



PROJECT

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

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PREPARED FOR



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I

Introduction

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

A school of the future will behave differently from the old model. It will be cleaner, brighter, healthier, technologically smarter, an open resource for the community. The building itself will be part of the curriculum.

CEFPI

The United Nation's World Commission on Environment and Development (WCED) report provided a widely known definition of *sustainability* when it pointed out humanity's desire to achieve "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED 1987, p.8). This definition, although not exempt from controversy (cf. Robinson, 2004), is a point of departure for reflecting about and establishing a position on human development and well-being in relation to natural resources and ecosystems.

In this context, education is perceived as a major force in the transition towards a more sustainable state of affairs (cf. Rowe, 2007; Sipos et al 2008; UNESCO, 1997). Indeed, the preparation of students as future agents of social change and environmental stewards is becoming a relevant element in curricular design and practice. As the places where students receive this preparation and spend a fair amount of their foundational years, school facilities and grounds should be considered important contexts for any process that supports sustainability.

This report documents a research project undertaken to provide a current state analysis and future guidelines for sustainable and environmentally supportive school facilities in the state of Arizona. The research process was designed under three major considerations: (a) a focus on school facilities and not on issues related to either a school's curriculum or its community (although both are discussed throughout); (b) a focus on Arizona public school districts and not on charter or private schools; and (c) a focus on four selected school facility "systems": energy, water, waste, and landscape and outdoors spaces. The results of this study are directed towards school and school district officials and administrators, the Arizona Association for Environmental Education and other promoters and supporters of sustainability in education, and the interested community in general.

The motivating research questions for the project reported here were twofold: what is the "current state" of sustainable projects and practices that are being implemented across public

schools in Arizona, and what might be a set of practical guidelines to direct future action and help define desirable visions for sustainability in school facilities. To address these questions, the research project was based on three major activities: an in-depth review of existing frameworks and efforts; a survey of public school district officials; and a series of interviews and site visits to selected exemplary case studies. Throughout, the project was based on a broad definition of sustainability, centered on its systemic nature and the balance of social, environmental and economic concerns and opportunities.

Research results focus in this report on the sustainable projects and practices that have been identified as well as other findings including goals and motivations, organizational and procedural issues, and relevant challenges and opportunities. Findings are followed by concise practical guidelines and recommendations to guide future decision making regarding sustainability in school facilities. They define, albeit in a rather preliminary manner at this point, elements for defining a vision for sustainable and environmentally supportive school facilities in Arizona. A concrete list of ten “principles” for sustainable schools closes this report and provides a summary for decision makers and supporters of sustainability in education.

Following this Introduction, Section II describes the conceptual background of this study, indicating its motivation and philosophical context and presenting the results of the existing framework review, along with an executive listing of major frameworks and guidelines. Section III provides the methodological background for the study. Section IV provides the central outcome of the research process, and includes: (A) a “Practical Summary” of survey, interview and visit findings regarding current projects and practices for each system and other relevant issues followed by practical guidelines and recommendations; and (B) a set of brief case studies to illustrate current practices, successes and challenges. Finally, Section V lists general conclusions and recommendations as well as future research and opportunities for further study.

II

Conceptual Background: Study Context and Existing Frameworks

A) Study Context: Objectives of Environmentally Supportive School Facilities

The Arizona Association for Environmental Education (AAEE), with support from the Nina Mason Pulliam Charitable Trust, is pursuing a broad project to achieve the development of an effective plan to promote environmental literacy of K-12 students throughout Arizona. The general objectives of this effort are perhaps best represented in one of AAEE's key documents, the *Arizona Framework for Environmental Concepts and Themes* (AFECT) which "serves to further define environmental literacy for our state's educators, and can be used to guide learning in both K-12 classrooms and non-formal settings" (AAEE, 2010a). According to the AFECT, an environmentally literate person will have:

1. *Foundations of learning (cognitive skills):* how humans learn and factors that play a role in acquiring and processing new information.
2. *Content knowledge:* natural systems and how they function.
3. *Sense of place:* how people interact with and influence these natural systems.
4. *Respect for self, others, and natural systems* when addressing issues: appreciating the complexity of the natural world and of personal and social behaviors.

As one of the five *goals* within their broader environmental literacy project, the AAEE has defined the need to develop a particular product, which has the intent of supporting the aspirations outlined in the AFECT:

"A prescription for **environmentally supportive school facilities** that is practical to implement. School facilities managers will work with our partnering green businesses to establish workable solutions to manage **energy**, **water** and **product waste**, as well as create **outdoor spaces** that can foster learning." (AAEE, 2009).

Elsewhere, the AAEE specifies that, "beyond EE [environmental education] integration," this goal will imply developing "recommendations for environmentally supportive school physical facilities and practices." Additionally, as a potentially cross-cutting initiative throughout the goals of the environmental literacy plan, AAEE highlights the proposal to promote the sharing of successful school practices (cf. "spotlight on school success", AAEE, 2010b). To support this effort, AAEE has engaged the collaboration of Arizona State University's *Sustainability Science for Sustainable Schools* program (cf. Elser et al, 2011).

School facilities are generally considered as a priority for public investment, at least on paper and in the opinion of public actors and the community in general. Diverse objectives are stated to justify this. As an example, a report on financing for schools in Tennessee states:

“School buildings are perhaps the most visible expression of society’s investment in K-12 education. Quality facilities can increase teacher satisfaction, allow for the incorporation of new technology into the classroom, and lower utility costs through improved energy efficiency. Most importantly, research has shown that inadequate facilities can lower student performance.” (Gurley, 2002)

More specifically, and informing Arizona’s and other state’s environmental literacy plans, efforts promoted by the *No Child Left Inside* initiative (cf. www.nclicoalition.org) and the North American Association for Environmental Education link their overall objectives to the necessity for improved school facilities. In the latter’s guiding document *Developing a State Environmental Literacy Plan* (NAAEE, 2008), a single recommendation regarding facilities and learning environments states that

“Ideally, a learning environment should incorporate environmentally sensitive practices. The operation of school buildings should be conducted in an environmentally sensitive manner. This could include, for example, restoring natural habitats on school grounds or practicing increased energy conservation. Many city, county, or state environmental management agencies are potential partners to develop strategies for new school construction and school renovation projects to meet *green building* design requirements. Over time, significant cost savings can be realized.” (p. 9-10)

While these arguments seem rather general and point to very diverse actions, they do outline a discussion of the possible benefits that motivate better school buildings, in general, and sustainable practices and projects in school facilities, in particular. In the literature and reference review for this study, three overlapping “threads” for the objectives of implementing sustainability in school facilities can be identified:

1) Academic performance.

Within an overarching theme supporting the relationship between “better facilities” and “better learning” (cf. Schneider, 2002; AZSFB, 2007; CEFPI, 2010), sustainability has gained traction in recent years. Indeed, many of the arguments that support the impact of facilities on student learning and performance are akin to those supporting sustainability projects and practices in a school’s physical environment. This argument is perhaps best summarized in the idea of integrating “building minds and minding buildings,” as expressed by Antonia Cortese of the American Federation of Teachers (CEFPI, 2010).

2) Cost reduction and savings.

Many of the arguments for sustainability interventions, particularly for school boards and public officials, center on the opportunity to reduce the operating and maintenance costs of school buildings and grounds. This argument is also used to explain the need for implementing expensive interventions at the front end of a project (new or renovation) in the expectation that operating costs will be reduced over the life of the facilities.

3) **Environmental stewardship.**

This motivation is most identified with the idea of sustainability itself, based on the impact and role that a school's building and grounds can have on the environment. It is argued under two major goals: (a) to reduce the environmental impact of a school's construction or renewal and operation and maintenance and (b) to serve as a tool for developing environmental literacy and the role of environmental stewards in children. Both goals tend to emphasize the responsibility of the entire school community toward the environment and help to legitimize its sustainable actions.

Across references and evidence of practical application, from a qualitative appreciation, it seems clear that it is difficult to focus on more than one or two of these motivations at the same time. In practice, particularly in the current economic climate, the economic argument has become the most defensible of the three motivations, with academic performance a close second (at least in theory and public discourse) and environmental stewardship lagging behind. This stresses the need to argue for the third motivation in a manner that aligns with the economic and academic arguments. Thus, the ideal approach is of course to hold the three issues as mutually reinforcing and providing for more effective results. More about this will be discussed in the findings and guidelines section, as part of this study focused on the definition of motivations and goals for sustainability in current school facility interventions.

Finally, a few brief words on the supporting philosophy behind this research project. 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.

