© Assassi

STRONGER, BETTER GREENER

BY CHARLES S. CASSIAS JR., FAIA

On a spring evening in 2007, a two-mile wide tornado plowed through Greensburg, Kan. (population 1,400). The National Weather Service issued a rare Tornado Emergency, reserved for only the largest and most violent tornadoes. Most buildings in Greensburg were damaged or destroyed by the EF-5 tornado that was the worst to hit southwest Kansas since the 1960s. The civic leaders of Greensburg chose to rebuild their town—in their own words, "Stronger, Better, Greener…"—and develop a sustainable comprehensive master plan that would guide the town's transformation.

After the tornado, the city council passed a resolution stating that all city buildings would be built to LEED Platinum standards, making it the first city in the nation to mandate such a rigorous requirement. The school district also committed to rebuilding a model green facility, focusing on simple and passive building systems and integrated design to maximize efficiency and reduce energy use and costs. The result is a school that uses 29.2 kBtu/ft^2·yr, less than half the energy used by a school built to code.

Opposite **Though the obvious function of this facility is to serve as a high performance environment for teaching and learning, the new Greensburg school—located in the heart of the town on Main Street—also serves as an important community resource by providing space for public meetings, recreation and other activities.**

Below **On the night of May 4, 2007, an EF-5 tornado nearly two miles wide ravaged the town of Greensburg, Kan., resulting in loss of life and displacing more than 1,500 people and destroying 95% of the town's homes and businesses.**

In Kiowa County, population declined as young adults moved away to seek better opportunities.

Unified School District 422 (USD 422) believed that first-rate facilities that supported student achievement were the solution to reinvigorate the district and plan for the future. USD 422 recognized the need to serve a larger geographic area with their new facility.

Two nearby districts with aging school facilities and small student populations chose to combine with Greensburg (by consolidation or cooperative agreement) to create a single county-wide facility, right-sizing at a regional scale. USD 422 decided to combine all of its facilities—seven buildings on five sites—into a single location on Greensburg's Main Street. This allowed the district to consolidate functions for greater efficiency, contribute to a walkable community (a tenet of the community master plan) and become a central civic resource for this small rural community (the library and large meeting rooms are shared community resources).

This consolidated facility addresses three critical concerns. It provides a high-quality learning environment; creates a single building, which offers the best long-term value to the three educational facilities housed there (elementary, middle and high school); and addresses other costs by integrating sustainable strategies that would allow for lower maintenance and operation costs.

The school district embraced student-centered design principles in the shaping and design of its new facilities. Throughout the design process, every decision was weighed against a single question: "How does this benefit the student(s)?"

BUILDING AT A GLANCE

Name Kiowa County Schools (formerly Greensburg K-12 Schools)

Location Greensburg, Kan. (110 miles due west of Wichita, Kan.)

Owner Unified School District 422

Principal Use K-12 Public School

Employees/Occupants
350 students, 60 staff

Occupancy 100%

Gross Square Footage 123,405
Conditioned Space 123,405

Distinctions/Awards
LEED Platinum for Schools (2007 Version), 2011; AIA/COTE Top Ten Green Projects, 2011

