ZERO ENERGY SCHOOLS
Beyond Platinum
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On the Cover
Zero Energy Schools
Beyond Platinum
Courtesy of The Putney School, Putney, Vermont

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One of the fastest growing trends in school design is Net Zero Energy Schools. There are now at least a dozen or more schools completed or in construction that have achieved, or have committed to, this incredible level of energy efficiency.

By Paul C. Hutton

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As just 19 months after the start of design, Stoddert Elementary School’s modernized and expanded campus in northwest Washington, DC reopened, welcoming back the school and its community. Featuring spaces that had been missing since the school was founded in 1932, such as a gym, cafeteria, and library/media center and up-to-date building systems and technology, the campus serves 300 students as a school by day and the diverse urban neighborhood as a community center, operated by the Department of Parks & Recreation, after hours.

Designed with the District’s first ground source heat pump system, the campus achieved LEED for Schools Gold with its pervasive daylight, views to the surrounding landscape, enhanced classroom acoustics, FSC casework, recycled content in the building’s materials and low-flow water fixtures. However, the most powerful argument for developing the sustainable design features of the campus was to allow the students to really engage sustainability hands-on, learning from their new environment and interacting with the people who helped to design and build it. The school has embraced this challenge, inspiring the students to become lifelong stewards of their environment.

As a microcosm of the world, Stoddert’s approach helps the students understand that they will grow up in a world where energy issues must be approached in a cooperative, international manner in order to achieve positive outcomes. Considering that many may return abroad with this knowledge, Stoddert’s students can become global ambassadors of sustainable design and development.

As Stoddert sits just off of Washington’s Embassy Row, students and families from more than 25 nations and a major military base attend the school, contributing an important international diversity to an already diverse local population. An education unto itself, this diversity creates an opportunity to examine the major issues of the day from a global perspective.

Tailoring a signature educational program around this international perspective, Stoddert ES has begun to focus on environmental and energy issues. As a microcosm of the world, Stoddert’s approach helps the students understand that they will grow up in a world where energy issues must be approached in a cooperative, international manner in order to achieve positive outcomes. Considering that many may return abroad with this knowledge, Stoddert’s students can become global ambassadors of sustainable design and development.

INNOVATIVE EDUCATIONAL DELIVERY

An Elementary School with a Global Perspective: The Building as a Teaching Tool

By Sean O’Donnell, Marjorie Cuthbert, Abbie Cronin and Melissa Nosal Urbieta

Ambassadors of Sustainable Design

As Stoddert sits just off of Washington’s Embassy Row, students and families from more than 25 nations and a major military base attend the school, contributing an important international diversity to an already diverse local population. An education unto itself, this diversity creates an opportunity to examine the major issues of the day from a global perspective.

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Laying the Groundwork

As the combined team--school, client (DC’s Office of Public Education Facilities Modernization), and design and construction teams (“the team”) — worked through the integrated design
process underlying LEED, the team realized that not only could the campus conserve resources and enhance the learning environment, but it could also provide the opportunity to integrate architecture, engineering, and landscape with the curriculum. While the idea of using the “building as a teaching tool” had been discussed elsewhere in DC, it had not been implemented in an elementary school; no local precedents existed for an elementary school to emulate. To that end, the team developed a proposal to tailor the school’s curriculum while concurrently developing the content for the initiative.

In order to modify the approved curriculum for all district schools, an individual school must gain “autonomy” from District of Columbia Public Schools (DCPS). In Stoddert’s case, autonomy would allow the school to adapt DCPS’s elementary school curriculum to reflect this emerging environmental theme. In July 2010, after building a grade-level curriculum based on its global-environmental signature, and importantly based on the school’s record of high achievement, a school review team comprised of outside evaluators and district-level educators granted the school this autonomy.

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While this effort was underway, the team met with representatives of the United States Green Building Council (USGBC) to inform and bolster their curriculum proposal. This conversation revealed that similar efforts were underway at the Green Education Foundation (GEF), which had begun developing teaching content through standards-based lessons targeted at sustainable design.

The GEF had established lessons aligned with the McREL Compendium of Standards and Benchmarks for K-12 education. Reflecting nationwide guidelines for learning, teaching, and assessment, the McREL standards are rigorous, researched, and peer-reviewed by subject-matter organizations. These standards are also compatible with DCPS science standards — in this case, for Pre-K through fifth grade.

The team started by mapping the existing GEF lessons against the opportunities presented by the design. A table organized into five categories—energy conservation, water conservation, indoor learning environment, learning landscape, and material conservation—enabled lessons ranging from “How Loud is Too Loud” and “Air Pollution Math” to “Garden Scavenger Hunt” to be coordinated with new campus resources, ranging from the ground source heat pump (aka “geothermal”) system, the green roofs, the recycled content to the community garden, and other features of the modernized and expanded facilities and grounds.

With this encouraging start, the school planned for the integration of these lessons into the curriculum and began to develop its own lessons/units. To ensure that at least 10 hours of green building-relevant instruction per student per year would be implemented, the school began to deliver a minimum of 2.5 hours instruction in each of its four advisory periods.

These lessons are punctuated by guest/expert presentations, which include key members of the design team (the architects, the mechanical engineers, and the acoustician) to continue to advance understanding about the renewed Stoddert campus and its green aspects.

The school proposed to evaluate learning from the lessons/unit age-appropriately, with products as possible outcomes, as well as pre- / post-measures where appropriate. What’s more, the school and the Green Education Foundation began developing new prototypical elementary school lessons/units on the building as a teaching tool that will be available on GEF’s website. Stoddert’s K-2 teachers will be the first to begin piloting the new GEF units in the last advisory period of this year as shown in the table.

The new prototypical units each establish goals, identify relevant stan-

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standards, define what students will come to understand, and what they will be able to do after the lesson. They define how teachers should assess student understanding and provide ideas and advice for teachers to implement the unit.

The First Three Advisories

After the school reopened in August 2010, the first advisory was underway, featuring Pre-K students building birdhouses from recycled wood, identifying trees on campus, and discussing how trees change in the fall and 5th grade students guiding tours of the building for their Pre-K “buddies,” beginning their role as the ambassadors of sustainable design.

In the second and third advisories this year alone, students and teachers have been involved in a variety of activities relating to the campus’ sustainable features, including: touring the campus with the Casey Foundation to learn about the trees; studying conservation methods of paper, water, and electricity; learning about site from the civil engineer and the ground source heat pumps from the geothermal contractor; planning the community garden with a coordinator, and discussing the design of their indoor and outdoor learning environments with an acoustician and a natural playground designer; and more.

Stoddert takes this learning outside of the classroom, importantly rooting these lessons and ideas in application and practice. For instance, following the school’s conversation with the garden coordinator, this spring a new community garden was planted adjacent to the new amphitheater. Seeds germinated in the classrooms are being transplanted into the garden and a greenhouse made out of 1,400 recycled soda bottles created by the first grade with volunteers from the design and construction team. With an active community surrounding the campus, the garden will become a primary opportunity for the school to engage the larger community in hands-on learning about the environment.

Empowering the Students

Little illustrates the students’ engagement with energy issues better than the student-led “Energy Patrol.” Active at the school even prior to the modernization, the spirit of the Energy Patrol was so pervasive that teachers shared anecdotes with the design team about returning from a quick break between classes to classrooms with the lights turned off and computers shut down. The modernization has afforded the Energy Patrol with numerous new opportunities to further display their enthusiasm for “green” learning. The GreenTouch Screen is a notable exam-
Linking Curriculum and Learning to Facilities: Arizona State University’s GK-12 Sustainable Schools Program

By Monica M. Elser, Lynette Pollari, Erin Frisk and Mark Wood

“Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

*World Commission on Environment and Development*

“It is widely agreed that education is the most effective means that society possesses for confronting the challenges of the future. Indeed, education will shape the world of tomorrow.”

*UNESCO*

Arizona State University’s *Sustainability Science for Sustainable Schools program* brings together graduate students, sustainability researchers, high school teachers and students, and school or district administrators in a project designed to address the challenge of becoming a “sustainable school.” Funded by the National Science Foundation and based on the ASU’s commitment to engage with and support its community, this program was designed to incorporate the research and teaching that is being developed in the Global Institute of Sustainability into the K-12 setting.

Our central goal is to equip graduate fellows with the skills to bring their sustainability-science research into K-12 settings. Graduate fellows are supported in this endeavor by two teams of ASU specialists and researchers: one focused on sustainability concepts and indicators, the other on curriculum and instruction (see Figure 1). Thus, the core of our program centers on enhancing the professional development of graduate students while supporting schools and districts in establishing sustainability projects and practices. This is expected to translate as a benefit not only to the K-12 schools and its members, but also to the community at large.

Our graduate fellows are currently working with six partner schools within the Metro-Phoenix area on a range of sustainability initiatives that includes:

![Conceptual Overview of the Project](image-url)
Supporting school administrators, teachers, and students in the development of site-specific sustainability projects and practices (for example: school gardens, sustainability competitions, science clubs, recycling and water-saving campaigns, etc.);

Developing and teaching introductory sustainability lessons (for K-12 students, teachers, and/or staff); and

Creating a set of focused sustainability science lessons that address the diverse “systems” that jointly constitute a school (Energy, Water, Food, Health and Well-Being, Waste, Outdoor Space and Landscape, and Supply Chain and Procurement).

While having particular components and implications, these systems interact with each other. This leads to the need for crossing disciplinary boundaries and for co-creating knowledge with diverse stakeholders — including students, teachers, administrators, scientists, policy makers and the community at large. In consequence, our sustainability science initiatives focus on this need and strive to engage K-12 students, teachers, administrators, and staff as active partners for sustainable development.

Our central goal is to equip graduate fellows with the skills to bring their sustainability-science research into K-12 settings.

Guiding Principles

As an emergent field of academic research, what has been called sustainability science is a discipline “defined by the problems it addresses rather than by the disciplines it employs” (Clark, 2007). Its objectives, broadly stated, are to harness scientific knowledge to support a transition towards a more sustainable future, to create solutions to environmental, economic, and social problems, and to facilitate the interaction and collaboration between diverse and relevant actors.

For Arizona State University’s GK-12 program, sustainability science is the driver behind each of our efforts. It is the source from which we have derived five guiding principles that - in our perspective - should guide students, teachers, administrators, and staff in a sustainable school. These principles are:

1. **Interconnectedness (Systems Thinking):** View the world as interconnected and human systems as a component of and dependent on ecological systems;

2. **Multiple Perspectives in Decision Making:** Acknowledge trade-offs, incorporate multiple perspectives, and strive to build consensus;

3. **Problem Solving for Well-Being:** Engage in problem-solving that improves student, school, community, and global well-being;

4. **Change Agents:** Assume an active role as promoters and executors of sustainability solutions;

5. **Future Thinking:** Understand that human action must look forward and consider the impact of our present actions on future generations.

**Sustainable Schools Framework (Curriculum – Campus – Community)**

Based on this set of principles from sustainability science, the Sustainable Schools program adapted diverse frameworks and ideas to establish a conceptual approach for intervention in K-12 schools. This resulted in a framework that explores and describes the necessary linkages that must exist between curriculum, campus and community if a successful K-12 sustainability effort is to be achieved.

As shown in Figure 2, the philosophical foundation for this framework is the “Three Pillar” concept which is at the core of any understanding of sustainability and sustainability science. Indeed, as stated by ASU’s Global Institute of Sustainability, “a sustainable society considers the interconnectedness of the environmental, economic, and social systems” in order to reconcile the planet’s environmental needs with development needs over the long term. The pursuit of this challenging balance is, then, the central focus of all sustainability efforts.

On this foundation, it is our program’s conviction that K-12 sustainability education should integrate efforts at three distinct yet interrelated levels:

1. **Curriculum:** Focus on teaching and learning. Areas of action are classroom activities, teacher/student interaction, content and class programming, professional development and training, etc.

2. **Campus:** Focus on school and school district operation, including institutional values and philosophy. Areas of action include staff and administration practices, physical facilities, school grounds and open space, system management (energy, water, waste, etc.), operation and maintenance, district-level decisions that affect a school, etc.

3. **Community:** Focus on a school’s wider influence and partnerships.
Areas of action include parent participation and influence, support from and collaboration with the business community, interaction with government and non-profits or NGOs, mutual relations with neighboring communities, etc.

In addition to the three pillars and these three “Cs,” our program is also committed to designing activities and projects that promote sustainability while acknowledging the learning process of an individual. Thus, different activities are designed to address three necessary stages in the process by which a member of a learning community may become a sustainability change agent: (1) **Engagement:** Presenting a learner with activities and tools related to academic study, analysis, and understanding of the need for sustainability and of its most important concepts; (2) **Enablement:** Providing a learner with the values, attitudes and practical capacities that are necessary to plan and implement sustainability solutions; and (3) **Enactment:** Allowing a learner to participate in project and system design and implementation, thus participating in an active manner in problem-solving for sustainability (these concepts were adopted from Sipos et al, 2008).

**Sustainable Schools Outreach**

Outreach to schools outside our six current academic partners and to the wider community is also an important function of the Sustainability Science for Sustainable Schools program. Our Outreach involves a wide variety of activities and interaction with a broad range of players within our educational community at different levels (K-12 to Higher Education) as well as with community groups, private groups and the general public. Our Outreach activities have included, among many others:

- Visiting schools to make presentations and conduct lessons or activities
- Participating in public events (for example, sustainability-themed fairs)
- Developing and presenting teacher workshops
- Presenting at education, sustainability, and other conferences
- Preparing and conducting sustainability summer camps for students
- Supporting and judging science fairs and competitions
- Supporting ASU’s collaborators and partners
- Supporting other institutions and organizations in research projects
- Providing a bridge between schools and specialists or researchers at ASU
CEFPI and the Sustainable Schools program

As part of a recent effort to find areas of collaboration between CEFPI and our program, we were invited to participate in the recent Symposium “Moving Sustainability Forward.” Two of the graduate fellows of our Sustainability Science for Sustainable Schools program presented a summary of the operation and activities that have been developed in our program’s first two years of activities. Our objectives in the session were to provide a vision, based on our experience, of the broad possibilities to link curriculum and learning to education facilities.

While presenting and explaining our experience with some of the most relevant activities and projects that have been developed by the GK-12 program (some of them described above), our objectives in this session were four:

- Understand sustainability education as applied within a K-12 context.
- Understand the linkages between curriculum, campus and community that are required for a successful K-12 Sustainability program.
- Illustrate the range of interdisciplinary sustainability projects that can become the platforms for linking “learning” with “facilities.”
- Reflect on the important role that school facilities play as “learning environments” to support sustainability education through built form, operations and maintenance.

Focusing on this final objective and as a closing for our intervention in this event, our graduate fellows invited attendees to reflect on the role that CEFPI can continue to play in educating our youth for a more sustainable future. This reflection should include at least three elements:

- How might CEFPI and its members enhance their contribution to creating school facilities as “learning environments” for sustainability?
- How might interdisciplinary collaboration (between facility planners and educators, between academia and practice, between science, policy and community) be enhanced?
- How might this collaboration contribute to the creation places and spaces which – through built form, operations and maintenance – help prepare students for a future that is more sustainable?

With these open questions in mind, we invite you to continue your efforts in creating high performing educational settings and to share our passion for incorporating sustainabilty science across the curriculum in every campus, and among all members of a school’s extended community.

Monica M. Else and Lynette Pollari – GK-12 Program Leaders

Erin Frisk and Mark W. Wood – Third Year PhD Students, ASU School of Sustainability

References


For more information on our program, please refer to:

Global Institute of Sustainability at Arizona State University website = http://sustainability.asu.edu

Sustainability Science for Sustainable Schools program website = http://sustainableschools.asu.edu/
Integrating Sustainability as a Learning Tool

By Steven M. Shiver and John R. Dale

With more than a decade of LEED, CHPS and similar green school initiatives, we really have made an impact on the educational environments we design and, more importantly, on the students and teachers that use these buildings every day. Yet, so many LEED and CHPS certified schools don’t live up to expectations with respect to their impact on the environment and energy use. Walk into many daylit schools and you will find the blinds closed and lights on. It’s no wonder they are not achieving the predicted energy savings.

In addition to incorporating sustainable design into virtually every school project that we work on, we must educate building users on the benefits and opportunities presented through truly integrated design. We have found that, when the opportunity is presented, students do care about how their buildings are designed and operated. They want to learn about building systems, energy use and how they can develop programs that will not only benefit themselves, but the community at large.

To that end, many design firms and school districts have begun to implement policies that are designed to educate end users on the benefits of green design. We have named this “End User Commissioning.” As we develop a design, we look for opportunities to communicate the intent of each building component, from rain water harvesting to integrated daylighting to displacement ventilation, and how each benefits the buildings inhabitants as well as the environment as a whole.

Implementation of user interfaces designed to explain sustainable practices and provide opportunities for integration into curriculum include the new Renton Secondary Learning Center near Seattle, Washington and the Mothers’ Club Family Learning Center in Pasadena, California.

The Renton Secondary Learning Center (RSLC) builds upon a “Continuum of Services” to expand offerings and opportunities for students in alternative educational programs that are currently housed in separate and deteriorating buildings. Designed to support a variety of learning modalities, RSLC is a highly flexible and environmentally sensitive educational facility that will serve as a teaching tool about environmental responsibility for students, faculty and the community at large - providing an integrated, project-based learning environment in which staff will be working as a team to identify each student’s unique needs and students will be empowered to grow and mature.

