



CASE STUDIES

Environmentally Supportive School Facilities in Arizona: Current State Analysis and Future Guidelines

FINAL REPORT Fall, 2011

PREPARED FOR



ARIZONA ASSOCIATION FOR ENVIRONMENTAL EDUCATION

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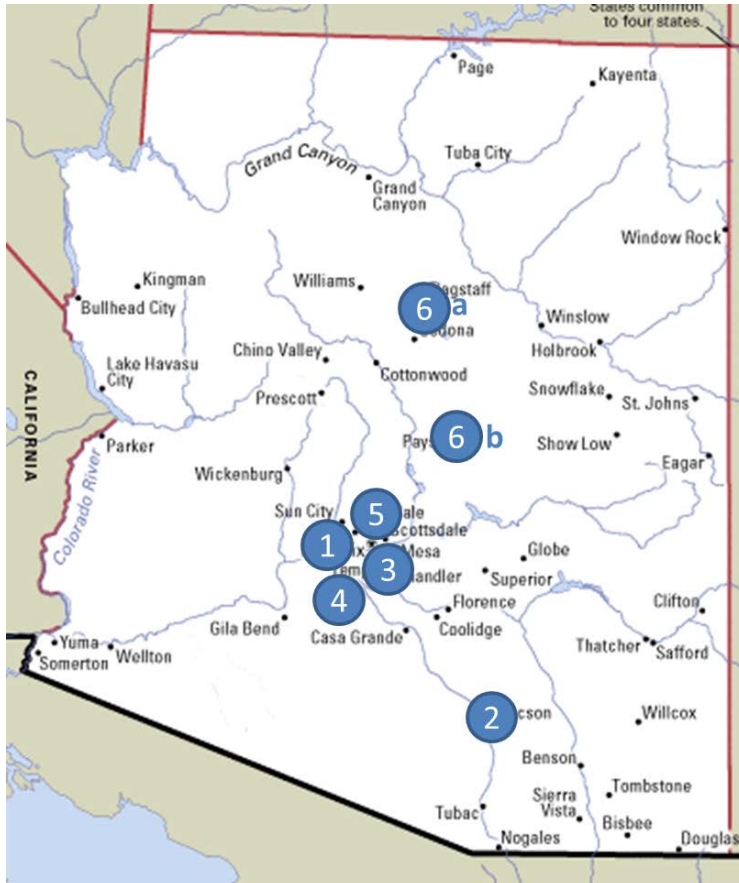
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Sustainability Science for Sustainable Schools (NSF-Funded GK-12 Project)
Global Institute of Sustainability ■ School of Sustainability
Arizona State University

IV_B

Sustainable School Facilities: Case Studies

B) Sustainable School Facilities: Case Studies



- 1) **Agua Fria Union High School District** (Avondale)
 - Desert Edge High School
 - Verrado High School
- 2) **Tucson Unified School District** (Tucson)
 - Davidson Elementary School
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CS 1

Agua Fria Union High School District Avondale

A leader in LEED and solar practices 5,950 Students / 5 School Facilities

In the past decade, the Agua Fria Union High School District (AFUHSD) has been actively pursuing a sustainability agenda for its facilities and operations, under a vision that incorporates learning. Its governing board has established a directive stating “that measures to conserve (all forms of) energy resources must be an integral part of the school program” (cf. www.aguafria.org). While focusing on reducing electric energy use from traditional sources, Agua Fria’s efforts have extended to the other systems to define “green” strategies for their facilities and for the district as a whole. In this effort, the entire community has been involved, including facilities managers and staff, school custodial managers, teachers and students.

Major District Highlights

- AFUHSD has been a national- and state-wide pioneer in using LEED standards for new constructions or expansions and for existing buildings (the latter used initially for a district-wide assessment of the current state of facilities and operations).
- All of the high schools and the district buildings have built on existing strengths and implemented “low- or no-cost and long-term projects for new initiatives and upgrades” (Gutter & Knupp, 2010). These projects have been actively linked to curricular activity.
- One new high school was expanded and another designed as LEED-accredited buildings. Both are exemplary of the state of practice in the design and operation of sustainable educational facilities (they were visited as part of this study and are highlighted below).
- Without the need for investing its own capital, the district has installed a broad solar-power capacity through partnerships with APS, CEC (Clean Energy Constructors), and (more recently) Skyline Solar Carports. Having installed rooftop solar panels in both LEED high schools (in 2010, through CEC), during fall 2011 additional solar panels were installed on metal canopies over schoolyards, bus stops, and parking lots. It is estimated that these projects will together provide about 40% of the school district’s energy needs.
- To communicate the effort and link it to academic activity, data generated from the solar panels is visible to students, staff and visitors by means of displays and kiosks in the school lobby. These kiosks are also available online and provide additional information on sustainability-related efforts in the district and schools (see Desert Edge H.S. “kiosk”).

Desert Edge High School (1400 Students / Goodyear, AZ)

- DEHS opened in 2002 and was expanded in 2005, being accredited as the first LEED-Silver high school in the state of Arizona and the fourth in the nation. The project was developed by **Emc2 Architects** and has been highlighted by the USGBC and the U.S. Department of Energy (see complementary documents for this case study, as example).

- Administrators, teachers and students all seem to be well aware and proud of their efforts towards sustainability.
- In 2010, via a solar agreement with CEC, the school installed 703kW of rooftop panels.
- As of fall 2011, the school has included sustainability (Green Science and Technologies) as one of three optional “Academies” of career and technical education (CTE) training for students (the other two are Sports Medicine and Entertainment Marketing).
- The 90,620 SqFt building expansion is 28% more energy efficient than a standard design, saving the school district about \$58,000 annually in energy costs. The project design achieves 88% savings of potable water use for irrigation (through xeriscaping) and 38% savings of potable water for domestic uses (cf. ADEQ case study and school website).
- Funding for expansion provided by AZSFB and a District bond.
- Over a twenty year period the district will save over an estimated \$1,235,000 in tax dollars on heating, cooling and water costs due to the high-performance building design.
- Project is reported to have been completed ahead of schedule and \$450,000 under budget, reinforcing this district’s philosophy that LEED does not cost more.
- Public interactive touch-screen to teach visitors about the sustainable features of the facility (cf., “GreenTouchScreen”, <http://desertedge.greentouchscreen.com> and Fig.3).



