



Photo: Finelite, CA

## 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.

# Improving Health, Safety and Comfort

## Supporting Your Educational Mission

To create the best possible learning environments requires that you address health, safety, and comfort - all three are critical aspects of sustainable school design.

### Health

The healthier your students are, the better they learn. Your students will have the best chance to advance if they are in the healthiest learning environment possible. There are many design strategies that you can employ which will have a direct impact on the health of your students, teachers, and staff. Two of the most important issues, natural daylighting and indoor air quality, are described in detail in the companion guideline in the High Performance School series called *Improving Academic Performance*. A third consideration, which impacts the health of everyone in your community, relates to how your students get to school. In many schools across the country, more energy is spent transporting students to school each day than the school building consumes. Because of the petroleum-based fuels commonly used, school-related transportation is often a significant contributor to localized air pollution. Using less polluting fuels for buses and service vehicles can help. Good community planning that incorporates safe, easy pedestrian ways from surrounding residential areas to the school can help even more.

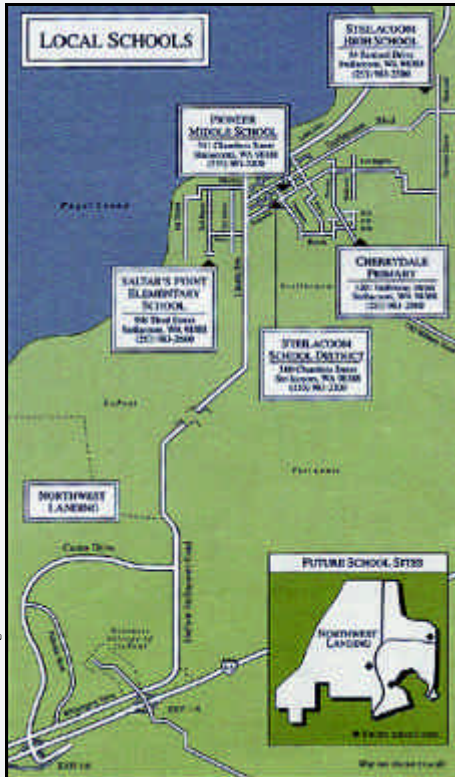
### Safety

The better your school site is linked to surrounding communities with safe walkways and bike paths, the less single car drop-offs and resulting traffic congestion will be occurring at your school. Reducing vehicular traffic substantially reduces the chance for accidents. Good sustainable school design emphasizes safe pedestrian access.

### Comfort

The educational process is strongly influenced by thermal, visual, and acoustical comfort. If classrooms are cold in the winter or if the school is located, unprotected, on a noisy street, students and teachers will certainly not perform as well. If unshaded windows are creating glare, or poor lighting results in eye strain, both students and teachers will be distracted. Across the county, millions of students face these situations every day. The following sustainable approaches will help you address these important issues.

# Insuring Success



## Chloe Clarke Elementary School DuPont, Washington

Vehicle transportation produces approximately one-third of the total carbon dioxide emissions in the United States. It is also estimated that one-third of our morning traffic and a greater percentage of the afternoon traffic is dedicated to school transportation. Because of the tremendous amount of fuel currently consumed in transporting students, and the resulting pollution, it is critical to locate schools in a manner that minimizes vehicular transportation and maximizes the potential for pedestrian access.

That was precisely the objective in locating the Chloe Clark Elementary School in the Northwest Landing Subdivision. The plan locates the school in the development's residential district, eliminating the need to transport children to another town.

Just by properly siting the school, it is estimated that air pollution is reduced by 300 tons of carbon dioxide per year, an amount equal to over one ton per student per year.

## ✓ Make Sustainable Approaches to Health, Safety, and Comfort a Priority

High Performance Schools should establish as a high priority inclusion of sustainable design strategies that positively address health, safety, and comfort issues. Establishing specific goals and clearly relaying these objectives to your design team will better insure success.

Make your expectation known regarding:

- **Health:**
  - daylighting
  - air quality
- **Safety:**
  - pedestrian access
- **Comfort:**
  - acoustical
  - thermal
  - visual

## ✓ Select a Qualified Design Team

Select a design team that has experience with sustainable approaches to addressing health, safety, and comfort issues. When qualifying firms, ask them to provide you with examples of their successes in designing green schools.