Total Cost $31,200,200
Cost Per Square Foot $238

Substantial Completion July 2010

Occupancy August 2010

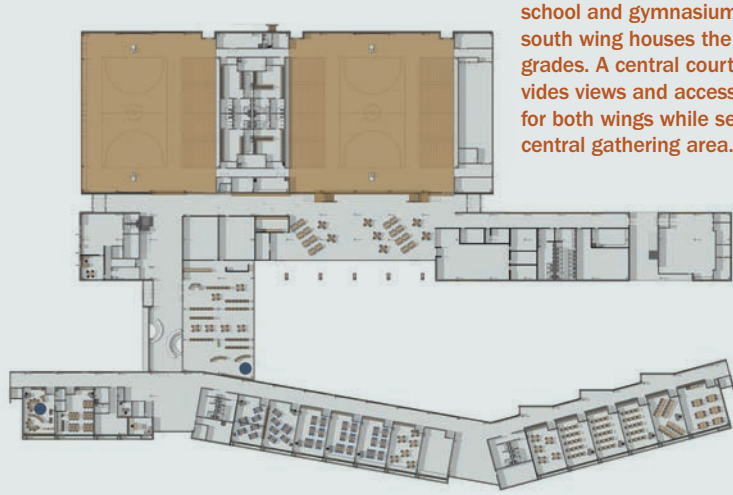
© Assassi

© Assassi

Top The gymnasiums are designed with windows and sawtooth skylight roofs to bring in natural light. These spaces are sited north of the classrooms to avoid blocking sun and air access.

Above The high school hallway and mezzanine are daylit and lined with smooth wood furring and paneling reclaimed from deconstructed warehouses.

GROUND FLOOR PLAN



The north wing houses the high school and gymnasiums. The south wing houses the lower grades. A central courtyard provides views and access to daylight for both wings while serving as a central gathering area.

The new school serves as an active teaching tool, demonstrating sustainable stewardship. The building is filled with daylight, providing an optimal learning environment. The school's energy efficiency allows more community resources to be spent on education rather than utility bills.

Designing for Students, Community

The selection of the site reinforces the Sustainable Comprehensive Master Plan by placing the school's front door along Main Street (the site is the former location of the district's football stadium). The building is organized around a central courtyard gathering space serving the entire student body.

The north wing houses the high school and gymnasiums. The south wing houses the lower school curriculums. The new school serves as a major community focal point, a catalyst for future development along Main Street and as a tool to promote student health, productivity and enhanced learning.

The school is a social hub for the small rural community. Fitness and athletic spaces meet the larger community's social and recreational needs, while other spaces accommodate adult education and senior citizens' activities. The program connects this small rural community in a way that didn't happen previously.

The team focused first on strategies with no associated operational cost. The design approach looked to passive design strategies: optimized siting; orientation; building envelope strategies; and effective daylighting strategies.

An integrated design process weaved together the primary design strategies, such as passive solar design with comprehensive strategies for rainwater reclamation, geothermal heating/cooling, on-site wind generation, reclaimed/regional building materials, and creating a community-centric campus.

KEY SUSTAINABLE FEATURES

Water Conservation Low flow fixtures, waterless urinals, xeriscape indigenous landscaping, rainwater capture/reuse for irrigation using five aboveground steel cistern tanks (four with 14,780 gallon capacity and one with 10,139 gallon capacity) and one 50,000 gallon underground fiberglass cistern tank.

Materials Exterior wood from Hurricane Katrina deadfall. Interior wood siding and furring/blocking from warehouses in Missouri and California.

- 46% of the wood (based on cost) is FSC certified.
- 24% of the materials (based on cost) are recycled.
- 27% of the materials (based on cost) are local/regional materials.

Daylighting All normally occupied spaces, except distance learning classrooms, receive natural light, which is provided by north facing clerestories in classrooms and the gymnasium. Daylighting control accomplished with dimming ballasts and photocell control in each space.

Individual Controls Individual temperature controls and operable windows in classrooms. Either individual temperature control or operable windows in offices.

Other Major Sustainable Features
Geothermal closed loop ground source heat pump system, on-site 50 kW wind turbine (8% of net energy needs), remainder of electricity from community wind farm, SIPS panel exterior wall system, sunshading device at south facing windows.

The mechanical system is a ground source closed loop heat pump, which reduces maintenance requirements because there are no condensers. The project is powered by natural gas and electricity from an on-site wind generator and the city's wind farm, which supplies the entire town of Greensburg with 100% renewable energy.

© Assassi

Circulation spaces are organized around a central courtyard. The multiple windows provide views of nature, outdoor activity and the academic community.