More concretely, the design of this project has been inspired by the “*sustainability transitions*” approach (cf. Loorbach, 2007; Wiek, 2010). This approach centers on understanding that societies, organizations, and institutions that wish to move towards sustainability should follow a set of steps (not necessarily sequential) to address persistent problems and challenges. These steps emphasize: (1) the collaborative definition of a desirable **vision** for the future; (2) the characterization of the **current state** (or “regime”) where any action must take place; (3) the identification of **niches or best sustainable practices** that deviate from the current state; (4) the proposal of “**experiments**” or **specific actions** that may mobilize the organization towards the vision; (5) the **engagement of stakeholders** to collaborate and support the transition; and (6) most importantly, a continuous process of **evaluation, learning and adjustment**.

With this general philosophy and approach in mind, this study strives to: provide some insight into the current state of sustainability in Arizona schools; facilitate information about relevant frameworks and practices that can support the construction of a clear vision for sustainability in schools; and show on-going interventions and strategies that exemplify the transition path towards a desirable vision. Hopefully, both the sustainability transitions approach and this study will provide valuable insights and concrete, applicable knowledge and tools for decision makers, officials, and supporters.

B) Existing Frameworks and Efforts

As a first process in developing this research project, and with the support and advice from AAEE, the *Sustainability Science for Sustainable Schools* program worked on identifying and reviewing a broad and diverse set of references, which included frameworks, documents and literature, websites, personal contacts, etc. It was clear from the outset that the creation of the intended “prescription” or set of guidelines and recommendations for environmentally supportive school facilities in Arizona could be based on many different existing sources. It seemed to make little sense to develop something altogether new for AAEE's purposes. Thus, a more practical alternative was defined, in order to build a "practical summary" of exiting frameworks and experiences, which could provide a reference on significant and practicable guidelines for school officials, promoters of sustainability in school facilities, and the interested public in general.

As stated in AAEE's intentions for this project, research focused on references for physical facility and operational projects and practices related to four specific school systems: **(a) energy, (b) water, (c) waste, and (d) outdoor spaces that support environmental learning.** Numerous organizations, both private and public, have developed frameworks and guidelines that focus on one or more of these systems. Many use the term "Green School" to refer more to curricular and other practices that foster environmental learning, sometimes with but more often with little or no reference to school facilities. Of the references that do include physical facilities and operational practices, some of them focus on only one or a few of the four systems in consideration and emphasize one of the three objectives outlined above. A few are more comprehensive in both regards.

From the review process, it was possible to identify the following major references, based on a qualitative assessment that balanced: (a) their comprehensiveness (as outlined above), (b) the utility and professionalism of their approach and/or materials, (c) their relevance and wide acceptance as a professional and/or national standard, and (d) their relevance for particular conditions of the State of Arizona. They are listed here (and in a summary reference at the end of this section) as a reference guide, to help schools and school districts sort through the abundance of information and choose some of the most applicable and comprehensive tools.

1) Center for Green Schools, United States Green Building Council's (USGBC)

www.centerforgreenschools.org

Use: Building professionals (architects, engineers, planners) on behalf of building owners

Perhaps the single most important and comprehensive reference, the United States Green Building Council (a national non-profit organization dedicated to sustainable building design and construction), is the promoter of the most accepted and visible industry standard in the U.S., the LEED (Leadership in Energy and Environmental Design) building rating system. The system focuses on balancing interventions in six areas:

- 1. Sustainable sites
- 2. Water efficiency
- 3. Energy and atmosphere
- Materials and resources
- Indoor environmental quality
- Innovation and design process

In addition, LEED may also award points for “regional priorities”. Practical guidelines and checklists are available for both *new* and *existing buildings* (EBOM or Existing Building, Operation and Maintenance) and can be readily consulted online. Both are very useful for

planning and decision making, even if the actual LEED certification is not pursued because of budget or time constraints (see appendices for current checklists of considered criteria).

LEED is criticized on some aspects, more saliently for pursuing “points” in each of six relatively independent areas rather than promoting a “whole-system” view and for the additional, up-front cost of the interventions and the formal certification process (though it is argued that both may be paid from savings and over the life of a building, some construction professionals consulted agreed that the up-front cost was significant enough to deter use of the system). Nevertheless, its visibility and acceptability make it a most relevant framework to consider for any school that wishes to implement environmentally supportive projects and practices in its facilities. In any case, it provides a useful language and reference that can be utilized to generate ideas and tools for promoting and executing sustainable projects and practices.

The new “Center for Green Schools”, which promotes a comprehensive *Green Schools Building program*, is the Council’s arm regarding school facilities. Their database of documents and guidelines is a great reference for schools and school districts. The LEED system is also available for application in school facilities (cf. *LEED for Schools* documents in the Center’s website) and the *Roadmap to a Green Campus* is an excellent source that describes the path towards sustainability in educational facilities (though not focused on the K-12 setting, its insights and suggestions are applicable and adaptable). The Council is also promoting its *Center for Green Schools Fellowship* program, which this year began placing full-time sustainability officers in school districts across the nation, a resource that Arizona districts may tap into in the future. In addition, “The Road to a Green District” (Gutter & Knupp, 2010) offers valuable insights.

Finally, another USGBC initiative is the *Mayor’s Alliance for Green Schools*, which is geared towards leveraging political (if not necessarily practical) support for sustainability in schools. This effort is underway in Arizona, particularly in the Phoenix metropolitan area.

Several successful school projects (new facilities) and leading School Districts in the State of Arizona were identified as leading the charge in applying LEED standards (see case studies, particularly the Agua Fria, Tucson, and Washington school districts).

2) Collaborative for High Performing Schools (CHPS)

www.chps.net

Use: Building professionals (architects, engineers, planners) on behalf of building owners

A regional initiative with origins and headquarters in California, this is a well-regarded resource by many in the professional industry, with activity across the U.S. Like the USGBC, this organization also has established two lesser-known “recognition” programs to promote those buildings that comply with their guidelines. For CHPS (pronounced “chips”) a “high performing school” is “a better place to learn [...] an environment that is not only energy and resource efficient, but also healthy, comfortable, well lit, and containing the amenities for a quality education” (CHPS, 2011). They focus on “the design, construction and operation of high performance schools” with the following stated goals:

- Increase student performance with better-designed and healthier facilities
- Raise awareness of the impact and advantages of high performance schools
- Provide professionals with better tools to facilitate effective design, construction and maintenance of high performance schools
- Increase school energy and resource efficiency
- Reduce peak electric loads

Implementation is based on criteria adopted by partners in each state and Arizona is yet to participate actively (although there has been some initiative in this direction). CHPS has edited excellent material that can and should be used, at least as a reference, by school district officials, facilities managers, and decision makers. In particular, their “Best Practices” manuals are very well crafted and highly useful. In addition, they provide on-site and web-based training (including a fair number of useful slide shows which are available online).

3) Green Ribbon program of the U.S. Department of Education

www2.ed.gov/programs/green-ribbon-schools/index.html

www.facebook.com/EDGreenRibbonSchools [for ongoing updates on implementation]

Use: State Education Departments, School Districts and Schools, Facility Professionals

During the research process for this study the U.S. Department of Education (USED), the Environmental Protection Agency, and the White House Council on Environmental Quality announced the “concept” for this program (on (April 26, 2011). With the intent of establishing a national recognition akin to the Blue Ribbon program (which recognizes excellence in academic achievement), the Green Ribbon program will be a non-mandatory and non-monetary recognition program. Predicated on achieving the three general objectives described before in this report (academic, economic, and environmental), the program recognizes as a monetary incentive the prospect of reducing operating costs. Specifically, the program aims to:

- Facilitate the dissemination of best practices and established metrics regarding energy efficient and cost effective, healthy and environmentally sustainable learning spaces and educational programs, among federal agencies, states, tribes and localities.
- Achieve these objectives by encouraging the coordination of efforts by the public (at federal, state and local levels), for-profit, and non-profit sectors and among schools themselves.

The specific standards have been officially released in the fall of 2011 and the first recognitions are expected to be presented on Earth Day 2012 (April 22). A school cannot apply directly to USED and must be nominated by its respective state department of education. The program’s standards are focused on “key features of green schools” under three overlapping categories: (a) energy efficiency and sustainability, (b) healthy school environments, and (c) environmental sustainability education. At present, there is an ongoing consultation and improvement effort that will probably incorporate already existing references and frameworks, including others listed here. The national visibility of the effort will certainly make it a relevant upcoming reference (see appendices for current checklists).

Though still in development, the features that have been released at the time of this report highlight several aspects which constitute broad and very relevant recommendations for schools and school districts that are committed to environmentally supportive facilities. These recommendations emphasize that interventions should be:

- Integrated and holistic
- Cost-effective
- Regionally appropriate
- Aligned with learning standards.

In addition and across the three categories, the program emphasizes:

- The participation of and with the broader community
- The need for professional development of staff and faculty
- The importance of institutionalizing change.

