THE BENEFITS OF GREEN SCHOOLS: A TRIPLE BOTTOM LINE APPROACH

Each year we invest billions of dollars into building and operating our schools. In fact, schools represent the largest construction sector in the United States, $80 billion from 2006-2008. Yet the vast majority of our nation’s schools are designed to minimum standards, waste millions of dollars in energy consumption and most importantly, fail to meet our children's needs. We know, however, from examples around the country that green schools can be built at or below the cost of conventionally designed schools and that amazing things happen when schools are designed, constructed and operated with a focus on occupant health and energy efficiency.

**Characteristics of a Green School**

- Conserves energy and natural resources
- Saves taxpayer money
- Improves indoor air quality
- Removes toxic materials from places where children learn and play
- Employs daylighting strategies and improves classroom acoustics
- Employs sustainable purchasing and green cleaning practices
- Improves environmental literacy in students
- Decreases the burden on municipal water and wastewater treatment
- Encourages waste management efforts to benefit the local community and region
- Conserves fresh drinking water and helps manage stormwater runoff
- Encourages recycling
- Promotes habitat protection
- Reduces demand on local landfills

A green school creates a healthy environment that is conducive to learning while saving energy, resources and money. The benefits focus on people, prosperity and the planet.
**People: Green Schools Promote Health and Learning**

**GREEN SCHOOLS IMPROVE STUDENT HEALTH, DECREASING ABSENTEEISM**

By improving indoor air quality through the exclusion of toxic materials and improved ventilation, green schools can improve the health of students, faculty and staff and can result in decreased absenteeism. More time in school translates into increased productivity and enhanced student performance. Improved attendance is of particular importance to schools in which federal funding is tied to Average Daily Attendance (ADA) rates.

Students in America miss approximately 14 million school days per year because of asthma, according to the U.S. Centers for Disease Control and Prevention. Studies show that asthma is the leading cause of missed school days among children ages 5 to 17. Controlling exposure to indoor environmental factors, such as carbon monoxide, dust and pollen, could prevent more than 65 percent of asthma cases among elementary school-age children, reports the *American Journal of Respiratory and Critical Care Medicine*. According to a 2005 study, asthma in school-age children is estimated to have a total economic cost of nearly $2 billion ($1993.6 million or $791 per child with asthma) annually.

Key components of a green school are improved indoor air and environmental quality. When toxic chemicals — often found in paint, flooring and furniture as well as conventional cleaning, pest management and snow removal products — are eliminated, students and staff report less eye, nose and throat irritation, and asthma-related incidents decline. Doctors have found that 65 percent of asthma cases among grade school students could be prevented through strategies to improve indoor air. In 2000, a multiple building study of 39 schools in Sweden, Smedje and Norback identified a 69 percent reduction in the two-year incidence of asthma among students in schools that received a new displacement ventilation system with increased fresh air supply rates, as compared to students in schools that did not receive a new ventilation system. In 2005 Carnegie Mellon University Center for Building Performance identified 17 separate studies that found that various improvements to indoor air quality (increased outside air, individual control/task air, moisture control, pollutant source controls) resulted in reduced illness symptoms ranging from 13.5 to 87 percent improvement.

**GREEN SCHOOLS HELP IMPROVE STUDENT PERFORMANCE**

These same green building oriented improvements – ventilation, thermal control and lighting – also correlate with increased productivity, or in the case of children, better learning. An extensive amount of research shows that green school design features positively impact learning. According to educational facilities expert Dr. Glen Earthman in a 2002 study, “School building design features and components have been proven to have a measurable influence upon student learning. Among the influential features and components are those impacting temperature, lighting, acoustics and age. Researchers have found negative impact upon student performance in buildings where deficiencies in any of these features exist.” A meta-analysis examining 53 studies showed a strong correlation between daylighting and student achievement.

Good teachers are the most important factor in improving student performance, but healthy and welcoming schools contribute significantly. When working and learning in a high-performing acoustic environment, children and teachers are given the opportunity for effective communication. Optimizing classroom acoustics so children can hear is a primary foundation for learning and helps preserve teacher health — the average teacher misses two days per year due to vocal strain. A school with clean indoor air, temperature control systems that create a comfortable classroom and efficient use of daylighting offers a welcoming learning environment that lessens distractions, encourages participation and instills a sense of pride and importance in students.

---

8 Asthma’s Impact on Children and Adolescents. Atlanta: National Center for Environmental Health, Centers for Disease Control and Prevention. (No authors given.) 8 June 2005.
9 Asthma Facts and Figures. Washington: Allergy and Asthma Foundation of America.
11 American Journal of Respiratory and Critical Care Medicine
A Mayor Leading by Example: The Honorable Joseph P. Riley, Mayor

CHARLESTON, S.C.