Supporting Academic Achievement

The design provides distinct areas for kindergarten, elementary, middle and high school grades to give students learning and social opportunities that are age appropriate. Two single-loaded academic wings, each with an east-west orientation, optimize solar orientation and prevailing breezes.

The lower and middle schools are in the southern wing, which bends to allow three distinct school zones. The high school is located on the second floor in the wing to the north and is placed above key support functions including the cafeteria/kitchen and distance learning facilities.

The district understood the importance of daylighting for increasing student academic performance. The design effort focused on daylight optimization in occupied spaces because of the recognized positive impact on cognitive ability and academic performance.

Detailed daylighting models and analysis allowed the design team to properly place and size the windows, including skylights in the corridors, for optimal performance. During normal school operating hours, electric lighting is not required except in the few

ENERGY AT A GLANCE

Annual Energy Use Intensity (Site)
29.2 kBtu/ft^2
Natural Gas 4 kBtu/ft^2*
Electricity 22.8 kBtu/ft^2
Renewable Energy 2.4 kBtu/ft^2

Annual Source Energy 83 kBtu/ft^2

Annual Net Energy Use Intensity
26.8 kBtu/ft^2

Savings vs. Standard 90.1-2004 Design Building 64.8%

Heating Degree Days 3,983

Cooling Degree Days 2,705

*Due to a metering problem, natural gas data is not available prior to October 2011. Gas use is extrapolated based on October 2011–January 2012 data.

WATER AT A GLANCE

Annual Water Use 617,000 gallons (2010–11)

The projected water use for the building flow and flush fixtures alone based on calculations for LEED was 1,396,928 gallons (40% below the baseline). The total first year water use water is 617,000 gallons, which is 779,928 gallons below the projection. These numbers include any water used for this first year of landscape establishment.

© BNIM

Above **Common spaces feature durable surfaces designed to hold up to the wear and tear of 350 students passing through each day.**

Below **The classrooms are carefully designed to integrate daylight, technology and tactile elements to supplement other teaching tools.**

BUILDING ENVELOPE

Roof
Type
Low Sloped Roofs and North Side of Gymnasium Clerestories White thermoplastic membrane over rigid insulation
Steep Sloped Roofs and North, East and West Portions of Gym Clerestories Standing seam metal roofing
Overall R-value
R-40 at SIPS panels at steep sloped roofs
R-30 average per roof area at low sloped roofs
Reflectivity
TPO SRI Value 95 initial, 83 aged
Standing Seam SRI Value 61

Walls
Type SIPS panel system with rainscreen overlay (limestone shingles, zinc panels or reclaimed wood siding)
Overall R-value R-40
Glazing Percentage 30%

Basement/Foundation
Perimeter Exterior Face of Foundation Wall R-15

Windows
U-value
South Facing
Winter: 0.35, Summer: 0.35
North, East and West Facing
Winter: 0.29, Summer: 0.27
Solar Heat Gain Coefficient (SHGC)
South Facing 0.66
North, East and West Facing 0.45
Visual Transmittance
South Facing 74%
North, East and West Facing 67%

Location
Latitude 37.36 N
Orientation East-west

interior spaces. Electronic timer light switches, indoor and outdoor photoelectric switches and indoor occupancy switches determine supplemental lighting levels.

The sectional shape of the classrooms incorporates a north-facing clerestory introducing daylight deep into the classroom and providing airflow through ventilation in the classrooms when environmental conditions permit. More than 50% of the building can be naturally ventilated as a result of the ventilation strategy. Individual user temperature controls and supplemental task lighting are also provided in the classrooms.

The exterior sun shading devices reduce both glare and heat gain. Overhangs for south-facing windows are specifically designed to limit summer solar gains while allowing for winter passive warming. The gymnasium also is illuminated by daylight captured by north facing clerestories, further reducing the electric demand.

State-of-the-art AV/IT technology, including a robust, adaptable infrastructure, is incorporated throughout the school. It is adaptable to accommodate future changes in teaching and learning styles, as well as technology advancements.