4) Council of Educational Facility Planners International (CEFPI)

www.cefpi.org

Use: Building professionals (architects, engineers, planners) on behalf of building owners

This is an international organization of architects, engineers and other professionals who specialize in educational facility planning, design, construction, and evaluation. An important element of their relevance for this project is the fact that their central offices are located in Scottsdale and are thus a very accessible source of information, action, and leverage. Their industry journal, *Educational Facility Planner*, is a good source of ideas and practical examples. Though not historically central to their activities and objectives, sustainability has become a major focus of attention for educational facility planners and the efforts at CEFPI.

According to their website, CEFPI's "sole mission is improving the places where children learn" and they contribute through advocacy and education of the general public, training and professional development of their members and others, and research and dissemination of information regarding the linkage between the educational facility, its design and student success (CEFPI, 2011).

In recent years, CEFPI has launched a the *School Building Week* (SBW) program (CEFPI 2010), which is a national contest where middle school students can propose ideas and solutions for making schools more sustainable. Arizona schools have participated successfully in the past (the team from Tucson's Imago Dei Middle School were the national first place winner in SBW 2009).

5) Federal Efforts

U.S. Environmental Protection Agency: www.epa.gov

U.S. Department of Energy: www.energy.gov and www.eere.energy.gov

Energy Star program: www.energystar.gov [see Buildings & Plants section]

Energy Star for K-12 School Districts: www.energystar.gov/schools

EnergySmart Schools: <http://www1.eere.energy.gov/buildings/energysmartschools.html>

Use: Varies: Applications for Schools, Teachers, and Facility / Building professionals

For many years and with renewed impetus in the current administration (particularly with Economic Stimulus resources), relevant Federal agencies have promoted environmental efficiencies for homes, institutions and businesses. Support and resources for schools and school districts are also widely available, and are referenced in the Green Ribbon efforts.

Among these Federal resources, perhaps the most recognized and utilized is the long-standing *Energy-Star program*, developed in collaboration by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE). Within this broad program and based on the premise that "energy is the first step to green" the *Buildings and Plants* section provides resources and information applicable to the school setting, not only for energy but also for water use. Their *Tools and Resources Library* has a wealth of information and documents that can be accessed by schools and schools districts. The *Portfolio Manager* application, in particular, provides widely used tools for different purposes, including: (1) managing energy and water consumption in buildings, (2) historical tracking and rating of building performance, and (3) carbon footprint estimations.

As they are available online free of charge, many schools and school districts are already taking advantage and using these tools to manage and document their energy and (less often) their water use.

Specific sections, in both the EPA's and the DOE's websites, provide information and tools applicable to K12 schools and districts (see links above). In particular, the EPA site provides a wealth of relevant resources for schools (see www.epa.gov/epahome/school.htm), from environmental quality regulations and recommendations to a broad section of information and tools about the reduction of the urban heat island effect in communities (<http://www.epa.gov/heatisland>).

6) State of Arizona Efforts

Use: Varies: Applications for Schools, Teachers, and Facility / Building professionals

Though the current budget crisis has severely limited General Fund allocations for education (especially for building construction and renovation), there are at least three major elements which offer support, at least conceptually, to sustainability efforts in school facilities.

(a) The **2005 Executive Order "Implementing Renewable Energy and Energy Efficiency in New State Buildings"** (www.governor.state.az.us/eo/2005_05.pdf) mandated that for new, state-funded buildings all executive branch offices shall implement "to the extent practicable" standards related to renewable energy and energy efficiency, and that they should be constructed to LEED Silver levels. However, "to the extent practicable" has been interpreted in practice as "where budget allows" and relatively limited progress has been made in public school districts other than a handful of new school facilities across the state.

(b) The **Governor's Office of Energy Policy** (<http://www.azenergy.gov>) provides a source of information regarding renewable energy and incentives.

(c) The **State of Arizona School Facilities Board** (<http://www.azsfb.gov>) is the overseeing and budget-allocating agency for school facilities. They have the authority to allocate General Fund resources for three categories of projects: new school facilities, building renewal, and emergency deficiencies correction (cf. Olson 2009, p. v). Based on the 2005 Executive Order and mostly predicated on the economic objective, the Board has a set of guidelines and recommendations regarding sustainability in school facilities (particularly focused on energy efficiency and other LEED-type benchmarks). Another document, "Building Arizona's 21st Century Schools," highlights the academic objectives of school facilities, in response to a corresponding 2007 Executive Order for improving the quality of educational spaces in Arizona. However, as AZSFB's share of the State's General Fund has decreased in recent years, school districts have turned to the issue of bonds, utility support, and other sources of capital finance for facilities projects (see Olson 2009 for a complete review and understanding of this issue).

(d) The **"Green Schools" program in the Children's Environmental Health program at the Arizona Department of Environmental Quality (ADEQ)** (www.azdeq.gov/ceh/green1.html) is an active source of information and promotion of sustainable initiatives in schools. Of particular relevance is a self-assessment tool (*Environmentally Healthy Schools* checklist), promoted by ADEQ to highlight environmentally supportive practices and links to ideas and tools. The EHS checklist is available at www.azdeq.gov/ceh/download/healthy.pdf. This and ADEQ's efforts provided support and insight to this study, particularly in some concepts for our survey. The rest of ADEQ has of course other resources linked to national efforts and guidelines related to health, water, waste, etc., including those mandated and/or regulated by the U.S. EPA.

7) Utility efforts

APS (Arizona Public Service) www.aps.com www.aps.com/businessrebates
 SRP (Salt River Project) www.srpnet.com www.srpnet.com/electric/business/biz
 TEP (Tucson Electric Power) www.tep.com <http://www.tep.com/Business/>

Use: School Facility and Building professionals / Some content for Schools and Teachers

Over the past years, Arizona public utility companies have been implementing programs and initiatives to promote energy and water efficiency for residential, institutional, and business users. Although constant change is happening, depending on capacity and/or budget, numerous current interventions in public schools have been achieved through support by programs and funds promoted by the utilities (e.g., APS's "Solutions for Business" or "Energy Answers for Schools"). Support, funds, training, and networking have been available during the past years. School Districts should consult with their respective regional or local utility to review programs and options, if applicable and available.

In several districts surveyed, these types of program and support have been instrumental in making some progress, particularly in the installation of solar panels in schools (though some constraints have been reached in recent months). In addition, school districts (e.g., Scottsdale Unified School District, Tempe Union High School District, and Payson Unified School District) have also turned to programs offered by an increasing number of private companies that finance the up-front cost of solar panels over a long-term contract, known as "Power Purchase Agreements" (more on this in Section IV).

8) Association for the Advancement of Sustainability in Higher Education (AASHE)

www.aashe.org

Use: Varies: Applications for Schools, Teachers, and Facility / Building professionals

A North American association of colleges and universities "working to create a sustainable future," AASHE has a number of resources and information that can provide insight for environmentally supportive public schools. Their **STARS** framework (Sustainability Tracking, Assessment and Rating System, <https://stars.aashe.org>) is a self-assessment tool "for colleges and universities to gauge progress toward sustainability and be recognized for sustainability leadership." However, it might be useful for school districts and schools by providing a first evaluation of what might be done under the STARS's three categories: Education & Research; Operations; and Planning, Administration & Engagement. Each of these categories includes subcategories such as Purchasing, Curriculum, Energy, and Human Resources.

9) Arizona State University's Sustainable Design Advisory Committee guidelines

<http://sustainability.asu.edu/practice/what-asu-is-doing/buildings.php>

Use: Varies: Applications for Schools, Teachers, and Facility / Building professionals

As part of Arizona State University's initiatives for campus-wide sustainability (in facilities as well as curriculum) this committee has developed and implemented ASU's own framework for pursuing sustainable buildings and spaces. A list of "Sustainable Design Guidelines" and "Green Building Standards" are available and useful as a reference for public K-12 schools. These have been defined as an alternative to LEED-type frameworks and pursue a more balanced and systemic approach, focused on overall building quality and effectiveness regarding its environmental impact.

Beyond guidelines specifically related to building standards, as a leader in sustainability education, ASU's approach to facilities and operations is quite comprehensive, and includes activities in the following fronts:

- Energy Conservation
- Renewable Energy
- Recycling and Waste
- Transportation
- Food Services
- Water Conservation
- Grounds
- Services and Maintenance
- Purchasing and Policy
- Recognition and Awards

References and links to projects and practices related to each of these categories are available at <http://sustainability.asu.edu/practice/what-asu-is-doing>.

10) "The Sustainable Answer Key: A Guide to Building a Sustainable, High-Performance Charter School Facility", NCB Capital Impact

www.ncbcapitalimpact.org/default.aspx?id=1318

Use: Decision makers, fundraisers, school facilities professionals, etc.

Though focused on the opportunities of charter school efforts and capital funding opportunities, this document provides practical guidelines and information as well as a self-assessment tool for school districts and schools considering sustainable interventions. Developed in collaboration with the USGBC, it also provides some insight into financing opportunities. Document is fully downloadable, with registration required.

