Sustainable Schools Create Better Learning Environments

The objective of this Sustainable Schools Guide is to provide you with information that will allow your school system to make informed decisions regarding energy and environmental issues that are important to your school, community, and country.

The concept of sustainable development reflects an understanding that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. A Sustainable School not only embraces the concept of sustainability but is, in itself, a teaching tool for sustainability.

"Good teachers never teach anything. What they do is create conditions under which learning takes place."

S.I. Hayakawa

By implementing the sustainable design practices included within these guidelines, you will be taking a significant step forward in creating the physical conditions in which the learning process can thrive.

Photo: Innovative Design

Photo: Innovative Design

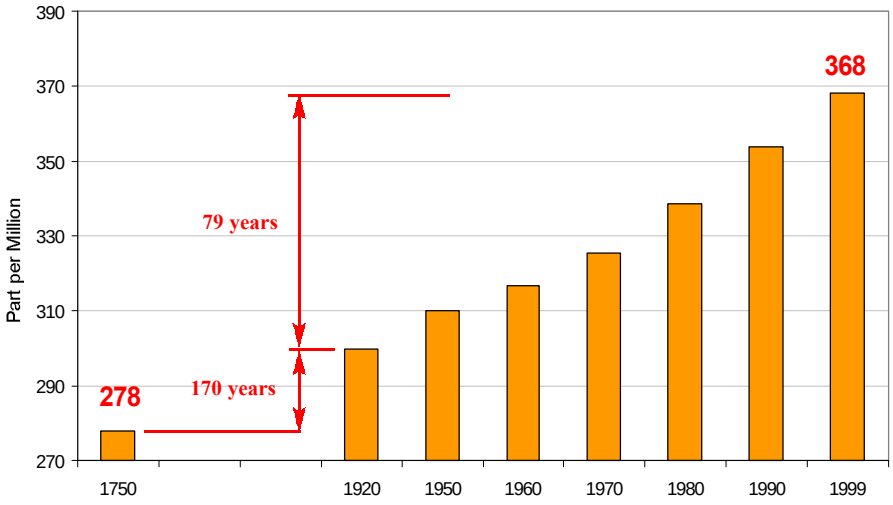
Protecting Our Environment

Supporting Your Educational Mission

We are surrounded by signs that the world is not on an environmentally sustainable path. Acid rain is killing our forests and reducing crop yields. Ozone levels, followed by asthma cases, are dramatically increasing. Enhanced nitrogen levels are choking our streams and waterways. Of the world's animal species, 11 percent of the birds, 25 percent of the mammals, and 34 percent of the fish are vulnerable or in immediate danger of extinction. And the 1990s marked the hottest decade ever recorded.

From 1750 to 1920, a period of 170 years, the level of atmospheric carbon dioxide concentration rose from 278 parts per million volume (ppmv) to 300 ppmv - an average annual increase of .13 ppmv per year. From the end of the pre-industrialization period in 1920 until 1950, the volume of CO^2 concentration started escalating upward, at a rate of .33 ppmv per year. In 1999, the carbon dioxide concentration reached 368.4 ppmv, the highest level in 420,000 years. The escalation rate has now reached an alarming 1.6 ppmv increase every year.

Atmospheric Concentration of Carbon Dioxide



Between 1950 and today, the world's population has risen from 2.5 billion to 6.1 billion and is projected to reach 8.9 billion people by 2050. As this population increases, so will our environmental problems. In the coming decade, schools face no bigger challenge than to educate the next generation about the ramifications of this unsustainable path and what is required to reverse this trend.

Information on CO_2 concentration from State of the World 2000 and Vital Signs 2000, WorldWatch Institute

Insuring Success

Photo: Roy Beaty

Kuwait oil fields

Photo: Innovative Design

Acid rain damage on Mount Mitchell, NC

✔ Make Environmentally-Friendly Design a Priority

By incorporating an environmentally-friendly carpet in your school, by choosing to implement a rainwater catchment system, or by installing a solar system, you are not only helping our environment today but educating a new generation of students about a more sustainable path.

Set clear objectives that require or at least encourage:

- renewable energy systems and energy-efficiency technologies;
- environmentally-sensitive building products and systems;
- water conserving strategies;
- less polluting transportation alternative;
- recycling systems; and
- environmentally-sound site design.

✔ Select a Qualified Design Team

Select a design team that has specific experience in designing environmentally-friendly schools. When qualifying firms, ask them to provide you with examples of their successes in green schools.