The team established three levels of classroom learning: 1) formal classrooms; 2) interior public spaces; and 3) outdoor classroom spaces (courtyard and art terrace), where the school itself serves as an active

© Assassi

Data center cooling just got simpler, faster, and more efficient.

Flexible

Flexible, fast, and cost-effective deployment to meet cooling needs today and tomorrow.

Scalable

The pre-engineered modules can be scaled to capacity and redundancy requirements as needed.

Adaptable

Ability to address any cooling requirement worldwide via multiple modules and frame voltages/frequencies.

Easy

Faster and easier installation because of a single point of connection for power.

Only Schneider Electric EcoBreeze maximizes year-round economization.

Data centers face unprecedented cooling challenges brought on by high-density computing, dynamic temperature profiles, regulatory requirements related to efficiency, and uncertain long-term plans for capacity or density. Today, Schneider Electric™ has the innovative answer to meeting these and other cooling challenges.

Introducing Schneider Electric EcoBreeze

EcoBreeze™ is the industry's only economizer with two economization modes in one footprint. Specifically, it automatically can switch back and forth between air-to-air heat exchange and indirect evaporative cooling to maximize local climate conditions at all times. As a result, it uniquely ensures the most efficient and effective form of cooling year round.

In addition, the innovative cooling solution boasts a modular design for capacity, redundancy, and service flexibility. What's more, scalable 50 kW modules make right-sized cooling possible, allowing data center operators to match cooling capacity to actual cooling needs. And EcoBreeze is much faster and easier to deploy than traditional data center cooling infrastructure.

Efficient, scalable, and flexible, EcoBreeze enables Business-wise, Future-driven data centers.

Business-wise, Future-driven.™

- **Faster and easier:** Flexible, quick, and cost-effective deployment since unit used zero white space with the data center.
- **Right-sized:** The pre-engineered 50 kW modules that fit into two frame sizes can be scaled to 200 kW – 400 kW increments of capacity and redundancy requirements as needed, lowering both CapEx and OpEx.
- **Energy-efficient:** Automatically switches between air-to -air and indirect evaporative heat exchange for the most efficient cooling. A supplemental DX circuit on board gives additional peace-of-mind reliability.
- **Two economizer modes:** Indirect evaporative cooling and air-to-air heat exchange in the same module enable more economization opportunities.

Make the most of your energy℠

HPB.hotims.com/37999-24

Economize with economizer modes!
Maximize savings after reading "Economizer Modes of Data Center Cooling Systems" and enter to win an iPad® 2.
Visit: www.SEreply.com Key Code: p381v or Call: 888-289-2722 x7278

Schneider Electric™

teaching tool and is integrated into portions of the curriculum.

Energy and water savings are monitored and shared with the students, reinforcing the significance of their environment and daily choices. Science classes study the ecology of the nearby streambed, which was restored and planted with native plants during the project. Students actively participated in the restoration efforts and continue to monitor the performance of the newly established ecosystem.

NATURAL GAS USE
OCT. 2011–JAN. 2012
(BTUS IN MILLIONS)*

Oct-11	17
Nov-11	79
Dec-11	121
Jan-12	114
Total	**331**

*Due to a metering problem, natural gas data is not available prior to October 2011.

ELECTRICITY USE
JULY 2010–JUNE 2011
(KWH)*

Jul-10	104,640
Aug-10	105,600
Sep-10	73,320
Oct-10	66,240
Nov-10	73,080
Dec-10	77,400
Jan-11	85,800
Feb-11	66,960
Mar-11	69,600
Apr-11	57,840
May-11	68,040
Jun-11	74,280
Total	**922,800**

*Purchased electricity only. Does not include electricity from on-site wind turbine.

© Assassi

Classroom designs incorporate controlled natural daylight, outdoor views, and good indoor air quality and acoustics, which are known to have an impact on students' mental alertness, productivity and psychological well-being.