Fig.3. Desert Edge High School, GreenTouchScreen

- Power usage reduction: meters to track consumption; shading devices and overhangs to reduce sun radiation; multiple light-switching with daylight and occupancy sensors.
- Waterless urinals and low-flow plumbing fixtures and hand wash stations.
- Low VOC adhesives, sealants, paints and coatings used inside the building.
- Green cleaning program implemented.
- Landscape design uses native and drought tolerant plantings which do not require a permanent irrigation system. Plans for a school garden linked to an agricultural academic program. Talks with the local government and utility for water reclamation project.
- Entry way grates and CO2 sensors were used to improve indoor air quality.
- Establishment of a program that eliminates harmful chemical use within the building.

Verrado High School (1500 Students / Buckeye, AZ)

- Verrado High School is a 220,000 SqFt high school completed in 2006. The project was developed by **The Orcutt/Winslow Partnership** and designed to achieve LEED-Silver accreditation.
- Administrators, teachers and students all seem to be well aware and proud of their efforts towards sustainability.
- Funding for the project totaled \$136 million and was provided by AZSFB and a District bond, as well as by the developers of the Verrado real estate community.
- In 2010, via a solar agreement with CEC, the school installed 382 kW of rooftop panels.
- School reports efficiencies in decreased water use (of roughly 23% indoor and 50% outdoor landscaping) and 28% more energy efficiency than traditional schools in the area (cf. ADEQ case study and school website).
- The school design incorporated a high efficiency central chiller facility with variable speed drives on chilled and hot water pumps.
- Metered faucets and waterless urinals.
- High efficiency indirect lighting with occupancy sensors and lighting controls.
- Demand control ventilation (HVAC system with monitors to gauge temperature and other conditions in every zone, to deliver the required ventilation where it is needed).
- Use of local materials such as brick and masonry (approximately 85% of the construction materials were obtained locally in the Phoenix metropolitan area).
- Overhangs and shading devices to reduce radiation on windows and incorporate daylight and/or views into 75% of spaces.
- Indoor air quality controls and CO2 sensing (linked to academic activities).
- Classroom and space layout are designed to promote flexibility in use and problem- or project-focused learning and interdisciplinary collaboration. Centrally-located auditorium and cafeteria spaces provide for interaction and flexibility. Outdoor spaces (patios) are accessible from classrooms and provide opportunities for environmentally-related activities and learning.
- Brochures and electronic displays available to highlight sustainability-related efforts. LEED plaque and a display from the 2009 USGBC Greenbuild conference grace the main lobby.
- Many of the "green" features of Verrado High School are being used as teaching tools. Students and teachers are generally aware of the green building design and features.



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Desert Edge High School [LEED Silver]

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Verrado High School [LEED Silver]

20050 West Indian School Road Buckeye, AZ 85396

Desert Edge High School



Entrance LEED and Energy Savings Displays



Interior daylighting features



Solar Panels



Cooling tower / Sports fields



Verrado High School



Surface shading structures

Entrance LEED
and Energy
Savings Displays



Outdoor spaces linked to classrooms

CS 2

Tucson Unified School District Tucson

Scaling awareness and conservation 59,060 Students / 108 School Facilities

The second largest in Arizona, Tucson Unified (TUSD) is a large and diverse urban school district, comprising over 100 of Tucson's K-12 schools. In its "support services" policies, the Governing Board has established its provisions for all non-instructional services and programs. Along other environmental and resource efficiency policies (including paper use and bus idling), TUSD adopted as early as 1991 an energy conservation policy (revised 2008) which guides its efforts in sustainability. In this sense, the stated mission is "to create a healthy and comfortable learning environment in new and existing facilities while controlling energy consumption and diverting the saved utility costs towards educational programs" and "to promote increased awareness among students, staff and members of the community to practice better environmental and economic stewardship" (cf., www.tusd1.org/contents/govboard/secte.html).

Major District Highlights

- The district achieved LEED-Silver accreditation for Davidson Elementary School (visited during the course of this project and documented below). LEED has also guided other more recent efforts, including the newly opened K-8 Mary Belle McCorkle Academy of Excellence. Designed by **Swaim Architects** and looking to achieve LEED-Gold accreditation, the project has allowed TUSD to polish their sustainable facility strategies.
- The district's policies on energy conservation and natural resources span at least three of the school systems analyzed in this report: Energy (electricity, natural gas, alternative fuels); Water (potable water for buildings and landscaping, reclaimed water, sewer, and rainwater); and Waste (trash or refuse, recyclable materials, and organic or yard waste).
- In response to the stated policies and over the years, the district implemented a wide-ranging and very successful **Resource Efficiency Awareness Program (REAP)** (cf., www.tusd1.org/contents/depart/reap/index.html). It was adopted by the TUSD Governing Board in 1991 in recognition of the District's responsibility to conserve natural resources as an integral part of its mission for providing quality education. It has succeeded over the years in scaling awareness and action throughout the district, by monitoring school utility data and promoting and documenting actions in energy, water and waste.
- REAP is a relatively low-cost program to reduce TUSD's utility expenditures by encouraging conservation by staff member at each site. Since its adoption, REAP has saved the District \$6.3 million in utility costs. Its current mission and five-year goals (2008-2013) are shown in the box below.
- Among other actions, the major lines of activity promoted and monitored by REAP are:
(a) Reduce unnecessary use of energy and water; (b) Start an Energy Patrol in each

school; (c) Turn school's conservation efforts into money for the school (a total of more than \$50,000 per year is offered to schools achieving a 5% per year reduction in utility costs); and (d) Encourage Commingled Recycling (contextually possible, TUSD is reducing solid waste produced by schools and sites by encouraging commingled recycling, which allows recycled materials such as paper, corrugated cardboard, and milk cartons to be mixed in the recycling containers).

- Based on their Energy Conservation Policy, TUSD will be increasing the number of solar sites by installing photovoltaic systems at two sites per year over the next five years. These systems will be integrated into curricula and used as a learning tool for the TUSD community and visitors.
- REAP promotes partnerships and actively engages with local and state agencies and corporations to achieve its goals.

REAP Mission: Everyone in TUSD can manage energy, water, and waste more wisely to improve both student and school facility performance. We all benefit by practicing better environmental and economic stewardship.

1. Conserve by reducing energy, water, and non-recycled waste per square foot by 5% per year each for next five years.
 - (a) Conservation tips will be distributed to educate students and staff yearly in August and April.
 - (b) Monthly usage and cost will be posted on website showing data for schools and sites.
2. TUSD will award a monetary incentive award to schools achieving a 5% per year reduction in yearly Avoided Utility Usage per square foot savings for the next five years. See Calculating Energy Conservation Rebate Program below for details.
3. TUSD will implement Energy Patrols at 10 schools per year for the next five years to help reduce energy and water consumption. All established Energy Patrols will be monitored by survey to determine their effectiveness and the need for additional assistance/training.
4. TUSD will increase the number of solar sites by installing photovoltaic systems at two sites per year over the next five years. A representative from the utility company will visit each new site to educate students and to discuss the installation and how it affects the school.

