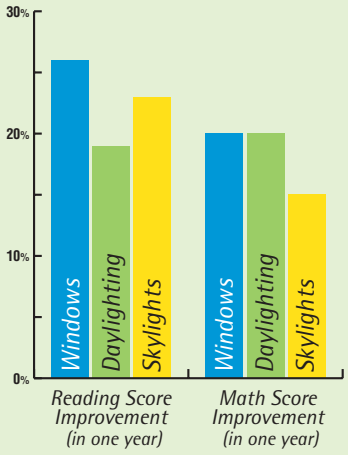
Many of the same design features that help to lower a school's energy consumption also serve to improve the learning environment. Daylighting, for example, is a common system used in energy-efficient schools to deliver natural light to classrooms. This energy feature significantly reduces electric lighting usage as well as heating and cooling loads. In addition, recent research reveals a strong correlation between the use of daylighting in classrooms and student attendance and academic performance.

A 1999 study by the energy consulting firm Heschong Mahone Group, sponsored by Pacific Gas & Electric Company, found that students in three districts with daylit classrooms scored 7 to 26 percent higher on reading and math tests than those in classrooms with minimal amounts of daylighting. Another study, by the architecture firm Innovative Design, found that students attending three daylit schools in North Carolina outperformed students in neighboring, non-daylit schools by 5 to 14 percent.

Energy improvements can also have a positive impact on student health and comfort. Children can't concentrate if their classrooms are too stuffy, or the heating and cooling systems are too noisy. Students with asthma are likely to be affected by indoor air pollution and miss school days. Efficient mechanical and ventilation systems ensure adequate fresh air in all occupied areas and minimize collection of dirt, moisture, and microbial growth.

Healthier, more comfortable classrooms have a positive impact on teachers as well as students, helping school districts recruit and retain teachers in today's competitive job market. The school's energy features themselves provide an added bonus: Teachers can incorporate these features into their curriculum to provide students with hands-on learning opportunities.

Daylighting Linked to Improved Test Scores



A recent study by Heschong Mahone Group revealed a correlation between the use of daylighting and improved student performance. In the Capistrano school district in California, students in classrooms featuring daylighting strategies, large windows, or a well-designed skylight performed 19 to 26 percent better on standardized reading tests than students in classrooms without these features. Capistrano students performed 15 to 20 percent better on standardized math tests.

Daylighting strategies and other energy-saving features have helped East Clayton Elementary School in North Carolina reduce its energy costs and earn the title "School of Distinction" for student academic performance.

Johnston County Schools Use 25 Percent Less Energy

In the 1990s, Johnston County in North Carolina built two daylit middle schools using an extensive south-facing roof monitor strategy. In their first year of operation, the schools used an average of 25 percent less energy than comparable schools in the same county and saved $.32/square foot in energy bills. Since their construction, these schools have saved Johnston County Schools in excess of $500,000 in energy bills.

A third daylit school—East Clayton Elementary School—has not only delivered energy savings, it has been singled out by the State of North Carolina as a "School of Distinction" for exceeding its academic improvement goal of 10 percent.

Clayton Middle School in Johnston County, North Carolina, uses daylighting to reduce electric lighting usage and heating and cooling loads.

Design Guidelines Help Create High-Performance School Buildings

A host of interrelated considerations—from site design to transportation issues—factor into the creation of a "high-performance" school. To effectively integrate energy-saving strategies, these options must be evaluated together from a whole-building perspective early in the design process.

To do this, your school district will likely want to form a team of key players from the community and school to work in collaboration with your design team. The design team must have expertise in integrating energy and environmental considerations into school designs. Inputs from all of these stakeholders factor into good functional design and ensure the long-term success of your decisions.

The following list provides basic information about 10 key elements to consider when designing a high-performance school building. Your school district can include these elements in your Request for Qualifications (RFQ) or Request for Proposals (RFP) for design professionals. Once a design team is selected, comprehensive design guidelines available through the U.S. Department of Energy's EnergySmart Schools campaign can provide your team with detailed information on the following strategies.

Site Design

Orienting the building to maximize solar access boosts the effectiveness of daylighting strategies, reducing the need for electrical lighting as well as heating and cooling loads. Designing the site to reduce or eliminate vehicular travel to the school helps to reduce fuel usage and emissions, improving the air quality in and around the school. Water requirements can be reduced by incorporating natural vegetation in the site design.