Because the school district had a goal of creating a physical plant repre-
sentative of what a 21st century school could be, the RSLC incorporates an impressive variety of environmentally sensitive strategies that enhance energy performance, as well as serve as teaching tools. Roof runoff is channeled to a cistern, where water is harvested and stored for reuse in toilet fixtures. When the cistern is full, overflow is channeled to a waterfall that provides water for plantings on the site. A ground source heat exchange system (made up of 140, 200-foot deep wells), a displacement ventilation system and radiant heating for large volume spaces provide a combination of indoor air comfort and quality. A five-kilowatt demonstration photovoltaic cell array provides further educational and energy performance opportunities.

Building performance is monitored throughout and communicated to individual learning areas and to the building at large through a system of accent lighting built into walls and ceilings. Light displays cycle from red to yellow to green to blue as power utilization changes, providing a visual indication to staff and students in each learning center of how well they are utilizing power as they open blinds, turn lights off and open windows. Lighting displays situated along the central spine and exterior are visible to occupants and from the building exterior, reflecting how well the entire building is performing. Thus occupants are able to continually monitor how various environmental conditions, as well as their own actions, affect energy performance.

Signage throughout the building communicates sustainable features and opportunities to incorporate those features in the curriculum of the school. Energy saving strategies, including the photovoltaic panel array, provide opportunities to learn about electricity, power systems and other alternative types of power generation. Solar hot water heating gives students the ability to learn how climate and other local natural attributes affect system performance. Students can trace overall building power usage and the effects of daylighting on overall energy efficiency.

Relative to indoor air quality and comfort strategies, signage documents the ground source heat pump, displacement ventilation, radiant floors and hybrid natural ventilation systems. Student learning opportunities could include exposure to the concepts of heating and cooling (both natural and induced) as well as heating and cooling systems including heat transfer, concepts in the movements of gases and air via natural convection and building systems and configurations designed to support natural convection.

Rainwater harvesting, pervious paving and rain gardens gives students an opportunity to study community water needs, storm water systems, drainage and water utility systems. Curriculum or student-led studies can be designed to address seasonal impacts on recycled water availability and monitor building water usage, comparing it to other schools in the district. View a presentation on this project, along with an environmentally friendly elementary school, at http://prezi.com/56fshjqpu07b/real-solutions-for-integrating-sustainability-as-a-learning-tool/.

At the Mother’s Club Family Learning Center in northeast Pasadena, California, the mission is to help prepare families living in isolation and poverty to succeed in school and in life through two-generation learning. This unique approach engages both mother and child in early education programs, parenting and other adult literacy education. To provide a high-quality learning environment that would support these goals the organization made the decision to relocate from its former residence of 40-plus years (borrowed space in a nearby church facility) to a new “green” building that was designed to meet LEED Gold certification. It is the first preschool nationwide to register for certification at the Gold Level.

An existing 10,000 square foot factory building was completely gutted and renovated. The south wall was punctured, opening the building up to the exterior to create flow between the indoor and outdoor play areas. Emphasis was placed on trying to incorporate as much natural light and natural elements into the design to keep the space open and welcoming. Included in the comprehensive redevelopment of the site was the transformation of half of the asphalt parking lot into a safe and colorful play area.

Renton Shared Learning: In the shared learning space LED accent lighting changes color based on the total energy used in the school. Separate accent lighting at classroom entries change color based on energy used in each building zone.
The front of the building is a sun-filled entry way and office space for the Center’s employees, a small library, resting room and large adult classroom that has movable partitions. The design kept the existing, load-bearing, exposed, brick wall in the front room, which gives the entry a warm, inviting feeling. Two kitchens in the center of the building serve adult activities and provide a place to prepare snacks for the children. The main kitchen is spacious and comfortable - the true “heart” of the building - and plays a central role in the adult programs.

The back of the building contains four classrooms designed for children ages one to four, as well as an infants’ room. Huge sliding glass doors at the corner of each classroom are designed to blur the boundaries between dedicated instruction, play space for each group and a large communal play area in between. When the doors are opened, the central space can expand to overlap the surrounding classrooms. When they are closed, the doors still provide clear visibility from classroom to classroom while giving students and staff a connected feeling. At the same time, visitors can move through the space unobtrusively and be aware of what is going on without disturbing activities. Natural light pours into the central space and surrounding classrooms from clerestory windows wrapping around three sides of the column.

The organization made a concerted effort to use the building as a learning tool, explaining the “why” to kids and parents- why they recycle, why green buildings are good and how they can do these same things at home. An example of this is the highly visible placement of the building’s vertical/horizontal photovoltaics that provide twenty-five percent of the facility’s electricity. A donor wall at the entrance to the building incorporates slide shows of the building and its construction. A permanent graphic near the central kitchen explains how the building achieves its Gold LEED Certification. Not only is the Learning Center a sustainable and healthy place to be, but the design allows inherent flexibility for a variety of activities and programs for different age groups within the same set of spaces, which is something the Center vitally needed to provide a high-quality learning environment.

Steve Shiver, AIA, LEED AP, NCARB, NCIDQ
Principal, NAC|Architecture, Seattle, WA, has spent the last two decades managing the planning, design and construction of more than $270 million in educational and state facilities. As an experienced and accomplished educational planner, Steve has in international reputation for his thoughts on how integrated sustainable building features can be used as teaching and learning tools. He is particularly gifted in integrating educational delivery goals into educational facility design and regularly speaks at national conferences on educational planning and design. Several of his recent projects were the recipient of multiple national and regional awards. Steve cochairs the American Institute of Architects, Committee on Architecture for Education PK-12 Subcommittee.

John R. Dale, FAIA, LEED AP
Principal, Harley Ellis Devereaux, Los Angeles, CA, has been involved in the master planning, programming and design of public and private projects for over 20 years. In 2007, he was honored with an AIA Fellowship for his work in school design. Mr. Dale has created high performance pre-school through secondary school environments. By defining small learning communities which boost student achievement, promote sustainability, and galvanize community involvement, he has established widely recognized models of regional and national significance. Mr. Dale has also been a leader in promoting green schools. Building on evidence-based research, he has put in practice the theory that students are healthier and learn more effectively in well-ventilated, acoustically balanced, naturally lit spaces with strong connections to the outdoors—all features of energy-conserving, sustainable design.
I
volve students in the design and construction stages of new schools? – “Are you serious?” “Leave it to the experts”, “We don’t have time - the programme is very tight”, “What do they know?”, “They’ll get in the way!”, “It’s not our job!” are still responses from some involved with design and build of new learning spaces. “We have our standard classroom design, we don’t involve staff or students – we know what works” is another comment heard recently from an American University facilities professional.

However, experience shows that many students, of all ages, are very concerned about their learning. They understand how they learn effectively and have clear views concerning in what types of spaces they learn most effectively. If so, why wouldn’t you involve them in the design and construction of new learning spaces, to ensure delivery of appropriate resources and importantly as part of a variety of wider learning opportunities?

In the United Kingdom, the previous Labour Government’s original plan was to upgrade or replace every secondary school in the UK as part of their Building Schools of the Future programme (BSF), at a predicted cost of £45 billion. During this period many local authorities (districts) and schools started to consider how students and staff could:

- contribute to the design of spaces to enable new pedagogical styles to be developed
- benefit and learn real skills from sessions during the design and building process
- learn how the new building can actively continue to be an ongoing learning resource

The amount and type of stakeholder engagement depended entirely on Local Authorities or more usually individual schools. The most motivated schools were typically led by dynamic head teachers. Many of these head teachers really wanted students to be involved throughout the process and saw the process as a massive learning opportunity. Where students were really engaged, their input was enthusiastic, creative, ambitious but also surprisingly pragmatic. In those schools where students were involved simply to ‘tick a box’ for engagement, the young people quickly, and not surprisingly, viewed their involvement as tokenistic at best. The fact that some students and staff only saw their new school being built next door for the first time when they moved in is, frankly, shocking.

“Where there has been engagement with what students, teachers and the community wanted from a school building…. it’s been inspiring,” ~ David Milliband, former UK Schools Minister

PLANNING PERSPECTIVES

Getting Students REALLY Involved in Design and Construction — Are You Mad?

By Gareth Long and Alison Watson

“Where there has been engagement with what students, teachers and the community wanted from a school building…. it’s been inspiring,” ~ David Milliband, former UK Schools Minister

“Where there has been engagement with what students, teachers and the community wanted from a school building…. it’s been inspiring,” ~ David Milliband, former UK Schools Minister

What surprises huge numbers of professionals is the level of mature and intelligent contributions students make through design sessions, workshops and charettes. On numerous occasions we have heard architects and construction companies be surprised and almost worried about how challenging and sensible students are.
Leading educationalists such as Sir Tim Brighouse noted:

“I’m very optimistic about student involvement... it’s not as deeply embedded as it should be – but it will be. Student voice is going to have a very powerful impact.” Sir Tim Brighouse

It’s not just about colours and types of furniture that they focus on, but how their pedagogical preferences impact the types of spaces they want to work in and how they are constructed to achieve them. They do talk about light, air quality, temperature, ability to move around, having agile spaces so furniture, both formal and informal, can be moved into a variety of formations, using technology when and where they want to use it and so much more...

Many construction consortia have learnt about the power and value of student voice along with the challenge and creative thinking they bring. They only ever underestimate them once! When construction company representatives arrived at a school expecting to offer some simple description about a new building they were put totally on edge when the first question was not about the look but “Why is your design only going to look and feel different to those built to look and feel different to those built to a generic design by facilities management teams for cost efficiency purposes? The process leading to the development and operating of a new building but maximising the massive learning opportunities it provides.

The two year construction process, coming well after the design consultation, is frequently a cursory affair when it comes to student inclusion with typical site visits, hoarding design competitions (which may or may not be used) and maybe a calendar completion or two. Hence this has no lasting impact and ultimately apathy to what goes on behind those very same hoardings which were beautiful-
ly decorated and unveiled two years before, to quote Lauren McGuigan, a Year 9 student:

“Hardly anyone was involved in our new school building. It was just like “don’t go near it”.

So what about the before during and after? One of the greatest challenges lies in proposing a new school to an established community. That takes communication, organisation, research, delegation, and motivation! It’s English, Citizenship, it’s absolutely about speaking and listening skills.

In terms of construction professions (and the critical importance of introducing built environment careers as being so much more than bricklaying) the topographical surveyor and ground investigation/environmental assessment team are first on site. The lay of the land and its formation is critical to a new school design and landscape project. In subject terms, it’s trigonometry, geography and science. It’s learning how to read a tape measure accurately, scaling, contours, levels, gradients. Get students and their teachers outdoors. Don’t just talk the talk – walk the walk and FEEL what dy/dx = 0.33 is like. Discuss the shallowness, the steepness, the accessibility issues for the less able, and why a picnic table on a 1 in 3 slope just isn’t going to work. But maybe you could make it work! Discuss……!!

Children can understand the importance of a foundation through design technology, science, mathematics, history and more. Of course! After all, 1600 hundred years ago, Venetian architects and engineers were experts in their field, but foundations go back way back beyond this. The Walls of Jericho were constructed some 1100 years before this. History, Technology, Science, Maths, Engineering, Religious Ed, and English: Can the resonance of a horn really make a wall fall down? Could a modern day structural engineer design the walls any better using the same traditional methods (methods which, I hasten to add, are still in use today….)? Discuss!

So why aren’t young people introduced at this early stage? Learning can start with a building that isn’t even built yet. All this research, all this capacity to learn, and the architects have barely put pen to paper...

Small wonder that they have little or any real idea of how buildings are designed and developed, and the professionals who make that happen. Research shows that the majority of young people perceive construction as ‘building’ and generally associate the industry with trade based skills. Perhaps with the exception of an architect, they are usually totally unaware of the diverse range of PROFESSIONS.

Thankfully, UK company ‘Class of your Own’ ([www.classofyourown.com](http://www.classofyourown.com)) is pioneering a new curriculum which introduces design, engineering and construction on a whole new level. With support from world class software company Autodesk, they are propelling young people and their teachers into the 22nd century by introducing technology used by some of the brightest, most inspirational designers around the world, from Manchester to Mumbai, Hull to Hollywood. They are using tools that professionals have yet to discover...and are leaving them standing in the race to a low carbon future.

To offer a cliché – a well performing building starts with solid ground and a firm foundation – much the same as a good student. Don’t be cynical. Children – and teachers - thrive on ‘real’ inclusion. Kamila Samin, the 15 year old ‘Managing Director’ of Roots Accrington speaks of her experience in developing the Eco Classroom programme described in last years CEFPI conference:

“It’s great being properly involved – children are leading it. It’s a completely different perspective to looking out of the classroom window and seeing builders doing it all instead”

How many contractors get engaged in real detailed conversations about how and why they make the design and construction decisions they do – why wouldn’t you? The standard answer of “Well these students will have left by the time it’s built so there’s no point” is simply an excuse. In fact, students can have an extremely positive impact on any public building. The interior design of a combined community and health centre in the middle of a multi-cultural, deprived area in the UK became a less clinical, less forbidding place for young people to discuss their personal health problems. The students involved in the design were brought in at a late stage, but given four internal spaces to ‘make their own’. Their creations were remarkable and very achievable, but most incredible was their insistence that everything was achieved sustainably. When it came to the environment, they knew their stuff. From engagement of the local workforce, to procurement of locally made eco friendly paint, these kids had this well known global contractor feeling very small indeed. Even having them create a wonderful sensory garden instead of the usual ‘security planting’ boring green space was wonderful. “After all” said Chloe, 13, “who wants to tell a doctor ‘I’m thirteen and pregnant’ in a little white room?”

Both the commissioning local authority and the contractor looked at each other. “What a great idea! Why didn’t we think of that?” Need we say more? ■

Gareth Long is an internationally recognized education consultant working on a wide range of projects with some of the world’s leading educational visionaries. As senior adviser to the former Minister of Education, Cayman Islands, Gareth played a major role in the design of transformational schools and was awarded the “Spirit of Excellence Award.” [www.garethl.com](http://www.garethl.com)

Allison Watson, a practicing topographical surveyor and founder of the company Class of Your Own, is nationally recognized as one of the UK’s emerging innovators in engaging young people in construction. Her extensive construction industry experience, including the surveying of many schools, led to her writing and leading interactive applied skills workshops and developing courses for schools in creating sustainable community learning environments. [www.classofyourown.com](http://www.classofyourown.com)
Communication and Stakeholder Engagement at Brighouse Elementary

By Robert Drew

“Our school must be a memorable place that welcomes, reflects and supports a community of diverse learners. It will be a collaborative and inclusive place that instills a sense of belonging around a friendly focus on students and their families. The school reflects and instills all with a strong visible presentation of our values of inclusion, sustainability.”

The Samuel Brighouse Elementary School, located in Richmond, BC, a city adjacent to Vancouver on the west coast of Canada, is a five-hundred student elementary school. When completed in September 2011, it will replace an existing older school on the same site. This project was identified early on as an opportunity for the Richmond School Board to promote sustainability and use the completed school as a teaching tool. The older facility was subject to a seismic upgrade study that determined it would be too costly to upgrade the existing building. The new school will implement a number of new and evolving priorities mandated by the school district, including new approaches to educational planning and sustainable design and operations.

The School design was developed through a collaborative methodology – one that brings together the perspectives of the students, parents, educators, staff, administrators, school district, the policy makers, the municipality, the neighbours, and the consultants, providing the most direct path to achieve responsive and successful design solutions.

“It takes a village ...”

Eric Thorleifson, manager of facilities of School District No. 38 (Richmond), believes engaging in a design methodology centered on collaboration is key to ensuring that a highly functional school design will be developed and delivered. He represents a growing number of project managers who are turning to firms to deliver designs that represent a shared vision between the various stakeholders in a project. Approval to proceed with the design and construction of a new school afforded Mr. Thorleifson an opportunity to work with Perkins+Will to expand the boundaries of collaborative design.

Process Overview – Establishing an ethic of inclusion

The story of collaboration begins with the formation of the project’s steering committee. The school district invited representatives from the district, the school itself, the municipality, the parent advisory committee, as well as representatives from the union and teachers’ association to participate in the design process for the new facility. While steering committees are typically formed for new school projects, this is the first time the school district formed a full sixteen delegate committee for an elementary school. The steering committee met once every two weeks during the programming and design phases of the project, working with the consultant team to develop an inclusive design for the school.
While the architectural firm did not have an extensive portfolio of local elementary school experience, it had developed a successful methodology of integrated design founded on establishing collaborative design teams that work together throughout all phases of the project. The collaborative design team was comprised of steering committee members and knowledge leaders in K-12 school design. Working with the school district, they developed an organizational structure around clear communication, developing a vision, establishing clear project goals and committing to a schedule of face-to-face meetings.

Visioning Charettes – Checking preconceptions at the door

“Our school must be a memorable place that welcomes, reflects and supports a community of diverse learners. It will be a collaborative and inclusive place that instills a sense of belonging around a friendly focus on students and their families. The school reflects and instills all with a strong visible presentation of our values of inclusion, sustainability.”

Project Vision Statement

Three visioning charette workshops were scheduled and held during the programming phase of the project. Facilitated by Wendell Vaughn, AIA, LEED AP, Perkins+Will’s K-12 Western Region Practice Leader, each day-long workshop was framed around collaborative discussion of project scope and vision. Each workshop explored, in increasing detail, the dynamic interplay between the analysis and synthesis of ideas. The objective of the charette process was to develop a programming document and vision for the project that would inform the design process moving forward.

It should be noted that, in addition to their ability to lend specific expertise to the process, the members of the collaborative design team were also selected because they were good listeners, listeners who welcomed and respected contributions made by each group. This prompted meaningful participation of all those in attendance, and perhaps most importantly, encouraged building strong relationships that would ensure the completed project met the goals established during the charette process.

The first visioning charette set out to explore broader concepts surrounding learning environments and educational space planning. Preliminary programming and planning goals supporting the client’s educational priorities emerged from the discussions, as did the affirmation of several core values including sustainability, inclusion, identity, engagement, and community.