Resource Efficiency Awareness Program Mission and Goals (2008-2013)

- Led by Tina Cook, REAP is essentially a monitor and promoter within the district.
- Interviews highlighted the challenges of being “first movers.” Learning to use and maintain new sustainable materials and strategies and responding to LEED’s point-based system have improved both within the district and in the expertise of their consultants and contractors (this is a common theme across various districts and agencies).
- More than half of TUSD’s schools date from 1970 or earlier. This was highlighted by one interviewee as a challenge to upkeep the schools, but also as an asset considering the quality and durability of some materials in those schools, which give an opportunity to upgrade and adapt to newer conditions.

- More than 40 schools currently use reclaimed water for irrigation, in a very active and successful coordination with Tucson Water. Around 12 schools harvest water as well.
- According to an interviewee, the philosophy of the district is to use LEED and other standards if they have an impact in the “educational effect” and produce a differential in the learning experience of students. This makes it worth to expend the financial resources. He cautioned (wisely) that “some things are just good design” by a “good architect,” and should not require additional fees or gimmicks.
- A major challenge for TUSD has been the size and diversity of its schools and facilities personnel, which makes this a good case study in scaling efforts. This has been done with the impulse provided by REAP and a long-standing awareness of the need for moving towards sustainable practices.
- Other smaller, site-based projects in schools are also occurring (e.g., PTA initiatives, garden plots, small water harvesting). These need to be approved and financed locally by school principal in order to get support from Bonds and Architecture and/or REAP.

Davidson Elementary School (400 Students / Tucson, AZ)

- Davidson is a 40,000 SqFt elementary school designed by **BWS Architects** and completed in 2006. Funding totaled \$5 million and LEED-Silver accreditation was pursued and achieved. This was a pioneering effort in Arizona and a first “experiment” for the TUSD. Interviewees conceded that it allowed for a learning process and an opportunity to understand LEED’s potential and drawbacks (as mentioned above).
- Metered faucets and waterless urinals. Waterless urinals are saving approximately 160,000 gallons per school year and total indoor water consumption is almost 6000 gallons less than a school in a similar area. It is estimated that use of this equipment is saving 40% compared to using standard fixtures (cf. ADEQ case study).
- Efficient HVAC system using Heat Recovery Units saves about 25% in energy costs per year over typical buildings. It is estimated that energy innovations are saving Davidson 39% or \$57,093 over comparable TUSD schools (cf. ADEQ case study).
- Solar panels installed on top of walkway covers, with informative displays and exhibits (both the installation and exhibit are used mainly for learning purposes, providing only 5% of the building’s energy requirements).
- Minimized use of finish materials (e.g., floors are bare concrete). Products sourced from local companies and recycled materials, (e.g., insulation made from recycled blue jeans).
- Used non-toxic materials and provided daylight and connection to exterior spaces.
- Use of reclaimed water for irrigation (part of district-wide efforts by REAP and TEP).
- Both the library and the multipurpose room are used as Community Space. The Library and Multipurpose Room provide meeting space for the kids and for the local community.
- The school is used extensively as an educational tool.
- Each classroom opens to the exterior of the building and has a roof window the length of the room for natural daylight. A complaint by current administration is that windows do not open but are sealed shut (a decision that would probably be reconsidered today).
- All materials are chosen for durability and for their non-toxic, benign content.
- The school district has also used the school for a “green cleaning” pilot program, where all materials used to clean and maintain the building are non-toxic and more benign to students and workers.

- According to BWS Architects, after the school's inauguration absenteeism among teachers was reported to drop by 50%. There is no follow-up on this data in this report.
- With leadership by the first principal and the school community, and in partnership with Pima County Neighborhood Reinvestment Program and the City of Tucson, a natural resource park was created next to the school grounds. It is a learning space, providing for nature observation and outdoor activity. The park includes labeled plants and gardens, a shaded amphitheater and other structures, and other learning features for the kids and community neighbors. This is indeed a highlight for this school and district.
- The original school principal was deeply invested in the project from design to implementation and operation. This may be an issue with current school administration, who emphasized the drawbacks in the approach to the building (reflecting possible mistakes and omissions in the design process to comply with some LEED standards).



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Davidson Elementary School [LEED Certified]

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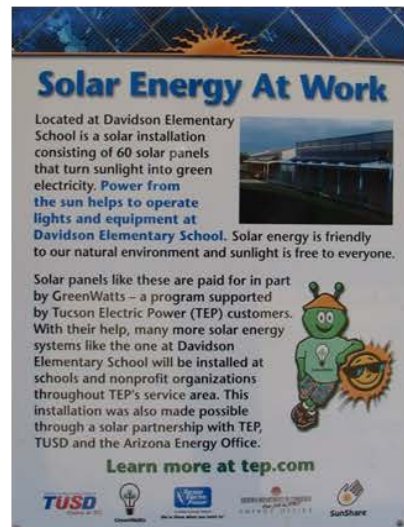
Davidson Elementary School



