GUIDE TO ENERGY CONSUMPTION AND RUNNING A GREEN EDUCATIONAL FACILITY

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Sustainability is a widely misunderstood and misapplied term, but it is fundamentally defined as an obligation to our future. In other words, an obligation to protect our environment so that future generations can continue to thrive on the earth. The vast majority of scientists agree that climate change is the most severe threat to sustainability and that the school campus "green" movement has found strength and impetus by focusing on measures to limit climate change.

Taken collectively, schools are major consumers of energy, paper, food, water, cleaning products, and other resources, and generate a considerable amount of waste, pollution, and greenhouse gas emissions. They also have the potential to use resources efficiently, become producers of their own power, and serve as models of environmental sustainability for their communities. This potential, combined with their ability to teach the next generation and communities of families by example, demands that schools be strategic players in the drive to transform the world's energy and resource consumption from a destructive model towards a more sustainable pattern of development.

Schools across the country are realizing the myriad benefits derived from the "greening" of their facilities. Environmental consciousness has long been found on college campuses, and that trend has increasingly become the norm — not only at colleges and universities, but K-12 facilities as well. Enlightened school administrators fully realize that building and/or retrofitting their facilities provides their faculty, the students, and the community at-large with vastly more sustainable, energy-efficient, and financially-responsible educational operations.

At sys-**tek,** our licensed professionals are experts at identifying and diagnosing operational inefficiencies at universities and other educational facilities. With 18 years' experience in Existing Building Commissioning (EBCx), we can help facilities lower energy costs by reducing energy consumption and implementing building automation systems that extend equipment life and reduce waste. Contact us today to learn more about our EBCx services.

This report will focus on the following issues:

- Green buildings and operations
- Cleaner and more efficient use of energy
- Improving transportation options
- Recycling, sustainable purchasing, and landscaping
- Financial opportunities

Green buildings and operations

Existing Building Commissioning

Existing Building Commissioning (EBCx) is a systematic process applied to existing buildings to improve overall system operations. Depending on the age of the building, EBCx will resolve problems that occurred during design or construction and address problems that have developed throughout the building's lifetime. EBCx improves building efficiency, boosting overall building performance, translating to energy savings.

Essentially, EBCx can benefit schools by:

- Lowering facilities' operating costs
- Conserving energy, water, and other resources
- Providing healthier and safer environments for all users and occupants
- Making possible money-saving incentives to further improve the facility(s)

Perhaps one of the more important aspects of greener school buildings has to do with productivity and health. There is a growing recognition of the large health and productivity costs imposed by poor indoor environmental quality. Even though the relationship between comfort/productivity and green building design/operation is complicated, there are numerous studies and articles on the subject that find significantly reduced illness symptoms, reduced absenteeism, and increased levels of perceived performance.

The following are some relevant attributes common in green buildings that promote a healthier work and learning environment:

- Much lower source emissions from measures such as better siting (e.g., avoiding locating air intakes next to outlets, such as parking garages, and avoiding recirculation), and better building material source controls.
- The use of less toxic materials, low-emitting adhesives and sealants, paints, carpets, and composite woods, and indoor chemical and pollutant source control.
- Significantly better lighting quality, including more day-lighting, better daylight harvesting and use of shading, greater occupancy control, and less glare.
- Generally improved thermal comfort and ventilation for occupants — especially in buildings that use under floor airspace for space conditioning.
- Commissioning, use of measurement and verification, and CO2 monitoring to ensure better performance of systems such as ventilation, heating and air conditioning.

The relatively poor condition and energy inefficiency of educational facilities in this country can be substantially mitigated by the application of EBCx strategies. Practical solutions provided by licensed professionals such as sys-**tek** can retrofit existing school buildings to meet the challenges of the future.

The Center for Green Schools

Launched in September of 2010, the Center for Green Schools builds upon the leadership, partnerships and programming the U.S. Green Building Council started through its Green Schools and Green Campus campaigns. The Center accelerates the transformation of schools and campuses through conversations with key decision makers, collaboration with education and environmental associations, and by offering tools and resources that help make green schools possible.