Daylighting and Windows

Increased use of daylighting helps to reduce electric lighting usage, and avoiding the heat generated by lighting fixtures helps schools use less conditioned air for cooling. Reductions in heating and cooling loads due to daylighting strategies often enable designers to downsize the heating, ventilation, and air conditioning (HVAC) system, reducing the initial cost of equipment. High-performance windows with low-e glazing also help to minimize heat gain in warmer months and heat loss in colder months.

Energy-Efficient Building Envelope

Increased insulation in the walls and ceiling helps to reduce heat loss and improve comfort. Light-colored exterior walls and white roofs help to reduce cooling loads. These factors also contribute to reducing the size and cost of the HVAC system needed.

Renewable Energy Systems

Use of solar electric and wind technologies in conjunction with battery storage can provide security lighting, emergency power supply, or a source of steady power for computers or other sensitive equipment. It can also contribute to reduced energy costs, depending on the size of the system installed.

Lighting and Electrical Systems

Use of controls in daylit spaces can automatically reduce or increase light levels as needed. Occupancy sensors automatically turn off lights in unoccupied spaces. These options increase construction costs slightly, but pay back that increase through energy cost savings in less than one year.

Mechanical and Ventilation Systems

Using the whole-building approach, school designers can factor in energy-saving choices that reduce heating and cooling loads, and downsize the HVAC system needed. A smaller system reduces the initial cost of equipment as well as long-term operating costs. Computerized energy analysis programs can further improve the energy efficiency of the equipment installed.

Environmentally Sensitive Building Products and Systems

Indoor air quality can be improved by eliminating or minimizing:

- Volatile organic compounds (VOCs) in paints, carpet, and adhesives
- Formaldehyde in plywood, particleboard, composite doors, and cabinets

Water Conservation

Rainwater collection systems incorporated into a school design can provide water for toilet flushing and irrigation. The increase in construction costs is offset by longer-term reductions in water costs as well as the overall cost of energy used to deliver and process water.

Recycling Systems and Waste Management

Strategies to reduce landfill waste require contractors to recycle construction waste material. This approach can reduce construction costs up to $.90 per square foot for new construction, and up to $1.20 for renovations. Later, schools can involve students in comprehensive recycling efforts.

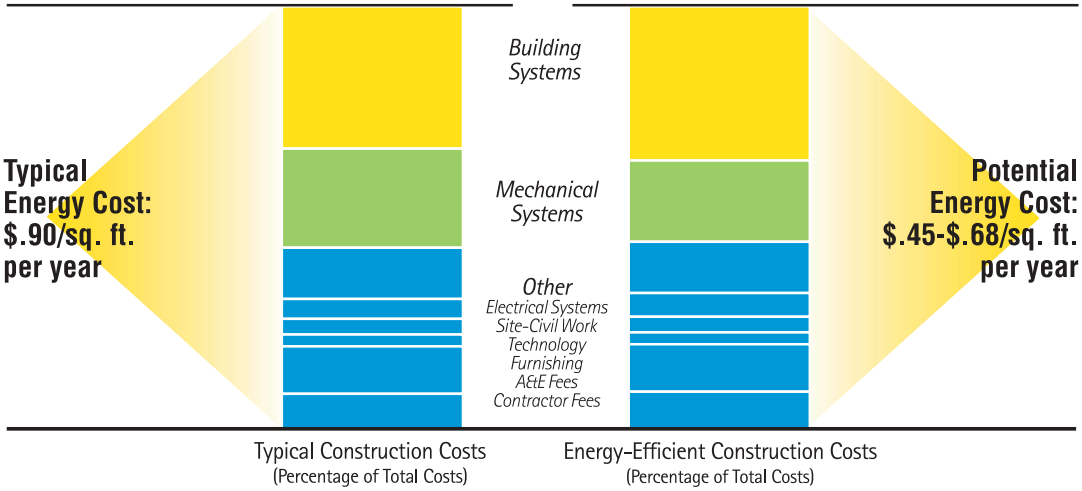
Transportation

Incorporating natural gas, biodiesel, methanol, or solar electric buses into a district's existing vehicle fleet helps to reduce fuel costs and harmful emissions. Lower fuel costs contribute to reduced operating and maintenance costs.

Photo: Southern California Edison

Students at Monterey Hills Elementary School in South Pasadena, California, are learning about solar electricity by studying the photovoltaic panels installed on their school's roof. In 1995, Southern California Edison installed a 115-kilowatt solar electric system on the school roof to defer the cost of replacing underground electricity lines in the area.