Library ducts and roof panels



Classroom lighting & AirDucts

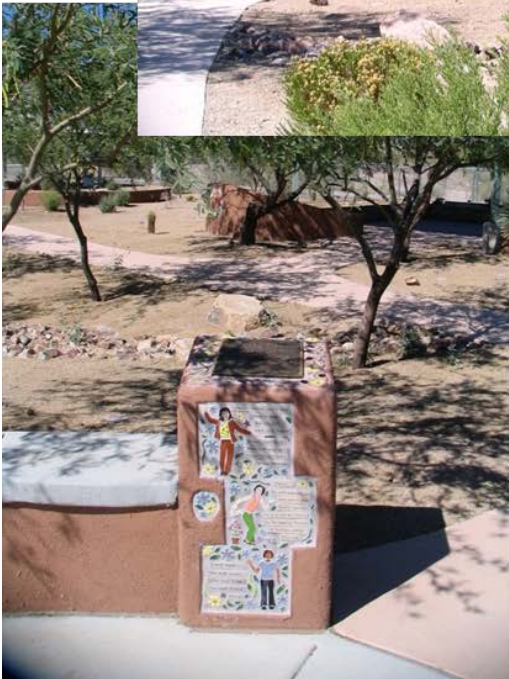
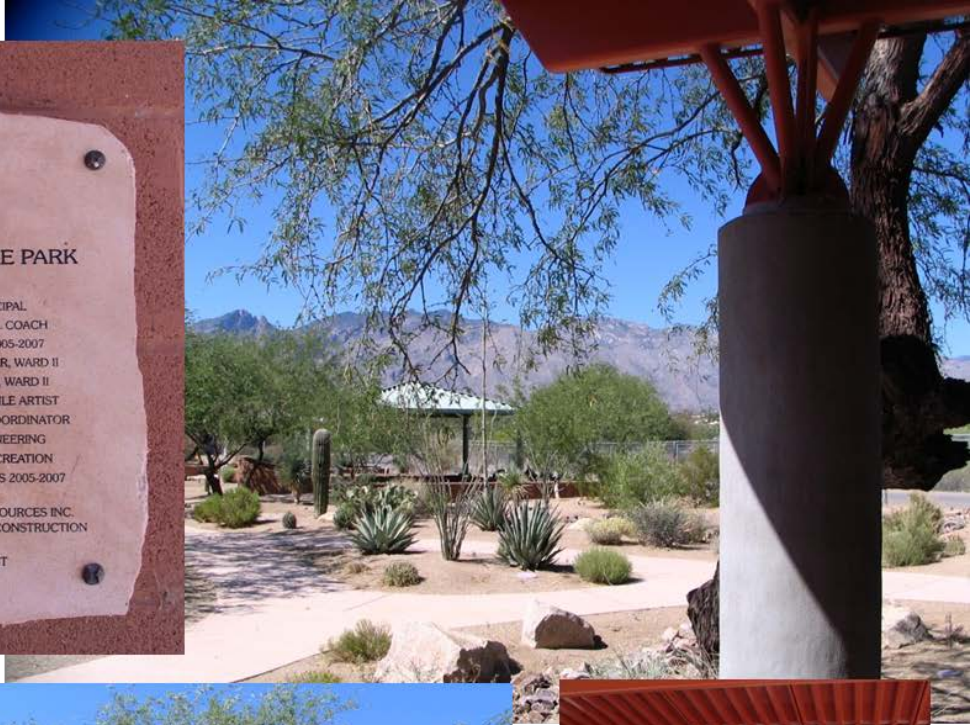
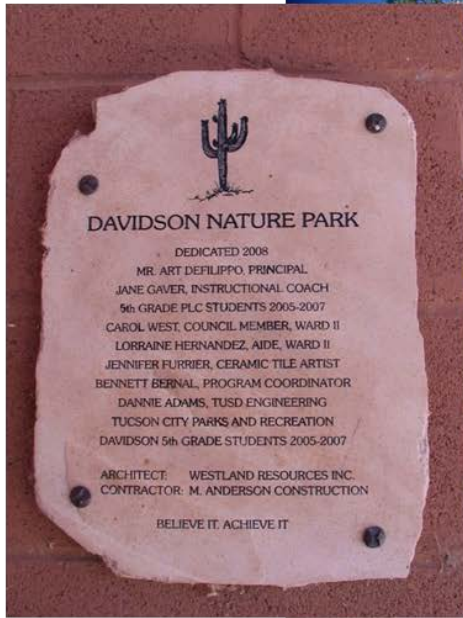


Solar panels and teaching display



Solar panels on courtyard porche





CS 3

Tempe Union High School District Tempe

Towards a comprehensive sustainability approach 13,400 Students / 7 School Facilities

Tempe Union (TUHSD) is among the 20 largest school districts in the State of Arizona, in terms of student population. Its seven school facilities are currently the subject of a comprehensive effort under an “Innovative Energy Solutions and Sustainability” project. In line with a district strategic objective for “optimizing the use of all resources to accomplish district goals” (<https://www.tuhsd.k12.az.us>) this project is identifying challenges and opportunities in policy and operations and implementing a 2010-12 strategic plan focused on resource efficiency and savings. However, the project extends beyond operations and maintenance and is also linked to teacher training and participation and student curriculum and career development. One of its schools (Tempe High School) has spearheaded a broad project (“Sustainability is First”) as a partner school in close collaboration with Arizona State University’s *Sustainability Science for Sustainable Schools* (S4) program. Other partnerships have also been actively pursued by the district to design and act on its sustainability project.

Major District Highlights

- The “Innovative Energy Solutions and Sustainability” (IESS) project had its origins in May 2010 when ASU fellows in the S4 program presented a “Sustainability in Schools” introduction to a group of motivated and committed teachers and administrators (most from Tempe HS, but some from other schools and TUSHD, including the director of district Plant Operations, Robert Anderson).
- While ASU fellows continued to work closely with Tempe HS as a partner school (more on this below), Plant Operations at the district office level took off with a commitment to define a broad plan for resource conservation and sustainability education. In this sense, the overall objective was to bring sustainability into operations and academia at TUHSD as a whole to make it a “green” school district.
- At the time of this report, TUHSD did not have a formal “Sustainability Superintendent” or similar position. Nevertheless this role has been taken, at least in action and committed leadership for this project, by Robert Anderson (who was interviewed for this project).
- The IESS project was launched at the February 16, 2011 Governing Board meeting, with the overall purpose not only of saving thousands of dollars in energy and water expenditures, but most importantly of creating a “living-laboratory” for students throughout the district. In this sense, TUHSD is taking pioneering strides to create a more systemic and comprehensive approach to school sustainability.
- In more detail, four broader educational objectives were outlined alongside overall resource efficiency objectives and actions:

- Defining a program to integrate environmental and sustainability education across the District;
- Creating a cutting-edge and unique program, launching the TUHSD into an unprecedented leadership position in sustainability operation and education;
- Linking classroom learning to co-curricular programs, campus operations, and civic engagement opportunities; and
- Using a portion of energy savings to fund new research opportunities and “living-laboratory” initiatives (learning and other activities that are closely linked to student career training and opportunities both in higher education and in the “green economy” and other innovative and cutting-edge sectors).
- A key action in the project timeline was the February 2011 award of a contract to Chevron Energy Solutions (www.chevronenergy.com) to develop a comprehensive energy audit at all District sites during summer 2011. Results were reported to District administration and the Governing Board in order to determine priorities and funding options for concrete actions. Close collaboration with Chevron is expected to continue as the project is implemented.
- The Chevron project was designed, specifically, as distinct from other performance or power purchasing agreements as it incorporates the curricular aspect and involves teachers, students, and staff in standards-focused, project-based learning experiences.
- For TUHSD, the IESS project will be developed in three phases over three years:
 - Phase I – Energy audit and study of alternatives (technical and financial)
 - Phase II – Procurement of equipment and construction of facilities and/or projects recommended in Phase I (including adaptations and extensions to existing facilities as well as internet-based telemetry system to collect, monitor, and communicate relevant data from school facility operations).
 - Phase III (concurrent to Phases I and II) – Training of teachers to incorporate sustainability into courses and develop projects in schools (in collaboration with ASU and Rio Salado College). It is expected that this curricular activity will incorporate data and projects defined and executed in Phases I and II.
- According to Mr. Anderson, “the proposed sustainability education program is cutting-edge and Tempe Union will be considered a leader in this area. Our district wants to create an opportunity for students, (to) give them an edge in this new frontier,” which will “draw interest and enrollment to our district” (personal communication, June 2011).
- In addition to Chevron, other partners in the project include: Arizona State University, Rio Salado College, The Intel Corporation, SRP, APS, Southwest Gas, and the City of Tempe. This exemplifies the need for trans-disciplinary interaction in sustainability.
- In general, the IESS project is expected to build on efforts that are already in place or in the process of being implemented. These include (1) relatively low-hanging-fruit type actions (like electric and water fixture upgrades and recycling programs), (2) the installation of solar panels, water bottle filling stations and high-efficiency boilers and chillers, (3) school bus upgrades and non-idling programs, and (4) school gardens.
- Funding for these projects has come from various sources, including utility rebates and bond issues. Mr. Anderson is optimistic that the IESS will continue to be supported.
- Communication and celebration of success is an integral part of the IESS project.
- An informational video on the IESS project is available in the District website at www.tuhsd.k12.az.us in the Sustainability “Quick Link”.

Major Highlights at Tempe High School (1,500 Students / Tempe, AZ)

- The “Sustainability is First” project is a collaborative venture between Tempe High School (THS) and the School of Sustainability (SOS) at Arizona State University, to promote the integration of sustainability science into K-12 learning and to foster the sustainable development and operation of the school. Part of Arizona State University’s *Sustainability Science for Sustainable Schools program (S4)*, funded by a National Science Foundation GK-12 grant, the THS project is one of several similar partnerships between SOS and high schools across the Phoenix metropolitan area.
- Project conceptualization began after the May 2010 introduction to “Sustainability in Schools” by S4 fellows. The school committed to joining the S4 program and further development took place over the summer with discussion workshops at SOS. In late July 2010, two S4 fellows were assigned to the project and an initial project meeting took place at THS on August 4, 2010.
- The Goals of the project at THS were:
 - Make sustainability an enduring, core value of Tempe High School.
 - Ensure students leave Tempe High School with an understanding of sustainability science that they carry with them into their personal and working lives.
 - Set and achieve annual targets for improving Tempe High School’s operational sustainability.
 - Make Tempe High School a leader in and an example of sustainable practice and K-12 sustainability education in the Tempe Union High School District (TUHSD), the local community, the City of Tempe, and Arizona.
 - Establish sustainability on the TUHSD curriculum, add sustainability classes to the curriculum and create a sustainability staff position at THS.
- The Approach to the project included: (1) integrating sustainability teaching into the curriculum across all departments; (2) focusing on a particular theme each year; (3) performing meaningful, concrete tasks and activities with useful products and outcomes that contribute to other sustainability goals; (4) promoting sustainability at Tempe High School and the community through a continuous campaign of public relations; and (5) working with the TUHSD to build a wider sustainability movement within the district and community.
- Major activities during the 2010-11 school year included teacher training, curricular projects, student club activities, and a series of physical interventions developed as practical pilot applications. With varying degrees of accomplishment (see Box below), the major of the piloted projects were:
 - Solar-energy applications: golf cart charging station and solar ovens.
 - Communication strategies: sustainable energy poster, sustainability public service announcements (PSAs), and sustainability bulletin
 - “Earth Day” activities
 - Sustainability themed art
 - Sustainable garden
 - Sustainability lesson development by GK12 Fellows (Energy and Supply-Chain).
 - Teacher training and implementation of sustainability lessons in all courses.
- The project is ongoing and currently into its second year of activity and development. It is considered a successful intervention and promises to deliver good results. In general, teacher participation and enthusiasm is very high.

<i>Output</i>	<i>Objective</i>		<i>Notes</i>
Lessons	Every teacher to teach at least one sustainability lesson	<input checked="" type="checkbox"/>	Yes, and most taught at least 2 class periods.
Golf Cart Charging Station	Student project with practical application, engineering and renewable energy learning outcomes	<input checked="" type="checkbox"/>	No. Financial and institutional barriers
Energy Posters	Class project to communicate sustainability with sustainable energy learning outcomes	<input checked="" type="checkbox"/>	Yes. A set of 3 posters created by 3 different classes
PSAs	Class project to communicate sustainability with sustainability learning outcomes	<input checked="" type="checkbox"/>	Mostly. Approx. 25 PSAs created but final editing not completed
Gardens	Class projects to initiate multiple campus gardens for hands on learning	<input checked="" type="checkbox"/>	Yes. 4 gardens initiated and at various stages of development
Bulletins	Create and broadcast across campus short sustainability tips and messages	<input type="checkbox"/>	Partially. Three bulletins emailed.
Earth Day	Exhibit work and engage the campus in sustainability	<input checked="" type="checkbox"/>	Yes.
Solar Ovens	Class project in conjunction with sustainable energy lesson (Not originally planned)	<input checked="" type="checkbox"/>	Yes. 7 classes constructed and cooked with about 35 ovens.
Art work	Create sustainability themed art (Not originally planned)	<input checked="" type="checkbox"/>	Yes. Individual student art work and wall mural.
Soap	Manufacture soap from raw ingredients (Not originally planned)	<input checked="" type="checkbox"/>	Yes. Students manufactured hundreds of bars of soap.

THS Actual versus Planned Accomplishments, ASU-S4 End-of-Year Report, May 2011



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CS 4

Gila Crossing Community School Gila River Indian Reservation, Laveen

Linking Curriculum, Campus and Community 500 Students / 2 School Facilities

The Gila Crossing Community School (GCCS) is a K-8 institution located in and serving the Gila River Indian Reservation. With a history dating back to 1900, it is chartered under the Gila River Indian Community and receives funding (as a “grant day school”) from the Bureau of Indian Education since 1995 (cf. www.bie.edu). The school, home to about 500 students, is housed on two campuses on adapted facilities that have seen improvement over the years but still show important physical and efficiency challenges. The school is making great strides to continue its growth and services, developing its academic quality, co-curricular activities, staff, technology, and physical infrastructure. While these efforts would merit more analysis, for the purposes of this report the case study focuses on a single, exemplary activity that emphasizes the connection between campus facilities, curriculum, and community: the *Gardening and Agriculture Program*. Thus, the case study emphasizes how, even in the face of constraints imposed by financial priorities, a school may be able to focus on programs relevant to culturally and environmentally supportive approaches.