Shortly after the first charette, the school’s principal assembled a group of primary and intermediate students. Each student was asked to think about what features or qualities he or she would like to see in their new school, and then to present it in a drawing. They were encouraged to select words that represented their ideas and include them in their drawing. The work generated was informed, dynamic, diverse and in many cases very progressive - demonstrating a relatively well-developed understanding of spatial relationships and environmental design for such young students. The school principal captured the students sharing their ideas on video. The students then presented their ideas to the design team in the format of a mini charette. Ideas proposed by the students included the desire for lots of windows, colour, recycling bins, gardens, a cafeteria, touch screen displays, a hot tub and environmental stewardship. This exercise was an invaluable contributor to the design process and was later used to substantiate many of the decisions made during the design process.

The results of the student mini-charette became a key resource to help shape the project and planning goals established in the second visioning charette. During this workshop the vision statement for the project was drafted and programming development continued. Site planning strategies and the challenges and opportunities associated with a single story building versus a two story building were discussed at length, as was the desire for collaborative project areas. Sustainable design remained central to all discussions.

The third visioning charette saw the vision statement defined, space programming progressed and the initial conceptual design approaches envisioned. Discussions evolving since the first charette had matured. Strong design drivers were developed. Implementation strategies were refined. The results of the visioning charette process were documented in a projects programming document compiled by Perkins+Will. This comprehensive document became a gateway into schematic design and a reference document used to keep the entire team focused and goal-oriented. The strong start encouraged the streamlining of the design and production processes, a welcomed outcome from both the clients’ and consultants’ points-of-view.

Partnering with the Community – A Neighbourhood of Learning

During the third visioning charette, the design team examined the idea of developing collaborative project areas in more detail. They strongly believed that these spaces supported the project goals around collaborative learning, however there was no funding available for them in the approved budget. Perkins+Will introduced the idea of expanding the school program to include a Neighbourhood Learning Centre and allocating a portion of the learning centre program into the school floor area, thus providing the school with its collaborative project areas funded outside of the approved school budget. The Brighouse Neighbourhood Learning Centre received approval from the ministry to proceed.

Neighbourhood Learning Centres were a new concept to the Province of British Columbia at that time. The Centres, built on school property, are facilities intended to accommodate any number of community-based organizations. In the case of Brighouse, the
school district collaborated with the City of Richmond and the YWCA to have an adult literacy agency and after school care provider operate out of the facility. Incorporating a Neighbourhood of Learning increased funding from the city and will allow the facility to operate longer hours than a typical elementary school, maximizing the new building.

Engaging the Students – Lights, Camera, Action!

Curiosity is the very basis of education, and the students in the existing school were definitely a curious bunch. As a result, several teachers elected to take advantage of the learning opportunity occurring next door. A decision by one teacher, early on in the construction process, unexpectedly planted the seed for a mutually rewarding collaborative relationship that developed between the school and the general contractor. Likely frustrated with having to compete for her primary students’ attention, the teacher invited the students to draw pictures of the heavy equipment working the site. Once the pictures were coloured and signed they were posted on the classroom windows, facing outward, for the construction crew to enjoy. The ice was broken. A second teacher incorporated the construction of the new school into their unit plan on structures. To accommodate the students’ “field trip”, the contractor worked with their trades to create a safe site by temporarily suspending construction activities and creating a hazard free zone. Each student was assigned a vest, hard hat and safety glasses before given a tour to highlight the concepts they were learning about in class.

The school principal also seized an opportunity and invited a small group of intermediate students to form a communication committee. Their primary task is to liaise between the collaborative design team and their fellow students. The student’s visited Perkins+Will’s Vancouver office and interviewed the design team regarding the primary design objectives for the school. They also toured the construction site and interviewed the contractor. The committee then made a presentation to a school-wide assembly, translated the technical language gathered from the interviews into a accessible language more easily understood by their peers. Perkins+Will also developed a blog for the students to keep the community up to date. Posts are developed based on site updates and the progress of the student committee. (www.brihouse.ca)

The committee members are genuinely excited about what they are learning through their exposure to the design and construction process. Full of seemingly endless energy, the students decided to direct some their excitement into the creation of a video that captures the ‘journey’ from the old school to the new, through the eyes of the student body. Realizing that the organisation and management of such a project requires careful planning, the architectural firm offered to lend assistance and mentorship to the group and held a series of workshops. The students gained knowledge of how to research and visualize ideas related to the development of their theme, and how to craft a compelling storyline. They also learned about the importance of time management in anticipation to meeting specific project deadlines. The students quickly generated a conceptual framework for the video and developed a story board, and began filming. The video is expected to make its debut at an upcoming reunion planned for students and staff, past and present, to say “Farewell” to the old school.

Epilogue – Reflecting on the Process

From the perspective of the school district, there is no questioning that the collaborative design process laid the foundation for what is to be become a successful expression of ambitious goals established for the project. The school is expected to gracefully respond to the evolving process of learning, and earn its reputation as a memorable place to attend school for generations of students to come.

In addition, the collaborative design process delivered a rich experience to all those involved. The students, parents, educators, staff, administrators, school district, the policy makers, the municipality, the neighbours, and the consultants felt inspired and empowered to share in the generation of ideas and the development of the design. Moving forward, the process that led to a shared sense of ownership by all is expected to be applied to future school projects across the district. ■

Robert Drew, MAIBC, Architect AAA, MRAIC, LEED AP, associate principal with Perkins+Will, acts as Project Architect for the design of the project. Perkins+Will provides an extensive range of consultant services including architectural design, urban planning, programming, and interior design.
Five Successful Strategies for Greening Your School

By Anisa Baldwin Metzger

No school or school district is too far behind to start improving the school environment they provide their students and teachers. A green school can be a new school or an old school, and any effort to make the school healthier, more efficient and more conducive to environmental learning is a gain for all involved.

We are asked the question all the time: “There seem to be a lot of groups working on green schools—do you all ever talk?” Indeed, we do talk, and quite often. In fact, if you attended one of the Moving Sustainability Forward Summits this past December and March, you may have been privy to just such a conversation amongst three organizations leading the charge.

The Center for Green Schools at the U.S. Green Building Council (USGBC), along with Energy Star and the Collaborative for High Performance Schools (CHPS), was asked by CEFPI to design a presentation on green schools. We were delighted. The simple fact is that the organizations and agencies working toward green schools are working toward the same goal. The tools and resources that these groups develop are all getting the message out in many different ways to reach the most audiences possible.

We all agree that a green school is a school that creates a healthy environment conducive to learning while saving energy, resources and money. We agree that greening our existing schools in addition to our new schools is an imperative that cannot be overlooked. For our joint presentation, we put together a list of several points that we believe will move us closer to the goal of green schools for every child within this generation. Read on for our list of five successful strategies for facilities managers to create a healthy, green school.

1. **Start wherever you are.**

   No school or school district is too far behind to start improving the school environment they provide their students and teachers. A green school can be a new school or an old school, and any effort to make the school healthier, more efficient and more conducive to environmental learning is a gain for all involved.

   The Recovery School District of Louisiana (RSD) in New Orleans is one powerful example of a district that started from behind and has made incredible strides toward greening their schools. The storm that flooded 80 percent of the city of New Orleans completely destroyed 50 school campuses and left the district with $1 billion in storm-related damages. Combined with existing deferred maintenance, post-storm theft and looting, and mold and moisture damage, Hurricane Katrina cost the schools in New Orleans over $2 billion.

   In New Orleans, the RSD had no choice but to start where they were: very far behind. And what they have done over the last five years has created a culture of renewal from leadership to academics to facilities. They set a goal of LEED Silver and 30 percent energy savings for all of their rebuilt and renovated schools, which will total over 80 schools in all. In addition, they have begun a rigorous indoor air quality program, started a comprehensive asthma tracking program, hired an Energy Manager, entered into a public-private partnership to install large solar arrays on four schools and trained capital project management staff in LEED and green building.

   At the 2010 EPA Indoor Air Quality Tools for Schools Symposium in Washington, D.C., RSD leadership heard from district leaders from across the country who had implemented impressive and comprehensive indoor air quality programs. There was a feeling around the table that perhaps they weren’t doing enough—that their efforts were small in comparison to what they were hearing. But someone finally reminded the group what their starting point had been in 2005. Healthy, high-performance schools are for every community and every child, no matter where you start.

2. **Benchmark energy use with ENERGY STAR.**

   Any good facility manager will tell you that you shouldn’t start making any improvements if you haven’t assessed the building as a whole. You
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could be throwing money out the window on the wrong project. Yet schools and school districts sometimes forget the importance of assessment when it comes to energy use and energy efficiency. ENERGY STAR Portfolio Manager has now become the benchmarking tool for over 28,000 schools—and for good reason. It’s free, it’s online and it is the basis for energy analysis in both LEED and in CHPS. School leaders can enter every school in the district and compare performance, while taking into account the age, square footage and amenities (such as kitchens and computer labs) of each school.

Gresham-Barlow School District, located in Gresham, OR, joined ENERGY STAR as a partner in 2005. As the 10th largest district in a state with almost 200 school districts, it had a big energy bill that it wanted to reduce substantially. It has since become one of the program’s stars, demonstrating just how effective targeted, measurable energy efficiency efforts can be for a school district. During the 2005-2006 school year, the district reduced its energy usage by 30 percent, achieving a cost avoidance of over $1 million. Since that first year, the schools have continually improved, saving more than $1.5 million in 2010 and achieving an average portfolio-wide ENERGY STAR energy performance score of 93 out of 100. Every school in the district is ENERGY STAR, using less energy than 75 percent of similar buildings in the region.

Benchmarking energy performance with a tool like ENERGY STAR Portfolio Manager didn’t only give Gresham-Barlow School District the information it needed to target energy hogs in its building stock. It also gave the district a way to communicate its efforts and celebrate its success with the schools and the surrounding community. If you don’t measure effectively, you can’t tell when you’ve done a good job.

3. Change behavior to change the culture in your school.

Whether a school is able to invest in capital improvements or not, changes in occupant behavior in a school can have an enormous effect on two of the major focus areas of green schools: energy and health. Teams of teachers and staff are trained to spot moisture problems, potential asthma triggers, and other situations that may be harmful to student health through the EPA’s Tools for Schools program. And various organizations provide training and resources for students and teachers to be champions of energy efficiency at their schools.

Over 25 percent of a school’s energy usage is in lighting, and a simple “turn off the lights” campaign can have a surprising effect on the amount of energy the school is consuming. In fact, through measures such as turning off cafeteria lights during the day, unplugging electronics at the end of each day and adjusting temperature set-points, a group of dedicated students around Phoenix, Ariz., has been able to realize energy savings of almost 30 percent. In Washington Elementary School District’s 34 schools in Phoenix, occupant behavior alone increased its ENERGY STAR average score from 45 to 72 in the span of two years, saving over $2 million.

Effectively changing the way that students, teachers and staff behave in a school requires a culture change that must be visible at all levels of school leadership. A classic example of the value of setting firm expectations for environmentally responsible school culture is Rocky Mountain High School at Poudre School District in Colorado. The behavior change at this school was studied extensively by a team from Colorado State University. In the early to mid 2000s, the principal of Rocky Mountain High School set up a code of conduct he called the “Lobo Way” (the school’s mascot is the lobo), in which the school community was expected to care for the building and the property of the school in a way the conserved resources, saved energy and water, and kept the whole community healthy. Through this motto, mascot, charismatic leadership, a culture of high expectations and a few minor building repairs, this 1970s school was able to cut its electricity usage by 50 percent over the course of eight years and educate scores of environmentally literate young adults.

Every single individual that participates in a school environment is responsible for setting in place a culture of conservation, including facility designers and managers. Smart, efficient equipment is essential to lessening buildings’ impacts on the world’s resources, but all the energy-efficient technology in the world cannot replace the value of teaching our children simple common sense and good will toward the environment.

4. Signs are a must.

We know that not every school has a catchy mascot or a charismatic principal. Why not simply start with a sign? Green school buildings can and must be used as teaching tools. This can be done with signage that explains an interesting building component to occupants; but it can be much more than that.

At the LEED Gold certified Manassas Park Elementary, every space serves an environmental and educational function. The architects worked with direct input from teachers and administrators to bring the outdoors in. The three floors of the school are named for the forest floor, understory and canopy of the forest that abuts the school property, and classrooms are named for species that live in the forest.

Sensors in the classrooms indicate when the temperature outside is at a level ideal for opening the windows,

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1 Sue Pierce, “10 Successful Strategies to Green Your School,” Panel presentation at CEFPI Moving Sustainability Forward Summit, 11 March 2011.
2 Ibid.
putting occupant comfort in the hands of the occupants but not at the expense of the overall system. Outside, a tall pole measures how full the underground water cistern is and displays the progress of rainwater collection to students. The cistern area has been turned into an outdoor classroom, teaching students about storm water runoff and its impact on the region.

No matter what green efforts are in place at a school or how well-designed the school building is, if occupants do not know what is happening around them, then all of the effort is falling short of its potential impact. Invest in good signage, and you may get a change in school culture in return.

5. Test the waters through pilot programs.

At the trainings we facilitate with school district facilities staff, the group often reaches a point in the day when all of the possible actions that could be taken to improve their school facilities become overwhelming. In conducting the type of gap analysis we do as a team, the point is to identify all of the potential areas for growth and then to focus in on a few key goals. Many school districts get stuck in the identification of possible projects and can’t bring their teams to a narrower focus. There is nothing wrong with starting small. Pick one undertaking at one school, and then expand to other efforts, deeper efforts, and other schools.

In 2009 the School District of Philadelphia was one of 12 districts across the country to participate in a USGBC pilot program for implementing LEED for Existing Buildings: Operations & Maintenance in K-12 school districts. In addition to the district’s commitments to LEED for its new schools, the facilities master plan includes long-range plans to right size the systems in its existing schools. Thurgood Marshall Elementary was the district’s first project as part of the USGBC pilot program. The district found that, in order to most effectively work through the LEED EB: O&M process, it had to put in place systems that enabled its capital and operations teams and their resources to operate together more seamlessly. While this was uncomfortable territory for the district, the nature of the pilot allowed them to be more inventive and experiment with their own systems and procedures. The district is now expanding the successful strategies implemented at Thurgood Marshall Elementary to at least one school in each of its 10 divisions. The Superintendent’s most recent master plan incorporated sustainability as well, and the district has hired its first full-time energy manager.

The School District of Philadelphia used its pilot project to not only test out improvements to school operational procedures but also test out changes to its own organizational structure. If many schools had been attempted at once, chances are that these types of changes would have seemed overwhelming and unachievable. You may be surprised at what is possible if you start small and work your way toward transformation.

There is more than one way to green a school. The goals of healthy, productive students and responsibly spent tax money do not rest with one particular organization or one particular pathway. The green schools movement has a place for everyone—including you. If you would like to read more about what we are doing at the Center for Green Schools, visit our web site at centerforgreenschools.org, and scroll through our key initiatives, such as the Coalition for Green Schools, the 50 for 50 Green Schools Caucus Initiative, and our network of over 1,300 Green School Committee volunteers.

Anisa Baldwin Metzger works as the Green Schools fellowship manager for the Center for Green Schools at USGBC. She arrived in New Orleans in 2008 with a broad assignment: help the school district rebuild LEED-certified schools and support community-based greening efforts. Her work transformed public schools in New Orleans, resulting in programs that created a standard for green in the district. Anisa moved to D.C. in 2010 to manage the Center for Green Schools Fellowship program and lead strategy for interaction with school district staff and their consultants. She is a frequent guest speaker and facilitates full day trainings with school district staff around the country. Anisa has worked with architecture firms in Little Rock and Seattle, and she holds a B.S. in Architecture from Washington University in St. Louis and an M.Arch. from the University of Washington in Seattle.
FUNCTION Follows FORM:
Building the Foundations for Student Achievement Employing “School as a Teaching Tool” Protocol a Place-Based Learning Approach

By Joseph da Silva and Manuel Cordero Alvarado

“...schools represent a promise for the future. Schools are more than, but are deeply affected by, the buildings that house students and teachers. These building matter, as a way to make our children healthier, promote an inspired relationship to learning and knowledge, and commit to the growth and prosperity of our communities.” (Castaneda, 2010)

Introduction
The experience of observing students actively engaged in the learning process is precious. There is no better way to celebrate “Children’s Health and Energy Awareness Month” than assembling in a world class high performance green school with gifted and talented students learning how to take an integrated approach to sustainable school improvements.

The place-based learning experience process requires students to develop critical thinking and real world problem solving skills. In October 2010, the culinary arts students at the Providence Career Technical Academy (PCTA) demonstrated this process by coordinating with local sustainable food providers to facilitate the catering of a farm fresh vegetarian feast for over 300 participants at the “School as a Tool” forum. These students participated in a place-based learning experience with the help of dedicated and exemplary educators and various community stakeholders. The forum brought together key stakeholders (US Senate members, US Environmental Protection Agency staff, US DOA staff, and staff from the Rhode Island DOEd, Rhode Island
Department of Health (RIDE), and Rhode Island Office of Energy Resources, as well as administrators, educators, local farmers, business partners, designers, planners, parents and students in a supportive learning environment. The forum focused on three main components of a “school as a teaching tool”: Place-based Learning Experience, Operations and Maintenance and Indoor Environmental Quality. The connection of these three critical components is crucial because it establishes the exciting potential of connecting facilities and curriculum. United States Senator Sheldon Whitehouse reinforced this idea remarking on the fundamental importance in creating a substantial link between education and the environment. Rhode Island Commissioner of Education Deborah Gist called attention to the “Green School Movement,” and reviewed how Rhode Island has played a national role in creating change towards “greening” their schools. Students from the East Bay MET School and Scituate High School “Green Teams,” demonstrated how environmental education has affected and altered not only their schools, but them personally. From international collaborative recycling programs to partnerships with Mary Spruill and the National Energy Education Development project, led by Charlie Plant Principal at the MET and Shannon Donovan, Rhode Island Teacher of the Year, respectively it was exciting to see how these high school students have been fundamental in creating change within their communities.