✔ Involve Students, Teachers, and Maintenance Staff

The more your students, teachers, and maintenance staff are involved in, and knowledgeable about, the sustainable features incorporated in your school the more you will benefit. By involving your students in recycling programs, monitoring the impacts of your solar system, or offering eco-educational programs associated with environmentally-friendly products, they will see first-hand practical examples of what can be done today to help our environment tomorrow.

✔ Understand the Environmental Impact of Energy

In 1992, a key message delivered from the Earth Summit in Rio de Janeiro was that if we are to effectively address environmental problems associated with sustainable development, we must address energy. It was estimated that returning to a sustainable path would require the world to collectively redirect $1.5 trillion in resources to address a wide range of environmentally-related problems. Two-thirds of these problems are directly or indirectly being caused by how we produce and use energy.

The very important energy-related recommendations associated with strategies to help protect our environment are included in the guidelines in the first document in the Sustainable Schools series entitled *Reducing Operating Cost.* Recommendations that address other key strategies to help protect our environment are included in the following guidelines.

Our Environment

The following checklist outlines key sustainable elements that should be considered by your A&E team during the design of your school.

Phot: Bill Sanders Photography

Montessori Island School, Tavernier, FL

Site Design

- consider solar access and the seasonal variations in wind speed and direction to maximize natural site conditions
- develop the site in a manner that protects the existing landscaping, ecosystems, and wildlife habitat
- incorporate environmentally-friendly design solutions
- utilize existing site contours to minimize grading and, where appropriate, create berming opportunities to earth-temper walls
- retain site features that will enhance eco-education programs
- select native trees, shrubs, and ground cover
- stockpile appropriate rock and topsoil from site development for later use as ground cover
- use organic fertilizers instead of petroleum-based products
- install photovoltaic (PV) lighting for parking areas and exterior walkways and use PV caution and crossing signal lights
- develop on-site erosion control and stormwater management strategies that:
  - work with site contours
  - minimize impervious surfaces, allowing rainwater to soak into the ground

Resources

The following funding and educational resources can help your students learn more on how they can help protect our environment.

National Wildlife Federation
www.nwf.org/atracks/resources/wmteach.cfm
Free educator workshops on wildlife habitats, wetlands, and endangered species

National Wildlife Federation www.nwf.org/campus
Campus Ecology Fellowships support campus projects

Miami University Foundation
www.muohio.edu/~kaufmadg/
Global Heritage Endowment awards grants to seniors to enable them to undertake environmental projects

National Gardening Association
www.kidsgardening.com/grants.asp
Awards grants to schools for environmental and educational initiatives

Air and Waste Management Association
www.awma.org/awma/educate/edmaterials.pdf
Provides K-12 educational materials on air and water quality, waste management, and pollution prevention

US Environmental Protection Agency www.epa.gov/kids
Great websites where kids can have fun while learning about waste, pollution, reducing, reusing, and recycling

Green Teacher, High School Ecological Footprint
www.greenteacher.com
Provides high school students a means be better understand their school's environmental impact and what they can do about it

Eco-Careers esa.sdsc.edu/highschool.htm
Provides information on careers in environmental fields

Environmentally-Sensitive Building Products and Systems

Photo: Forbo Industries

Flooring made with environmentally-friendly manufactoring process.

Photo: Forbo Industries

Flooring made with environmentally-friendly manufactoring process.

In 1996, according to the US Environmental Protection Agency the United States disposed of an estimated 95 million tons of building-related construction and demolition materials that could have been used in new construction and renovations.

consider the impacts of manufacturing processes by:

- optimizing the use of materials to avoid consuming more resources than necessary
- utilizing products made by low-polluting processes or solar energy
- using products, processes, or materials with low embodied energy
- selecting products made from raw materials without severe mining or harvesting impacts
- avoiding wood from old-growth forests unless wood is salvaged from a previous use
- specifying products and materials that are made from recycled materials
- choosing products or materials that are recyclable

prefer products and materials that:

- are locally produced or are made from readily available resources
- minimize transportation in delivery
- enhance the connection to “place” by utilizing indigenous materials

consider the impact on the building operation by:

- evaluating the environmental life-cycle impacts
- incorporating renewable energy systems
- maximizing rainwater catchment and graywater use

do not include products that pollute by:

- excluding those that emit excessive amounts of VOCs, formaldehyde, or particulates
- using the least toxic termite and insect control

minimize pollution associated with maintenance by:

- avoiding products or materials , such as toxic cleaners, which require maintenance with high environmental impact
- specifying products and materials that can be maintained in an environmentally sound way

Recycling System & Waste Management

- carefully plan recycling and waste management systems that include:
  - spaces within classrooms or classroom wings, the administrative area, and cafeteria for convenient recycling receptacles
  - separate collection bins for paper, glass, aluminum, and plastic
  - central points within building for cardboard collection
  - centralized bins that have easy access for the school's maintenance staff and the recycling company
  - a location for yard waste and composting
  - chutes to accommodate recycling in multi-story facilities

Photo: Innovative Design

Recycling center at Cary Elementary School, Cary, NC

Before

Photo: Davis, Carter, Scott

Arlington Mill School & Community Center Arlington, VA

An Arlington building that was once a supermarket has been converted to the new $1.8 million, 24,000 square foot Arlington Mill School and Community Center, consisting of a media center, two computer rooms, three multipurpose rooms and 10 classrooms. Windows were installed in the masonry portions along the front, side and rear walls to bring natural light into the building. To reduce costs, the building's original steel and wood structure was reused.

After

Photo:Estate of Doug Brown

- incorporate recycling systems to save our natural resources and save energy
- encourage recycling and proper waste management during construction by:
  - considering all recyclable job-site wastes
    - corrugated cardboard
    - metals
    - clean wood waste
    - beverage containers
    - clean fill material (concrete, brick)
    - sheet rock
  - specifying locally-collected job-site wastes to be recycled
  - requiring contractor to have a waste management plan
  - saving appropriate topsoil and rock for future ground cover
  - providing for safe use and control of hazardous waste products (e.g., oil, paint, thinner, cleaners, etc.)
  - verifying that product and material substitutions occurring during construction contain same level of recycled content
  - ensuring that contractors properly handle and store materials to minimize waste
  - requiring that packaging of products, materials, and equipment to site be made from recyclable or reusable materials and discourage unnecessary packaging

Water Conservation

- capture rainwater for toilet flushing and site irrigation, thereby reducing the impact of rainwater run-off and need for site retention ponds
- incorporate graywater systems from sinks and water fountains for site irrigation
- use water conserving fixtures
- encourage contractor to conserve water during construction by:
  - including in the specifications disincentives for excessive water use or incentives for reducing water consumption
  - specifying that the contractor is responsible for water cost during construction
- develop landscaping designs that minimize potable water use by:
  - using soaker hoses and drip irrigation techniques to minimize evaporative losses and concentrate water on plants
  - providing timers on watering systems to insure that irrigation occurs during the night
  - incorporating native and drought-resistant plants and xeriscape principles to minimize irrigation requirements

Photo: Albuquerque Public Schools

Rainwater storage tank. Inez Elementary School, Albuquerque, NM

Inez Elementary School
Albuquerque, NM

The Inez Elementary school has installed a rainwater collection system for drip irrigation. The rainwater is harvested from the roof and collected in cisterns to provide for irrigation. Planting has been located in the runoff areas. Because of the project's success, two additional schools in Albuquerque Public Schools System are now being designed with rainwater harvesting strategies.

Transportation

- design a pedestrian-friendly site that will reduce single car drop-offs
- use high-efficiency and low-emissions service vehicles
- use biodiesel and solar electric buses
- provide for easy, safe bicycle access to site and conveniently placed bike racks
- provide easy, safe access to public transit

Photo: Innovative Design

Pedestrian walkway to Roy Lee Walker School, McKinney, TX

Driving students one at a time to school each day is responsible for 0.5 to 3.3 tons of carbon dioxide per student being emitted into the air each year. Providing safe pedestrian walkways can help.

Brunswick High School

Brunswick, Maine

Case Studies

Owner:
Brunswick High School
116 Maquoit Rd
Brunswick, ME 04011
Contact:
Bruce Cook, Principal 207-798-5500
Jack Despres, Head of Science Department
Phone: 207-798-5500