Energy-Efficient Buildings Don't Necessarily Cost More



Construction cost trade-offs often enable designers to incorporate energy-efficient features without a large increase in building costs. Incorporating daylighting features, for example, may increase the percentage of construction budget typically designated for building systems. However, the resulting load reductions enable designers to specify a smaller HVAC system, decreasing the percentage of construction costs needed for mechanical systems.

Special Financing Helps Norristown Make Energy Improvements

Norristown Area School District in Pennsylvania chose to address needed energy improvements through a competitive bid process, ultimately selecting eNERGYSolve.com (formerly SYCOM Enterprises), an energy services company. The company not only installed energy-efficient equipment throughout the district but also financed the equipment through an energy performance contract, which spared the district large up-front costs.

Energy Equity Finances School Energy Improvements

Every school district considering energy options in its capital improvement plans faces the same problem: How to balance the initial cost of energy improvements with the life-cycle cost savings? One approach gaining popularity is to consider the energy inefficiency of your school facilities as a ready source of cash. Like home equity, this "energy equity" can be used to leverage a loan or to directly finance both energy and other facility improvements.

Energy performance contracts are one way of using your energy equity to implement facility improvements. Financing options available through energy service companies enable school districts to finance energy improvements based on the resulting energy savings. School districts face no initial costs and pay for the improvements with the money they save on energy bills. Once the improvements are paid for, districts can redirect the savings to meet other needs.

Smart Energy Decisions Help Schools, Communities, and the Environment

Implementing energy-saving features in school designs is a win-win strategy that benefits not only schools but the community and the environment. When a school saves money, taxpayers benefit from dollars spent more wisely, and the community benefits from cleaner air and more efficient water use.

Schools that reduce their energy consumption help to reduce the environmental impact of power generation. They also provide an opportunity to teach the next generation of decision-makers about the importance of making energy-efficient and environmentally sound decisions for the future.

Getting Started

If incorporating smart energy choices makes sense for your school district, the EnergySmart Schools campaign can help you get started. The campaign is administered through the Rebuild America program, a national DOE initiative to improve energy use in buildings. This means that if your school is part of a Rebuild America community partnership, you're already reaping the benefits of EnergySmart Schools. In fact, community representatives in your area probably use the names interchangeably.

Rebuild America and the EnergySmart Schools campaign offer free technical help and training, as well as contacts in other communities who have already built or renovated using smart energy concepts. For more information, visit the EnergySmart Schools website at www.eren.doe.gov/energysmartschools or call DOE's energy hotline at 1-800-DOE-3732 to have a Rebuild America representative contact you.

The design for Roy Lee Walker Elementary School in McKinney, Texas, incorporates numerous energy-efficient, environmentally sound features, including rainwater collection systems and cisterns like the one shown at left. This water conservation technology reduces long-term water costs as well as the cost of energy to deliver and process water.

For helpful resources or more information:

Call DOE's energy hotline: 1-800-DOE-3732

- *Ask a question about saving energy in your school or request information about the EnergySmart Schools campaign. You may want to inquire about the availability of the following EnergySmart Schools resources.*

Publications and videotapes

- *High-Performance Design Guidelines for new schools and major renovations in seven climate zones*
- *Portable Classroom Guidelines*
- *Designing Smarter Schools, a 30-minute videotape that originally aired on the CNBC television network*
- *EnergySmart Solutions for America's Schools, a 10-minute videotape produced by the Department of Energy*
- *Educational CD-ROM featuring teaching and learning materials*

Services

- *Technical assistance*
- *Regional peer exchange forums*
- *State-based forums for school decision-makers*
- *Financing workshops*
- *Technology workshops*

Visit the EnergySmart Schools website

- *Learn more about the campaign*
- *Find practical guidance for improving energy use in schools*
- *Tap into resources for teaching and learning about energy*

You may also wish to investigate other DOE programs or campaigns of value to schools: Clean Cities, a program aimed at helping communities adopt alternatively fueled vehicles and buses; the Million Solar Roofs Initiative, which helps schools and other organizations employ solar energy technologies; and the State Energy Program, a DOE program that provides grants to schools and other organizations and is administered through state energy offices.

Also, you can find information about how to install solar energy systems on your school via the Schools Going Solar initiative, which is sponsored by DOE. Your EnergySmart Schools representative can guide you to these resources, or you can find them through the DOE energy hotline and the EnergySmart Schools website.

www.eren.doe.gov/energysmartschools

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