The forum continued offering ways in which schools can improve their facilities while keeping costs at a minimum. The Indoor Air Quality “Tools for Schools” action kit, developed by the Environmental Protection Agency (EPA), presented by Marybeth Smuts is a comprehensive resource for schools to adopt and administer environmental protection and education throughout the school. These set of six guidelines can easily be used to identify and correct indoor air quality issues that can cause symptoms such as excessive fatigue and nausea to more severe problems such as asthma which are responsible for increased student and staff absence. Ms. Jones introduced Karen Verrangia who is the energy manager at Cranston Public Schools; one of the most energy efficient school districts in Rhode Island, having recently received Energy Star status. Ms. Verrangia discussed the importance of organization in creating and maintaining an energy efficient school. She gave a call to action for everyone, from the students to the superintendent, to take responsibility in this environmental movement. Tom Caroulo, an industrial hygienist from the Rhode Island Department of Health in Indoor Air Quality, displayed photographic evidence of what poor environmental maintenance can do to a school. From a basement filled with mold, to foot long mushrooms growing out of classroom walls, Mr. Caroulo demonstrated how important it is to create and maintain proper environmental conditions.

After a delicious meal including locally grown fresh vegetables, Emily Desrosiers and Dorothy Brayley talked about the importance of teaching our students how to live environmentally friendly lifestyles, beginning with the food that they eat. Emily Desrosiers from the US Department of Education introduced us to the “Healthier U.S. School Challenge” and encouraged schools to form partnerships with local farms to promote bringing healthy food and sound nutrition into the classroom community. The “Farm to School,” program was introduced as a way to promote cafeterias as a sustainable place to promote and maintain healthy eating.

It was no accident that the event took place in a school during the school day. The forum participants were immersed into a typical school day at the Providence Career Technical Academy, one of Rhode Island’s first High Performance Green Schools, verified by RIDE utilizing the Northeast CHPS Protocol. (RIDE, 2007) This school facility is a model of energy efficiency and responsible resource use and serves as a site of exploration for science, engineering and career technical studies as well as a unique community center hosting over 300 public events annually.

The place-based learning experience can be the bridge between the infrastructure and instruction. This experience reveals the strength of educational facilities in optimizing sustainable resources as one of the ultimate goals. The emphasis on place-based instruction highlights the relationships with the natural and built environment and the sustainable connections and interdependency of each. This relevance is a critical component to inspiring student engagement.

“The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions...” (UNESCO, 1975)

Ecological Background

The new century has ushered in a new ecological paradigm shift. This shift, according to the United Nations Framework Convention on Climate Change is a “dangerous anthropogenic interference with the climate system” (UN, 2007), which has disrupted our planet’s ecological equilibrium. This human interference is propagated by climate change, non renewable energy, resource overconsumption, waste disposal, food production, soil erosion, water quality, deforestation, reduced biodiversity, increased population and enormous ecological footprint. Understanding these conditions is essential in mitigating the severity of the ecological shift.

Resilience is a critical prerequisite for sustainability. Sustainability is a broad term frequently used in diverse contexts, defined by the Sustainability Education Center (2002) as a dynamic condition, which requires a basic understanding of the interconnections and interdependency among ecological, economic, and social systems. It
has since expanded to “strive to achieve a decent standard of living for all people and live within the limits of natural systems” (Berke & Conroy, 2000). Unfortunately, no definite standards currently exist defining the scope, scale and range of sustainability planning, much less something as specialized as educational facility planning, (Newton & Freyfogle, 2005).

Today we are a world at carrying capacity, wherein resources decrease and waste accumulates. This trend is clearly not sustainable, and will increasingly limit society’s room to maneuver. (Barrett & Odum, 2000) Mathis Wackernagel & Rees, (1996) developers of the Ecological Footprint, have calculated that if all the earth’s inhabitant’s consumption were to match that of the average American, we would presently require five additional planets the size of the earth to provide sufficient resources and assimilate all the waste.

We are experiencing a new paradigm shift - a need for ecological resilience, which includes both natural and built environments. Braced together by the concepts of sustainability, architecture must now be framed within the economic, social and environmental spheres, and is only limited by the breadth of experience and creativity of the architect and the adaptability of the construction industry and the users. This framework includes whole system thinking and warrants another round of analysis that looks to 20th century practices and adjusts each to the new resilience paradigm, in order to achieve a more sustainable solution. Architects and planners are poised to examine these systematic interdisciplinary connections and interdependencies.

Making Connections

One of society’s potential long-term resilient resources is the contribution of our children and the investment in their education bolsters readiness. Our children’s future ability to contribute is linked to the quality of education and environment that they experience. What we teach students must include resilience principles to ensure sustaining our quality of life for generations. Collaboratively if we create positive change and align our values with 21st century sustainable principles we can improve student achievement from infrastructure to instruction.

Our children have a high stake in the future. Sustainable schools go beyond high standards of achievement toward heightened levels of awareness about healthy living, environmental awareness, community engagement and citizenship.

Under-Secretary of Education Martha Kanter recently (2010) indicated that according to the United States General Accounting Office, approximately fourteen million students attend schools whose facilities are in need of extensive remediation or replacement. Along this same line, she also reports that students who attend schools that are in poor condition score 11% lower on the state standardized tests than those students who attend schools in good condition.

Research has also confirmed that public schools affect communities and their economic strength (Weiss 2004). Schools influence the reputation, quality of life, and vitality of neighborhoods. Conversely, the quality, vitality, and support of a neighborhood affect local schools. Because school facility improvements mean an influx of capital dollars into a neighborhood, there is great potential to positively impact that community. (Filardo, 2007) Evidence increasingly supports the following facts: school quality has a direct and positive impact on residential property values (Kane et al. 2003), school quality helps determine a localities’ quality of life and can affect the ability of an area to attract businesses and workers (Salveson and Renski 2002), investments in the construction and maintenance of school facilities inject money into local economies through job creation and supply purchases (Economics Center for Education and Research 2003), new or well-maintained school facilities can help revitalize distressed neighborhoods (Local Government Commission 2002), and the activities that occur in and around school buildings can help build neighborhood social capital and affect student achievement (Blank et al. 2003).

The concept of “School as a Teaching Tool” is organized around three main concerns: Place-based learning, Indoor Environmental Quality, and Maintenance and Operations. The unifying element is the ‘Green Team,’ a group of invested stakeholders representing various viewpoints that are uniquely positioned to make important connections between curriculum and facilities. Coincidently, the US Department of Education recently created a “Green Team” that is focused on creating polices and strategies to educate citizens in creating multiple pathways towards a sustainable future. (Kanter, 2010) ‘School as a Tool’ protocol can advance the teaching/learning culture of our schools to more sustainable levels where districts, educators, students and other stakeholders with a collective pool of resources take an integrated approach to school improvements in energy and water consumption, waste reduction, the food quality and many others.

The Place-based learning experience bridges curriculum and infrastructure by making students aware of and connected to their environment – both built and natural. It uses the school building as a hands-on laboratory with opportunities for real world problem solving integrating greening activities into science, art, math, language arts, and career technical studies.

Incorporating green technology into the students’ lives should encourage them to live more of a green lifestyle. Being surrounded by sustainable architecture will influence our nation’s youth to learn and experience their surroundings in an entirely new way. The success of STEAM (science, technology, engineering, art and mathematics) fields is dominant in our country. It is these scientists, technicians, engineers, designers, and
children will face unprecedented challenges in the future for which they will need to find solutions. Climate change, global poverty and tensions between nations warrant a higher level of environmental awareness, and “sustainable schools” could provide a strong cultural mechanism for addressing some these challenges.

Why should educational architects attempt to tackle this overwhelming global development issue? It is simple: because architects have an opportunity and because they can have a significant impact. Furthermore, architects, by their training, are systematic multidisciplinary three dimensional spatial thinkers, which coincide with sustainability’s multi-dimensionality. More importantly the built environment has a significant impact on resource depletion and ecological shifts not to mention that we spend most of our lives confined within its walls. According to the United States Green Building Council (2007), buildings are responsible for 12% of the water used, 39% of the CO2 emissions, 65% of the waste output and 71% of electricity consumption. Economic development and environmental protection have been at odds. (Daly, 1987) Sustainable building practices attempt to reconcile these seemingly opposing pressures by a more responsible approach to development. This includes reductions in energy and material use, which translates to externality reductions and/or elimination. Further, it proposes to equitably enhance the natural capital stocks, while securing the quality of life, within the limits of nature. Therefore, the way architects orchestrate the building environment is intuitively linked to society’s long term quality of life and involving students in this process helps to invest them in achieving these positive goals.

School as a Teaching Tool Protocol

1. Establishing a “green team” consisting of at least students, parents, community stakeholders, teachers & staff that will be responsible for coordinating and integrating sustainable schools elements.

2. Adopt an environmental vision statement

3. Conduct a School Environmental Survey

4. Create a Green School action Plan

5. Monitor and evaluate progress

6. Integrate greening activities into the curriculum including science, art, math, language arts, history, anthropology and economics. Involve the entire school in initiatives such as saving water, recycling, saving energy, and promoting outdoor education.

7. Inform, involve and celebrate recognize achievements and partner with external organizations

Review Opportunities

For far too long the architectural and planning professions have rendered services, only until the “ribbon cutting” phase and the process culminates in a photographic eruption and marketing fallout spectacular. The 21st century has ushered in a new era of architecture, one that demands a more resilient and sustainable commitment. This new paradigm shift in which the architecture (form) sparks an awareness of the natural and built environment in a pedagogical celebration (function) is the concept of “school as a teaching tool.”

Humanity’s future is shaped by the education its children receive and the natural and built environment in which they live. Education and the environment are linked to the quality of life for the next generation. Our challenges represent a significant risk to our current quality of life. Over 30 years ago, Rachel Carson challenged us to become resilient and demonstrate our mastery not of nature, but ourselves. Where is humanity heading and do we have the collective wisdom to choose the right path as a civilization at this crossroads? At the beginning of the 21st century, we are being called to individually act on behalf of our collective future.

The 21st century has ushered in new challenges never before encountered by humanity; education can play a crucial role in meeting these challenges. This article acknowledges the growing understanding that current global environmental changes represent a profound threat to the health and well-being of human and nonhuman species worldwide. Primarily, these challenges have been induced by humanites’ “overshoot” (irresponsible consumption) of our earth’s resource capacity. (Wackernagel, 1996) Our global society stands at a crossroad in human development and place-based learning appears to have considerable potential to promote important behavioral changes to effectively harvest this potential to combat drastic environmental changes. School developments and activities conducted locally are of global concern.

Education in the United States has hinged on the Aristotelian philosophical dualism of the Learner and the Environment. For the most part this duality has remained disconnected. “School as a Teaching Tool” breaks through the silo approach by integrating curriculum, operations and infrastructure through the place-based learning experiences. Sustainable developmental awareness and its potential impact on conservation of natural resources is one method primed to overcome this challenge.

There is a strong compliment between education programs and involvement in resource management. Through the utilization of the “School as a Teaching Tool” Protocol a better understanding of and deeper interest in the environment will prove valuable in
achieving a more sustainable balance. Sustainable schools can create positive change and align curriculum and infrastructure with 21st century sustainable principles to improve student achievement. Several months after the conclusion of the ‘School as a Tool’ Forum, students at the Providence Career and Technical Academy demanded change in the school’s lunch options. By expanding students’ awareness and giving them the tools and the agency to make change, these students contributed to a healthier and more sustainable future.

References

Joseph da Silva, NCARB, REFP, LEED AP BD+C, earned his undergraduate degree from University of Massachusetts, his graduate degree from the University of Rhode Island and is a doctoral candidate at the University of Massachusetts, where he is focusing on educational facility planning. He is an award-winning school architect with over 25 years of experience. He enjoys an outstanding high performance design reputation and his projects have been recognized for school design excellence. Joseph is the School Construction Coordinator charged with oversight of the school construction program for the Rhode Island Department of Education (RIDE).

Manuel Cordero Alvarado, AIA, LEED AP, earned his undergraduate degree from Yale College and received a Master of Architecture degree from the University of California, Berkeley, where he focused on the study of thermal and lighting environments in buildings. Manuel worked for several years on schools in California and helped shepherd CHPS and LEED projects through design and construction reviews toward certification. He is licensed to practice architecture in Rhode Island. Manuel is the RIDE Assistant School Construction Coordinator charged with the review of Necessity of Construction applications, design drawings, and NECHPS documentation.


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Healthy, high-performing schools offer long-term benefits with multiple rewards that will benefit society now and well into the future. In addition to helping protect the health of students and staff, environmental health programs ensure that schools make healthier, safer and more cost-effective choices in managing their indoor and outdoor environments. That’s why the Environmental Protection Agency (EPA) aims to take environmental protection to the next level of sustainability by drawing on advances in science and technology; implementing government regulations; and establishing voluntary State guidelines to encourage the adoption of best practices to benefit school districts with limited resources, as well as those districts that are already making significant strides in improving the environmental health of schools.

Making the grade

One way to promote the creation of healthy, high-performing schools is to establish State or Tribal environmental health programs to support an enhanced focus on the environmental conditions of school facilities. EPA is currently establishing voluntary School Environmental Health Program Guidelines to assist States and Tribes with implementing state school environmental health programs. The voluntary guidelines will emphasize the importance of creating state and tribal programs that support and encourage the use of best practices to benefit school districts with limited resources, as well as those districts that are already making significant strides in improving the environmental health of schools.

School environmental health programs are instrumental to promoting sustainability by advancing policies and strategies that meet society’s present needs without compromising the ability of future generations. Moreover, healthier school environments can bring money into the school by lowering absenteeism and increasing funding based on Average Daily Attendance (ADA) (EPA 2010). The healthier the school environment, the more likely students will be healthy enough to attend school.

In addition to cost savings, a number of studies have confirmed the relationship between a school’s physical condition, especially its lighting and indoor air quality, and student performance (EPA 2010). According to a pilot study investigating classroom ventilation rates, children in classrooms with higher outdoor air ventilation rates tend to achieve higher scores on standardized tests in math and reading than children in poorly ventilated classrooms (Shaughnessy, et al. 2006). Additional research also shows that modest changes in room temperature (e.g., 77°F to 68°F) can have a positive impact on the students’ ability to perform mental tasks.
requiring concentration, such as addition, multiplication and sentence comprehension (Wargocki and Wyon 2007). Studies such as these, demonstrate that school environmental conditions impact not only the health of students, but their academic performance as well.

In addition, students and staff must be healthy enough to physically come to school in order to get the most from the curriculum. A school that minimizes health risks potentially minimizes the number of sick days for students and staff, putting that school in a better position to become a high-performing facility. When policies and practices for healthy environments are strategically implemented, the benefits stretch far beyond improved environmental health to include reduced operating costs, higher test scores, increased teacher satisfaction and reduced liability.

Basic principles of a healthy school environment

A healthy school environment addresses seven basic principles: The school should be 1) clean and dry; 2) free from contaminants; 3) pest free; 4) well sited; 5) designed for high performance; 6) energy and water efficient; and 7) have good indoor air quality. Incorporating these principles into day-to-day maintenance and operations leads to more healthy and high-performing schools for our future leaders.

When it comes to healthy schools, facility designers and school officials are increasingly embracing “high-performance” school designs. These designs use an integrated, “whole building” approach to school planning that incorporates current technology and common sense principles to protect health while saving energy, natural resources, and money. In terms of utility costs alone, school districts can save 30–40% annually for new schools and 20–30% for renovated schools by applying high-performance design and sustainability concepts (EPA 2010). For example, a typical 450-student elementary school today pays over $45,000 annually for energy-related utilities. Incorporating energy-efficient design improvements into the design and building of the school could save that school $13,000 annually (Heschong Mahone Group 1999). These designs can also incorporate practices that yield additional benefits through improved occupant health, productivity and performance from integrating high-performance design features.

School environmental health programs are instrumental to promoting sustainability by advancing policies and strategies that meet society’s present needs without compromising the ability of future generations.

Oftentimes, there is an assumption that adopting green and healthy practices and designs in schools requires major renovations or costly reconstruction, but that doesn’t have to be the case. There are a number of simple, cost-effective ways to lay the foundation toward making environmental changes that have a major impact. Practices like keeping vents clean and clear of clutter; drying wet areas within 24-48 hours; and removing dust with a damp cloth can help improve indoor air quality, reduce pest contamination and exposure to contaminants, as well as prevent serious and costly maintenance issues in the future.

Identifying the areas of greatest need and the resources that are available will help a school determine where to focus its initial efforts. The ultimate goal, however, is to integrate all seven principles into a comprehensive, well-structured school environmental health program. After taking initial steps, it’s important for schools to take action and implement other critical best practices toward becoming a healthy and high-performing school.

Paying it Forward

Focusing on school environmental health programs not only provides a return on investment for individuals but for society as well. Incorporating facility best practices, energy efficiency, and other environmental health concepts in the students’ curriculum and staff training will ultimately advance sustainability. Both staff training and student curriculum are vital components of a school environmental health program because they promote behavior changes that improve school environments and can potentially impact areas beyond the school campus. School environmental health programs encourage the entire school population to participate in a school’s success. From school administrators and teachers, to nurses and maintenance personnel, all staff members play an important role in protecting the school’s environmental health. Staff training is an effective way to ensure that staff members understand their roles and how they can contribute to keeping the school “green and healthy.” The health program coordinator, school staff, maintenance personnel and any other persons involved with implementing policies and procedures for effective cleaning and building maintenance are the front line for environmental changes in schools. Adequate staff training helps to create the support for environmental health necessary to move sustainability forward within our schools.