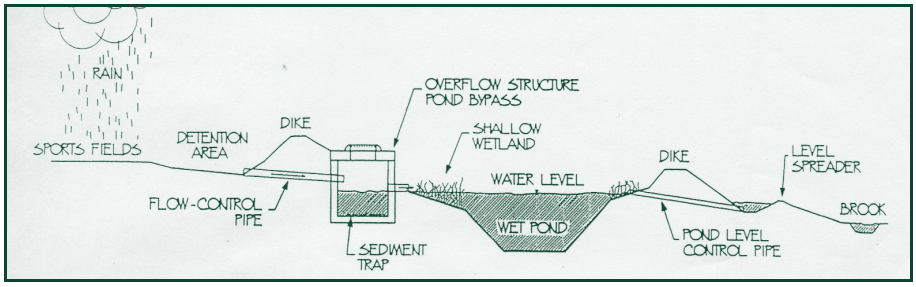
Photo: Chris Barnes

Photo: Chris Barnes

Maquoit Bay near Brunswick, Maine, supports a productive shellfish industry. When a fifty acre site a mile from the bay was selected for the town's new high school, strong concerns were voiced by the community that pollutants from storm-water runoff would migrate to the bay, destroying fish. As a result, the town enacted one of the strictest environmental ordinances in the nation to protect the bay.

The design of the new high school and grounds, completed in July 1995, employs a system of man-made ponds, wetlands, and grassed swales that collect, divert, and slow the rate of storm-water runoff. Native sandy topsoil has been replaced with silty loam to promote quality turf for the playing fields, and minimize leaching of nutrients into the ground water. A detailed site maintenance plan spells out acceptable fertilizers and usage to minimize nitrogen run off. Fifteen of the school's fifty acres have been preserved in their natural state. More than seventy five species or varieties of native trees and shrubs are marked with identification tags, giving students a distinctive place for nature studies which have been integrated into the curriculum.

The design of the school building itself minimizes energy consumption and its impact on the environment by incorporating the use of local building materials, natural daylight, energy efficient light fixtures, energy recovery equipment, and an energy usage monitoring system that is also used as a teaching tool.



Drawing: Harriman Associates

"The wetlands appear to be very natural and are full of wildlife including muskrats and migrating ducks."

Jack Despres

"We have not found any need to continue water monitoring ... We have not had any concerns about the water quality".

Herb Hopkins

"... With all of our various tests and observations we have found no dangerous readings or observed any indications of stress to the environment near the school. The retention ponds and water flow patterns around the school grounds appear to have functioned exactly as envisioned in both normal and abnormal weather events. Erosion and resulting sediments are not a problem in the slightest degree. Runoff from the parking lots and roofs is processed in the ponds which are healthy and full of wildlife."

Jack Despres

Ross School Addition

Ross, California

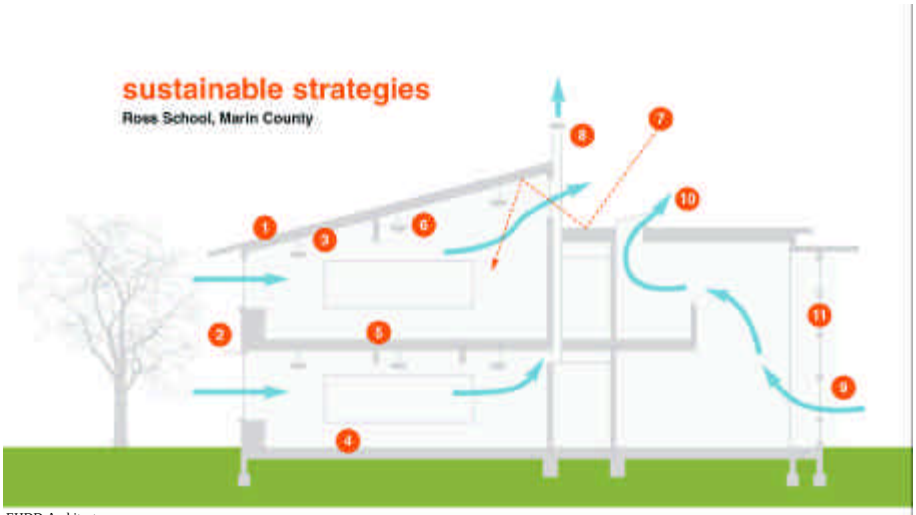
Case Studies

Owner:
Ross School
Post Office Box 1058
Ross, CA 94957
Contact:
Catherine Townsley, Superintendent
Phone: 415-457-2705

"Our kids study about the importance of the rainforests. It's important for them to know that the lumber in our school is not from the rainforests, but from sustainable sources"

Catherine Townsley, Superintendent

The new addition to the Ross School makes use of a wide range of environmentally-friendly features. Building materials and products have been carefully chosen to minimize environmental impacts and improve indoor air quality. Framing lumber and hardwood veneers are certified to be from sustainable sources. Fluorescent lamps have low mercury content. Carpeted areas have been minimized and carpets with a high recycled content have been chosen. Low-VOC paints, finishes, sealants, and adhesives have been used throughout. Salvaging and recycling of materials was a priority during demolition of an existing one-story wing to make room for the two-story addition which includes nine classrooms for grades 6 through 8. The site plan has been shaped to preserve the existing oak trees and includes a wildlife habitat garden. Stormwater is filtered across the site to reduce runoff. Some of the numerous energy saving features of the design include the use of passive cooling, radiant heating, and natural daylighting.