Mayor Riley is committed to a strong educational system in Charleston and believes in green schools, noting that students should learn in an environment that is healthy, inviting and promotes sustainability. When asked why school design has changed so much over the years, Riley noted that culturally we have moved away from making our schools great civic spaces. He believes this shift has been detrimental to our children and communities. Riley thinks schools are important public buildings; they should be handsome, beautiful and inspiring. To ensure schools again take their rightful place as cultural and stirring icons, Charleston has implemented a one-cent sales tax to support green school construction.

“A school should be innovative and make a civic statement; it should be a building that makes the community proud.”

The Honorable Joseph P. Riley, Mayor, Charleston, S.C.
Hood River Middle School  
*Portland, Ore.*

A MAJOR RENOVATION OF AN EXISTING SCHOOL YIELDS A NET-ZERO ENERGY SCIENCE LAB.

**KEY PROJECT FACTS**
- **Project Size:** 6,712 square feet
- **Project Costs:** $1,573,142 (1.8M including PV array)
- **Energy Cost Savings:** $6,565/year
- **Annual Savings:** $6,842.23
- **Simple Payback Period:** 19.89 years
- **Architect:** Opsis Architecture

**Reductions:**
- **Energy:** 67% of energy used produced on-site  
  [58% reduction in energy use after renovation.]
- **Water:** 98% potable water-use reduction (136,000 gal/year)
- **Emissions:** reduction of 2,412,589 lbs annually, which equates to removing 162 cars from the road or planting 330 acres of trees.
- **Diverted Waste from Trash:** over 95%

**Background**
Hood River Middle School in Portland, Ore., was built in 1927. The school’s major renovation included the addition of a free-standing science lab. The school’s Historical Preservation Committee wanted the addition to keep in line with the architecture of the original building, but also sought to showcase the school’s commitment to sustainability. The new building is a net-zero energy facility that received LEED Platinum certification. The added costs for the energy-efficient measures were $284,640, but with total incentives of $154,000, the net added cost was $130,640.

**Green Performance Measures**
The school’s sustainability features include efficient lighting and plumbing fixtures, a storm water management system and low-water landscaping. The school also used renewable and recycled materials and enacted a robust plan to recycle construction waste. The historical building installed all new major mechanical systems, such as boilers, heating and ventilation systems and updated the lighting and plumbing systems as well.

Through its energy-efficiency efforts — such as photovoltaic panels on the roof and thermal walls — the science lab produces as much energy as it consumes (net-zero). All systems will be commissioned regularly to ensure they are working at full capacity and that the planned energy and cost savings are realized. Other green features include bicycle parking, a recycling program, a green cleaning policy and a vegetable garden.

*Photos courtesy of Opsis Architecture/Michael Mathers*
GREEN SCHOOLS SERVE AS A TEACHING TOOL

Teachers at green schools can use the building as the basis for project-based, experiential learning. Green schools provide a clear opportunity to connect students with curricula in environmental and science technology engineering and mathematics (STEM) education and can serve as a tool for interactive lessons. For example, math students can track and chart utility cost savings, science students can analyze and compare the difference between eco-friendly and traditional cleaning products. All students can learn first-hand about renewable energy and water conservation systems. These types of exercises provide students with the opportunity for hands-on learning and demonstrate the interconnectedness of the built environment and natural systems.

GREEN SCHOOLS BRING THE COMMUNITY TOGETHER

Cities and towns rely on public schools as the venues for thousands of organized community events and activities. “The nation’s schools serve as pillars of local communities and often serve a dual purpose as disaster-relief shelters,” according to the American Society of Civil Engineers 2009 Infrastructure Report Card. “As local governments hold the prime responsibility for funding schools, the economic downturn has had a negative impact on rehabilitation, modernization and security improvements.”

By inviting the community to be part of the collaborative process to green a school, and by including them in on-going sustainability initiatives, a green school can become a source of civic pride. Local horticulture experts can be invited to conduct research with biology students on native plants and how they can save water, builders and facilities managers can help students in math class track the energy savings generated from the use of solar panels and students can plan community-wide recycling programs based on the success of their own school’s efforts. Students can become green ambassadors, educating their family, friends and community about the value of going green. The school’s website can provide an opportunity to share the school’s green initiatives with the community, including tracking the school’s reduced utility costs, highlighting the pounds of trash sent to the recycling center and showcasing sustainability programs that are bringing the school and community together.

“Education and Infrastructure—Hardware and Software—the payoff lasts for generations, but our country’s investment in both is far lacking. With the greening of our schools we have an opportunity to change this.”

Mayor Patrick Henry Hays, North Little Rock, Ark.