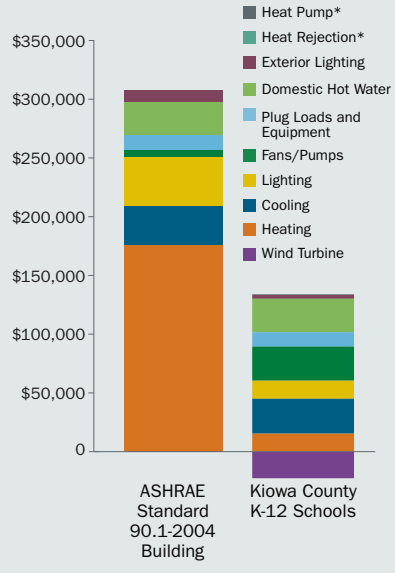
Energy

One-hundred percent of the Kiowa School's purchased electricity is from renewable energy sources. An on-site 50-kW wind turbine provides 8% of the electricity needs, while the remaining power is generated at the wind farm located outside of town (within clear view of the school).

The on-site turbine is expected to produce $700,000 worth of electricity over its life cycle and will pay for itself in 11 years. Because of the effectiveness of the wind turbine and the city's nearly ideal location for wind generation, the district is now considering adding a second on-site wind turbine to further reduce its reliance on purchased power.

The building uses a geothermal closed loop ground source heat pump system, with 97 wells that are each 400 ft deep. A dedicated outdoor air system with energy recovery ventilators provides outdoor air based on demand as detected by carbon dioxide sensors. The HVAC mechanical system design also facilitates the maintenance of the building and its equipment. Controllability of temperature and supplemental task lighting improves the comfort levels of the interior