The Center for Green School's primary purpose is to assure that every student has the opportunity to attend a green school within this generation.

About 25 percent of the U.S. population goes to school every day in nearly 140,000 schools, colleges and universities. No one has ever counted the number of buildings, but thousands are barely built to code.

We know that fresh and clean air improves health, daylight boosts concentration, comfortable temperatures increase focus, and improved acoustics enable communication. By transforming the physical environment of a learning institution, we have the ability to impact how students, teachers, and communities engage in their world.

A green school also serves as an interactive teaching tool, imparting lessons of stewardship and kinship, preparing students for life beyond its walls.

Studies have shown that green schools use less water and energy and can save an average of more than $100,000 a year on operational expenses. That is enough savings to hire at least one teacher, purchase 200 computers, or buy 5,000 textbooks!

Through the Center, the U.S. Green Building Council is escalating its work with legislative, executive, and educational decision makers through:

- Green schools caucuses in the U.S. Congress
- A "50 for 50 Initiative" with state legislatures across the country
- The nationwide Mayors' Alliance for Green Schools

The Coalition for Green Schools represents more than 10 million members collectively and is composed of organizations such as the National PTA, the National School Boards
Association, the National Education Association, and the American Federation of Teachers.

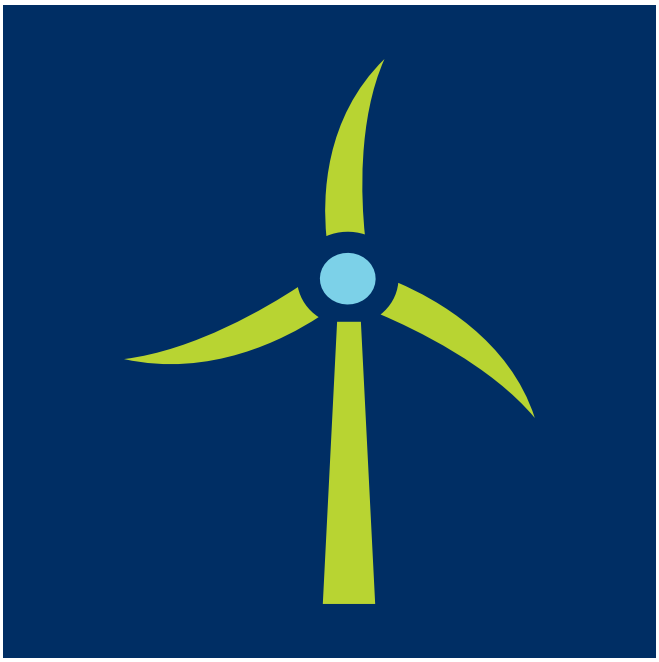
The Center is creating new resources and advocacy tools to support USGBC student groups on college campuses and a national network of more than 1,000 Green School Committee volunteers. Through it all, the center is focused on providing trainings and helpful resources to those who need it most: K-12 schools serving lower-income families, under-resourced institutions, and community colleges.

Cleaner, more efficient use of energy

Reducing overall energy consumption and switching to cleaner energy sources is a critical component of attaining sustainability on our school campuses. As energy costs continue to escalate, the push for more energy-efficient school operations has become a critical issue for education administrators everywhere.