NCB Capital Impact is "a national, non-profit community development organization", providing "financial services and technical assistance to help make high-quality health care, housing, and education more accessible and attainable, and eldercare more dignified and respectful."

11) Personal references and consultation

Several local contacts were established and supported this research, including: Julie Ann Finke and Amber Chapa (ADEQ); Caroline Lobo (LEED AP and Director of the Education Studio at Orcutt-Winslow Partnership, architects and planners); Sue Pierce (consultant for the Washington School District); Dean Gray (director of the Arizona School Facilities Board); and Leslie Lindo (Arizona Chapter of USGBC Green Schools Advocacy Committee). In addition, contacts at schools and districts selected for the case study section were consulted and enhanced this research with their insight and experience (specific contacts are listed in Section IV.B).

Other References

In addition to those listed here, innumerable sources of information for supporting sustainable projects and practices in school facilities and across the curriculum are widely available. While research focused on facilities and operational practices, attention was given as well to curricular and education practices that are already occurring or that may be facilitated, as any plan should consider these issues as simultaneously as possible.

- **University of Arizona's Arizona Project WET (Water Education for Teachers)**
 - ➔ State-wide program with excellent material and training workshops, to prepare teachers in the delivery of water-related classroom content. Curriculum is correlated to Arizona State Standards at all grade levels and in all curricular areas.
 - <http://ag.arizona.edu/arizonawet>

- **Arizona State University's *Ecology Explorers***
→ Provides online curricular and classroom material and gives Phoenix area K-12 students and teachers opportunities to do real scientific research as part of the Central Arizona–Phoenix Long-Term Ecological Research (CAP LTER) project.
<http://ecologyexplorers.asu.edu/>
- **Facing the Future**
→ Curricular and classroom material. A leading provider of sustainability and global issues curriculum, professional development, service learning, and free K-12 lessons.
www.facingthefuture.org
- **The Sustainable Sites Initiative**
→ LEED-type assessment and design tools for landscape design and development, for use by designers on behalf of their clients.
www.sustainablesites.org
- **Green Schools Coalition / National Green Schools Conference (Denver, Feb. 2012)**
→ Provides resources and contacts for developing sustainable facilities and curriculum. Focused on environmental learning, it is rapidly incorporating other sustainability issues in schools. Partnered with USGBC to develop the National Conference.
<http://www.greencharterschools.org>
www.greenschoolsnationalconference.org/index.php
- **National Wildlife Federation Eco-Schools**
→ Provides curricular and classroom material and recommendations for greening schools. It is an internationally acclaimed program that provides a framework to help educators integrate sustainable principles throughout their schools and curriculum.
www.nwf.org/Global-Warming/School-Solutions/Eco-Schools-USA.aspx
- **Green Education Foundation (GEF)**
→ Curricular and classroom material, recommendations for greening schools. GEF provides curriculum and resources to K-12 students and teachers worldwide with the goal of challenging youth to think holistically and critically about global environmental concerns and solutions.
<http://www.greeneducationfoundation.org>
- **National Clearinghouse for Educational Facilities**
→ General building and design resources for planners, architects, and engineers. Information on planning, designing, building, and maintaining safe, healthy, high performance schools.
www.edfacilities.org

➔ Summary of References : Frameworks and Tools

Major References

<ul style="list-style-type: none"> ▪ United States Green Building Council USGBC <ul style="list-style-type: none"> • Center for Green Schools • LEED for Schools 	www.centerforgreenschools.org http://www.centerforgreenschools.org/leed-for-schools.aspx
▪ Collaborative for High Performing Schools (CHPS)	www.chps.net
▪ Green Ribbon Program (US Department of Education)	www2.ed.gov/programs/green-ribbon-schools/index.html
▪ Council of Educational Facility Planners International (CEFPI)	www.cefpi.org
▪ U.S. Environmental Protection Agency (EPA) Energy Star (with U.S.Department of Energy)	www.epa.gov www.energystar.gov www.energystar.gov/schools
▪ U.S. Department of Energy	energy.gov www1.eere.energy.gov/buildings/energysmartschools.html
▪ Arizona State Executive Order (2005-5)	www.governor.state.az.us/eo/2005_05.pdf
▪ AZ Governor's Office of Energy Policy	www.azenergy.gov
▪ Arizona School Facilities Board (AZSFB)	www.azsfb.gov
▪ Arizona Department of Environmental Quality (ADEQ) "Green Schools" program	www.azdeq.gov/ceh/green1.html www.azdeq.gov/ceh/download/healthy.pdf
<ul style="list-style-type: none"> ▪ Public Utilities Sustainability websites: <ul style="list-style-type: none"> • APS (Arizona Public Service) • SRP (Salt River Project) • TEP (Tucson Electric Power) 	www.aps.com www.srpnet.com www.tep.com
▪ Association for the Advancement of Sustainability in Higher Education (AASHE)	www.aashe.org
▪ ASU Sustainable Design Guidelines and Green Building Standards	sustainability.asu.edu/practice/what-asu-is-doing/buildings.php
▪ NCB Capital Impact's "The Sustainable Answer Key"	http://www.ncbcapitalimpact.org/default.aspx?id=1318

Other References

▪ Arizona Project WET (Water Education for Teachers) – UofA	http://ag.arizona.edu/arizonawet
▪ Ecology Explorers – ASU	http://ecologyexplorers.asu.edu/
▪ Facing the Future	www.facingthefuture.org
▪ The Sustainable Sites Initiative	www.sustainablesites.org
▪ National Green Schools Conference (Green Schools Coalition / Denver, February 2012)	www.greenschoolsnationalconference.org/index.php http://www.greencharterschools.org
▪ National Clearinghouse for Educational Facilities	www.edfacilities.org
▪ National Wildlife Federation Eco-Schools	www.nwf.org/Global-Warming/School-Solutions/Eco-Schools-USA.aspx
▪ Green Education Foundation	http://www.greeneducationfoundation.org

III

Methodological Background: Approach to the Study

Setting out to prepare a practical summary of guidelines for environmentally supportive school facilities in Arizona, this research project followed three major lines of work as a methodological approach: (A) a review of existing frameworks and efforts; (B) a survey of public school districts; and (C) a series of interviews and site visits to selected case studies. Each of these lines of work will be briefly described and discussed in this section.

A) Review of Existing Frameworks and Efforts.

As presented in the previous section, this project reviewed abundant information regarding “green schools” and “environmentally supportive” or “sustainable” practices and projects in school facilities. To allow for decision makers and advocates to sort through all this material, a selection was made and used to guide our own analysis and proposal.

The insight from this review framed the work in two additional activities executed to assess the current state of projects and practices in public school districts and schools.

B) Survey of public school districts.

To assess the current state of sustainability efforts in school facilities across Arizona, a statewide online survey of public school districts was conducted. Respondents were asked about specific projects and practices in each of four studied school systems. Questions about organizational issues, process, funding and motivations were also included. The composition of the survey sample is discussed below.

There was some difficulty in constructing a solid, current database of contact information for districts and officials. Though information is publicly available, particularly through the Arizona Department of Education (www.ade.az.gov/edd, see box below) there was a need for some actualization and correction in that information (this study’s database is available for consultation and improvement).

Another difficulty in the implementation of our survey was surely timing. The survey was prepared and approved for deployment late in the school year (during the first half May 2011), when many districts and facilities managers were preparing for both the closing of academic activities and the initiation of a busy summer period, which is used for facility improvement and maintenance. Future applications of the survey should take this into account.

Finally, it should be noted also that the survey had a “teaching objective” itself, as it was hoped that it could help broaden the respondent’s view about sustainable practices in schools, beyond energy and cost-saving solutions. Specifically, the final question asked respondents to rank how their familiarity or knowledge regarding school sustainability projects and practices had improved by taking the survey. On a scale of 1 (not at all/remained the same) to 7 (very much/learned a lot), answers were concentrated toward the extremes of the scale (2 and 6), with a 3.81 average answer. While this may point to the diversity of experience and training of respondents, no hard conclusions can be derived from this, as the sample of respondents was

small and the question itself perhaps poorly designed. Future applications of the survey could certainly improve on this objective and how it might be measured.

Sources Used for School District Contact Information

- List Wizard for SD and Schools (AZ Dept. of Ed) - <http://www.ade.az.gov/wizard/default.asp>
- Public School Search (AZ Dept. of Ed) - <http://www.ade.az.gov/edd>
- CEFPI Database (partial)
- Personal contacts and references / Internet searches

C) Interviews and site visits to selected case studies.

In order to more deeply understand and witness the implementation of projects and practices in schools and districts, we conducted a series of interviews and visits to selected district and/or school officials and sites. Interviews were open-ended, semi-structured conversations with identified key individuals (including school and/or school district officials, school facilities personnel, experts, and consultants). The site-visits were conducted to selected districts and schools, for documentation and confirmation of findings. The open-ended interviews were guided by the same questionnaire, prepared and approved in advance by ASU's Internal Review Board standards (cf. IRB approval and sample of interview guide in appendices).