## ✓ Involve Your Maintenance Staff

A large part of the ultimate success of these sustainable features will be determined by how they are maintained. You can install the best low-VOC carpet made from recycled content, but if the cleaning products your maintenance staff uses is toxic, the benefit will be severely diminished. It is important that your maintenance staff be knowledgeable about the sustainable features incorporated in the school and implement a maintenance procedure that is consistent with your overall goals.

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



Photo: Innovative Design

Dillard Drive Middle School, Raleigh, NC

## Dillard Drive Middle School, Raleigh, NC

At Dillard Drive Middle School, the traffic noise coming from the nearby road was an issue addressed by using earth berming and planting strategies to isolate the school from the road.

## ■ Site Design

- design site to have easy, safe pedestrian access to surrounding communities and public transit
- connect the school's walkways and bike paths directly into greenways and sidewalks surrounding residential areas
- to improve safety and save energy, use remotely located photovoltaic systems for:
  - crossing and caution lights
  - lighting at walkways and parking areas
  - telephone call boxes for emergencies
- create earth berms and dense landscaping to provide sound barriers

## ■ Environmentally-Sensitive Building Products and Systems

### ▶ Walls and Ceilings

- use masonry in exterior walls to moderate temperatures and lag summertime heat gain from entering into spaces
- increase insulation in walls and ceiling to improve comfort as well as energy performance
- employ strategies to control air infiltration and moisture penetration
- incorporate radiant barriers to reduce heat gains through the ceiling
- install light colored roofing materials
- consider the color and finish of interior surfaces in controlling glare and improving visual comfort



Photo: Innovative Design

Radiant barrier in roof assembly



Photo: Innovative Design

Lightself and window treatment at Selma Middle School. NC

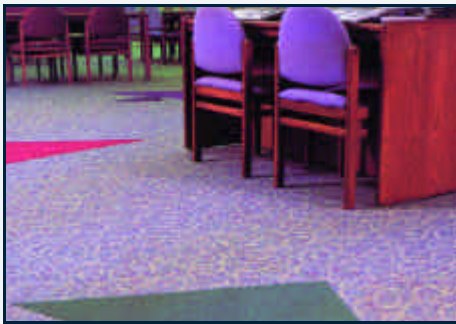


Photo: Interface, GA

Recycled carpet



Photo: Finelite, CA

Indirect lighting fixtures



Photo: Finelite, CA

Indirect lighting fixtures

## Windows

- in moderate to cold climates, incorporate double-glazed windows with thermal breaks to prevent condensation
- minimize east- and west-facing glass and tint and/or shade those which are installed
- provide proper overhangs over south windows to eliminate excessive radiation during hotter months
- provide window treatments to eliminate glare and avoid direct beam radiation from entering teaching and working areas

## Acoustical Treatment

- create sound barriers between classrooms and
  - exterior sources of noise (e.g., street, adjacent commercial or industrial operations)
  - mechanical rooms or equipment
  - noisy spaces within school (e.g., band room)
- incorporate vibration isolators to reduce equipment noise
- select interior finishes that reduce sound reverberation

## Lighting and Electrical Systems

- design lighting to uniformly light each space
- don't overlight spaces but design lighting to optimum levels
- install indirect lighting systems to reduce glare, particularly in computer areas where a low, uniform, low-glare light is desirable
- in conjunction with daylighting strategies, provide photocell controlled, continuously dimming lighting controls to improve the performance and create a smooth transition between daylight and artificial light
- incorporate fixture lenses that reduce glare
- conduct a commissioning process that verifies the proper operation of equipment and systems
- implement a regular maintenance schedule to insure proper operation

# Medford Township Schools

Medford, New Jersey

*"It's a very cheap price to pay for clean air."*

Arthur Brown, New Jersey Secretary of Agriculture

*"It will help us in the future, so we don't get polluted."*

Fifth Grader, Haines School

With the help of the New Jersey Division of Energy and a US Department of Energy grant, Medford Township Schools converted twenty-two of their school buses to a fuel consisting of 20% soy bean derived biodiesel. According to Joe Biluck, Director of Operations for the school system, their goal of reducing pollution has been achieved. Particulate emissions have been reduced by 35% to 40%. At the same time, there has been no increase in routine maintenance and it is anticipated that the life of the engine will be substantially increased.