Renewable energy

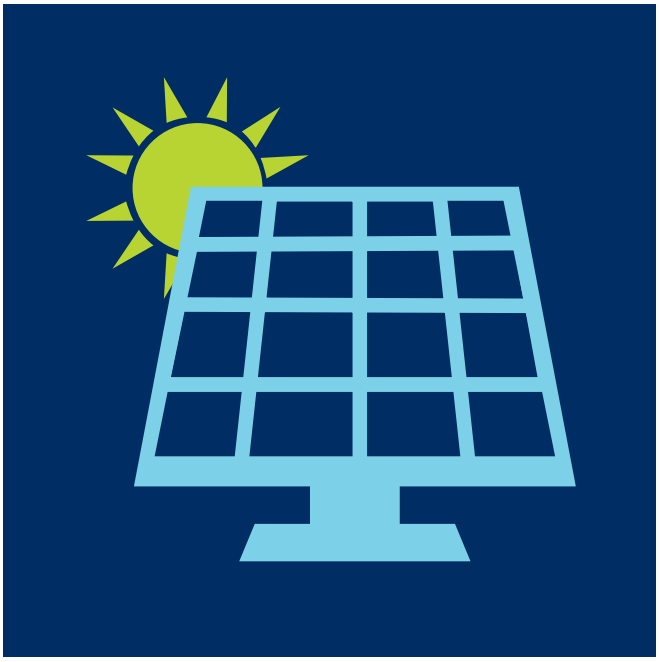
Wind



Many educational institutions across the country have invested in wind turbines either on-campus or nearby. Carleton College in Northfield, MN, was the first to erect a utility-scale 1.65 MW turbine on a college campus in 2004 and tracks day-to-day data from its turbine online. The turbine provides 40% of campus electricity and reduces carbon dioxide emissions by over 4,300 tons in addition to serving as an invaluable learning tool for students.

Whitman College in Washington State offered its farm property to be used for the installation of 65 turbines as part of a larger 300 MW wind farm project built by FPL Energy Co. The turbines generate enough electricity to cover twice the consumption of Whitman per year. Cost to the University: Zero, due to the royalties paid to Whitman for the use of their land.

Solar - Photovoltaic



Solar panels provide at least a portion of the power needs for many schools in all 50 states. Over the summer of 2012, crews at Rutgers University's Livingston Campus began transforming a 32-acre, 3,500-spot parking lot into one of the largest solar canopy arrays in the nation. The array will have a capacity of 8 megawatts, enough to power 1,000 homes. Antonio Calcado, Rutgers vice president for facilities and capital planning, expects that with the financing structure, grants and energy credits, the investment will return about $28 million to the university over the next 20 years.

"Combined with the electricity we produce, it's a winner all around," says Calcado. "We're an institution of higher learning — we teach this stuff — so we should also lead by example. It's a living laboratory in many respects."

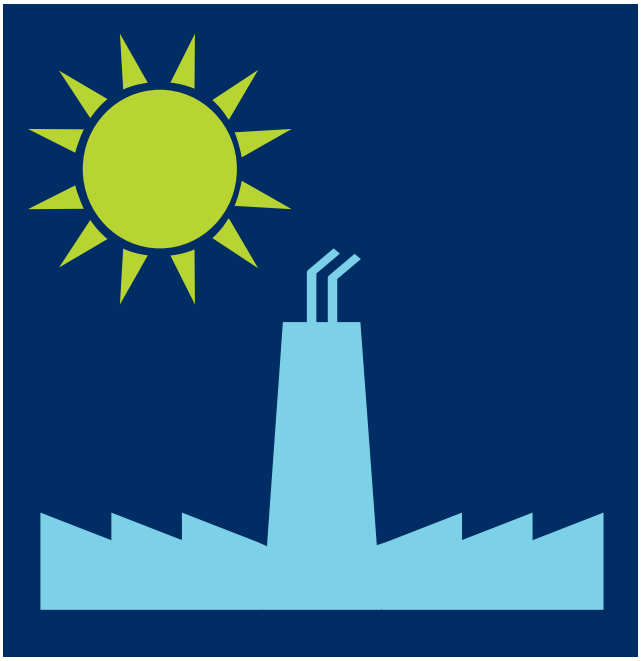
Another recent example of the use of solar energy can be seen in the Tanque Verde Unified School District in Tucson, Arizona. The District is going green on all four of its campuses with solar power installations expected to generate 2 million kilowatt-hours each year. The district expects the installations to cover 70 percent of the energy usage across the four campuses, according to district superintendent Douglas Price.

"The Tanque Verde School District will receive not only the benefits of clean electricity for 25 years but the lasting legacy of environmental consciousness fostered within its schoolrooms," said Jeff Glavan, managing director of MP2 Capital, in a release.