Selection of interviewees and sites was based on multiple factors, including the relevance of the case (i.e., leading examples of projects and practices in the State), recommendations from contacts, and/or existing contact with key districts and individuals (for example, Tempe Union High School District has been one of the partner districts for our *Sustainable Schools* program at ASU and has shown ample evidence of action and progress). The case studies section (IV.B) includes some numerical information regarding energy, budget, and other savings. It is important to note that this data was provided by the case study districts and it was NOT validated independently as part of this project.

Findings and recommendations based on both the survey and the interviews and visits inform the core of our results, which are discussed amply in Section IV of this report.

COMPOSITION OF THE SURVEY SAMPLE: Selected School Districts

An invitation to participate and a link to our survey (prepared in Survey Monkey) were individually e-mailed to specific persons at 111 selected districts. The addressees of the e-mails in each of the selected districts were both the Superintendent and the person deemed by researchers as key to answer the survey, depending on district organizational structure, size, and/or type (i.e., facilities superintendent, business director, etc.). The intention was to make the leadership of the district aware of the survey process and that it would either be responded by them or be assigned for response to people wide a broad enough vision of the relevant issues.

Each selected district's website was consulted to find the person that could be more suited to respond, and case-by-case corrections were made, if necessary, as emails were sent. Several superintendents responded our email, and at least one was personally interviewed.

The sample of 111 districts was selected first on the basis of district size and student population. As can be seen in Table 1 below, we emailed all of the State's 50 largest districts, which account for 80.10% of the student population in the State. The next 50 districts represent 14.80% of student population, so 56% of them were selected for participation. Finally, we invited 26.89% of the remaining districts (which in total represent only 4.32% of the student population). In addition, invited districts were also selected based on other criteria, including: regional relevance (particularly climatic conditions, as we wanted to make sure that diverse types

were considered), geographic coverage (cities and towns across the state were included, as well as all major urban areas), and personal references regarding salient efforts.

SD Block (by size)	Number of Districts in Block	Students Represented	% of Total Students Represented	Acumulated	Nbr. School Districts Contacted	% Contacted in Block
1 to 15	15	485,099	50.0318%	50.03%	15	100.00%
16 to 50	35	298,999	30.8379%	80.87%	35	100.00%
51 to 100	50	143,540	14.8043%	95.67%	29	56.00%
100 to 219	119	41,944	4.3260%	100.00%	32	26.89%
TOTAL	219	969,582	100.00%		111	50.68%
Initiated Surveys					29	26.13%
Completed Surveys					19	17.12%

TABLE 1. Detail of School District sample

Emails were sent on May 28, 2011. We had an immediate response from several districts while others responded during the following days and weeks, with the last completed survey recorded on June 8. Respondents were informed that the survey's intent was to "assess current sustainability practices and projects at public school districts and/or schools in Arizona", focusing on "practices and projects that relate to four school systems: energy, water, waste, and outdoor space." Confidentiality was offered, unless respondents consented to be contacted.

COMPOSITION OF THE SURVEY SAMPLE: Survey Respondents

In total, 29 of the contacted districts started the survey and only 19 completed it fully (representing 17.12% of contacted districts). While not negligible, the small size of the respondent sample does not allow us to make much of a statistical analysis. Statistical tests (Chi-Test) were run to test for the correlation between district size and sustainability projects and practices, and the results were negative (i.e., no correlation could be supported). Future studies would of course benefit from (a) a better, larger respondent sample, (b) better timing, and (c) a survey design that is better able to measure the possible influence of district size, type and socioeconomic condition, as well as age of buildings).

While it is true that only a few of the state's school districts responded to the survey, those that did respond account for approximately 485 schools and for more than 40% of the total student population in the State of Arizona (i.e., respondents represent approximately 389,000 Arizonan students). Thus the potential impact of current projects and practices reported by respondents seems relevant in that regard.

It should also be noted that, quite possibly, districts who responded to the survey may be the most readily enthusiastic about sustainability projects and practices. In other words, the survey may have been "preaching to the choir" and, thus, its results skewed towards those districts that are already more actively engaged in some form of approach towards sustainability. This is hard to fully assess at this point: hopefully future applications of the survey may help paint a better picture of the current state of interventions that are being implemented in Arizona.

▪ Role in District	Administrator = 95.8% / Both Administrator & Faculty = 4.2%
▪ Gender	Male = 70.8% / Female = 29.2%
▪ Function	Facilities = 42.9% / District Staff = 38.1% / Other = 19.0%
▪ District Type	K-8 = 29.2% / K-12 = 62.5% / 9-12 = 8.3%

TABLE 2. General Survey Respondent Information

Comments and recommendations for possible future surveys

It seems that it would be fruitful to improve on our survey and continue its periodical application among school districts. Beyond design and timing issues (i.e., when during the school year the survey is conducted, to allow for a more appropriate response by officials), there are future opportunities to recruit the support of key agencies and players that can promote a broader response.

An initial, late effort was made to invite the Arizona School Facilities Board to support our effort this year and could be proposed again in the future. Similarly, discussions were initiated with our contacts at the Arizona Department of Environmental Quality, to possibly enlist the support of their community liaison structure to contact districts and promote the study.

Other possible organizations that might contribute to this effort and recruit their constituents as respondents are:

- Arizona Association of School Business Officials (AASBO) www.aasbo.org
- Arizona School Boards Association (ASBA) www.azsba.org
- Arizona School Administrators Association (ASA) www.azsa.org

IV_A

Sustainable School Facilities: A Practical Summary of Findings and Guidelines

A) Sustainable School Facilities: A Practical Summary of Findings and Guidelines

This section reports and comments on the sustainable projects and practices that have been indicated by survey and interview respondents, as well as other findings including motivations, organizational issues, procedural aspects, and funding. The section is structured under the following five parts or themes: (1) sustainability interventions in school systems: projects and practices (highlighting the major core of the study, with findings and observations related to each of the four school systems considered); (2) objectives, goals, and motivations; (3) planning and implementation process; and (4) challenges and opportunities.

In the first part, we will address findings and recommendations under each of the four school systems reviewed (i.e., *Energy*, *Water*, *Waste* and *Outdoors & Landscape*) as well as a set of “Other” interventions. The structure of each of the system sections will address: (a) the frequency of projects as reported by our survey respondents, which will illustrate what kinds of sustainability interventions might be becoming part of the current state in school facilities construction, operation and maintenance, and (b) a set of concise practical guidelines and recommendations, that can guide future decision making regarding sustainability in school facilities, particularly those that emphasize environmental literacy as outlined by AAEE. These guidelines and recommendations will also be informed by concepts derived from the interviews and site visits that were developed as part of the research. They will define, albeit in a rather tentative manner at this point, elements for defining a vision for sustainable and environmentally supportive school facilities in Arizona.

Thus, the first part of this section (Sustainability interventions in School Systems: Projects and Practices) constitutes the core of our conclusions and recommendations regarding environmentally supportive school facilities in Arizona. The following parts will provide further comment on the current state and a few additional recommendations and guidelines regarding other important issues about how to move towards more sustainable school facilities. In this sense, parts two through four of Section IV.A of this report will delve in issues more related to the process of transitioning towards a more sustainable vision for school facilities and districts.

It is important to emphasize, again, that while survey respondents represent a broad swath of the student population, they still account for a small number of the state’s school districts. The percentages of responses shown in the next parts only represent how many of the *responding* school districts reported on implementing a particular project or practice. Thus, this report may not show an exact picture of the current state in Arizona, but rather an approximation of what a few noteworthy and active districts are doing. An improved future application of this survey, which may be replicated periodically, should provide a clearer picture of the current state of practice in Arizona, and of the transition towards a different, improved vision for school facility sustainability.

1) Sustainability interventions in School Systems: Projects and Practices

As mentioned above, this part of the report lists what survey respondents report to be implementing in their districts for each of the four selected systems and “other” possible interventions that support sustainability goals through school facilities, operations, and maintenance. For the purposes of eliciting this information, the survey used a list of possible “projects or practices” for each system, and requested the following from respondents:

“From the following list of possible projects or practices, please mark all that have been or are being implemented in your School District or School. For each category, please add and evaluate any existing projects not included in the list.”

Please note that the list of options in each system went beyond “technical” or “physical” interventions. Also included were a few operational and/or organizational issues, most notably the implementation of behavioral campaigns and the use of signage to inform students and other building users of other interventions. This type of issue was deemed important in our preliminary research and will be discussed and highlighted across our recommendations and guidelines.