About 66,000 gallons of biodiesel are used each year, reducing the pollution created by the equivalent of five buses or an amount equal to 694 pounds of carbon dioxide, 245 pounds of particulate matter, 868 pounds of nitrogen oxides, and 474 pounds of THC.

When the program first began several years ago diesel fuel was cheap to buy and biodiesel was about twice the initial cost. However, much has changed in the past couple of years. Today, the cost is about the same, even discounting the extended life of biodiesel engines and the positive health impact created by improved air quality.

## Case Studies

**Owner:**

Medford Township Public Schools  
128 Route 70 East, Suite One  
Medford, New Jersey 08055

**Contact:**

Joe Biluck  
Director of Operations  
Medford Township Board of Education  
Phone: 609-953-2507



Photo: Medford Township Board of Education



Photo: Medford Township Board of Education



Photo: Medford Township Board of Education

New Jersey's Alternative Fuel Vehicles Rebate Program now offers, for up to six vehicles per year, a \$6,000 grant per biodiesel vehicle.

# Deer Valley Unified School District

Phoenix, Arizona

*"Biodiesel is one of the best kept secrets in the industry. It reduces pollution from major diesel sources without expensive engine or fueling equipment conversions."*

Bill Sheaffer

Director of the Arizona Division of Southern States Power Company

**D**eer Valley Unified School has found a solution to local air quality problems. They changed their school bus fuel to a mixture of biodiesel and petroleum diesel to reduce odor and particulate matter and to lessen pollution. Biodiesel is a non-toxic, recycled, bio-based, clean burning fuel that does not require engine or fueling station conversions.

The source of the fuel is recycled vegetable oils and restaurant grease. Because this mixture burns more completely than conventional diesel, its use results in about 30% less particulate matter entering the atmosphere. This reduction can be significant considering that carbon particles from vehicle exhaust collects in the lungs, causing an irritation that increases the risk of lung ailments such as asthma, bronchitis and lung cancer.

**Contact:**

Harrison A. McCoy  
Executive Vice President  
Southern States Power Company  
830 Havens Road  
Shreveport, LA 71107  
Phone: 909-476-3575



Biodiesel school bus and demonstration car



Photo credit: Southern States Power Company, AZ

According to the American Lung Association, asthma is the leading cause of long-term illness in children and is currently responsible for 10 million missed school days each year. The incidence in children has increased by 160% over the past 15 years and now affects 5.3 million children.

# Willis Forman Elementary School

Augusta, Georgia

*"The perception of the indoor air quality has gone from very poor prior to the modifications to very acceptable. The bonus was a more energy-efficient HVAC system."*

Betty Shepherd

Providing adequate fresh air in schools is critical for the health and comfort of students and teachers. In humid climates this objective is complicated by the necessity of keeping humidity levels low. Willis Forman Elementary School's students and teachers were complaining of being too warm as well as suffering from allergies created by mold and mildew. Their air conditioning system simply could not keep humidity levels low enough.

Willis Forman Elementary's solution was to install a desiccant system that pre-conditions the outdoor air before it reaches the HVAC system. This allows plenty of fresh air to be introduced to the building but removes the humidity before it is cooled. Since the cooling coils in the HVAC system were not always on in the early mornings and afternoons when it is cooler, the humidity was increasing to 70%, creating an uncomfortable indoor climate and encouraging the growth of mold and

## Case Studies

**Owner:**

Richmond County School District

**Contact:**

Betty Shepherd, Principal  
2413 Willis Foreman Road  
Augusta, GA 30815  
Phone: 706-592-3991



mildew. With the addition of total energy recovery outdoor air pre-conditioners, they were able to increase the energy efficiency and greatly improve the comfort and health of the indoor environment.

# Mary McLeod Bethune Elementary School

Rochester, New York

**Contacts:**

Rochester City School District  
131 West Broad Street  
Rochester, NY 14614

**Contacts:**

Norma Bushorr, Principal  
Mary McLeod Bethune Elementary School  
Phone: 716-325-6945

Indirect lighting in schools can solve the problem of glare and visual discomfort for students and teachers. Lighting that is too bright or glaring on work surfaces or computers, creating high contrast between those surfaces and dark backgrounds, can give teachers and students headaches and eyestrain and can lead to absenteeism and poor performance.