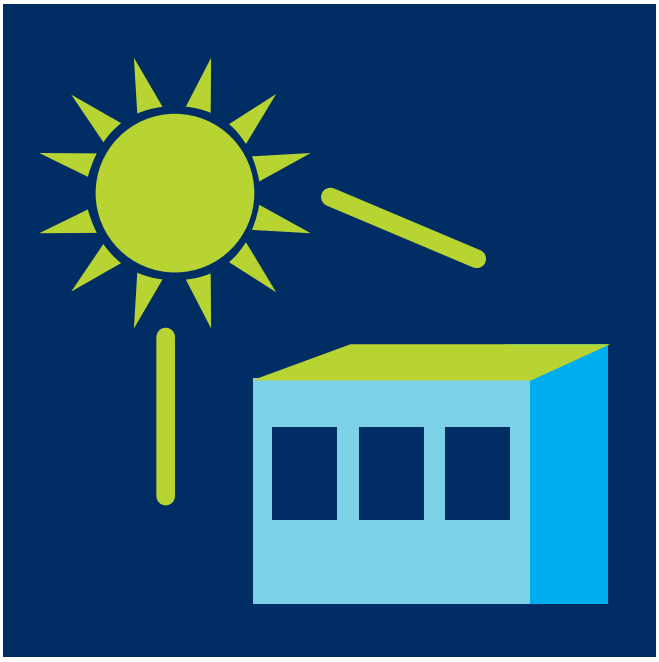
Solar - Thermal

Many universities around the country have installed different types of solar thermal projects of varying sizes that generally provide hot water for on-site residential or academic building hot water use. These projects consist of glass panels that collect the heat of the sun and transfer it to water, which is passed through panels. These systems are generally relatively inexpensive and very efficient, capturing 60% of the sun's energy.

Governors State University of Illinois has a solar thermal project mounted on the roof of its gym that preheats all of the water for its Olympic-sized pool, the hot water for the gym locker room, and hot water for many of the University's other buildings. The system consists of 64 solar thermal collectors. Heat is collected on tempered, nonreflective glass that covers collectors. Water is passed through these collectors, heated, and passed through a series of heat exchanges and storage tanks until eventually used to provide the building's hot water. The project is very efficient and self-sustaining, requires no maintenance, and heats water even on cold days. It saves the university approximately $10,000 annually. When the project was originally proposed, it had an expected 12-year payback. With rising oil prices and regional political instability, this time line is getting shorter.



Solar - Passive



The importance of passive solar energy through innovative building design and construction cannot be overemphasized. For at least the last twenty years, architects have designed school buildings to take advantage of the power of the sun to reduce the use of less efficient energy sources. Passive solar buildings combined with active solar systems are regarded as relatively economical, and have been proven to be quite effective in the reduction of energy costs and carbon emissions from fossil-fuel use.

The University of Oregon is experimenting with innovative solar awnings to cover windows on the campus Onyx Bridge – a footbridge linking two campus buildings. These panels will each be equipped with one KW of photovoltaic panels, will shade windows that get a lot of sun (and heat) and will include light-shelves at the top to provide light in the hall next to the window. As part of the experiment, temperature and electricity use of the building will be monitored and compared to previous data to test viability of awnings. If successful, it will be implemented university-wide. Total power capacity of project: 12 KW, plus power reduction amounts to be determined. Project hardware: 12 4' awnings designed by U of O architectural professor Ihab Elzeyadi and his students. Total cost of project: $50,000, university funded.

Fossil-fuel to biomass

Some campuses are saving money and reducing carbon emissions by converting fossil-fuel power plants to operate on biomass. (Biomass is organic material that is considered "CO2 neutral" because, left to rot or burn, the biomass would produce an equal amount of CO2.)

The power facility at the University of Iowa had historically operated on coal and supplied 100 percent of campus heat and 30 percent of campus electricity. The UI campus power today is primarily provided by burning oat hulls supplied by the nearby Quaker Oats Company. The University saves over half a million dollars in energy costs every year due to their switch to this relatively inexpensive, locally sourced biofuel.