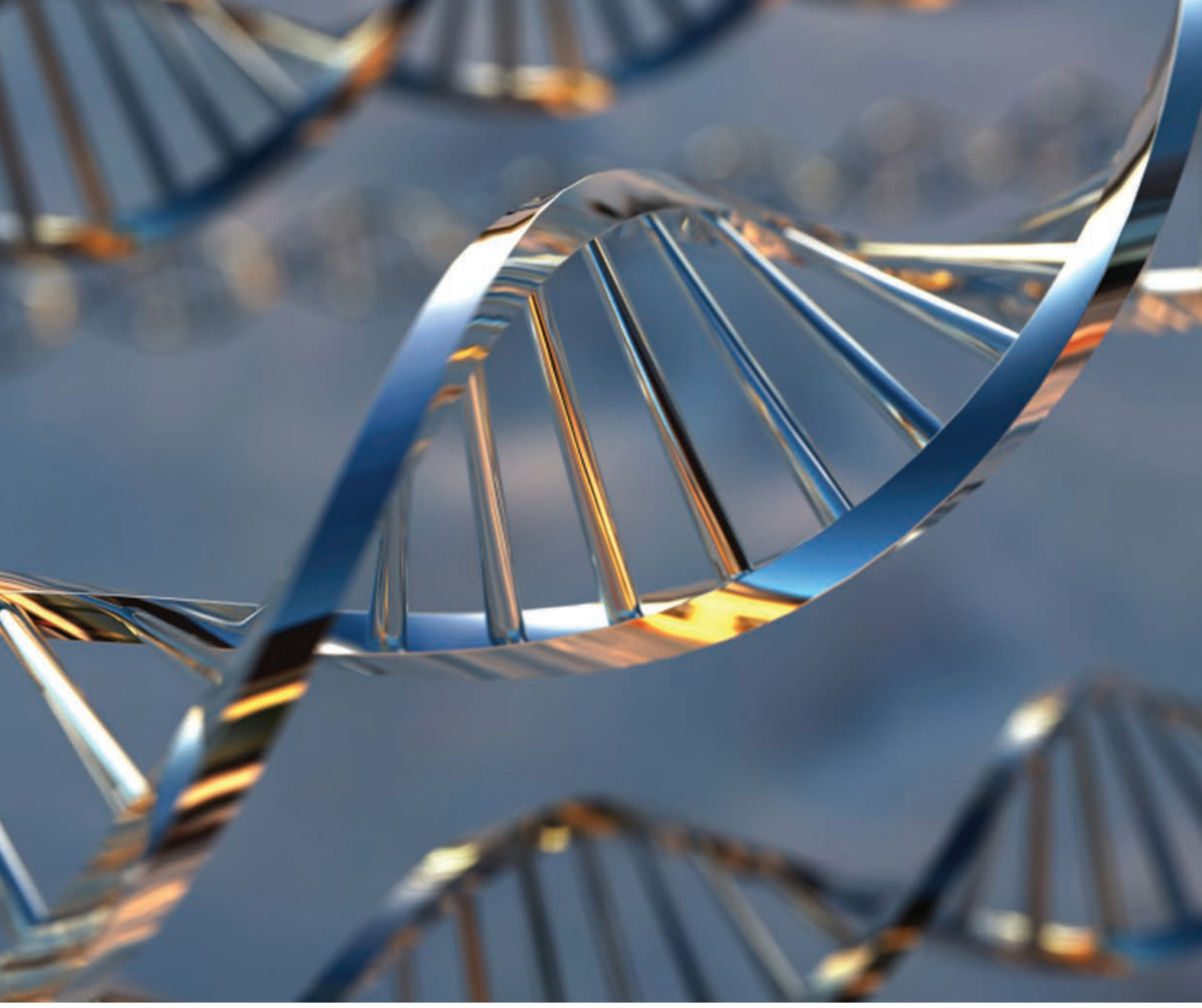
PREDICTED ANNUAL ENERGY COST SAVINGS



*Projected annual cost for the heat pump is $433 and cost for heat rejection is $209.

© National Renewable Energy Laboratory

Energy analysis modeling indicates that annual energy costs for an ASHRAE Standard 90.1-2004-compliant building of the same size and shape would be about $308,000. The column on the right represents the expected energy costs for the school—a reduction of more than 50%. Actual energy use is 2% lower than modeled predictions.



Creating exceptional environments.
Transformation; adapting to change and molding our future.

At Syska Hennessy, we help our clients realize their goals and aspirations. Understanding that change is the only constant in our industry, we thrive on the challenges and opportunities that comes our way. Together we can develop a vision for the future and commit our technical competence to help you create exceptional environments.

For more details, visit www.syska.com

SYSKA HENNESSY GROUP

CONSULT + ENGINEER + COMMISSION

© Assassi

The central courtyard and shared learning space is a hub of activity for gathering and play. Its location at the heart of the school's two wings ensures a connected community environment.

environment, promoting productivity and well-being.

The building envelope, orientation, lighting and sun-control systems for the school buildings minimize heating and air-conditioning loads. Structural insulated panels (SIPs) with an R-value of R-40 reduce thermal loading and create a high performing building envelope.

A rain screen cladding system improves resistance to moisture infiltration and reduces thermal loading. White and metallic silver roof finishes further reduce thermal loads. In conjunction with high efficiency chillers and modular air handlers, these strategies have resulted in substantial savings (65%) over an ASHRAE Standard 90.1-2004 baseline building. Beyond the design, continuous monitoring equipment tracks performance of the systems and equipment to verify performance throughout the life of the building.

Water Strategies

Greensburg's low annual rainfall of 21 in. made reducing water use vital. Much of the community's water is drawn from the Ogallala Aquifer, which has been withdrawn from excessively in the last decades for agricultural use.

A variety of strategies are used to achieve long-term water saving goals of reducing the potable water demand and the burden on municipal waste water systems. Reduction strategies include ultra-low-flow plumbing fixtures, dual-flush valves and waterless urinals.