Participants at the Greening of America’s Schools Summit at Sundance, Utah

Photo courtesy of Jack Allred
Prosperity: Green Schools Strengthen the Economy

GREEN SCHOOLS CREATE JOBS
Green schools strengthen the local economy, advance the use of new technologies and contribute to job growth. A recent study found that green building will support 7.9 million U.S. jobs and pump $554 million into the American economy over the next four years (2009-2013). In another current report, researchers at Rutgers University found that each $1 million of spending on school construction generates $467,000 in income, more than $13,000 and $16,000 in state and local tax revenue, respectively, and $611,000 in gross state product and local jobs. Over a five-year period, the state of New Jersey alone will spend $5.4 billion on school construction, which will generate almost 9,400 full-time jobs annually, $2.5 billion in income, $3.3 billion in GDP, $369 million in tax revenues, $72 million in state tax revenues and $87 million in local tax revenues.

GREEN SCHOOLS SAVE MONEY
According to Greening America's Schools: Costs and Benefits by Greg Kats, green schools use 33 percent less energy and 32 percent less water than conventionally constructed schools, significantly reducing utility costs over the average 42-year lifecycle of a school. The state of Ohio is currently investing about $4 billion in green schools, and expects to generate $1.4 billion in operational savings over the next 40 years. On average, green schools save $100,000 per year on operating costs — enough to hire at least one new teacher, buy 200 new computers or purchase 5,000 textbooks. Further, green schools have a positive net present value of more than $7/square foot from energy alone, meaning that a 50,000 square foot green school would save $350,000. And as previously mentioned, if we scaled up these solutions in America's schools over the next 10 years, we would save $20 billion.

The cost savings in green schools are generated from many sources, including energy-efficient heating and air conditioning systems and energy-efficient lighting as well as occupancy sensors, daylighting strategies, water-efficient fixtures and lower operations and maintenance expenses. The landscaping at green schools can minimize water use and decrease maintenance costs by using native, drought resistant plants, rainwater harvesting and innovative irrigation systems.

GREEN SCHOOLS INCREASE PROPERTY VALUES
According to the Turner Construction 2005 Survey of Green Buildings, 87 percent of school executives who have invested in green buildings report improved community image as one of the top benefits of green schools. Well-regarded schools increase property values, encourage business investment and job creation and serve as the cornerstone of vibrant communities.
GREEN SCHOOLS INCREASE TEACHER RETENTION

Attrition among new and experienced teachers is a common challenge for school districts. Green schools help improve teacher retention. Studies show teachers in green schools report they are more satisfied with their school environments than teachers in conventional schools, making them more likely to stay.\(^\text{18}\) They cite indoor air quality, access to daylight and outside views and better acoustics as reasons they prefer these high-performing schools. Increasing teacher retention helps to lower a school district’s personnel replacement, recruitment and training costs.

GREEN SCHOOLS DO NOT COST MORE THAN CONVENTIONAL SCHOOLS

A 2007 report, *The Cost of Green Revisited*, looked into 100 buildings achieving LEED certification. When compared to a random sample of traditionally designed buildings and controlling for time, location and cost, the study found no significant difference in average costs for green buildings as compared to non-green buildings.\(^\text{19}\)

By utilizing the integrated design process, a process that brings all stakeholders together to identify and resolve problems early in the process, green schools can be built for no additional premium. Costs to operate energy and water efficient schools are far less than conventional schools. To create green schools, a community does not have to build new schools. There are many cost-effective measures available to turn the approximately 99,000 existing public schools in the United States into green schools.


\(^{19}\) Davis Langdon. *The Cost of Green Revisited: Reexamining the Feasibility and Cost Impact of Sustainable Design in the Light of Increased Market Adoption.* July 2007
Planet: Green Schools Protect the Environment

**GREEN SCHOOLS LESSEN ENVIRONMENTAL IMPACTS AND CONSERVE RESOURCES**

Buildings are one of the heaviest consumers of natural resources, consuming more than 70 percent of electricity and contributing to nearly 40 percent of CO₂ emissions in the United States.²⁰

Along with the environmental benefits generated from reduced energy and water usage, green schools lessen environmental impacts through responsible approaches to the building site and local ecosystems. This is achieved by recycling efforts during and after construction, native and adaptive landscaping and practices that reduce the demand on municipal infrastructure. On average, green schools reduce water by 32 percent compared to conventional schools. Green schools often help improve wastewater systems. These applications are beneficial to the school and the community. As Greg Kats notes, “In Dedham, MA, the school design team, through providing rainwater storage capacity on site, saved the town the cost of enlarging an off-site stormwater retention facility. The city valued this infrastructure improvement at $400,000.” Green buildings are built with sustainably produced, recycled and recyclable materials and products. They also lessen the reliance on fossil fuels, thus decreasing carbon dioxide emissions and other forms of harmful pollution.