The Garden and Agriculture Program at GCCS: Major Highlights

www.gccseagles.org/programs/garden-agri/index.html

- An overarching community emphasis on cultural and environmental heritage guides the efforts at GCCS in general and of the Garden and Agriculture Program (G&A). The school’s mission reflects this: “Work together to promote academic excellence. Honor the teachings of our elders, culture, and environment. Promote a safe and healthy learning environment.” In addition, the website indicates that “efforts will be made to [...] recognize the diversity of Pima/Maricopa cultural traditions as well as other Native American traditions. These traditions will be integrated into our curriculum whenever and wherever possible.” (www.gccseagles.org).
- As part of other culture- and environmentally-related curricular programs, the G&A program was introduced at the elementary school level in 2007-08 and today has a school-wide focus and curriculum plan. It is supported and promoted by the GRIC tribal government and community.
- The program has been developed and promoted with the leadership and participation of Tim Moore and Ed Mendoza, and is supported by “a network of community volunteers including kids and even community elders.”
- A full curricular description of the program plan (not necessarily as implemented) can be found at www.gccseagles.org/programs/garden-agri/agri_garden.pdf. The name of the program in the Akimel O’othom language is VECHICH O’OTHAM E’ES (Young People Planting).

- The program is generally built around the knowledge and appreciation of the role of food and agriculture in the cultural landscape and heritage of the Gila River Indian Community and the region as a whole. According to the curricular plan, the “*umbrella standard*” for the G&A program is:

“By the time students are promoted from the eighth grade, they should have a comprehensive historical knowledge of the agricultural and cultural aspects of how plants and people interact in the desert. Paramount within this knowledge are the historical and current tribal agricultural practices.”
- The plan calls for all students at every grade level to “plant crops, weed, harvest, water, and eat what the garden provides.” According to the G&A program plan, each grade level has its set of standards, goals, and activities (for details, please refer to the PDF of the full program as referenced above and in the appendices).
- In general, each grade level builds on preceding standards, goals, and activities to achieve at least the following competencies in students:
 - In-depth knowledge and appreciation of plants and of the cultural relevance of agriculture for their own community and region. The latter includes knowledge of and participation in agriculturally-related activities and festivities in the school and community as well as visits to the Heard Museum and other relevant sites.
 - Hands-on ability to work the land and grow produce and other plants and vegetables.
 - Scientific knowledge and comprehension of seeds, plants, food (standards-based).
 - Knowledge and appreciation of the nutritional quality of diverse types of food.
 - Knowledge and appreciation of the role of agriculture for a family and a community, by means of using what students grow to provide sustenance for themselves, their family, and their immediate community.
 - Understanding of their agricultural experience in relation to specific values and attitudes (e.g., respect and responsibility).
- As a main feature in the program and for the whole school, the G&A program established a community garden and greenhouse. This is the space where teachers, students, and the involved community come together to implement curricular and related activities. The garden is placed in a location where it is visible to visitors and to the school community (between visitor parking lot and main building). Though in need of physical improvement, it is a good example in Arizona of the use of outdoor space for educational activities that link the curriculum with campus and community.



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CS 5

Washington Elementary School District Glendale and Phoenix

Advancing behavioral and operational change 24,290 Students / 32 School Facilities

The Washington Elementary School District (WESD) is the largest elementary school district in Arizona (tenth largest overall), serving a broad area of north central Phoenix and east Glendale. It is comprised of 32 schools (19 K-6 schools, two K-5 schools, one 5-8 school, six K-8 schools and four middle/junior high schools) and 3 support facilities. In addition to its size and diversity, WESD is remarkable as a case study for the design and implementation of a comprehensive energy management program for the whole district, which began in 2008. Starting with an energy behavior management program (which promoted conservation-oriented behavior among students and staff across the district), it has continued as a relevant example of operational and cultural transformation. WESD gives credit to this program for embracing energy conservation, for providing the incentive to pursue a number of other very creative and groundbreaking initiatives, and for “outstanding results” (including several awards and grants).

Major District Highlights

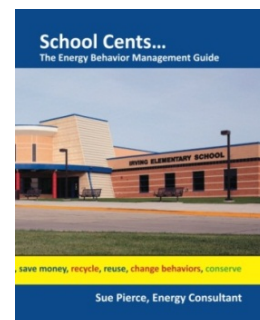
- In spring 2008, the Governing Board of WESD approved a district-wide “Energy Policy,” which challenged all facilities to reduce energy costs by a minimum 10% in the first year.
- The Facility Planning department is in charge of working with district personnel, students, parents, and the community to design and build “high performance school facilities” (conceived after LEED and CHPS philosophy and standards). In this sense:
“High performance school facilities are comfortable, healthy, and efficient buildings where students and staff want to be and where they do well. For school buildings, the goal is to build high performance schools that will improve student achievement and occupant comfort, reduce costs, and preserve environmental resources” (cf. www.wesdschools.org).
- Under the direction of Sue Pierce (who worked with the district initially as a professional consultant), this department designed and coordinated the efforts of the overall energy management program and has actively pursued other pilots and interventions.
- Facility Planning also “facilitates” the work of five WESD *Regional School Facility Planning Councils*. Each Council includes parents, staff, and community members and serves the following functions: (1) Identify and communicate issues and concepts regarding high performance schools; (2) Gather information on existing facilities in the region and on regional demographics impacting school boundaries; (3) Identify major facility projects that support high performance schools in the district; (4) Communicate with the community, district staff, and other councils; (5) Prioritize each project by assigning it a level of urgency; and (6) Bring findings to the superintendent and governing board.