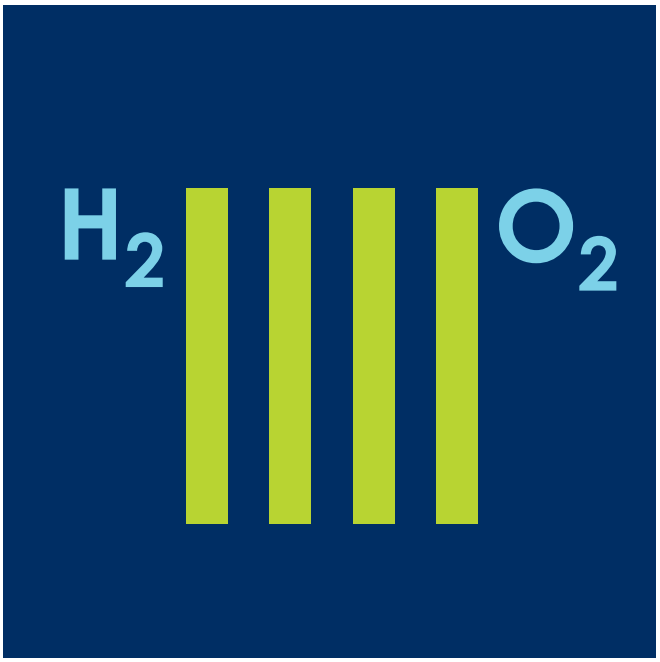
Geothermal

Geothermal power for schools may be the next big thing because it is readily available and relatively inexpensive to harness.

Numerous schools are looking into or are already developing this resource to power their operations.

Ball State University in Muncie, Indiana, is completing construction of the nation's largest geothermal system. The ground-source heat-pump system, which will provide super-efficient heating and cooling for the campus's 5.5 million square feet, involves the drilling of 3,600 boreholes, the installation of two 2,500-ton heat pump chillers and a hot water loop. The geothermal project will allow the school to transition away from four coal-fired boilers and become completely energy self-sufficient by 2014.

Fuel cells



Stationary fuel cells use a technology in which fuel and air are supplied separately to alternating layers of electrodes, producing DC electricity. There are no direct carbon emissions from these systems when powered with hydrogen, and minimal emissions when powered with natural gas. A number of universities and other institutions have installed fuel cells that run on hydrogen or natural gas to provide power for part of a campus building, and to help test the viability of the emerging technology. In general, however, the technology remains too expensive to be implemented on a wide scale, with installation costs running at ~$4,500 per kilowatt, their application has been limited and widely dependent on grant money.

In 2004, Yale installed a 250 KW fuel cell that runs on natural gas. The fuel cell is hooked up to the Environmental Science Center and supplies 40-50% of the electricity of the building. The fuel cell waste heat is captured and used to heat the building as well.

Tidal Power

While tidal power technology has not been implemented at any U.S. universities or schools, there is growing interest in the potential of tidal energy. In New York City, along the East River, six small tidal turbines have been installed as part of a state-funded demonstration called

the RITE Project. This demonstration has been used to test the technology's viability and thus far the turbines have generated ~50 MWh of electricity since their installation in 2006 and 2007. The electricity is presently used to power a supermarket and parking garage. If the experiment is successful, hopes are to install 300 turbines in the East River, with a 10 MW capacity. If made commercially viable, the projected installation cost is $2,000 per KWh.

Purchasing renewables

Often times, the on-site construction of renewable energy power sources is impractical for myriad reasons (high cost of construction, lack of available land, etc.). For hundreds, if not thousands of colleges, universities and K-12 schools, the purchase of renewables off-site is a more viable option.

The U.S. Environmental Protection Agency (EPA) initiated a Green Power Partnership to facilitate renewable energy purchases by U.S. organizations, including institutions of higher education. More than 100 colleges and universities purchase renewable energy through the Green Power Partnership. Currently, New York University (NYU) is the biggest purchaser of renewable energy among the EPA's college and university partners, with an annual wind power purchase of 118 million kilowatt-hours.

Some schools have achieved 100 percent renewable energy or electricity, albeit with smaller annual purchases.