While building an awareness of environmental health at schools might begin with the staff, the students play an integral role as well. From an academic standpoint, integrating environmental education into daily assignments, projects, and lesson plans teaches students the importance of environmental health and helps them become active participants in implementing the rules and behaviors asso-
associated with maintaining a healthy school. Environment-based education can also help improve student’s critical thinking skills (Ernst and Monroe 2004). Similarly, volunteer opportunities, clubs, and organizations are great ways for schools to promote environmental health issues while teaching students environmental stewardship and how to practically apply the lessons learned in the classroom. Lessons and experiences gained in schools can potentially expand to the home and local communities - reinforcing the concepts associated with creating healthy, sustainable environments.

If it’s not Healthy, it’s not Sustainable

When announcing the National Research Council study on sustainability, Lisa Jackson, Administrator for the EPA, stated “We have a new opportunity now to focus on how environmentally protective and sustainable we can be. It’s the difference between treating disease and pursuing wellness.” The bottom line is you can’t have sustainability if you don’t address health.

In terms of the race to sustainability, environmental health, and funding, schools that focus on health and high-performance are the winners. By decreasing spending in areas such as electricity, gas, water, and maintenance, school districts can decrease their environmental footprint while increasing funding for salaries, books, teaching supplies, and other items that support the true mission of schools: educating students.

Healthier school facilities and campuses can be leveraged as learning tools to educate students and staff about healthy environments and sustainability. By encouraging the adoption of school environmental health programs and innovative green practices, we put future generations at the heart of sustainability and make a long-term investment in establishing healthy, high-performing schools. The return on this investment is the protection of our children’s health as we meet the needs of the current generation while strengthening the possibilities for future generations.

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References

School Cents...The Energy Behavior Management Guide

By Sue Pierce

“The difference between what we do and what we are capable of doing would suffice to solve most of the world’s problems.” - Mahatma Gandhi

Sometimes we don’t know what is possible until someone shows us. For years, the 4-minute mile was considered not merely unreachable but, according to physiologists of the time, dangerous to the health of any athlete who attempted to reach it. For many years it was widely believed to be impossible for a human to run a mile (1609 meters) in under four minutes. In fact, for many years, it was believed that the four minute mile was a physical barrier that no man could break without causing significant damage to the runner’s health. The achievement of a four minute mile seemed beyond human possibility... like climbing Mount Everest or walking on the moon... And yet, on May 6, 1954, during an athletic meeting between the British AAA and Oxford University Roger Bannister crossed the finish line with a time of 3 minutes, 59.4 seconds, and broke through the “four minute mile” psychological barrier. Within three years, 16 other runners also cracked the four minute mile. So what happened to the physical barrier that prevented humans from running the four minute mile? Was there a sudden leap in human evolution? No. It was the change in thinking that made the difference. Bannister had shown that breaking the four minute mile was possible. Others now saw that it was possible and then 16 runners went on to do the same.

And so it is in my work. Saving energy in schools through behavior is all about believing that it is possible and that it can be done. Many of the barriers that hold us back today exist only in our minds. So where do we begin?

As a school official or consultant, you probably know the annual energy bill to run America’s primary and secondary schools is a staggering $6 billion — more than is spent on textbooks and computers combined. What you may not know is that the least efficient schools use three times more energy than the best energy performers and that the top energy performing schools cost $.40 per square foot less to operate than the average performers. These statistics are from ENERGY STAR, a program of the United States Environmental Protection Agency. Schools can play a valuable role in teaching students about becoming energy efficient and in leading their communities to become more efficient, too. In the process, you positively impact the environment, teach social responsibility, and help the school district save money on energy bills.

The first step in creating an energy strategy is to create a vision, a mission statement, and strategic goals for your school community. It is important to know what you are all working to accomplish. And to accomplish this, it will take commitment and buy-in from the superintendent and school board. However, leadership must occur at all levels within the district if the program is to succeed.

Program Leadership

Leaders are critical to the success of an Energy Behavior Management Program. In essence, leadership in an organization involves (1) establishing a clear vision, (2) sharing and communicating that vision with others so they will follow willingly, (3) providing the information, knowledge, and methods to realize that vision, and (4) coordinating and balancing the conflicting interests of all members or stakeholders.

In a school, the principal and administrators with the support of a carefully selected planning team usually work together to identify the vision and mission and communicate it to stakeholders. However, all staff and students in the school community have a critical leadership role to play in the program. Every action a student takes to conserve energy or remind others to conserve energy is demonstrating leadership. Teachers who discuss energy conservation in the classroom and use it as a teaching lesson are showing leadership. Facility staff who monitor building equipment and grounds to make sure all is functioning properly and efficiently are demonstrating leadership.

The Energy Behavior Management Program is best supported when everyone on the school campus realizes that they have a leadership role to play in saving energy.
A change in culture occurs when a majority of stakeholders identify with the vision and take some responsibility for bringing it about. Administrators are change agents. As the most visible leaders in the organization everyone is watching what they do. In a school, staff, students and parents respond to the direction set by the principal. If the principal takes action to turn off lights, use daylighting whenever possible and maintain district standards for temperature setpoints in his office, the school community understands he is committed to the vision. They will follow this example. Building staff are change agents. Students watch to see what they are willing to do to save energy. Do teachers implement energy education into the curriculum? Do teachers encourage energy fairs and Earth Day events? Do teachers turn off lights, use daylighting whenever possible, and maintain district standards for temperature setpoints in the classroom? School staff is aware of what is going on in the building and can play a key role in supporting the energy program. Students are change agents. Students can be the greatest cheerleaders for an energy program. When staff forget to take action, students are great at reminding them. Students love to participate in a wide variety of energy experiments and activities. They are a vital part of any building energy team.

Who Are Your Energy Cheerleaders?

A challenge most schools face is how to get everyone fully engaged in the Energy Behavior Management Program. The best way is to identify an energy cheerleader(s) or advocate(s). These cheerleaders are students, staff, parents and community members who are passionate about the environment, energy conservation, and/or sustainability. These advocates become the core energy team members and work with the principal to expand the committee. Their leadership, passion, and persistence in communicating the vision to all stakeholders will attract others to the cause.

Cultures change over time and not overnight. It can take time to identify Energy Behavior Management Program advocates especially if the school has not engaged in any energy or sustainability initiatives in the past. Getting everyone in a school community on board is a huge task and the initial results are hard to quantify. Significant results occur over time. For all of these reasons, persistence is critical to the Energy Behavior Management Program and its viability in the long term.

Policy Drives Decision-making and Action

The American Association of School Administrators states that the typical school district spends $400,000 each year on utility bills; some generate costs as high as $20 million per year. The U.S. Department of Energy (DOE) estimates that many districts could save 25 percent of that money through energy behavior management programs, better building design, widely available energy technologies, renewable energy use, and improvements to operations and maintenance. Nationally, the estimated savings could pay for 40 million new textbooks, 30,000 new teachers or 1.5 million new computers every year. To support quality energy programs, the DOE recommends that schools adopt smart energy policies, standards and procedures that detail how to implement the policy. Schools that adopt and implement smart energy policies in their buildings, schools, buses, and classrooms save money but also receive many other benefits: (1) Classrooms are more conducive to learning, with better lighting, better temperature control, air quality, and less outside noise; (2) Students learn about energy conservation and how they can contribute to the environment; (3) Buses emit fewer dangerous pollutants, particularly into areas where children learn and play; (4) Schools spend less time and ultimately fewer resources maintaining and operating buildings and buses; (5) The community appreciates the district’s wise use of taxpayers’ money.

What is an energy conservation policy?

An energy conservation policy is a statement(s) containing the principles, rules, and guidelines formulated by administration and adopted by the school board to reach its long-term energy goals and to achieve its energy mission and vision. The policy is designed to influence and determine all major decisions and actions related to the Energy Behavior Management Program. Some school administrators object to creating policies thinking the policy may in some way restrict their decision-making ability and limit their flexibility. Since policy making is a function of the elected school board, a policy statement usually must go through a public review process including several readings before the board and prior to final adoption. It is cumbersome to create and difficult to change. Policies by their nature are broader statements that address the philosophical issues and as such are not changed frequently. The advantages of having an energy conservation policy statement far outweigh the disadvantages especially if the policy is written correctly. The policy statement provides direction, focus, and credibility to the Energy Behavior Management Program. During implementation of the energy program, the policy statement adopted by the board puts all district staff on notice that this is the direction we will pursue. It gives the energy team authority to carry out their mission sometimes in the face of objections. The policy aligns all district departments so the independent actions of each works together to achieve the energy vision. For example, after the district installs new energy efficient lighting in a school, purchasing will need to shift buying habits and carry the new replacement products. The energy policy supports this alignment as well as consistent decision-making to bring about a universal objective. The policy further influences planning and budgeting decisions.

Data Supports the Energy Behavior Management Program

Data is the fuel that drives the Energy Behavior Management Program. Data analysis allows us to determine where we are today in terms of energy use in each of our buildings, thus creat-
ing a baseline for future comparison. Data supports decision-making regarding where and how to spend resources to improve energy performance. Data allows us to track our daily, weekly or monthly progress toward our goals. Data supports competition among the schools participating in the Energy Behavior Management Program. Here are my top five tips for sharing energy data:

1. **Simple easy to understand report format.** A simple and easy to read report format will be most useful in sharing information with a diverse group of people. Not every reader is an engineer or facility expert. Therefore, create a report using terminology everyone can understand.

2. **Consistent report creation.** Energy team members will expect to see the reports regularly -monthly, bimonthly, quarterly. Failure to consistently create and issue these reports will undermine the Energy Behavior Management Program.

3. **Distribution to all stakeholders.** The energy information will best support the program when it is made available to everyone. Presentation of energy reports to all administrators, the school board, staff, parent groups and the community will raise awareness and build support.

4. **Transparency.** A report format that details the energy results of each school and district campus so that all can see not only how their campus is performing but how everyone else is performing encourages friendly competition, resulting in greater effort and more energy savings.

5. **Accuracy.** The information entered into the energy management software and used to create reports must be accurate and credible. It is best to take data directly from utility bills rather than from in-house generated worksheets.

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**Energy Teams Become the Key to Success**

The Energy Behavior Management Program model is the responsibility of the entire school district. Every administrator, every staff member, every campus, every facility person and every student have responsibilities. An effective structure for the program is to work through energy teams. There are two different types of energy teams at work throughout the program.

1. **Energy Advisory Team.** The energy advisory team is a group of community leaders, industry professionals, and district staff who are appointed by the superintendent. It is important to have district staff, school staff and student representation. The advisory team meets periodically to review district progress in reaching energy goals and to offer suggestions as to how the program can be improved.

2. **Campus Energy Teams.** Everybody plays! An energy team is created at every school, administrative center, and support services building. The energy teams become the engines that drive the program. It is their responsibility to design and deliver the Energy Behavior Management Program on their campus.

It is important to structure energy teams correctly from the beginning. At school locations, the principal or assistant principal and building support person (facility/maintenance staff) should serve on the team. In addition, teachers, staff, students, and parents representing different grade levels can complete membership. The principal will want to create a process for determining membership which can include an application or nomination process. Ideally, he will want to identify some “energy cheerleaders” early on who will bring their passion to the program and can assist him in finding other members. The size of the team will depend upon how the school chooses to structure and organize the team. If the school wants to have a representative(s) on the team from each grade or allow more student involvement, the team will be larger. Administrative and support service buildings are not excluded from creating energy teams. In fact, as visible leaders many will watch to see what they are doing. Over time, their action or lack thereof will be a key indicator of how well the Energy Behavior Management Program performs district wide. Energy teams in these buildings should once again always include administrators and building support staff. These teams will generally be smaller in size than teams at the schools. The energy team is responsible for developing an energy plan for their site designed to achieve and implement the annual energy goals. In some cases, the district provides an annual energy goal to each site but sites will be allowed to set their own. Some of the activities the team will become involved in include managing energy consumption, educating themselves and the school community, and building energy awareness. Ultimately, Energy Behavior Management Programs succeed because people are constantly reminded to change habits. The energy team is charged with keeping the message in front of everybody. Energy Behavior Management Programs in schools properly implemented can generate amazing results both in terms of energy savings and educational benefit. And I know you can do it.

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**Sue Pierce,** Principal, Pierce Energy Planning, serves as principal of Pierce and Associates, a consulting firm located in Arizona that specializes in energy conservation and facility planning and management. Sue Pierce has spent the last 22 years working as a consultant in these areas initially in Iowa and the Midwest and more recently in Arizona. As a CPA her initial work was in the area of financial operations, helping organizations improve their bottom line and operate more efficiently. In 1994, this focus shifted to facility and energy planning. In all of the work she has done, her most remarkable skill set is the ability to organize people to accomplish a common goal.
Every citizen enjoys one or more support services that are usually delivered through a wide range of public, private and not-for-profit agencies. These services include programs that support our basic health, social, cultural, educational, recreational, transportation, safety and other individual and institutional needs. The degree to which these services are effectively delivered is determined by how well they are managed and how accessible they are to the people who need them. To a large degree the complex network of agencies and providers established to deliver these public services is cumbersome and inefficient. With respect to low-income communities, where barriers to access are at their highest, access to the most essential of these services can be critical.

One of the reasons why the delivery of public services is less than perfect is because the process that leads to their implementation is usually disaggregated. For example, in the area of educational services, programs for early childhood education are often managed autonomously from programs aimed at the elementary, middle and high school grade levels. Additionally, programs for vocational, community college and higher education are usually administered through a separate group of independent agencies, and adult literacy programs are most often offered through still another program delivery system. For the underserved population of workers whose livelihood depends on multiple jobs, whose access to technology or literacy training may be challenged, or whose income levels are too low to support private transportation, access to these programs and services is often limited. A new strategy for the planning and distribution of public services must be created to provide for a more equitable and effective means of program delivery.

**Challenge Brings Opportunity**

In most cases where a disaggregated delivery system exists, the barriers to change are formidable. Longstanding commitments to existing administrative alliances and physical infrastructure are often prominent obstacles. Community programming is often divided between a wide assortment of elected and appointed bodies, and non-governmental organizations. Each entity is usually responsible for planning, funding, building and operating its own administrative and facilities infrastructure. In order to improve efficiency and quality of services to all citizens, a new model is needed that can create a “nexus” of planning for all of these people, programs and places. This nexus planning model might include a collaborative entity, call it a Community Trust, composed of representatives from many public, not-for-profit and community based organizations, who would share in the responsibility of coordinating the delivery of all community programs and services.

**Why is it called a Nexus?**

The “nexus” concept is a programmatic, administrative and physical planning model that is highly integrated in both its design and execution. A fully developed community nexus is conceived as a place where a wide range of programs and services are effectively sited, coordinated and administered in a way that addresses the needs of the people who most need them. The programming and design of programs and facilities that accommodate the full range of community needs must be conceived and developed as part of a common and collective whole. Included in each nexus center could be public open spaces, centers for K-12 education, career and technical training, adult learning, multi-modal transportation and information access, community fitness, visual and performing arts, recycling, emergency refuge, disaster recovery, community health and other services. With a collaborative approach to public and private pro-
programming, these community nexus centers could also provide walkable access to neighborhood-based farmers markets, community gardens, grocery and dry goods outlets, retail services, and public transit.

**National Issues of Confidence and Trust**

Gaps in public confidence exist in many urban and rural communities, resulting in high turnover rates of political officials, including school superintendents and their key administrative staff. In this environment it is often difficult for communities to maintain a common vision for the planning and administration of integrated community services. But a more democratic model that is authentically implemented at the scale of rural villages and urban neighborhoods could help to foster more inclusion and stability.

Any reformation of the economic, management and policy frameworks used to deliver community programs and infrastructure must carry with it a new vision for a desired outcome and a clear theory of change. In the domain of education, this means that the outcomes outlined above would require increased management efficiencies and produce more graduates. Recent research indicates that these goals can be better achieved through a holistic model that supports the whole family and child by providing better access to wrap around services. Nexus planning is a process through which these services can be planned and coordinated all at once. Included are a full spectrum of the people, programs and places that support the complex systemic structure of child support and community life.

Some of the most meaningful planning and design interactions can happen at the scale of the school or neighborhood. One critical part of the puzzle are the spaces where people come together, including buildings housing multiple agencies and programs that are often referred to as neighborhood centers. But a community based nexus of people, programs and places can deliver more efficient and effective outcomes. When created in collaboration with residents and other local stakeholders who will use them every day, an authentically integrated community nexus can:

- Increase efficiency by reducing duplicative services
- Coordinate and leverage public and private interest and investment
- Increase the power of resident voices to create and manage facilities and programs in their neighborhoods
- Enhance community investment through collaboration among various agencies and institutions that can help support and sustain programs over the long term.
- Increase connectivity between local residents

To more fully explore the synergistic qualities of the community nexus, it may be helpful to review the six domains that encompass the largest segments of individual and community needs. First is the physical domain, which includes all built and natural resources, like buildings, bridges, highways and electronic communications infrastructure, as well as natural resources like parks and recreation areas. A second category of assets and needs is contained within the community’s cultural domain. Included in this category are programs and artifacts related to individual and collective values, including ethnic, religious and aesthetic diversity. The third nexus domain incorporates many of the community’s social assets and needs. This includes all aspects of human well being, including programs related to health, human services and housing. The fourth component of the integrated system of community assets is contained within the economic domain, which incorporates programs, activities and initiatives that are meant to maintain a healthy balance between financial, human and environmental capital. A fifth domain includes all of the community’s organizational programs and services. These include everything from families, small groups, specialty clubs, city and county school boards and councils to a myriad of political parties and other private and civic entities. The domain of organizational activities also incorporates the wide variety of mechanisms through which community issues are deliberated and implemented. A sixth domain of the community nexus incorporates all of its educational resources and learning assets, including everything from pre-natal to early childhood, primary, secondary, community college, college, university, adult education and workforce training programs and services.