- Councils are expected to hold "town hall meetings" within their region to receive feedback from parents and the community and must present findings by the end of December (for facility planning and completion purposes).
- **Behavior management program.** The most relevant element in this case study is that, according to Sue Pierce, the design of the overall energy management program began with a *behavior management program*. This was seen as a necessary first step, to show that savings could be derived from behavioral change even before physical adaptations or new projects (personal communication, October 2010). As part of this behavioral phase of the program, three major elements can be highlighted:
 - A series of "procedures for general energy usage" were established and promoted, with the expectation that they be followed not only by facilities and maintenance personnel, but also by students, teachers and staff. Other procedures were also established for heating and air conditioning equipment use, and a few for water conservation and waste management (cf. Pierce, 2010, pp. 54-58).
 - Students, teachers and staff were trained and motivated through an energy conservation campaign that was launched across all district schools and offices.
 - Using the Energy Star Portfolio Manager, schools and district facilities were monitored and savings results were shared and widely communicated and celebrated.
- Guidelines, recommendations, and suggested formats and sources can be found in Sue Pierce's book, *School Cents: The Energy Behavior Management Guide* (Pierce, 2010). It is particularly useful for the behavioral management portion of a district's plans and it also lists WESD's proposed set of procedures.
- Among relevant results, the WESD highlights:
 - WESD schools and district departments significantly reduced electrical use annually since it began this comprehensive energy conservation program in 2008.
 - At 24 months of the program's implementation, the district had reduced electric energy consumption across all campuses by 26%. By the third year it is estimated that savings approach 30%.
 - In December 2010, the U. S. Environmental Protection Agency (EPA) named the WESD an Energy Star Leader for reducing electrical energy usage by 20% over the previous two years. WESD is the first public school district in Arizona to receive this designation.
 - As of fall 2011, twenty WESD schools and the district's Administrative Center hold "Energy Star" designations for energy efficiency. Each site received an Energy Star plaque to display on the exterior of the building.
- Following the behavioral phase of the program, the district has engaged and completed several operational and physical adaptations and new projects, which include both "low-hanging fruit" interventions and broader transformational projects. The latter include:
 - **Geothermal Pilot Project.** In 2009-10, the district was approached by a team of architects, contractors and engineers to conduct a geothermal pilot program at Desert View Elementary School (in Phoenix). Approved by the Governing Board and funded in part by donations, the pilot is expected to determine the feasibility of using this technology in Arizona to reduce electric energy usage in schools.
 - Simply put, this technology uses the earth's relatively stable underground temperature to either capture or dissipate heat. While successful

- applications in schools regularly are used for building heating, WESD's pilot obviously expects its major efficiencies to come in cooling costs.
- At Desert View ES, one wing of the school building was equipped with geothermal heating and air conditioning while a second, similar control wing has traditional roof-top HVAC units. Each wing was sub-metered and data was collected during the 2010-11 school year.
 - Pilot results estimated in summer 2011 that the geothermal wing used 50% less electricity than the control wing.
 - Though further testing of this application is probably needed, the results show promise that this technology may be applied in Arizona.
- **LEED Projects.** With no major school facilities in its current plans, WESD embarked on two smaller-scale “experiments” (about 6,000 SqFt each). Both are pursuing LEED-Platinum accreditation and will probably stand as good examples of creative financing, partnerships, and community participation. At the end of 2011, both \$1.5-million projects were in construction phase, through a grant from the *Green Schoolhouse Series* (cf. <http://greenschoolhouseseries.org>), an initiative funded by diverse corporate and institutional partners.
- Roadrunner Elementary School (K-5): *Safari Green Schoolhouse* model (this is the inaugural school of the *Series*).
 - Oranewood Elementary School (K-8): *Studio Green Schoolhouse* model.
- These schoolhouses will serve as teaching tools and, depending on the specific model, use diverse exemplary sustainability features in its construction and operation, including: rainwater harvesting; solar roof system; native green garden; energy efficient fans; water bottle refilling stations; no VOC paints, etc.

KEY REFERENCE:

Pierce, S. (2010).
School Cents: The Energy Behavior Management Guide.
Self-Published
Available through www.energyplanning.org



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CS 6

Flagstaff and Payson Unified School Districts Northern Arizona

Making the best of climate and geography **Flagstaff USD: 10,300 Students / 15 School Facilities** **Payson USD: 2,750 Students / 6 School Facilities**

Flagstaff and Payson were selected with the intent of documenting current sustainability practices and concerns in colder regions of Arizona. Both are unified, K-12 districts and both were studied by in-depth interviews with key administrative officials (see contact information below) and additional research and consultation. It is possible that open-ended conversations may taint results with subjectivity and particular viewpoints (on the part of interviewees) and that fine-grain detail about each district's operation and approach may be lost in this brief case study; nevertheless, the information below provides an initial overview of current state and opportunities for sustainable facilities in this type of Arizona climatic and geographical condition. While many parts of the state are of course concerned with the high cost of cooling, colder-climate cases must derive more efficiency from the heating demands of winter and may explore projects in solar technology and other applications and materials. Both Flagstaff and Payson illustrate advances in these and other areas.

Major District Highlights ■ Flagstaff USD

- FUSD is a fairly large district, with 15 school facilities (with some consolidation and closures in recent years).
- Sustainable projects and features highlighted in interview:
 - With support from private companies (Kennedy Partners and NGR Solar) and its electric utility (APS), FUSD has advanced with reducing its energy consumption through solar panel installations by means of power purchasing agreements.
 - Solar project: Completed 85kW at Flagstaff HS with more schools coming online at the end of 2012: APS 250kW solar project at Cromer ES; APS grant for two more solar projects (115 and 180 kW); and a Middle School 350 kW project. Thus, FUSD is trying to reach 50% energy production with solar panels in five years.
 - Water reduction features and projects: waterless urinals; use of reclaimed water for fields; and three artificial turf fields installed.
 - There is waste recycling, with the usual challenge in training for correct separation by users and service staff. No composting at this time.
 - Translucent, high efficiency windows were installed on south facades of all elementary schools, to allow for enclosed spaces with natural daylight and a consequently improved environment for learning (see KalWall panels, www.kalwall.com).