- The College of Atlantic in Bar Harbor, Maine has committed to utilizing the wind to provide all of their power needs in the near future.
- Colby College uses Maine hydropower and biomass for 100 percent of its power needs, completely eliminating

fossil fuel energy.

- Western Washington University has committed to 100 percent of its electricity from off-site wind and solar sources, due to a student-led initiative to increase their fees.
- The University of Wisconsin campuses (four in all) became completely energy independent in 2012 utilizing renewable energy, some of which is purchased. Solar, wind, fuel cells, and biomass energy sources have reduced greenhouse gas emissions and increased energy efficiency.

Conservation & energy efficiency

Many U.S. schools have made significant strides to conserve energy and improve energy efficiency. In doing so, they save money and reduce CO2 emissions, often with minimal investment.

The ENERGY STAR program started jointly by the EPA and the U.S. Department of Energy in 1992 provides a system that identifies and labels energy-efficient products. The program has promoted the use of more energy-efficient technologies for schools and universities across the nation and has made a considerable impact on energy conservation.

Schools at all levels are reducing energy usage through campaigns to adjust thermostats, turn off lights, and generally increase awareness about energy use.

For example, the University of Wisconsin-Madison initiated a "We Conserve" campaign in 2006. Staff and students were challenged to turn off lights and computers when feasible, set thermostats sensibly, and use laboratory and other equipment wisely. The campus has reduced energy costs

by more than 20 percent since 2006 as a result of the on-going "We Conserve" program.

Improving transportation options

U.S. schools, particularly colleges and universities, are rapidly making changes in the direction of cleaner fuels, fewer cars and alternative forms of transportation.

Given the large number of vehicles that schools own and operate, cleaning up the fleets with fuel-efficient vehicles that run on lower emission fuels can contribute significantly to overall campus sustainability. An increasing number of schools use bio-diesel in their bus fleets. Electric vehicles are also being widely utilized when feasible on schools campuses for a wide variety of transportation uses.

Many schools now offer "car-sharing" programs (often electric vehicles) such as "Zipcar" and "Flexcar" that can be paid for by the hour or the day. Having convenient access to car-sharing is a viable alternative to car ownership for many students and staff, reduces pressure on parking spaces, and also reduces CO2 emissions.

Many schools are working to integrate with local mass transit, promote car-pooling, improve bicycling and pedestrian access, and provide better shuttle service.

Cornell University restructured its transportation system with the assistance of the local transportation department and avoided building a new parking garage for 2500 vehicles. Commuters who car-pool are given discounted parking passes, while parking fees were increased for those who did not participate. Cornell estimates that the savings are about $40 million over 14 years in avoided construction, maintenance, and transportation costs.

The EPA has reported that "More than 50 colleges and universities currently have Unlimited Access Programs (also called Upass) that provide fare-free transit to more than 825,000 students and staff."

Bike-sharing programs are also being used to reduce our dependence on the automobile and improve our health along the way. Duke University, among others, encourages the use of bicycles over automobiles by providing free bike repair stations, free parking passes to bike commuters, and free re-conditioned bikes around campus for anyone's use.

The University of California-Los Angeles (UCLA) provides a Vanpool Program that serves more than 1,500 faculty, staff and students with fuel-efficient vans. Like Cornell, UCLA also works closely with local mass transit authorities to facilitate free university access.

Recycling, purchasing, landscaping

U.S. schools need to have a comprehensive approach to integrating sustainable practices throughout the operation of the institution. Active programs in recycling and sustainable purchasing and landscaping will continue to advance the cause of sustainability.

Recycling

Recycling has been a mantra of our educational facilities for several decades and although success has been significant, schools can continue to advance and expand existing programs to increase overall effectiveness.

For example, public and private schools, institutions of higher education, and any other educational institutions in New York State are required by law to recycle materials collected in their local recycling program. Each municipality is required to have a recycling law or ordinance requiring source separation of recyclables. The municipalities have developed recycling programs that fit their needs and meet the goals established by the state. Each municipality has its own penalties or fines for those people who do not recycle. Recycling is one part of a total solid waste management program in NY, and waste reduction and reuse take precedence in a comprehensive solid waste management program.