The energy-efficient indirect lighting system at Mary McLeod Bethune Elementary School directs the light to the ceiling, where it is bounced into the classrooms and workspaces uniformly and without

glare. This system is controlled by occupancy sensors and can be adjusted manually. In areas that need more direct task lighting, compact fluorescent lights are used to downlight specific workstations.

Mary McLeod Bethune Elementary also capitalizes on natural daylighting. Indirect lighting works well with daylighting, matching the light quality and complementing its energy saving attributes. Use of dimmable lights ensures that a constant and high quality light level is maintained in classrooms, work areas, auditorium/cafeteria and media center.



Photo: Jim Wilkes, Photographer

# For Helpful Resources and More Information

## Initiatives

### **Alliance to Save Energy**

[www.ase.org/greenschools](http://www.ase.org/greenschools)

### **American Electric Power's Solar Schools Project**

[www.aep.com/environment/solar](http://www.aep.com/environment/solar)

### **Energy Quest**

[www.energy.ca.gov/education](http://www.energy.ca.gov/education)

### **Energy Smart Schools**

[www.eren.doe.gov/energysmartschools](http://www.eren.doe.gov/energysmartschools)

### **Maryland's Solar Schools Program Plan**

[www.energy.state.md.us/executiv.htm#Plan](http://www.energy.state.md.us/executiv.htm#Plan)

### **On-Line Renewable Energy Education Module**

[solstice.crest.org/renewables/re-kiosk/index.shtml](http://solstice.crest.org/renewables/re-kiosk/index.shtml)

### **Solar Energy: A Science Unit for Intermediate Grade Students**

[alpha.fsec.ucf.edu/ed/solar-unit](http://alpha.fsec.ucf.edu/ed/solar-unit)

### **School Going Solar Program- IREC**

[www.schoolsgoingsolar.org](http://www.schoolsgoingsolar.org)

### **Solar Schools - Brighter Future**

[www.ises.org](http://www.ises.org)

### **Solar Now**

[www.eren.doe.gov/solarnow/solarnow.htm](http://www.eren.doe.gov/solarnow/solarnow.htm)

### **SolarQuest**

[www.solarquest.com](http://www.solarquest.com)

### **Solar Schools**

[www.eren.doe.gov/solarschools](http://www.eren.doe.gov/solarschools)

### **Training Student Organizers Program**

[www.cenyc.org/HTML/EE/mainee.htm](http://www.cenyc.org/HTML/EE/mainee.htm)

### **Watts on Schools**

[www.wattsonschoools.com](http://www.wattsonschoools.com)

## Organizations

### **American Solar Energy Society**

[www.ases.org/solarguide](http://www.ases.org/solarguide)

### **Center for Renewable Energy and Sustainable Technology (CREST)**

[solstice.crest.org](http://solstice.crest.org)

### **Energy Center**

[www.caddet-re.org](http://www.caddet-re.org)

### **Energy Efficiency and Renewable Energy Network (DOE)**

[www.eren.doe.gov](http://www.eren.doe.gov)

### **Florida Solar Energy Center**

[www.fsec.ucf.edu](http://www.fsec.ucf.edu)

### **International Solar Energy Society**

[www.ises.org](http://www.ises.org)

### **Interstate Renewable Energy Council**

[www.irecusa.org](http://www.irecusa.org)

### **Million Solar Roofs Initiative**

[www.millionsolarroofs.org](http://www.millionsolarroofs.org)

### **National Energy Education Development (NEED)**

[www.need.org/need](http://www.need.org/need)

### **National Network of Energy and Environmental Education Professionals**

[www.leeric.lsu.edu/network/network.htm](http://www.leeric.lsu.edu/network/network.htm)

### **National Renewable Energy Laboratory**

[www.nrel.gov/ceb.html](http://www.nrel.gov/ceb.html)

### **North Carolina Solar Center**

[www.ncsc.ncsu.edu](http://www.ncsc.ncsu.edu)

### **Solar Energy Industries Association**

[www.seia.org](http://www.seia.org)

### **Solar Energy Research and Education Foundation**

[www.seref.org](http://www.seref.org)

### **US Department of Energy**

[www.doe.gov](http://www.doe.gov)

This document was specifically developed for school board members and school system administrators and it is part five 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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