All lavatories are 0.5 gpm and have sensor controls. Showers use low flow heads. Dishwashers, pre-rinse spray valves and clothes washers and

REBUILDING GREENSBURG

After 95% of Greensburg, Kan., was destroyed or severely damaged by the massive tornado that struck on May 4, 2007, residents decided to rebuild the city as a sustainable community, rather than relocate.

City leaders, business owners and residents worked with the U.S. Department of Energy (DOE) and National Renewable Energy Laboratory (NREL) to identify ways to incorporate energy efficiency and renewable energy technologies into the town's new buildings. Greensburg also passed an ordinance that all city-owned buildings more than 4,000 ft^2 must be designed to the USGBC's LEED Platinum rating.

The result so far is 13 Greensburg buildings saving a combined total of $200,000 in energy costs per year. These include five LEED Platinum and two LEED Gold buildings, as well as one LEED certified building. One of the LEED Platinum buildings is the rebuilt John Deere dealership, a 33,000 ft^2 pre-engineered building. Another is the 5.4.7 Arts Center. The 1,670 ft^2 LEED Platinum building for community arts takes its name from the date of the tornado.

Source: http://tinyurl.com/nrel-greensburg

GREENSBURG WIND FARM

The Greensburg Wind Farm consists of 10 1.25 MW wind turbines that supply 12.5 MW of renewable power to the town—enough to power every house, business and municipal building in Greensburg. The town uses only about one-quarter to one-third of the power generated to reach its "100% renewable energy, 100% of the time" goal.

Excess power is placed back on the grid and offered as renewable energy credits for other Kansas Power Pool and NativeEnergy customers.

Source: "Rebuilding It Better: Greensburg, Kansas; High Performance Buildings Meeting Energy Savings Goals." April 2012. National Renewable Energy Laboratory. http://tinyurl.com/nrel-greensburg

© Assassi

A 50 kW wind turbine adjacent to the school occupies the indigenous landscape where bioswales, walking trails, and constructed and restored wetlands process rainwater.

© Assassi

Above The library is an example of a shared space that serves the larger community. Also, the large meeting rooms serve as a central civic resource for this small rural community.

© Assassi

Right The cafeteria, which faces the interior courtyard, doubles as a gathering space for large community events. The reclaimed wood surface of the mezzanine wraps into the cafeteria ceiling for acoustics and a warm aesthetic.

ice machines are all compliant with LEED requirements. The facility also captures condensate from HVAC equipment for reuse as makeup water in cooling towers.

To further reduce potable water use, captured rainwater is stored in six cisterns—with a total storage capacity of 125,000 gallons—to meet irrigation needs during dry months for the native, low-maintenance landscape. As Greensburg has no storm water collection system and the school site is bisected by a floodplain, it is necessary to capture all rainwater on site. A constructed wetland uses biological systems to purify storm water runoff, and allows it to percolate and replenish the water table. While this system is largely symbolic, it demonstrates the need for thoughtful water management for future generations.

Materials: Recycled, Reclaimed and Local

The building envelope uses SIPs panels, detailed to minimize thermal bridging, with a rainscreen system of Kansas limestone "shingles," zinc panels and reclaimed cypress wood. Inside, raw materials such as polished concrete floors and concrete block, are used in high traffic areas, while reclaimed wood is used in tactile areas.

Preference was given to materials manufactured within 500 miles, which conserved transportation

© Assassi

Building and site integrated sustainable strategies and technology reduce operating costs and add vitality to the grounds—and to the community.

energy while supporting local industry. Materials were chosen for their environmental appropriateness, durability, recycled content and site distance. The furniture, fixtures and equipment selection process followed similar criteria.

The limestone "shingles" came from a regional quarry 120 miles from the site. The regionally sourced interior concrete masonry units are burnished, requiring no painting and reducing sources of volatile organic compounds (VOCs). The polished concrete floors are easy to maintain and also have low levels of VOCs.