EHDD Architecture

Photo: EHDD Architecture

Photo: EHDD Architecture

Photo: EHDD Architecture

Santa Rita High School

Tucson, Arizona

"This project is clearly a win/win/win arrangement for Tucson United School District, Tucson Water, and the whole community. It makes me proud to live and work here."

Steve Montano, TUSD Grounds Facilities Coordinator

"This is the best our ball fields have ever looked."

John Powers, Santa Rita High School Assistant Principal

Case Studies

Owner:
Tucson Unified School District
Santa Rita High School
3951 South Pantano Road
Tucson, AZ 85730
Phone: 520-733-8000
Contact:
Doug Crocket, Natural Resources Manager
Phone: 520-617-6855

Because 100% of Tucson's potable water was from wells that were depleting the aquifer at twice the rate at which it was being replenished, the community found itself facing a big problem. To help the city as well as reduce their own costs, the Tucson Unified School District teamed with Tucson Water to develop a unique water reclamation pilot project that used waste water for irrigation.

Previously, the Tucson United School District spent $1.4 million annually on landscape irrigation.

In a pilot project, Santa Rita High School retrofitted its 18-acre irrigation system to switch from using potable water to reclaimed water that is treated to meet health standards for discharging into streams. The project cost was $150,000 and saved 18 million gallons in drinking water. The tremendous savings in unnecessary treatment costs, $30,000 annually, were passed on to the school system.

Due to the success of the project, 150 acres on 23 school sites in the school district have now been retrofitted by Tucson Water, which has implemented the changes at their cost and restructured their rates to mutually benefit both the school system and the utility.

Photo: Santa Rita High School

Samson Environmental Center Darrow School

New Lebanon, New York

Case Studies

Owner:
Samson Environmental Center
Darrow School
110 Darrow Road
New Lebanon, NY 12125
Contact:
Lisa Riker, Director
Phone: 518-794-6011
sec@darrowschool.org

Photo: Darrow School

Located on the site of the Mount Lebanon Shaker community, the Darrow School has a strong tradition of environmental stewardship. When it became clear to the headmaster Larry Van Meter that the school was due for a major investment in its wastewater infrastructure, the school went looking for solutions. The Living Machine™ was an exciting discovery, as they realized that it could take a problem and turn it into something ecologically-sound, attractive, and educational. Today, students at the small private boarding school have a unique environmental laboratory that also processes nearly all of the campus's wastewater.

The Living Machine is a garden that recycles water. It uses large tropical plants to create a refuge for the microorganisms that break down nutrients and chemicals in the water, and releases water that is treated to tertiary or, if desired, drinking-water-quality.

Since it was completed in 1999, the Living Machine has treated about 6,000 gallons per day of wastewater from four dormitories, the classroom buildings, the dining hall, and other facilities on campus. The effluent from the Living Machine is returned to the earth through a "mound system" leach field, that is much smaller and more benign than the leach field from a conventional septic system. It could also be recirculated for non-potable uses, but to date the school has not found it justifiable to do the necessary plumbing for such reuse.

The educational value to the school is significant as well. Science classes at all the grade levels from 9th grade through 12th use the facility extensively. The lower-level science classes learn to monitor water flows and analyze the results. Biology classes study the food web in the system. A stream ecology class studies the water in the system with the same tools they use to study the health of a natural stream and are surprised to find that the effluent from Living Machine is cleaner than the stream water!. An added, unexpected, benefit is the value of the system for art classes. In February, the greenhouse allows a watercolor class to paint live tropical plants.