In order to provide a baseline for what “sustainability” and “sustainability projects and practices” mean to us, the following definitions were provided conspicuously in the survey:

For the purpose of this survey, please consider the following definitions:

- **Sustainability:** The goal of a personal and/or organizational commitment with maintaining the environment, improving economic results and efficiencies, and/or enhancing human/social well-being. The interconnectedness of environmental, economic, and social systems.
- **Sustainability PRACTICES:** Any planning, operational and/or maintenance practice that gives priority to maintaining the environment, improving economic results and efficiencies, and/or enhancing human/social well-being. “Practices” refers to activities and experiences planned and developed by members of the district or school communities.
- **Sustainability PROJECTS:** Any building or remodeling improvement in the physical facilities of a district and its schools that is developed to support sustainability goals. “Projects” refers to improvements in physical facilities (either new or existing) and/or physical features in a school.

In each of the following five parts, we will (a) report and comment on survey and interview responses and (b) outline our guidelines and recommendations for future interventions in schools and school districts. As mentioned above, information derived from the interviews and site visits will also inform these results and our comments, particularly in the guidelines and recommendations section for each “system”.

→ Energy: Taking the “First Step to Green”

Current State Findings

With respect to interventions concerning the use of energy in schools (energy-efficient lighting, air conditioning, power generation, water heating, kitchens, etc.), the survey sample shows evidence of important strides in a positive direction, showing why energy has often been called “the first step to *green*.” Many of the so-called “low hanging fruits” (i.e., relatively obvious and easy to implement projects and practices) have been addressed; in some cases, some more sophisticated interventions have been implemented and/or tested as well.

It is evident from survey and interview responses that “energy” interventions are top-of-mind for school and school district boards, administrators and facilities personnel and, in many cases, are closely identified with what is meant by the concepts of “sustainable” and “green”. It is also evident that they are a first fundamental response to the objective of reducing costs (often mandated by school boards and district policy) and only secondarily seen as supporting the environmental stewardships and/or academic performance goals.

This general finding echoes what a recent study identifies as the “universal first moves” by businesses and organizations that are pursuing sustainability in their operations, products, and services: finding opportunities for resource and cost efficiency (cf., Haanaes et al 2011, p.25). In the case of Arizona schools, it seems that this objective is also the prime motivator for action at this point, so a good next step is to actively support ongoing activity with the other objectives.

1. Use of energy-efficient lighting fixtures and/or light bulbs (new or upgrades)	94.4%
2. Separate controls in classrooms and other areas (A/C and/or lighting)	94.4%
3. Energy utility bill tracking (historical comparison)	94.4%
4. Use of energy-efficient A/C and other equipment (in new building or upgrades)	88.9%
5. Use of utility incentives or support (i.e., APS / SRP Business Solutions or similar)	88.9%
6. Natural indoor daylighting (e.g., skylights)	83.3%
7. Shading of windows by means of architectural features (i.e., overhangs, louvers, trellises, other shade structures)	77.8%
8. Energy efficiency management practices in place (LEED or similar)	66.7%
9. Energy reduction campaigns with student, teacher, and/or staff participation	66.7%
10. Use of energy management or tracking software (EPA’s Energy Star Portfolio Manager or similar)	66.7%
11. Periodic survey(s) of indoor comfort by users	44.4%
12. Signage or similar exhibit that highlights energy-saving projects/practices	44.4%

On-Site renewable energy production

■ Solar panels	92.9%
■ Geothermal energy production (One School District, *Washington ESD)	7.1%
■ Wind generators (One School District, *Vail SD)	7.1%

[Percentages refer to those school districts, from all survey respondents, that reported implementing a project or practice]

Respondent Comments and Clarifications

- *Please remember that these answers may or may not reflect one or more schools (Tucson USD).*
- *Please note that without any building renewal or bond money, there have been no funds to spend on remodeling or new construction.*
- *Site recognition and celebration of effective strategies (Tempe UHSD).*
- *Regarding On-Site renewable energy production:*
 - *Solar panels are being used more as an educational tool (Tempe USD).*
 - *Small learning applications only (Peoria USD).*

On-Site Energy Production

- **Solar:** As can be seen, some districts report “small learning applications” or use of solar panels more as an educational tool, rather than a formal energy production scheme. This is a valid effort, which aligns the three threads of objectives for environmentally supportive interventions. However, several districts (e.g. Scottsdale, Flagstaff, and Payson) have made great strides to install fairly large scale solar photovoltaic arrays to reduce their energy consumption. These projects have been executed in different ways, some with the collaboration of utilities and others with power purchase agreements with private companies who cover the up-front money for installing in exchange for a long-term financial agreement with a district or school, which is of course expected to be lower than current energy costs.

Many architectural and engineering firms, as well as contractors and consultants are offering this type of service. Among these, four were identified in the course of research as having been involved in different projects across the state:

- *Emc2 Architects and Planners* → www.emc2architects.com
- *Kennedy Partners* → www.kennedyprtnrs.com
- *Clean Energy Constructors LLC* → www.cecllc.com
- *Chevron Energy Solutions* → www.chevronenergy.com

Schools and districts can also consult the Database of State Incentives for Renewables and Efficiency (DSIRE), a “comprehensive source of information on state, local, utility and federal incentives and policies that promote renewable energy and energy efficiency” (www.dsireusa.org).

- **Geothermal:** the Washington Elementary School District (in the Phoenix metropolitan area) has been conducting a pilot project for geothermal heating and air conditioning at Desert View Elementary School (financed in part by donations). Initial results are reported by the district as positive, but more analysis needs to be conducted to determine whether this technology may be used broadly in the state.
- **Wind:** One responding district (Vail School District) reported the use of wind generators (locally installed, small-scale windmills that provide some electrical output). Other projects in Arizona are reported by the “Wind Powering America” program of the US Department of Energy (www.windpoweringamerica.gov/schools), which includes the installation of larger-scale projects and links to the curriculum. School districts should be informed about this and about new solutions and proposals that will come their way as the technology becomes more widely developed and used in other settings.

Practical Guidelines and Recommendations: Energy

- Take advantage of government support and available incentives (most if not all districts and boards are already committed to energy efficiency as a policy and/or in mission).
 - Take advantage of utility services and/or private partners to evaluate opportunities, garner technical expertise, and explore financing options and incentives. 89% of respondents report using of some form of utility incentives or support.
 - Most “low-hanging fruit” will have to do with major forms of energy consumption (lighting, A/C, and water heating). However, schools should also look into other forms, for instance kitchen and lab equipment and procedures. Consider that savings in utility bills, for instance, may be used to upgrade equipment or invest in other school priorities.
 - Any project for technical and physical changes (new or retrofits) should follow a plan that includes at least: (a) measuring, (b) changing behavior, (c) integrating practices with the curriculum, and (d) communicating results and success.
 - **Measure:** As any improvement process requires data, most districts reported some form of energy utility bill tracking (historical monitoring of use and cost) and two thirds confirmed using some type of software. While there are many types of applications for this (some provided by consultants as those mentioned above), districts of all sizes, types, and budgets can readily use the EPA’s *Energy Star Portfolio Manager*. This free, online application allows districts to track their energy (and water) consumption and provide information and feedback to facilities personnel, administrators, and users.
 - **Change Behavior:** Any program to change facility operation regarding energy should be accompanied by a formal behavioral program that includes students, teachers, and staff regarding their use of lighting and A/C. A prime example of this can be found in the work of Pierce Energy Planning (www.energyplanning.org), an Arizona consulting firm that has worked closely with the Washington ESD and other districts. Their work, outlined in the book “School Cents” (Pierce, 2010), centers on behavioral campaigns that prepare the way for technical and physical transformations in the schools.
 - **Integrate:** Explore the opportunity to link any facilities projects and practices to academic performance and environmental stewardship objectives, considering state standards and specific courses (not only environmentally related, but also STEM, language, social sciences, etc.). Many of the references listed in section II offer this type of curricular activities, already correlated to Arizona or other standards.
 - **Communicate and celebrate:** Less than half of reporting districts are using some form of signage or exhibit that highlights their efforts in energy and behavior change. Of these, some use only a single, small electronic display provided by their utility or private partner (which shows real-time energy use and savings). Schools and districts should explore broader forms of communication and celebration of success, to make sure the efforts are recognized and shared by the full school community, including students, parents, and visitors. Some districts have established recognition ceremonies for the most efficient schools, which in turn celebrate with students and teachers.
- [Note: Measure / Change Behavior / Integrate / Communicate and Celebrate are four general recommendations common to all projects and practices in this report]*
- LEED- or CHPS-type certifications are not imperative, and should only be pursued if the effort and budget can be allocated and if the external recognition is important in terms of image or communication. New facilities, per the 2005 Executive Order should comply with LEED, budget permitting.