To mitigate construction waste flow, the team incorporated reclaimed materials, from interior wood furring and paneling reclaimed from deconstructed warehouses, to exterior furring, siding and exterior bridges from cypress salvaged from Hurricane Katrina. Through early sourcing, material options were located, coordinated and shipped to the site when needed by the contractors, resulting in a savings for the project while diverting materials from the landfill.

The construction waste management plan diverted 95% of the construction waste from landfills to recycling. The school has an ongoing waste-recycling plan including a plan to compost kitchen waste for use in gardens.

BUILDING TEAM

Building Owner/Representative USD 422, Darin Headrick, Superintendent

Architect, Landscape Architect, LEED Consultant BNIM

Educational Planning Consultant Armstrong Torseth Skold and Rydeen

Construction Manager McCown Gordon Construction

Mechanical, Electrical Engineer; Energy Modeler BGR Consulting Engineers

Structural Engineer Structural Engineering Associates

Civil Engineer Professional Engineering Consultants (PEC)

Environmental, Energy Consultant NREL

Lighting Design BNIM/BGR Engineers

Commissioning Agent Dome-Tech Inc

Funding

Working closely with USD 422, FEMA, USDA and representatives from the state of Kansas, the district was able to creatively craft a comprehensive funding strategy that fully funded the replacement cost of the school using insurance proceeds (USD 422), FEMA reimbursement (75% of gap funds), state of Kansas (15% of gap funding), state of Kansas rural development funding (10% of gap funding) and private donations. This allowed the school to be fully funded without putting

LESSONS LEARNED

During the design process, Greensburg was implementing a community-wide Comprehensive Master Plan, which heavily informed the school's planning. The site was selected as part of an initiative to strengthen Greensburg's density and the fabric of development along Main Street. Other community-adopted criteria were also incorporated: the ability to safely walk and bicycle between home and school; the availability of basic services within walking distance of the school; and the ability to share theater, meeting spaces, athletic fields and other facilities with the larger community. The master plan served as an invaluable tool in helping both the school and larger community, lending support to civic and business leaders and lowering the perceived risk of implementing green technologies and energy efficiency measures.

Early in the design process, many donations were offered for building products and systems. At first, these seemed like exciting propositions, yet through the course of design, it became evident that many products and strategies would not be suitable from a building operations standpoint. The school district had one person to maintain/operate the facility and the addition of many new technologies would have made the facility more difficult to maintain.

Extensive time was spent working with many state and federal agencies. These included FEMA, USDA, NREL and the governor's office. The district was able to effectively leverage the resources available to craft a funding package that not only replaced its lost school facilities, but did so in a way that delivered facilities that provide exceptional learning environments and will reduce operating costs for generations to come.

© Assassi

A series of bioswales, constructed wetlands, restored prairie and walking trails recreate natural environment areas that also process storm water.

additional tax burden on the patrons of the district, who were already severely burdened by having to put their personal lives and community back together following the tornado. This also greatly simplified the consolidation process since neither USD 422 nor the surrounding districts had to resolve how to allocate debt service.

Conclusion

The Kiowa County Schools, which received a LEED for Schools Platinum rating, are a testament to the resilience of this rural Kansas community and its search for vitality as it creates a new model for the future of rural America. Rather than developing low first-cost buildings, the district created facilities that will bring value to the community for decades to come. Designed and constructed on a rigorous schedule to be ready for the 2010 academic school year, the schools weave together many site, energy, water, daylighting and renewable energy strategies under one roof.

According to a five-year performance report by NREL (http://tinyurl.com/nrel-greensburg), the town's many green buildings are meeting the ambitious energy savings goals established in 2007. But, most importantly, the schools are helping to preserve one of the community's most precious resources: its youth. The facilities are a source of local pride and have inspired students. Leaders hope the innovative schools will help the youth recognize the opportunities that Greensburg provides for them to learn, stay, work and contribute to their community. ●

ABOUT THE AUTHOR

Charles S. Cassias Jr., FAIA, is a principal and director of practice at BNIM in Kansas City, Mo. He was project principal for Kiowa County Schools.