Photo: Darrow School

Case Studies

Noblesville High School

Indiana City, Indiana

Contact:
Interface, Inc.
Corporate headquarters
2859 Paces Ferry Road / Suite 2000
Atlanta, GA 30339
Phone: 770-437-6800
www.interfaceinc.com

Many schools systems, faced with rapidly expanding construction needs and limited capital budgets, are often forced to decide between environmentally-sound green products and those with low first costs. The carpet company, Interface, has solved this problem by offering a complete line of environmentally-friendly carpet tiles that are recycled. To reduce waste and be good stewards of our environment, Interface leases and maintains their carpets, thereby better insuring that the carpet is not thrown away and maintained in an environmentally-sound way.

Photo: Interface, GA

Recycled carpet

In addition to the obvious recycling benefits, the carpet line has eliminated the outgassing problem by eliminating VOCs. The carpet helps the indoor air quality by incorporating a dust mite treatment that reduces, by ninety-five percent, the asthma inducing pests. An environmentally-sound treatment is also added to inhibit mold, mildew, bacteria, and microorganisms. To further reduce their ecological footprint on the world, they have initiated numerous efforts to improve the efficiency of their operation including the use of solar energy in their manufacturing process.

The best thing about this product is that the school is not only getting a great environmentally-sound product, but their up front costs are eliminated all together.

Roy Lee Walker Elementary School

McKinney, Texas

Owner:
McKinney ISD
#1 Duval Street
McKinney, TX 75069
Contact:
Wyndol Fry, Executive Director
Facilities and Construction
Phone: 469-742-4132

The Roy Lee Walker Elementary School in McKinney, Texas, is a shining example of sustainable school design at its best. One of the many environmentally-friendly features featured prominently at the school is the use of rainwater harvesting which saves the school over 700,000 gallons of water per year. Cisterns placed in key locations store rainwater collected from the roof and are presented to the eye as an important design element.

Photo: Innovative Design

The harvested rainwater mainly provides water for irrigation of athletic fields and a small amount feeds an eco-pond, which is an important focus of student activities and studies.

Photo: Innovative Design

For Helpful Resources and More Information

Initiatives

Alliance to Save Energy
www.ase.org/greenschools
American Electric Power's Solar Schools Project
www.aep.com/environment/solar
Energy Quest
www.energy.ca.gov/education
Energy $mart Schools
www.eren.doe.gov/energysmartschools
Maryland's Solar Schools Program Plan
www.energy.state.md.us/executiv.htm#Plan
On-Line Renewable Energy Education Module
solstice.crest.org/renewables/re-kiosk/index.shtml
Solar Energy: A Science Unit for Intermediate Grade Students
alpha.fsec.ucf.edu/ed/solar-unit
School Going Solar Program- IREC
www.schoolsgoingsolar.org
Solar Schools - Brighter Future
www.ises.org
Solar Now
www.eren.doe.gov/solarnow/solarnow.htm
SolarQuest
www.solarquest.com
Solar Schools
www.eren.doe.gov/solarschools
Training Student Organizers Program
www.cenyc.org/HTMLEE/mainee.htm
Watts on Schools
www.wattsonschools.com

Organizations

American Solar Energy Society
www.ases.org/solarguide
Center for Renewable Energy and Sustainable Technology (CREST)
solstice.crest.org
Energy Center
www.caddet-re.org
Energy Efficiency and Renewable Energy Network (DOE)
www.eren.doe.gov
Florida Solar Energy Center
www.fsec.ucf.edu
International Solar Energy Society
www.ises.org
Interstate Renewable Energy Council
www.irecusa.org
Million Solar Roofs Initiative
www.millionsolarroofs.org
National Energy Education Development (NEED)
www.need.org/need
National Network of Energy and Environmental Education Professionals
www.leeric.lsu.edu/network/network.htm
National Renewable Energy Laboratory
www.nrel.gov/ceb.html
North Carolina Solar Center
www.ncsc.ncsu.edu
Solar Energy Industries Association
www.seia.org
Solar Energy Research and Education Foundation
www.seref.org
US Department of Energy
www.doe.gov

This document was specifically developed for school board members and school system administrators and it is part four in a six part series on how implementing energy-efficient, environmentally-sound construction practices can help you in addressing your educational mission.

The Sustainable Schools Guide includes:

- Reducing Operating Costs
- Buildings that Teach Sustainability
- Improving Academic Performance
- **Protecting our Environment**
- Improving Health, Safety & Comfort
- Supporting Community Values

This document has been developed by Innovative Design with technical assistance from Padia Consulting, BuildingGreen, and the Sustainable Buildings Industry Council and has been extensively reviewed by a technical review committee with broad based expertise in education, as well as energy and environmental issues.

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