---

**Green Schools Cut Harmful Pollutants**

As a rough estimate, a green school could lead to the following annual emission reductions per school:

- 1,200 pounds of nitrogen oxides (NOₓ) – a principal component of smog.
- 1,300 pounds of sulfur dioxide (SO₂) – a principal cause of acid rain.
- 585,000 pounds of carbon dioxide (CO₂) – the principal greenhouse gas and the principal product of combustion.
- 150 pounds of course particulate matter (PM₁₀) – a principal cause of respiratory illness and an important contributor to smog.

---

River Crest Elementary School
Hudson, Wis.

A GREEN SCHOOL CONSTRUCTED BELOW THE COST OF A CONVENTIONAL SCHOOL.

KEY PROJECT FACTS
Project Size: 93,450 square feet
Project Cost: $15.5 million (excluding land)
Completion Date: 2008
Architect: Hoffman LLC
River Crest was built for $166 per square foot — 25% below the $233 per square-foot-average construction cost for elementary schools in the region.

Reductions:
Energy: 30%
Water: 40%
Diverted Construction Waste: 97%

Background
River Crest Elementary School is located in Hudson, one of the fastest growing counties in Wisconsin. In seeking ways to cut costs and cater to the community’s concern for the environment, the Hudson School District decided to build a green school. The school is the first elementary school in Wisconsin to receive LEED Gold certification and was completed in 2008.21 The school has state-of-the-art classrooms, media center, gym and cafeteria as well as a walking and bike trail that connects the school to the surrounding environs. The school is open to the community after hours and has become a source of civic pride for Hudson residents.

River Crest Elementary is bordered by pastoral land and the St. Croix River where geese, turkeys and deer roam freely. To protect the wildlife, the development plan emphasized land preservation, and the architects reflected the school’s surrounding environment in the building’s design, including a west-side exterior that mirrors the silhouette of the St. Croix shoreline.

Green Performance Measures
The majority of the school’s windows were placed to optimize daylight and views and to minimize glare and heat. The energy-efficient light fixtures have motion sensors, and the building is 30 percent more energy efficient than the ASHRAE requirement.

The building has a 40 percent reduction in water usage through its water conservation features, such as low-flow lavatories, dual-flush water closet levers and waterless urinals.

The majority of materials used were manufactured within 500 miles of the construction site, reducing transportation pollution and fuel cost and supporting the local economy. Over 97 percent of construction waste was recycled. The school displays information about its green features on smart boards located in each classroom that are used as teaching tools to educate students and faculty about sustainability.

A State Representative Championing Sustainability: Jules Kopel Bailey

PORTLAND, ORE.

Representative Jules Kopel Bailey was elected to the Oregon state legislature in 2008. During his time in the legislature, he has championed sustainability issues, including forming a working group on green schools. To Bailey, retrofitting schools for energy performance is one of the best ways a community can create jobs, trim budgets and support healthy learning environments for students.

Representative Bailey is currently working with his colleagues in the legislature to advance a program that would retrofit every school in Oregon to green building standards. This program will tap a new category of bonds recently approved by voters that allows state bonds to match local school-district bonds to renovate school facilities. “This is essentially an off balance sheet solution for districts that does not cost general fund dollars,” says Bailey. “A small investment by a local school district can leverage money from other sources.”

In addition to his efforts to advance green schools within Oregon, Bailey also serves on the National Advisory Council of USGBC’s 50 for 50 Green Schools Caucus initiative. In this role, Rep. Bailey helps guide a national network of leading state legislators who are working to bring the benefits of green schools to their communities. He has participated in meetings with legislators from around the country who agree that the timing is right to have a national focus on green schools. “States learn from what other states are doing. In Oregon, for example, we looked at the green schools bill that Washington State passed to guide our efforts,” he explains. Through the 50 for 50 initiative, Bailey and his colleagues are able to share best practices and draw on each other for support.

Rosa Parks Elementary School

Rosa Parks Elementary School in Portland, Ore., is located in an affordable housing development with a high proportion of its children coming from low-income families. The school earned LEED Gold certification and showcases Bailey’s belief that green schools can serve as tools to educate parents and the community on how to save on energy costs and conserve resources.


Bailey sees green schools as a learning tool for the entire community. “Sometimes you think of green schools as being something for the urban elite, but that has not been the case in Oregon.” To Bailey, building green schools in low-income neighborhoods has made a tangible difference in helping families understand the value of water and energy efficiency. Not only are students becoming advocates for sustainability, they are also helping to educate their parents about how green measures lower utility bills and conserve resources.