- Facilities managers and school district administrators should be on the lookout for breakthroughs and innovations in other technologies, which at present are in development (i.e., wind, geothermal, etc.) to evaluate if they are economically and regionally viable. In general, schools should move toward the use of renewable sources of energy, whether derived from on-site renewable energy generation or from purchased renewable energy sources (provided by their respective utilities, where available).
- Where regionally appropriate, for new projects and retrofitting, consider simple solutions as natural daylight (to reduce use of artificial lighting) and shading structures (to reduce heating by sun). Innovative materials provide clever solutions: one district in Northern Arizona reports the use of KalWall, an insulated, translucent enclosure material which allows for large walls that let in light while maintaining inside temperatures; another district in Phoenix remodeled a walled-in room as a dining space and brought in sunlight using dome-like product Solatube.

→ Water: Caring for a Precious Resource

Current State Findings

The use of water in schools is also a top-of-mind issue for school districts: indeed, conscience regarding water usage and conservation is a concern of district administrators and facilities personnel and also is closely identified with the goals of sustainability and environmental stewardship. However, in the interviews it was an issue more significant for some districts than others, depending on contextual issues of water utilities, perceived water scarcity, and general community attitudes (an issue that may hopefully provide interest for future research). Anecdotally, interviewees in both Flagstaff and Tucson appear to identify water conservation as a prime sustainability issue for schools and the community, more so than counterparts in the Phoenix metropolitan area. This may emphasize regional differences, which include a community-wide perception of its role in water conservation for the region (Flagstaff) and local distribution and pricing schemes (Tucson).

Despite water conservation awareness, survey results show that interventions in this respect are still lagging in some districts, perhaps because the financial payback may not be seen as relevant as in the case of energy use and water saving may be an issue motivated more by environmental responsibility. Nevertheless, a majority of responding schools report use of water-efficient landscaping and equipment in buildings, as well as utility bill tracking (though not necessarily through formal software that is available, such as EPA's Portfolio Manager).

Low in the list are both efforts to communicate visually any ongoing effort as well as other practices like storm water reuse or recharge or rainwater harvesting (capturing rainwater in tanks for later sanitation or landscaping use). Both issues are not straightforward in implementation, as they may depend on municipal or state initiatives, conditions, or concerns (for example, water harvesting may be a health issue for the ADEQ). Some schools in the state have implemented small-scale pilot projects (e.g., Phoenix's MetroTech High School) and others have implemented or are in the process of implementing reclaimed water projects for irrigation (e.g. the Tucson USD reports more than 40 sites and the Agua Fria HSD reports advance with local authorities).

Trying to assess an issue that spans energy and water use, the survey asked whether school districts had in place cooling tower water management practices and 55.6% of respondents reported in the affirmative. This is one of the Department of Energy's 14 best management practices (BMPs) regarding water efficiency, and while school facility managers are probably well aware of them, administrators and decision makers should look into this relevant operating issue to find areas of opportunity. More information on the BMPs regarding water can be found at: <http://www1.eere.energy.gov/femp/program/waterefficiency.html>.

Finally, water conservation is of course an important issue in curricular environmental literacy programs across the state's K-12 schools. Though not mentioned specifically in surveys and interviews, the University of Arizona's *Arizona ProjectWET* (Water Education for Teachers) is a standards-based training program for teachers to incorporate water literacy and conservation issues and activities into their coursework. In particular, their *School Water Audit Program* (SWAP) has been successful in incorporating standard-based curricular activities with the preparation of students as water stewards, by performing indoor and outdoor water use audits in their schools (and homes).

In the process, these types of activities have often promoted relatively simple physical solutions to save water (e.g., installing faucet aerators, installing water-efficient toilets and

urinals, periodic revisions of leaks, etc.). This is a fine example of how schools can integrate learning with facilities improvement and intervention. However, and despite the fact that there is no data in this study regarding how widespread these activities are at this point, from the survey results it may be surmised that only some schools have implemented formal water-savings campaigns across campus (38.9% according to the survey).

1. Water efficient landscaping (e.g., xeriscaping)	83.3%
2. Water utility bill tracking (historical comparison)	77.8%
3. Use of water-efficient equipment in new building or building upgrade – (e.g., low water or waterless urinals)	66.7%
4. Cooling tower water management in place	55.6%
5. Periodic revision for leaks and other problems	50.0%
6. Water saving campaigns with student, teacher, and/or staff participation	38.9%
7. Lead testing in drinking fountains	27.8%
8. Use of water management or tracking software (EPA’s Energy Star Portfolio Manager or similar)	22.2%
9. Signage or similar exhibit that highlights water-saving projects/practices	22.2%
10. Stormwater reuse/recharge or “rainwater harvesting”	16.7%

[Percentages refer to those school districts, from all survey respondents, that reported implementing a project or practice]

Respondent Comments and Clarifications

- *Tucson USD has 40 plus sites on reclaimed water for irrigating fields.*
 - www.tusd1.org/contents/depart/reap/water.html
 - cms3.tucsonaz.gov/water/who_uses_reclaim
 - www.watereuse.org/sites/default/files/images/TW_TUSD.pdf
- *We are currently looking into the cost and environmental benefits of synthetic turf (Tempe UHSD).*
- *Rain water capture (San Fernando SD35) [listed under Energy section by the SD].*

Practical Guidelines and Recommendations: Water

- Compared to energy, water conservation may not be as readily “top-of-mind” for boards and administrators in terms of efficiency and savings. However, the same arguments for those committed to energy efficiency as a policy and philosophy can apply, particularly when educational value and curricular activities can be integrated with facilities projects and practices.
- Utility services and/or private partners are also available to evaluate opportunities, garner technical expertise, and explore financing options and incentives.
- Any project for technical and physical projects (new or retrofits) should follow a plan that includes at least: measuring, changing behavior, integrating with the curriculum, and communicating results and success.
- **Measure:** Utilize one of the available utility tracking software, including EPA’s *Energy Star Portfolio Manager*, to monitor water use and savings and provide information and feedback to facilities personnel, administrators, and users.
- **Change Behavior and Integrate:** Support any facility or equipment improvement project with a behavior campaign or curricular activity, that includes all possible forms of water

conservation awareness, including ProjectWET-type audits and activities as discussed above. In this sense, there is also an opportunity to explore both academically and in facilities practice the trade-offs and possible links to other school “systems”, in particular the *Energy-Water nexus* (as in the cooling tower operation mentioned above, there are other local and broader-scale issues of how water is used to produce or manage energy and how energy is needed to pump water across long distances and different altitudes to reach users).

- **Communicate and celebrate:** Only a handful of reporting districts indicated the use of some form of signage or exhibit that highlights their efforts in water and behavior change. Schools and districts should explore broader forms of communication and celebration of success, to make sure the efforts are recognized and shared by the full school community, including students, parents, and visitors. This may include visual exhibits and/or ceremonies or recognition events.
- Install water efficient equipment as much as possible (e.g., low-water or waterless urinals, low-flow faucets and toilets, etc.). Note that some jurisdictions require waivers for this. In particular, faucet aerators are a low-cost, easy to install way of reducing water flow and efficiency. Tracking data can provide information on initial cost versus savings to justify installation.
- Periodic and effective revision and repairs to leaks and equipment flows is also an efficient and relatively economic way to save water (an evidently leaky faucet or toilet communicates negatively in this regard).
- Review opportunities for saving water in operations, particularly in cafeteria related procedures and spaces. Schools have implemented “trayless dining” to eliminate the need to wash trays (as long as the possible waste that is generated is not less sustainable).
- Many districts already report xeriscaping and other water-saving landscaping practices, the Arizona Municipal Water Users Association (AMWUA) provides excellent material regarding appropriate plants and practices, including auditing guidelines and tools (see Bibliography, particularly AMWUA, 2008 which may be applicable to school settings).
- Though most responding districts report xeriscaping and low-water landscaping, this should not entail completely eliminating green spaces and tree cover (for groundwater recharge and cooling effects). AMWUA brochures and experts in the field can provide guidance in this respect.
- A major challenge is of course the maintenance of sports fields, which underscores the importance of exploring reclaimed water and rainwater harvesting initiatives as a substitute or complement to water from local utilities. Tempe UHSD has reported that they are evaluating the sustainable trade-offs of installing artificial turf on sports fields, an experience that will be important to consider in future analysis.

→ Waste: Learning to Appreciate It

Current State Findings

Perhaps contrary to expectations, the issue of waste seems to be one of the trickiest systems for school districts to grasp and incorporate as a relevant environmentally supportive practice for facilities, operations and maintenance. Not surprisingly, with the long-standing social campaign and practice that have been in place for decades, waste reduction, reuse, and recycling programs are reportedly in place at every school district in the survey, and probably are a fact of life in every school across Arizona (100% of districts in the survey report having a 3 R's program in place). Anecdotally, it is known that in several school districts and schools, the program is implemented as an activity of special education children, who perform the duties of recollecting and disposing recyclables from classrooms and offices (mostly paper, cans and bottles).

However, going down the list of other waste-related practices and projects, positive responses fall below 50% in all categories. Again, at least in part because it is still not viewed as a cost-saving practice, waste-related activities seem not to be at the top of mind and are often (and surprisingly) a source of confusion as to how they relate to sustainability and environmental literacy.