- Improved and more efficient lighting was installed at many of the district's schools in the last few years (transitioned to more efficient T-8 lighting in all buildings in school and district office facilities).
- FUSD reported that they do not have any special signage or exhibit to highlight their projects or efforts. They do not seem to have any promotional material or documents to explain and communicate their projects.
- Flagstaff in general feels to have been “way ahead of the game” with the use of reclaimed water (since the 1990’s), as part of a community that seems more attuned to their environment, particularly in the conservative use of water. Though solar projects were highlighted, FUSD seems to be equally excited about water savings practices, particularly the new artificial turf fields, one of which runs of water into a retention pond.
- Climate imposes a challenge in the winter months, with enclosed hallways that take up 20% of a building with “non-usable” space that requires heating.
- Regarding the process and challenges of implementing change, FUSD reported that:
 - They do have a group of trained staff functioning as an “Energy Audit” team. This group includes retired teachers and is trained to review opportunities in energy-saving procedures. Working after school hours, they leave notes to users about practices and behavior. They report back to the Operations department.
 - Energy conservation and resource efficiency is a board policy, as in most districts. However, no formal committee or position has been set in place.
 - Project funding has come from a 2006 Bond for energy efficiency upgrading and building remodeling and from APS rebates or grants (buy back procedures).
- Regarding the most important motivation or objective in FUSD’s efforts, efficiency and savings were top of mind. “Comfort” was also emphasized, considering the need for a balanced temperature conditioning during colder months and its impact on student learning.
- Regarding the use of industry standards and guidelines, FUSD has looked at LEED and their project manager is a LEED AP (Accredited Professional). However, they have not found justification or need for the added costs of paperwork and interventions. While for a new building they would consider using it (last new building in 1989), for remodeling “it is tough”. Finally, their experience with consultants (solar companies and APS) has been positive and they see a tendency towards professionalization and better results.
- A couple of tradeoff examples in their experience are: waterless urinals seem to demand an increased use of fans because of odors; in addition, the chemicals used in them damaged some existing pipes which had to be fixed. Local fire department is not equipped yet for dealing with solar panel failures and accidents, but this was seen mostly as a learning process for fire department, rather than a negative view of the practice itself.
- Finally, regarding possible limitations for further action on sustainability in facilities and operations, FUSD emphasized that money is issue number one: much more could be done if more funding were available from the State. In addition, other issues are lack of training and knowledge and potential leadership changes (loss of drive and momentum).

Major District Highlights ■ Payson USD

- PUSD is a smaller district, with six school facilities (consolidating to five in the current school year). District offices are housed in a separate building in one of the school campuses.

- During the interview, the District Superintendent was very enthusiastic about various PUSD sustainable projects and features. Highlights mentioned were:
 - As in the case of FUSD, Payson has also conducted solar projects with support from the same private companies (Kennedy Partners and NGR Solar) and its electric utility (APS).
 - Solar projects: PUSD is conducting a “fairly large scale” solar photovoltaic (PV) project, with more than 5,200 panels installed on rooftops and parking and playground shade structures. Established as a Power Purchase Agreement with participation of EMC2 and Kennedy Partners LLC for a total project of US\$13 million, installed with no up-front cost for the district. Online in December 2010, the panels produce 1.4 Mw of energy. Monitors are installed where public and students can look at data and “use it for science classes.”
 - In Middle School and High School, athletic fields use reclaimed water, in collaboration with Northern Gila County Sanitation District. Payson has always been progressive in water use and conservation over the years.
 - The Julia Randall Elementary School was recently opened as a replacement school on an existing site, with a project designed by EMC2 Architects. Among its features it counts with passive solar lighting. The building was designed with site and climate sensitivity, but did not follow specific LEED guidelines because of perceived added cost (both in construction and certification).
 - A Bond was approved for district-wide efficient lighting retrofits and for an energy management system to monitor heating, cooling, and lighting use and cost. System is through APS Energy Services.
 - Project for a facility for their Agricultural Education Program, which includes a 1,500 gall water harvesting system. This will support a curricular program focused on small animal care and vocational agriculture (not food production).
 - Received an Innovative Program Grant from the Arizona Department of Education (channeling federal money) for a Building Trades CTE program, focused on principles and practices of solar water heating. A trailer was purchased and fitted to travel to elementary schools and make presentations and demonstrations. If grant is extended for a second year, the district hopes to add solar PV and wind principles and practices.
 - High School Student Government recycling program (aluminum, glass, plastic) although Payson does not have a city-wide recycling program, only for paper.
 - Outdoor space use and related programs are reportedly common at PUSD, including: (i) Waterwise Project with water department for Payson and UofA; (ii) Firewise Program with Tonto Forest for safe fire practices, conservation, and safety; (iii) Game and Fish training on fishing and wildlife management; (iv) Environmental Science teacher earned the Golden Bell Award, for projects with 11th and 12th students at the East Verde River, measuring and publishing data about water quality.
 - When talking about student/teacher involvement and enthusiasm, Superintendent recalled a recent ASU Energy Efficient Dog House contest, won by a PUSD team.
- PUSD does not seem to have any promotional material or documents to explain and communicate their projects, other than the screens linked to solar panel performance.

Their website has some projects highlighted, particularly the recent solar efforts but other materials are absent, blamed on lack of both time and manpower to prepare any of this.

- Considering whether sustainability is a distinguishing characteristic, PUSD seems to be particularly proud of its solar project and of some curricular efforts as noted above.
- Regarding the process and challenges of implementing change, PUSD reported that:
 - District Governing Board is supportive and has promoted these projects and initiatives as a “collective effort” of teachers, principals and superintendent.
 - Students have participated in recycling programs and curriculum-related projects and contests, but not necessarily in planning or implementing broader, district- or campus-wide projects and procedures.
 - There is no formal committee or position, as all projects have been promoted and managed at the district level by the Superintendent and/or the Business Office.
- Regarding the most important motivation or objective in PUSD’s efforts, the Superintendent mentioned the wish to “try and set by example for students in terms of innovative practices” for sustainability.
- Regarding their experience with consultants, PUSD indicated that they will continue to work satisfactorily with APS to tweak their project, in order to make sure that accurate data is available and positive results are achieved.
- Finally, regarding possible limitations for further action on sustainability in facilities and operations, PUSD emphasized that for any construction in the future there will be need for financial incentives, as materials, construction techniques and systems evolve and improve in the future. Also expressed the need for training and continued expert education and the desire for teachers to become even more engaged in initiatives.



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Disclaimer

The case studies discussed in this report include some numerical information regarding energy, budget, and other savings as a result of their efforts. It is important to note that this data was provided by the case study schools and/or districts and that it was NOT validated independently as part of this project.

Case Study Acknowledgements

Though duly noted in some instances and in the contact information, particular acknowledgement must be made to several individuals who were extremely supportive during visits and/or interviews:

- At Desert Edge High School: **Dan Grumbling**, Assistant Principal and **Paul White**, Facilities Manager.
- At Verrado High School: **Tom Huffman**, Principal.
- At Tucson Unified School District: **Marcus Jones**, Bonds and Architecture Manager; **Tina Cook**, Energy and REAP Manager; **Dannie Adams** and **Don Bailes**, Project Managers.
- At Tempe Union High School District: **Bob Anderson**, director of Plant Operations.
- At Gila Crossing Community School: **Victoria Jones**, Assistant Principal and **Ed Mendoza**, Garden Project.
- At Washington Elementary School District: **Sue Pierce**, director of Facility Planning and **Mike Kramer**, Director of Capital Projects, Maintenance, and School Safety.
- At Flagstaff Unified School District: **Robert Kuhn**, Assistant Superintendent for Operations.
- At Payson Unified School District: **Casey O'Brien**, Superintendent.