These combined physical, cultural, social, economic, organizational and educational domains incorporate the community’s most vital quality of life resources. Although each domain defines a different set of assets and needs, it is the nexus of interactions between them that can most effectively support the health and well being of the whole community system. When the nexus of planning and design resources is operating at its full potential, all of the community’s systems will be operating in a synergistic and harmonious mode. Here educational assets can interact with economic, cultural and social assets – and on and on – to a point where interactions reinforce each other through a living web.
of knowledge, information and communication services.

Above is a visual illustration of how a Community Nexus Center might be organized for a small town or urban neighborhood.

New Orleans, Louisiana: Building Nexus Neighborhoods

One place where the Nexus model is now taking shape is in the recovery and rebuilding of New Orleans after Hurricane Katrina. In the development of a new School Facilities Master Plan only 70 of the 127 sites owned by the public school system were needed for K-8 schools and 15 for high schools to meet demographic projections. And since twenty-nine percent of New Orleans citizens do not have access to private transportation, it was important to provide walking access to each of the nexus sites. So all seventy of the K-8 school/nexus sites have now been located within a safe walking distance of every child and family in the city. And the community’s needs for community gardens, farmer’s markets, community-based health centers and other social services have also been incorporated into a nexus strategy for all community development.

More than $2.5 billion dollars in public school and other municipal funding has now been allocated to implement the school facilities and community nexus concept. Twenty-three schools are now in design or under construction. The City of New Orleans is working with the school district to re-allocate as much of its recovery funds as possible for co-located libraries, parks, social service centers and other community facilities. Combining recovery assets to develop community nexus centers could manifest a vision for the future of New Orleans that post-Katrina citizen-planners could until now only dream about. And with walking access to each of the community nexus sites, every citizen may some day have equitable access to a full range of community programs and services. With this reduced dependence on automobiles, the nexus plan will also deliver a more economical, environmentally sustainable and healthy community for everyone.

Don’t Wait for a Hurricane

Every community has programs, services and facilities that exist in different silos of organizational and physical space. Through a process called “asset based mapping”, these components of the community nexus system can be identified and reallocated to more effectively serve the needs of all residents. But in order to access these benefits, those responsible for planning must learn to work together more collaboratively. New planning tools are now emerging to encourage and facilitate this process. The result could be a more efficient and cost effective means for delivering community services where the whole is greater than the sum of its parts.

Steven Bingler received his architectural training at the University of Virginia where he was free to indulge his curiosity of democratic principles. In 1983 he founded Concordia, a community-based planning and architecture firm, to pursue systemic and collaborative design practices. Concord - which means harmony among things and agreement between people - is the firm’s one word mission statement. Design projects include the Contemporary Arts Center in New Orleans, where a cooperative partnership with seven sculptors explored visual art and architectural design as a collaborative enterprise; and the Henry Ford Academy in Dearborn, Michigan where Concordia worked with teams of teachers, students and arts curators to integrate a learning environment for 400 inner city high school students into the 80 acre Henry Ford Museum complex. In 2006, Concordia coordinated the development of the Unified New Orleans Plan, a comprehensive strategy for the redevelopment of the city of New Orleans after Hurricane Katrina. The process incorporated the work of 12 urban planning firms, 54 community planning district meetings and 3 citywide community congress events with a combined participation of more than 9,000 New Orleans citizens. Concordia’s research alliances have included the MIT Media Lab, Harvard University’s Project Zero, the University of New Mexico, the National Aeronautics and Space Administration, the Thornburg Institute, the Appalachian Education Lab and the West Ed Research Lab.
Finding Funding: Making School Improvements Possible

By Jim Simpson

Green Bay Packer coach Vince Lombardi is quoted as saying, “Winning isn’t everything, but wanting to win is.” Whether it’s a major university or an urban school district, pulling together and developing a plan and being confident in the financing through performance contracting is the best way to meet student, taxpayer and community needs.

Considering sustainability projects for your school or campus is like giving a kid a toy catalog. It’s easy to be captivated by all the glossy pictures of solar panels and fancy new lighting fixtures. But when it comes time to think about the bill, many facility planners often sigh and just forget about it.

They’re not alone. A survey of almost 1,700 business decision makers for companies and institutions in North America, the Johnson Controls Energy Efficiency Indicator, found that money issues form the biggest barrier to energy efficiency. Some 81 percent of institutional respondents noted that insufficient internal budget is the top financial barrier.

The good news is that educational institutions actually have several options to choose from when it comes to financing. Perhaps the most interesting is performance contracting - a procurement tool that allows schools to leverage the savings they get from improving buildings in order offset the costs of the projects themselves. The approach brings many benefits:

- The process provides access to capital when budgets are limited or revenue is low.
- There’s a legal contract stating that the savings will materialize over the lifecycle of the investment.
- Schools have access to specialized technical skills and innovative approaches beyond energy or water to include security and other technologies.

The turnkey approach means that facility managers who often don’t have the time, expertise or manpower to oversee comprehensive facility retrofits have an accountable way to get the work done with minimal direction and minimal disruption to the school or campus.

Wyandotte Public Schools

For instance, planners in the Detroit suburb of Wyandotte, Michigan were proud of their schools...
Measure to Manage

To install confidence in a project, all performance contracts contain some form of measurement and verification. By following an international standard, ESCOs develop a benchmark for a project’s savings, then compare energy use before and after the project. The options provide a range of approaches depending on the characteristics of the project balanced with accuracy and cost.

- **Option (A) Retrofit Isolation: Key Parameter Measurement** – Savings are determined by measuring some of the key performance parameters which define the energy use of the energy conservation measure’s affected systems in relation to the success of the project. When those measurements are not available, estimates are determined with specific documentation based on historical data, manufacturer’s specifications, or engineering judgment.

- **Option (B) Retrofit Isolation: All Parameter Measurement** – Savings are determined by measuring all key performance parameters which define the energy use of the specific ECM-affected system.

- **Option (C) Whole Facility** – Savings are determined by measuring energy use at the whole facility or sub-facility level.

- **Option (D) Calibrated Simulation** – Savings are determined through simulation of the energy use of the whole facility, or of a sub-facility.

For more information, see http://www.evo-world.org/

but knew they needed to develop safer, state-of-the-art facilities for its 4,700 students. With tough economic times and low state funding, there was no money and little hope in asking taxpayers for much-needed improvements.

To make the project affordable, the district and Johnson Controls entered into a series of performance contracts designed to provide energy and operational savings that would pay for the upgrades and renovations. The sustainable improvements included:

- Replacing old lighting with new energy-efficient fixtures.
- Installing photovoltaic solar panels.
- Using solar energy instead of boilers to generate hot water at the high school and middle school.
- Deploying the Metasys® building management system to monitor and optimize all building systems.
- Installing a rainwater capture system in the high school.

The project also reduced the schools’ computer costs by turning lab computers into servers to which multiple monitors, keyboards and mice could be connected. This approach let Wyandotte eliminate six of every seven lab computers, which helped save energy in the schools and decrease equipment replacement costs.

Savings under the performance contracts are estimated to be $6.9 million over a 15-year period, which means Wyandotte can fully pay for improvements to classrooms and facilities. The contract also included grant writing support, which led to solar project funding of $50k from State of Michigan Energy Office. Most importantly, the district now offers all of its students and faculty exceptional learning environments that are conducive to academic achievement.

**Performance Process**

Each project is different, based on the budget, size and preferences, but here’s how performance contracts generally work:

- The school or institution contracts with an energy service company (ESCO) to develop an audit of the energy and water use for the district or campus.
- The ESCO identifies Energy Conservation Measures (ECMs) based on their ability to save utility costs and operations & maintenance expenses.
- A preliminary business case and cash flow are created to substantiate the ECMs’ economic benefit and environmental impact.
- The district reviews the business case and selects those ECMs to be included in the project.
- The project is fully engineered by looking at capital, installation and operating issues.
- A project-specific methodology is established for each ECM to measure and verify the savings.
- The ESCO determines the expected outcomes and develops a contract to fund any savings shortfalls.

As concerned as campus trustees and school boards may be about financing projects, they’re even more worried about risk management. How can they be sure these big projects will actually work and they won’t be stuck with a bill or equipment that doesn’t work?

It’s the measurement and verification (M&V) component of performance contracts that make them so attractive. International standards (see sidebar) provide assurance and a rationale for the performance of the equipment installed.

**Beyond Energy in Buffalo**

Building owners are looking at performance contracts for elements other than just energy and water. Buffalo Public Schools wanted to improve its energy efficiency level, but
it also wanted to improve student and staff security issues at its schools. A $1.4 billion, district-wide project was aimed at modernizing its 65 facilities and creating more safe and secure academic environments for the 37,000 students and staff.

The project included a multi-phase performance contract with Johnson Controls that guarantees positive cash flow of $20 million over 20 years for the district. While the state supported the modernization plan with a 93.7 percent building aid reimbursement rate, performance contracting was the district’s financial solution to achieve the remaining local share of the funding.

Using a multi-phased approach, Johnson Controls focused on key instructional and operational needs first.

- **Phase One** - Lighting retrofits, HVAC equipment and controls upgrades, building envelope improvements, steam traps, insulation, pool covers and installation of a Metasys® building management system at select schools. An initial security project included installing Johnson Controls IFC-3030 fire alarm system and a P2000 security management system, IP video surveillance, HID card readers, clocks, bells, public address, auditorium sound systems, temperature controls and a master antenna system for nine schools.

- **Phase Two** - Expansion of the Metasys system, lighting retrofits, replacement of burners, boilers and steam traps, installation of boiler controllers and new interior storm windows at an additional 13 schools.

- **Phase Three** - Expanded the initiatives to an additional nine schools and begin the district-wide security upgrade.

**Security for All**

The district wanted to focus on improving student and staff safety and deterring break-ins at all facilities. Through a district-wide technology and security project, Johnson Controls set out to bring as much visibility of facilities as possible to the District’s administrative and security staff.

The project included the installation and integration of nearly 4,000 video cameras in schools, district-wide, which will be strategically placed to provide maximum visibility to major public spaces. A Johnson Controls Digital Vision Network system is used for recording, archiving and retrieval of all activity captured by the cameras.

The main offices at each school are equipped with 42-inch plasma monitors so camera activity can be viewed in real time. The monitors provide visual identification of school visitors before they are allowed to enter a monitored door. A district-wide burglar alarm system is integrated so if an alarm is triggered, cameras automatically train on the door or window alarm point so the activity can be recorded.

Johnson Controls supports all installed equipment and controls under a service agreement, which includes an onsite building environment specialist and comprehensive training. The renovation project resulted in an Outstanding Achievement Award in Public/Private Partnerships for the city from the United States Conference of Mayors.

**Higher Education Benefits**

An increasing number of colleges and universities also are using performance contracts, especially as they work to attract students interested in green careers and the sustainability of their own campuses. For instance, Mt. Hood Community College (MHCC), in Gresham, Ore., serves more than 31,000 students each year, with more than 70 associate degrees and certificate programs in a wide variety of disciplines.

Through a partnership with Johnson Controls, MHCC is providing a more efficient, reliable and comfortable learning environment to students and staff with an energy savings program that is anticipated to reduce the school’s carbon footprint and energy costs by more than $760,000 each year.

**Central Utility Plant on Brink of Disaster**

The spectacular natural surroundings of the campus in the foothills of the Cascades were in stark contrast to a 40-year old central utility plant that was on its last days after fires and decades of...
deferred maintenance. Although the school did its best, it couldn’t pass a bond issue, and budgeted funds were eaten up with emergency fixes.

Through a state-approved performance contract, MHCC developed an approach that uses utility savings to offset $10.7 million in improvements over 17 years. Additional funding for the project was secured through tax credits from the Oregon Department of Energy and the Energy Trust of Oregon.

After an extensive audit – which found potential for saving more than half the campus energy bill – Johnson Controls embarked on a comprehensive rebuild of the central utility plant. It was completed on budget nearly three months earlier than a typical six-month implementation with minimal impact on the occupants.

Campus Wireless and Water

Improvements also include the installation of the Metasys® building management system, which provides efficient building controls to link the entire campus wirelessly – one of the largest arrangements in the country – and ensure better indoor air quality.

Additionally, a smart irrigation system conserves water usage, a solar thermal system helps heat the school’s three pools, and low-flow fixtures save water throughout the buildings. Other green features include extensive recycling, improved lighting in gyms and classrooms – and perhaps most visible, funds for a low-energy Smart Car for security officials.

The improvements are projected to reduce annual carbon emissions by more than 3,000 metric tons, equivalent to the annual amount of electricity used in 287 homes, as well as the carbon sequestered from 233 acres of pine forests per year. The work also created hundreds of jobs, ranging from engineers and architects to skilled trades and construction.

Setting Goals

Beyond performance contracts, educational institutions and school districts can explore other funding options, such as bank loans, bonds and capital, operating or tax exempt leases. No matter what, the first step is setting a goal. The Johnson Controls Energy Efficiency Indicator results show that companies and institutions that set a public goal for reduction – or even an internal target – actually end up saving more.

Jim Simpson, Director, Higher Education Energy Solutions, North America

Johnson Controls, Inc., heads up a team of sustainability and energy efficiency experts in the higher education market. His team is responsible for developing and deploying the technologies and expertise surrounding all of Johnson Controls’ Solutions offerings including performance contracting, water efficiency, renewable energy, security, and sustainable construction. Before joining Johnson Controls in 1994, Jim held several sales and leadership positions with Honeywell. Jim joined Johnson Controls as a branch manager in San Antonio, Texas. Since then Jim has held various leadership positions, such as regional sales manager, area general manager, and regional vice president. Jim has a consistent track record of bringing increased value to customers through innovative offerings such as the bundling of services with technologies, creating new energy efficiency measures, incorporating student engagement, and increasing quality in the delivery and installation of projects. He is a member of National Association of College and University Business Officials, American Council on Education, and National Association of State Facility Administrators. A graduate of Texas A&M University, Mr. Simpson has two children and resides in Houston, Texas.
Zero Energy Schools – Beyond Platinum

By Paul C. Hutton

One of the fastest growing trends in school design is Net Zero Energy Schools. There are now at least a dozen or more schools completed or in construction that have achieved, or have committed to, this incredible level of energy efficiency.

Definitions of Net Zero Energy Building

There is no universally accepted definition for Net Zero Energy Building. Fortunately several credible organizations have developed definitions. Several of the most common variations are quoted below. ASHRAE’s definition has the virtue of being succinct and to the point, but there is some value in NREL’s more elaborated version. It makes the point that a Net Zero Energy Building should not be a building with typical energy use and a large compliment of renewable energy added on. It clearly advocates for achieving energy efficiency first and renewable energy second. This attitude closely mirrors the approach we adopt within our own practice and that is promoted in this article.

- **American Society of Heating Refrigerating and Air-conditioning Engineers (ASHRAE):** “A building which, on an annual basis, uses no more energy than is provided by the building’s on-site renewable energy sources.”

- **National Renewable Energy Laboratory (NREL):** “A residential or commercial building with greatly reduced energy needs through efficiency gains such that the balance of energy needs can be supplied with renewable technologies.”

- **Department of Energy:** “A building that produces and exports at least as much emissions-free renewable energy as it imports and uses from emission-producing energy sources annually.”

**NREL Zero Energy Building (ZEB) Hierarchy**

NREL has developed a further set of definitions in order to evaluate different gradations of compliance with Net Zero Energy goals. They are as follows:

- **ZEB A:** renewable energy sourced within building footprint
- **ZEB B:** renewable energy sourced on-site
- **ZEB C:** renewable energy generated on-site from off-site resources
- **ZEB D:** renewable energy generated off-site

In general, schools pursuing Net Zero Energy will fall into either Category A or B. Which category generally depends on where renewable energy technology is installed, on the roof or on the ground. A few schools, including at least one of our examples, is Category D as it uses off site wind generated by the local utility. And although there is no example included in this article, a school that uses woody biomass could conceivably pursue Category C.

Other Relevant Terminology

There are other terms related to Net Zero Energy Building, but they have subtle differences. A few of them are less stringent than our Net Zero Energy (Grid Neutral, for example), while a few are even more stringent (Zero Carbon, for example). In order to avoid confusion, a few of those will be described here.

- **Net Zero Site Energy:** A site Zero Energy Building produces at least as much energy as it uses in a year, when accounted for at the site.
- **Net Zero Energy Cost:** In a Cost Zero Energy Building, the amount of money the utility pays the building owner for the energy the building exports to the grid is equal to the amount the owner pays to the utility for the energy services and energy used over the course of the year.
• **Net Zero Energy Emissions:** A building that produces at least as much emissions-free renewable energy as it uses from emissions-producing energy sources.

• **Grid Neutral Site:** A site that produces at least as much electricity as it uses in a year. Building may still use fossil fuel on site.

• **Zero Carbon:** Zero Carbon buildings produce no net carbon emissions from all energy use over the course of a year. Such a building derives all of its energy from renewable or carbon-free sources.

For the purposes of this article, we will generally adhere to the NREL definition and refer exclusively to Site Energy Use Intensity (EUI) as our energy use metric.

### School Energy Use Trend

The average existing school building in the U.S. has an EUI of 76 kBTU/SF/YR, and an average age of 42 years. Current building and energy codes limit new school building EUI to approximately 55. Typical new school construction in the state of Colorado, where there are funding incentives for better performance, averages approximately 38, and integrating all available best practices may result in an EUI of approximately 18. These numbers would vary, of course, depending on climate, occupancy patterns, and other variables.