According to the latest numbers, New Yorkers generate over 5.0 pounds of solid waste each day. There is a tremendous cost to both society and the environment to collect and dispose of this waste material. In addition, if we are land filling or incinerating our wastes, the resources contained in those waste materials are no longer available to us in a useful form. The advent of widespread recycling has changed the way many of us view our solid waste. Instead of a useless "waste," we have come to realize that much of what we once threw away can be used again many times over.

Purchasing

Sustainable purchasing practices for schools has come to the forefront of the conversation in the past several years. Sourcing products and materials locally makes sense on a number of levels. It sustains the local economy and reduces the costs and environmental impacts associated with long-distance transportation.

One example is the growing impetus on college campuses around the country to provide sustainable options such as "fair trade" coffee and other environmentally sensitive products to their students.

Landscaping

Sustainable school landscapes are environments that are designed to respect the local climate, provide outdoor educational opportunities, and require reduced amounts of resources, including fertilizers, pesticides and water. Sustainable landscapes begin with an appropriate design that includes functional, cost-efficient, attractive, environmentally friendly and maintainable areas.

In 2007, the U.S. Green Building Council began certifying school projects under its Leadership in Environment and Energy Design (LEED) rating system. Whether or not a project is LEED certified, important principles and design ideas can help achieve sustainability.

Installing a sustainable school landscape sets an example for students and serves as a teaching tool for the school and community. Considering the importance of teaching the next generation about sustainability, education facilities from preschool through college are among the best places to experience and learn about sustainable landscapes. They may be marginally more expensive in the beginning to install, depending on the amount of technology used and the choice of plants and other materials, but sustainable landscapes are likely to thrive and can provide a school with additional educational opportunities, while saving money and manpower by reducing water use and maintenance requirements.

Whether the landscape represents new school construction or is a renovation, consider preserving natural elements such as native trees and shrubs for shade, wind reduction, and habitat protection. Riparian areas such as stream banks can be used as teaching tools for science classes. These areas can bring nature into the school setting, introducing wildlife such as birds, butterflies, bees, and dragonflies. School and community gardens can be used to connect students with nature, help teach them about more healthful food choices, and involve the community with the school.

Preserving the site's topsoil and adding organic matter to the soil can help the landscape to thrive. Native and adapted trees, shrubs, and perennials used around the building perimeter can soften and cool the exterior of buildings.

Sustainability goals can be furthered by using local materials that do not have to be shipped great distances. Shredded wood chips from local trees can help reduce the need for watering and weeding in planting beds. Native boulders are often used for informal seating areas and provide a sense of locality. On renovated sites, existing materials such as pavers and benches can often be reused in the new landscapes.

Financial opportunities

The financial obstacles in years past that prevented U.S. schools from embracing the "greening" of their campuses have largely disappeared. Today, our educational institutions have come to realize that, while steps to improve campus sustainability require some upfront investment, often the investment pays off with significantly lower operating costs in the relatively near future.

Renewable energy is not always fully competitive, but the availability of state and federal grants, in combination with the willingness of students to sometimes pay the differential, has proven the feasibility of hundreds of successful clean energy projects in our schools.

Revolving loan funds have also proven to be a useful mechanism to create greener campuses. Grants and gifts from alumni or other benefactors can be available for startup capital. Improvements in energy efficiency can yield high rates of return to provide funding for renewable energy projects that may require a longer payback period. Energy savings can be used to finance clean energy purchases.

Many commissioning providers may claim they have the experience and skills needed for Existing Building Commissioning, but sys-**tek** has a successful track record for completing EBCx projects that result in annual energy savings of

20%. Most facilities will also see EBCx projects paying for themselves within two years from the project end date. The bottom line is that schools at all levels in the United States have realized that greener campuses serve to attract positive media attention and therefore more students and benefactors.

School administrators and politicians understand that investing in innovative energy efficient programs, informed new building designs, and thoughtful retrofits are absolutely necessary for truly sustainable educational facilities.

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Contact sys-tek today for more information on how our EBCx services can help your facility reduce energy usage and lower utility costs.

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