### Relationship of Net Zero Energy Schools to LEED

Three LEED credits deal with the energy use of a building. One LEED credit focuses on improving energy performance over ASHRAE 90.1, giving more points for each percentage threshold over the baseline model, based on cost, up to a reduction of 48%. A Zero Energy School would try to surpass this goal and minimize energy use so that the balance of energy needs can be supplied with renewable technologies. Another LEED credit focuses on on-site renewable power to offset building costs, awarding points for each percentage threshold in renewable energy cost savings, up to a 13% reduction. A Zero Energy School in the ZEB A or B category may have a 100% reduction in energy costs. The final LEED energy credit is for purchasing off-site renewable energy in order to offset building energy use.

In addition to having less energy use intensity, schools have another advantage in the race towards Net Zero Energy. They are typically more receptive to the application of renewable energy because they have larger sites (except in a few denser urban conditions), they have large roof areas relative to their gross floor area, and they are owned by entities with a long term investment horizon.

### Why Schools are good candidates for Zero Energy

Schools are good candidates for Net Zero Energy because they already use less energy than most commercial building types. Schools use only 33% of the energy of hospitals per square foot and 51% of the energy of office buildings per square foot. Collectively, schools use only 17% of total non-residential building energy. Schools use less energy than other building types due to a combination of factors:

- Less use during the summer
- Extensive vacation periods when building systems are in unoccupied mode
- Shorter period of use in the typical day
- Minimal process loads

Studies regarding the energy efficiency of LEED rated buildings are unfortunately a bit inconclusive, and there is some debate about their real world energy performance. A Net Zero Energy School would not necessarily be LEED rated, but its energy performance would exceed the threshold needed even for Platinum.

The LEED system has no mechanism by which to recognize Net Zero Energy performance, but the National Renewable Energy Laboratory maintains a database on all verified Zero Energy building in the U.S. Based on the current trend, it is entirely possible there will be more Net Zero Schools than LEED Platinum schools in a year or two.

### Relationship of Net Zero Energy Schools to the 2030 Challenge

As an advocate of the 2030 Challenge, adopted by the American Institute of Architects and hundreds of other municipalities and organizations, I am glad to witness the Net Zero Energy Schools trend. The ultimate goal of the 2030 Challenge is, of course, Net Zero Energy for all buildings of every type, new and existing. But it allows that to occur as late as the year 2030. And even in 2030, the challenge allows up to 20% of a building’s energy use to be offset by off-site renewables, a ZEB D condition which many Net Zero Schools have already surpassed by supplying all their energy needs on-site.

The design and construction of Net Zero Energy Schools now is fortunate, for they allow designers to test strategies and technologies for application to a wider range of building types. Because some building types are inherently more energy intensive and others are inherently less energy intensive, achieving the 2030 Challenge may result in an average condition of Net Zero Energy. In this condition, a few buildings may be “allowed” to exceed Net Zero Energy use, while other building types may be “required” to produce more energy than they con-
sume. Schools may very well fall into the category of Energy Producers in the 2030 future.

**Fundamental Design Strategies to achieve Zero Energy**

In order for a school building to achieve Zero Energy, without over-reliance on renewable energy, it must get all the basics of sustainable design right. The checklist we use consists of the following elements. Every one of these design components has the capability of reducing building energy use by 10% or more. Conversely, if the design team ignores any one of these, it may have to overcompensate with excessive design or cost on one or more of the others. Each of the main points is followed by a brief explanation.

- **Orientation/Massing:** While not every new building can be optimally oriented, we have found that it is almost always possible to orient the main axis of the building within 15 degrees of east-west. Doing so results in energy savings by reducing heat load on the building in the summer, and by facilitating daylight harvesting. Whenever possible we seek to obtain a reasonable ratio of surface area to volume, without denying daylight access to learning spaces. We also seek to utilize two and even three story construction in lieu of single floor designs. Combining optimum orientation and massing can easily yield 15% energy savings.

- **Envelope:** Current Building codes require continuous insulation, which is a significant improvement over previous codes without that provision. Our goal for exterior walls is an effective R-value of 25. We also routinely exceed building code required roof insulation, using R-30 minimum instead of R-20. With both wall and roof insulation, it is still important to understand there is a definite point of diminishing returns, beyond which increasing insulation may be a poor investment compared to other possible energy conserving measures. Providing a well designed, constructed, and insulated envelope can yield energy savings of 15% over minimal code compliant construction.

- **Daylighting:** Because electric lighting can consume as much as 20% of total site energy use, it is important to do everything possible to minimize that. The best place to start is by substituting free daylight for costly electric light during the day. As the school schedule coincides well with daylight hours (more so than office building or hospital schedules), it is easily accomplished. We routinely plan to reduce electric lighting energy use by at least half through daylight harvesting.

- **HVAC and controls:** The combination of space heating, ventilation, and air conditioning consume more energy than any other single component in a school building. Design and integration of these systems is therefore critical to improved energy performance. Air delivery through displacement ventilation has the potential to reduce energy use slightly while greatly improving both indoor air quality and acoustics. Geo-exchange systems have become quite popular and in fact are used in all but two of the example projects here. They can reduce site energy use substantially. Energy recovery, natural ventilation, and radiant heating are HVAC strategies rapidly growing in popularity and all have the potential to reduce energy use. The most important issues in HVAC design are to integrate the system selection with basic building design and to align the systems with owner expectations and maintenance capabilities.

- **Electrical lighting and controls:** The first step to reduce energy use related to electric lighting is to minimize lighting power density (LPD) while still maintaining comfortable interior or lighting. This is done through careful fixture selection and placement. If this is achieved, energy use is limited even without sophisticated controls or occupant acceptance. Automated controls that turn off electric lights such as occupancy/vacancy sensors, timed sweeps, and dimming in response to daylighting all can be used to reduce the time during which electric lights are turned on, further reducing energy use for lighting.

- **Occupant Behavior and Plug Loads:** School designers and administrators are well aware of the challenges posed by occupant behavior. Nowhere is this more evident than in the effort to control potentially excessive and wasteful plug loads. A recent study by one of our client school districts revealed one refrigerator per every three classrooms. These appliances had been brought in by staff after the building was competed and were never factored into our energy models. Another example of wasteful plug loads is the inclusion of incandescent lamps for “mood lighting.” And finally, neglecting to turn off computers and monitors can substantially increase energy use in a building.

- **Renewable energy:** Renewable energy sources on a school building or site are necessary in order to achieve Net Zero Energy, but the selection should be made in consideration of other building sys-
tems, local climate, and financial constraints such as rebate availability. Installing PV panels in very cloudy climates, or wind turbines in poor wind energy areas, is simply not good decision making and in the end will only harm the movement toward Net Zero Energy Schools. One other form of renewable energy popular in sunny climates is pre-heated ventilation air. This strategy utilizes wall mounted panels on the east and south to deliver pre-heated air to the HVAC system, or exhaust it directly in the cooling season.

Search for Examples of Net Zero Schools

When I began the research for this investigation more than a year ago, I had begun to hear about Zero Energy Schools, and conducted a Google search. The results of that search, as well as connections through various architectural colleagues, form the basis for the schools used as examples in this article. I am sure that I have overlooked other worthy examples, and I know for a certainty that there are design teams with conscientious clients across the United States, who are now developing a whole new group of Zero Energy Schools. It is not my intention to imply the projects included in this article are the best examples of Net Zero Energy Schools, but they serve admirably to illustrate the variety and scope of this trend.

Example Projects

The projects selected for illustration in this article fall into two broad categories. First are those that have actually achieved, or will soon achieve, Net Zero Energy through installation of renewable energy technology. Second are those that have been designed according to basic energy efficiency principles and have had renewable energy technology designed and sized, but are still awaiting funding for those renewable sources. There is actually a third category populated by only one project. That is the Greensburg, Kansas project, Kiowa County K-12 School, which utilizes off-site renewable energy from the local utility (ZEB D). The projects, listed in chronological order, include the following:

<table>
<thead>
<tr>
<th>School Name</th>
<th>Location</th>
<th>Architect</th>
<th>Energy Consultant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prairie Hill Learning Center</td>
<td>Roca, Nebraska</td>
<td>The Architectural Partnership</td>
<td>E Group / Dixon Power</td>
</tr>
<tr>
<td>Putney School Field House</td>
<td>Putney, Vermont</td>
<td>Maclay Architects</td>
<td>Kohler and Lewis</td>
</tr>
<tr>
<td>Marin County Day School - Learning Resources Center</td>
<td>Corte Madera, California</td>
<td>EHDD Architecture</td>
<td>Stantec Consulting</td>
</tr>
<tr>
<td>Hayes Freedom High School</td>
<td>Camas, Washington</td>
<td>Interface</td>
<td></td>
</tr>
<tr>
<td>Evie Garrett Dennis PK-12 School</td>
<td>Denver, Colorado</td>
<td>DLR Group</td>
<td>E Group</td>
</tr>
<tr>
<td>Centennial PK-12 School</td>
<td>Centennial, Colorado</td>
<td>SlaterPaull</td>
<td>E Group</td>
</tr>
<tr>
<td>Richardsville Elementary School</td>
<td>Bowling Green, Kentucky</td>
<td>Sherman Carter Barnhart</td>
<td></td>
</tr>
<tr>
<td>Kiowa County K-12 School</td>
<td>Greensburg, Kansas</td>
<td>BNIM Architects, ATS&amp;R Architects</td>
<td>CMTA Inc.</td>
</tr>
<tr>
<td>Sangre de Cristo PK-12 School</td>
<td>Mosca, Colorado</td>
<td>Hutton Architecture Studio</td>
<td>BGR Consulting Engineers, NREL</td>
</tr>
<tr>
<td>Lady Bird Johnson Middle School</td>
<td>Irving, Texas</td>
<td>Corgan Associates, Inc.</td>
<td></td>
</tr>
<tr>
<td>Colonel Smith Middle School</td>
<td>Fort Huachuca, Arizona</td>
<td>Emc2 Group Architects Planners, PC</td>
<td></td>
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</tbody>
</table>

Area of Example Schools

The size of school buildings attempting to achieve Net Zero Energy has steadily increased in the last few years. The blue line in Graphic 3 illustrates the total area in gross square feet of each school, plotted in chronological order. Initially, only very small school buildings attempted Net Zero Energy, but now there are full size elementary and middle schools pursuing the goal.

Energy Use Intensity of Example Schools

The example schools all have Site Energy Use Intensity well below national averages and code maximums. Graphic 2 illustrates all the example schools EUI, still plotted in chronological order. The energy data for this chart excludes renewable energy. This is done in order to gauge the inherent energy efficiency of each building design, and eliminate the results being skewed by different building owner’s ability, or inability, to fund renewable energy technology.

Building Area Relative to On-Site Renewable Energy

Graphic 3 looks at Energy Use Intensity in a different manner altogether. It focuses on how much on-site renewable energy is required to maintain the building. Renewable energy sources, whether wind or photovoltaic, have a rated capacity. Using the rated capacity, the chart displays how many square feet are supported by each kW of renewable. More square feet supported per kW implies higher building efficiency.
Rural Schools and Energy Consumption

We are fortunate to have within our example schools group several in rural locations. These schools range in size from the 3,700 s.f. Prairie Hill Learning Center to the 132,000 s.f. Kiowa County PK-12 School. Rural schools can be every bit as energy efficient as their suburban and urban counterparts. They may even have a Net Zero Energy advantage in that their large sites allow renewable energy technology deployment. In fact, two of our rural schools planned ground mounted photovoltaic installation, something that would be impossible in an urban setting.

Rural schools, however, encounter two trends that may adversely affect energy efficiency. Because they frequently serve a dispersed population of small size, it is more common for them to gather more grade levels in one building. Four of the rural schools in our sample group provide K-12 (or PK-12) under one roof. This type of building configuration is inherently less efficient than single age group schools, such as elementary, middle, or high school.

Rural schools also need to serve as community centers. They must therefore provide facilities that are not available nearby. Such facilities may be gymnasiaem with large amounts of seating for assemblies, libraries, meeting spaces, and computer labs.

The combination of multi-age facilities and community amenities results in rural schools often having significantly more area per student than other schools. Whereas the average new school built in the U.S. has 141 s.f. per student, rural schools frequently have up to 200 s.f. per student, and occasionally even more. Graphic 4 illustrates the impact of rural school size on energy use intensity, when measured in kBTU/student/year. The point here is not to criticize rural schools for the almost inevitable use of more energy per student. Rather, it is to illustrate the challenge faced by rural schools and to demonstrate their need for realistic budgets in both construction and operating costs.

Conclusions

Given the geographic, climatic, size, and programmatic variation among the example schools, a wide diversity of approaches to achieving Net Zero Energy would be expected. What is most surprising about this group is the high level of consistency of approach. One strategy is used by all the projects – daylighting. All projects use optimized orientation and photovoltaic panels, and all but two projects use a geo-exchange system. This remarkable consistency may be a clue as to how to approach Net Zero Energy Schools in the future, but only time will tell if this trend persists or other energy conserving strategies emerge and dominate.

The Future of Zero Energy Schools

The projects included here as examples suggest there is currently a practical limit to site EUI for school buildings using off the shelf technology and without exorbitant budgets. Depending on climate and other variables, that limit is estimated to lie between 15 and 25 kBTU/SF/YR. The gap between that range and Zero Net Energy must still be closed with renewable energy technology. According to our example projects, the preferred renewable technology is photovoltaic. Wind energy appears only occasionally and usually in wind power areas and better. Occasionally wind turbines are included in areas with less wind potential, but they seem to be used more as learning opportunities than as actual energy production devices.

It may be hoped that progress will continue in photovoltaic panel efficiency and cost effectiveness, as well as wind turbine efficiency. PV efficiencies have doubled over the last 20 years. If renewable energy technology continues to advance, Net Zero Energy Schools will be more affordable than ever. Without that, we will have to hope for continued refinement in other areas such as envelope insulation, HVAC systems, and lighting design. More likely is a combination of all the above, in which we integrate our efforts and incorporate the most appropriate strategies and technologies into a synergistic building that supports the most fundamental mission of our school buildings – to facilitate learning. ❖

Paul Hutton, AIA, LEED AP, is the founding Principal of Hutton Architecture Studio, in Denver, Colorado. From its origin more than 20 years ago the firm has been dedicated to creating high performance, daylighted, environments for learning. Paul has conducted research, lectured, and written extensively about daylighting schools for nearly 30 years. He developed and still teaches the daylighting and sustainability course at the University of Colorado at Denver College of Architecture. The firm’s Aspen Middle School was Colorado’s first completed LEED NC Gold school building. Since early 2009, Hutton Architecture Studio has partnered with the Governors Energy Office to administer the state’s High Performance Building Program. Paul lives on a sustainable ranch south of Denver, where he is actively pursuing the goal of living at zero net energy. A special thanks to Pete Jefferson at M.E. Group for help providing data on net zero schools.
Evidence abounds that “green strategies” greatly impact both the academic and operational performance of a school. Agencies from the U.S. Environmental Protection Agency to the American Lung Association to the National Education Association agree on the following: Improved indoor-environmental-quality assures healthy students and staff, resulting in lower absentee rates. And professional studies, such as the Heschong-Mahone Report confirm that day-lighting can affect student performance while lowering energy usage. These human benefits combined with the economic impact of conserving resources, gives a school district every reason to invest in improved facilities.

While new schools seem to have the greatest advantage in providing the latest in sustainable, high-performance technology, the fact is that the average school in the U.S. was built over 40 years ago according to the National Center for Education Statistics. The good news is that even these older school campuses may have equal opportunity to improve their energy efficiency factors through renovation or re-building to help move sustainability forward.

When is it Time to Renovate?
Typically a facility needs renovation every 18-20 years or every new generation. If a building is within this age span, five questions can help determine when it’s time to make some changes.

1. Is the school population growing or shrinking?
2. Are warranties for systems about to expire?
3. Has the delivery of curriculum changed to the point that new space is required?
4. Is the condition of the building affecting our teacher’s abilities to teach and the student’s abilities to learn?
5. Will the cost of renovation be greater than 60% of the cost to build new?

If any of these questions are answered in the affirmative, it may be time to start planning ways to modernize, renovate, retrofit or re-build areas of a facility using more resource-efficient systems and strategies. That planning begins with sustainable goals.

Sustainability Goals
For any goal to be a “smart goal” it needs to be specific, measurable, attainable, relevant and time sensitive. This is equally true for sustainability goals for educational facilities. When Scottsdale Unified School District (Scottsdale, AZ) determined it was time to renovate their high schools, Rick Freeman, Director of Facilities was charged with facilitating three high performance goals attached to their Bond campaign of 2004. “First, we wanted to increase energy efficiency and lower maintenance 25-30% resulting in savings of over $1 million per year. Second, we needed to reduce repair costs, saving $92 million in capital expenditures over 10 years. And finally we wanted to extend the life of our systems and lower life-cycle costs at each school.”

In addition to the green strategies that affect student performance, other sustainability goals for a school district may also include elements of educating students, staff and community in sustainable efforts and results.
Communicating the positives of saving money and improving learning outcomes is one of the first methods to build trust when a district seeks additional funding through future bond campaigns.

**Sustainability Strategies**
To meet sustainable goals, specific strategies can be implemented which require making wise choices based on budget and impact.

**No-Cost Strategies**
• Create a resource-conscious culture. This includes assigning responsibilities for common areas to ensure that lights and PCs are turned off and that recycling and water conservation opportunities are part of the daily routine.
• Control classroom temperatures – For every degree on the thermostat, there is a 1% impact on energy use and cost.
• Establish plug load plan. Unplug power strips when not in use.
• Measure and verify – Benchmark your school energy and water consumption over a period of time. Use this to determine improvements after changes in operation or systems are in place.
• Optimize your existing systems with regular maintenance of chiller tubes and filter replacement. Fine tune automation systems and assess weaknesses or trouble areas before breakdown.

**Low-Cost Strategies**
• Measure and verify at a more detailed level than mentioned in the no-cost strategy. Consider a retro-commissioning of your systems. (Commissioning is a service that licensed specialists or engineers can deliver, providing a review of all operating systems to determine levels of performance and areas needing improvement.)
• Automate with scheduled shut-off of lighting, appliances, motorized dampers, exhaust fans and water heaters, using a low-tech time clock. Further invest in programmable thermostats or occupancy sensors to better control use of electricity.
• Optimize your energy usage with lighting upgrades, replacing standard 32W lamps with T8 lamp technology. This gives the same light output characteristics while using 12% less power.
• Consider light-color interior finishes for better light reflectance and less use of illumination.
• Replace dated equipment with energy efficient equipment, upgraded door and window hardware seals and closers, high performance roofing insulation.

**Smart-Investment Strategies**
If funds are available for more extensive investment in modernizing a school, consider the following:
• Measure and verify with in-depth software analysis such as TRACE 700 or Revit. These are systems that most architecture or engineering firms are familiar with and can run based on input provided by a school district. These systems allow the user to use “energy modeling” to establish an accurate energy budget.
• Automate your building with systems that use controls to properly operate chillers, monitor outdoor conditions and reset chilled water temperatures, use occupancy sensors for lighting and cooling systems.

• Optimize lighting design to avoid over-lighting for specific tasks. Install high-performance glazing, shade canopies, overhangs and sun screens to minimize heat gain, or skylights and clerestory windows to optimize day lighting without increasing heat gain.

**Renewable Energy Strategies**

Faced with overwhelming budget constraints, schools are challenged to drastically reduce costs without affecting learning. Solar energy is a perfect solution to offset escalating energy costs. However, most districts across the nation cannot take advantage of Federal rebates and tax incentives offered to the general public. With public/private partnerships, solar solutions are not only possible for public schools, but may require minimal or no capital outlay by the district, resulting in significant electric energy savings.

Photovoltaic systems can also help stabilize operating budgets by avoiding rising utility costs. Under a Power Purchase Agreement, a fixed price at today’s rates may be locked in over the next 20 years. In addition to operational cost benefits, renewable energy communicates to the community a commitment to transition from dirtier energy sources to clean energy. Depending on the size of the PV solution, a school can anticipate upwards of 80% of their energy could be generated through photovoltaic systems.

Installation options include rooftop, carport / parking structures, shade structures or ground mount. Some districts, such as Payson Unified School District (Payson, AZ) have used a variety of installation options based on the site needs and opportunities to improve the campus. At the District’s Julia Randall Elementary, shade structures over playground areas allow students to benefit from shade in the hot months and even during rainy days. At their high school, roof-mounted panels made more sense.

Regardless of levels of investment, schools old or new can increase the positive impact on both the natural and learning environments, directly benefiting operational costs. Moving sustainability forward becomes a win-win-win strategy for the district, the community and the environment.

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**Bill Taylor, AIA, LEED-AP,** has been an education design leader at DLR Group for 27 years. His work in educational facility design has received numerous awards from the American Association of School Administrators, the National School Board Association and the Council for Educational Facility Planners International. Bill’s strong knowledge of sustainable elements of design, programming, and construction documents has been instrumental in making him an industry leader through DLR Group’s National Education Forum and as former Chairman of AIA Arizona’s Governmental Affairs Committee and the current Co-Chair of their School Facilities Committee.
Rebuilding It Better:
Greensburg Kansas

Our community has faced many challenges since May 4, 2007. The rebuilding of all the town’s school facilities was just one of them. However, as we approach the end of the first year in the new building, we are happy with the outcome. The facility already feels like home.

On May 4, 2007, a massive EF-5 tornado destroyed 95% of Greensburg, Kansas. Over 900 homes and 125 businesses, including all school facilities were totally lost in the storm. Since then, the city and community leaders have been committed to rebuilding the town as a model sustainable rural community.

The challenges facing the community immediately after the storm were far reaching. However, the most significant challenge was to decide whether to rebuild the town the same as it was before the disaster or to rebuild the community in such a manner as to improve the community’s chances for survival and recovery. We were a typical rural town with an aging population, deteriorating retail on Main Street, and a school population that was in decline. If we built it back the same as it was, we were destined to the same less than promising future.

The final decision was made after much thought and deliberation by community leaders. Let’s rebuild the most sustainable community in America. Let’s do everything we can to give Greensburg the chance at survival, offering something totally different than you see in most every other rural community. The result is a town that boasts a ratio of 1 LEED building for every 80 residents to date. There are at least 13 new buildings scheduled...
to be LEED certified in the next few months. The school is scheduled to be LEED Platinum and services 340 students, PreK through 12th grade.

Design Challenges

While searching and interviewing architectural firms to “lead” in the design of the new facility, we stepped away from the norm and hired a firm that had less experience in designing schools and more experience in sustainable design. We hired BNIM out of Kansas City. They have been fabulous to work with and we are very pleased with the end result.

Our goal was to design a school unlike most you will ever see. We had a strong, experienced administrative team that had a clear vision of what we needed in our learning environments. We also didn’t want our new school to look like all of the other schools being built today. We wanted and demanded more from our architects.

We also had the challenge of working within the guidelines set forth by the Federal Emergency Management Agency (FEMA) with regard to disaster recovery. Though FEMA does not always get the highest of praise around the country, in our situation, they have been a great partner. Our initial challenge was to identify everything that was lost in the storm and determine the cost to replace these items to the same level they were before the storm.

The second, and more difficult challenge, was to find partners and to leverage money so that we could improve upon that and build a state of the art building with the latest in sustainable features. In the end, we accomplished both.

Energy Conservation

To reach the 50% energy savings and LEED Platinum certification goal, the school design team incorporated a number of energy conservation and efficiency measures.

Lighting

Immediately after the storm, the National Renewable Energy Lab (NREL) encouraged me to take a trip to Raleigh, NC to look at some of the new school facilities they were building there and get ideas to incorporate into our design. The one feature that stood out the most to me was their use of natural day lighting, especially the use of north facing clear story windows. By orienting the building from east to west we are able to capture the abundant natural daylight from south and north facing windows which helps warm the building in the winter and floods the spaces with natural light.

This feature is most evident in our two gymnasiums. During the day it is rare that we ever need to turn on artificial lights to conduct classes. Regularly occupied spaces such as classrooms and corridors, along with the gyms, are fully day lit to reduce artificial lighting. When we do need artificial lighting, electronic timer light switches, indoor and outdoor photoelectric switches, and indoor occupancy switches determine how many lumens to use.

Building Envelope/Insulation

The walls and portions of the roofing system are constructed with structural insulated panels (SIPs) rated from R30-R40, which eliminate the heat/cold migration through the exterior building envelope that typically occurs with metal stud framing. It was also beneficial that the wall envelope system was constructed in an extremely controlled environment off site, reducing both on-site waste and construction time.

Heating, Ventilation, and Air Conditioning (HVAC)

One feature that is proving to be both reliable and energy efficient is our geothermal system used to heat and cool the building. We have a hybrid closed loop ground source heat pump system made up of 96 geothermal wells, each 410 feet deep. This system, combined with a fluid cooler, provides heating and cooling by extracting both from the earth.

In addition, a dedicated outdoor air system with energy recovery ventilators provides outdoor air based on
It controls carbon dioxide levels, allowing us to have fresh air in the building.

**Wind Power**

Every system in our building is operated with electrical power. That said, we have an on-site wind generator which produces 50-kW of power. It is scheduled to produce $700,000 of power over its life cycle. To date, our generator is the top-producing 50-kW Endurance generator in the world. In addition, our entire city uses 100% renewable energy. The city has its own wind farm that produces all of the power required by the community.

**Sustainable Features**

The new school’s numerous sustainable practices and features provide a healthy indoor and outdoor environment for students, faculty, parents, and visitors. Our goal is to continue to improve and utilize the areas around the school for ecological classroom activities including a composting area and school garden.

**Materials**

All of the building materials were chosen with sustainability and reclamation in mind. The cost-effective and easy to maintain polished concrete flooring is manufactured with low volatile organic compounds (VOCs). Some interior walls are also constructed of regional concrete masonry unit burnished block that requires no painting and maintenance, further reducing VOCs.

Ceilings and walls in the hallways and classrooms are covered with reclaimed Douglas fir board paneling. The wood looks great aesthetically and acoustically benefits the spaces.

The outside of the building features more than 3,500 board feet of reclaimed wood salvaged from cypress trees destroyed in the Katrina Hurricane. The wood is accented by Kansas limestone cladding and a metal zinc material that has zero maintenance.

**Water Efficiency**

All of the rainwater that falls on the property is captured and stored in water storage tanks or cisterns. The cisterns store 121,000 gallons of water that is used to irrigate all of the grasses, plants, and shrubs on site.

In the interior of the building, waterless urinals and low-flow fixtures in all showers, faucets, and toilets reduce water use. As of now, we anticipate seeing over 50% reduction in water consumption.

In the parking areas and around the building, bioswales (straight runoff channels filled with vegetation) are incorporated to remove silt and pollution from surface runoff water.

**Thoughts at the End of Year 1**

Many people come here and say, “Wow...this is really nice.” And we agree. However, if given the chance to avoid the tornado in the first place most of us would love to have our old town back. Unfortunately, that wasn’t an option. Given our circumstances, we feel fortunate to have worked with the many people and companies that partnered with us in this endeavor. We have been able to give our students, who spent three years in temporary facilities, something they can be proud of. Beyond that, we feel like we have given them a state-of-the-art learning environment that will serve not only our current students, but students for generations to come.

Darin Headrick is now in his 8th year as Superintendent of Schools in USD 422 Kiowa County.

In the wake of a devastating EF-5 tornado that decimated 95% of the city and 100% of the local school on May 4, 2007, he led the effort to construct temporary facilities and managed to open school on schedule on August 15, 2007. In addition, USD 422 just finished construction of the first LEED Platinum PreK-12 School in Kansas. Darin, along with numerous other public officials, is working toward the construction of a model community with the latest in green design.
What’s Keeping Us?
Some Thoughts on Moving Forward

By Robert J. Kobet

Recognize we still have a massive job of educating all the critical stakeholders, especially those with administrative decision-making and fiscal responsibility. Understand the potential for LEED and CHPS to enrich the educational delivery process. Ultimately, the goal is to provide the best learning environment possible. Work to optimize the investment in high performance green schools while minimizing the risks associated with the design, construction, operation and maintenance of high performance green schools.

Anyone involved with the high performance green school movement knows we have a lot to celebrate. The concept of energy, material and resource efficient facilities optimized for the health and productivity of the occupant and user designed, constructed, operated and maintained to the extent possible within the carrying capacity of the planet has certainly made inroads in the K-16 arena. School administrations are benefiting from a growing awareness and appreciation of maximizing the connections between facilities, the community and curriculum and what that can do to enrich the educational delivery process. Happily – and I believe very significantly – greening school curricula has taken on a life of its own, independent of the need for a modern, high performance green school facility. The literature is full of case studies, articles and examples of successful green school initiatives that cite a variety of projects genuinely deserving of the title “green school.”

At the same time, my experience is that eleven years after the founding of CHPS and five years after the launch of LEED for Schools, many stakeholders in critical decision making positions know very little about what comprises each and certainly cannot accurately compare the two. When I teach LEED for Schools workshops I often ask the group, “What is LEED Silver?” They know they want “LEED Silver”, based on the popular position that LEED Silver is the minimum they should accept, but are not sure exactly what they are asking for. More important is often project participants responsible for writing requests for proposals and reviewing the requests for qualifications are not aware of their own central role and responsibility in insuring the success of a LEED or CHPS project.

This realization becomes significant when the popular press features schools embroiled in lawsuits based on failure to perform as anticipated. (www.greenbuildinglawupdate.com) The economic downturn, staff reductions and pressure to limit resources only to core services and basic needs has distracted decision makers from pursuing high performance green schools or investing in an integrated design approach that would justify the investment in a robust, comprehensive project. In many of these scenarios the enthusiasm for teacher and staff workshops to learn how to use the school as a teaching tool, green the curriculum or pursue public / private partnerships and community connections is dampened. The priority becomes building the building and little else. Faced with tight budgets and abbreviated building programs and education specifications the project team has little incentive to go beyond what they are charged to do. “LEED Silver” loses its luster as the team ponders why a site with little potential to achieve any Sustainable Sites credits was chosen.

When first cost is the only parameter for pursuing the minimum number of LEED points necessary, teams staffed with cost estimators who do not understand integrated design, or who do not believe it is their responsibility to suggest savings based on the same, are at a disadvantage from the beginning. Teams instructed to ignore life cycle cost issues cannot be expected to advocate for sustainable design features or LEED points like Enhanced Commissioning, Daylighting and Measurement and Verification, even though the literature shows these are sound investments that pay back in a
short period of time. Their academic value is well established, so the purpose of the school – to educate – is also impacted. More critical, perhaps are the LEED points and associated opportunities lost when the successful project “team” quickly argues them away because they simply do not understand or know how to approach them, or when time and budget constraints or the need to involve other consultants make them marginally desirable.

Once the facility is constructed, the same pressures can limit effective operation and maintenance and cause the administration to overlook the cost effectiveness and proven academic value of involving the staff and students in the environmental stewardship and care of the school building and site. This limits the potential return on the investment and influences the long-term ability to keep energy and maintenance costs to a minimum. As is so often the case, every dollar drained by inadequate maintenance is one lost to academic programs. The irony of this is that in a high performance green school each reinforces the other and maximizes the effective each. Yet, how many school administrators or RFPs connect effective maintenance and academic performance?

I have had several pointed discussions with stakeholders who are tracking the emergence of the International Green Construction Code (IGCC). The fact that USGBC is a primary partner in the ongoing effort to implement IGCC is noted. Participants frequently ask, “If I comply with the IGCC do I need to do LEED?” Or, “If I am primarily concerned about energy and operating costs, why should I subject my school district to the costs and complications of a LEED for Schools submission?” These are fair questions in hard economic times. I tell them the fact the IGCC focuses largely on energy, material and resource issues and does not address the essence of what makes a high performance green school a superior learning environment.

So, we find ourselves in an interesting place as we ponder moving sustainability forward. The USGBC Center for Green Schools and the Collaborative for High Performance Schools continue to expand their programs and influence. The growing National Green Schools Network and the International Green Education Network are embracing a highly varied group of constituents. A number of programs joining K-12 and institutions of higher learning focused on architecture as pedagogy and the connection between facilities, the community and curriculum continue to make their mark. We need to support these organizations and appreciate them for what they and so many others are contributing to moving sustainability forward.

To keep sustainability moving forward as part of a robust high performance green school movement I believe we also need to do the following:

- **Recognize we still have a massive job of educating all the critical stakeholders, especially those with administrative decision-making and fiscal responsibility.** Board members often have different backgrounds and skill sets that collectively benefit the district in a variety of very important ways. While these individuals may not have a need to hold LEED AP credentials or serve on a CHPS committee, we would all be better served if they have the best understanding possible of what these systems are and how they function. Most important is for them to have a working understanding of their role and how they influence the feasibility and success of the project.

- **Understand the potential for LEED and CHPS to enrich the educational delivery process.** Ultimately, the goal is to provide the best learning environment possible. Too often compartmentalized administration and a linear approach to project development separate responsibilities attributed to developing and maintaining the physical plant from those associated with curriculum and education per se. This is neither wise nor cost effective. It has been said 80% of students who drop out of school have passing grades; they simply don’t want to be there. I believe the most important successes to date are those where LEED or CHPS criteria has been used to optimize the facility as a teaching tool and students have found new excitement and relevance in curriculum that engages them in collaborative learning based on their surroundings. This is particularly important to the success of STEM programs that can benefit significantly from school building systems data, interfacing classes with energy management and measurement and verification systems, building forensics, and a number of other learning opportunities that synthesize academic requirements and the physical environment. Other success stories are those in which the site is utilized to grow food and create natural landscapes. This reality is manifest in the growth of the urban agriculture movement in school gardening programs that benefit the community and the contribution of these and other meaningful
outdoor school site activities to stress management and positive self-esteem. None of these efforts should be additive. They need to be integrated into the school day and the academic year in ways that are valued, not burdensome.

• Work to optimize the investment in high performance green schools while minimizing the risks associated with the design, construction, operation and maintenance of high performance green schools. In order to accomplish these two directly related goals the effort must start as far upstream as possible. Owners must understand the new role and critical influence the RFP process when issuing invitations to participate in LEED and CHPS based projects. Simply dropping a few lines about “must meet LEED Silver” into an otherwise standard RFP format is not sufficient and can lead to contractual and building performance failures. An effective RFP begins with the author(s) having a working understanding of the rating systems and their responsibilities. It should be based in part on canvassing the teachers, students, staff and community about the extent they are willing to participate to achieve their goals. This takes additional work, but goes a long way to build support, maximize the return on investment and establish a sense of ownership that will survive well beyond the ribbon cutting. The RFP must also exhibit the owner’s insight to the value of such things as requiring building systems modeling as a deliverable early in the project and the willingness to adjust fees or incentivize the effort to be sure the building performance will be optimized prior to the end of design development. In the best case, the RFP should convey the owner as an active, informed participant who understands the project’s potential for greening not just the building, but also the culture of the school district, the community and the region.

There are many other things we can do to move sustainability forward. In the end, it is the product and process of individual efforts that collectively make a difference. We have come a long way; let’s keep going.

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