An issue to consider for waste management in schools is the context. In interviews, it became clear that districts and schools are of course dependent on the local waste management scheme. For instance, Tucson reports comingled recycling availability, while Payson reports that there is still no local scheme for collecting separate waste. It is likely that, as opportunities in waste recycling, composting, and related processes are identified by local authorities and waste-management utilities and/or private companies, this will become more of a mainstream activity, one that can and should also be harnessed not only for cost-saving but most importantly for educational and environmental literacy purposes.

A huge opportunity comes in something that is often overlooked in waste management for sustainability: the fact that waste is viewed as a “downstream” issue (i.e., “what do we do with the waste that we generate”) versus viewing it as an “upstream” concern (i.e., “how do we reduce the waste we generate in the first place”). In the survey, only 12.5% of responding districts (only two) reported having a “packaging waste reduction process in place (related to supply and other purchasing)”. One district (Tempe Union High School District) highlighted the installation of water-bottle filling stations in order to reduce waste from plastic bottles. While later in the survey other similar practices are also reported (see part 5 of this section, for “other” projects and practices), conscience of “upstream” waste reduction is a most relevant practice for sustainability in general, and hopefully will be more promoted in the future by school communities.

Finally, composting of organic matter (food scraps or cafeteria waste, either at a small/classroom scale or at a large/campus-wide scale) is done by very few school districts. This is in part due, of course, to lack of knowledge about processes and tools that have become very much commonplace today, at least in the residential setting (see recommendations below). On the other hand, there is the perception (partially based on fact) that composting is not allowed by law in school grounds, although certain forms of composting may be explored. Again, ongoing development of processes and opportunities are helping to find ways to circumvent these issues.

1. Waste recycling program in place (3R's – Reduce/Reuse/Recycle)	100%
2. Separate waste containers in place for public use	43.8%
3. Separation of waste prior to final destination	37.5%
4. Efforts and/or success in reducing use of plastic bottles	31.3%
5. Composting of organic matter (food scraps or cafeteria waste)	
■ Small-scale / Individual or classroom projects	12.5%
■ Large-scale / Campus-wide project or practice (One district, *TUSD)	6.3%
6. Waste stream audit in place (LEED or similar)	12.5%
7. Packaging waste reduction process in place (related to supply and other purchasing)	12.5%
8. Composting of waste from yard or landscape maintenance (grass cuttings, etc.)	12.5%
9. Signage or similar exhibit that highlights waste-management projects/practices	12.5%

[Percentages refer to those school districts, from all survey respondents, that reported implementing a project or practice]

Respondent Comments and Clarifications

- *TUSD is on comingled recycling program so that separation of recycled wastes is not necessary.*
- *We have started installing water bottle refilling stations to reduce the amount of plastic water bottles being used in our facilities (TUHSD)*

Practical Guidelines and Recommendations: Waste

- Reducing waste in everyday operations is a most important lesson in environmental stewardship for school-age children, a commitment that can and should extend beyond the campus (to the home and community). This argument can provide leverage to improve current operation of “Three R’s” programs and incorporate new practices.
- Schools and school districts must engage contextually with their local authorities and waste-management utilities and/or private companies, to determine available opportunities in waste recycling, composting, and related processes.
- The approach to waste should begin with campaigns and purchasing practices that focus on the “upstream” reduction of trash (the first “R”). This is still a challenge, as product packaging by suppliers is still generating tons of solid waste, but a vigilant procurement process at schools can look for strategies to reduce this.
- Any project to implement new waste management practices should follow a plan that includes at least: measuring, changing behavior, integrating with the curriculum, and communicating results and success.
- In order to measure, it is advisable to conduct a waste stream audit to identify how much and what kind of garbage and recycling moves through a school’s waste stream. Using LEED or similar assessment processes, this activity can be done by external providers or with appropriate training can be done on-site. The actual information of the amount and type of waste generated at a school will establish a level of awareness and support the identification of ways that waste can be: (a) avoided in the first place (“upstream” or before it reaches users in the school), (b) recycled more effectively and actively by improving practices, and/or (c) considered for possible composting (food or yard scraps).

- Consider composting at the school level, if possible, or engaging with companies that may collect residue for composting.
 - Yard (or green) waste has no restriction for composting. Many schools already do this either on-site or with agreements with a growing number of companies.
 - Food composting is more complicated and has legal restrictions in the state, but it is possible to establish some form of on-site composting if it is fully contained and managed properly. Useful for demonstration and curricular purposes.

- Vermicomposting (small bin worm composting)
- Composting in medium-scale tubs

While vermicomposting in particular can be done with home-made bins and materials, schools and teachers might want to look at providers that supply materials and equipment of different types. Two examples, for illustrative purposes only:

- www.wagle.com/composters
- www.compostingtechnology.com/invesselsystems/earthtub

Resulting compost can of course be used on-site for landscaping, and the whole process can be well integrated in academic activities and programs, for example Facing the Future's "Buy, Use, Toss?" lesson plan (see references in section II).

- Promotion of reusable water bottles can diminish considerably the waste from plastic bottles in school campuses. Install water bottle filling stations to foster a waste-reduction activity on campus. As an example, the Tempe UHSD has installed a type of bottle filling station (Elkay's *EZH2OTM*) which displays how many disposable plastic water bottles have been diverted from landfills and/or the need to recycle them (Fig. 1). Other similar stations are available in the market and help visualize the rewards in a school campaign.



Fig. 1 Water Bottle Filling Station Models / Tempe UHSD
(Photo: www.elkayusa.com)



Fig. 2 Landfill vs Recycle Waste Bins / ASU Tempe
(Photo: M.Wood)

- Consult the EPA's "WasteWise" program site. This is a free, voluntary program to incentivize municipal solid waste and some industrial-type waste reduction. Information and materials are available at www.epa.gov/epawaste/partnerships/wastewise/index.htm.
- Review opportunities for reducing waste in purchasing and operations, particularly in cafeteria related procedures (a major source of pre- and post-consumer waste). Schools should look as much as possible to reduce non-sustainable packaging and serving utensils.
- Provide school communities with information on waste stream audit results, best practices, and available recycling bins. Fig. 2 shows a recent bin model that emphasizes recycling versus landfill destinations.

→ Landscape and Outdoors: Expanding Educational Spaces

Current State Findings

The focus of this section in the survey centered on understanding the use of outdoor space and/or landscapes to develop awareness of nature and ecosystems and to promote environmental stewardship in schoolchildren and the broader school community. Respondents were also asked about four heat-island reduction (UHI) strategies.

Many of the school districts (92.3%) report some form of programmed and periodic learning activity that is held outdoors in their schools, while more than half (69.2%) report dedicated outdoor space that is used for environmental or natural science learning activities. In addition, of those responding, 84.6% report the existence of school gardens and/or orchards. It should be noted, of course, that this is a rather high-level assessment of the current situation, as the survey may not reflect widespread activity and spaces (in other words, a district may have answered in the positive if only one of their schools has a programmed activity or a dedicated space). However, the results show some promise of activity and understanding of the issue.

In addition to the survey, visits and interviews allowed a glimpse at how this activity and these spaces may be playing out in reality. Schools are moving to incorporate some level of outdoor environmental activity and devoting spaces for this purpose. Prime examples of this are two schools included in our case studies, Gila Crossing Community School (CS4) and Davidson Elementary in the Tucson USD (CS2). Other schools, for example Desert Edge, Tempe, MetroTech, and Mesa High Schools (all in the Phoenix metro area), have developed or are in the process of developing orchard and/or garden spaces, linked to academic activity.

In summary, the current state seems to show promise for this “system” and projects will hopefully continue to be promoted with a clear integration of the three objectives. School districts should strive to make sure that any dedicated outdoor space is academically integrated and that it is cost effective from the onset. In this way, while it may be promoted by one or a few teachers and/or staff members, it may stand a better chance of becoming institutionalized and remaining safe from personnel or budget changes.

Regarding UHI reduction strategies, school districts use “cool roofs” and vegetation to reduce heat from buildings and outdoor spaces, but have not explored other technologies (which of course may be low in the priority list). New school projects in the future would benefit from exploring new technologies and design schemes for walkways, pavements and parking lots. However, “green roofs” are not recommended (particularly in the hotter areas of the state) and trade-offs should be evaluated, to balance the heat-reduction properties of vegetation with xeriscaping and low-water use strategies.

1. Programmed and periodic learning activities conducted in outdoor spaces, related to curriculum and standards	92.3%
2. School Garden and/or Orchard	84.6%
3. Support from science/biology classes (environmental science curriculum)	76.9%
4. Outdoor space dedicated to environmental / natural science learning activities	69.2%
5. Natural habitat recovery areas (school grounds section that have been kept or restored to a more natural state)	46.25%
6. Signage or similar exhibit that highlights outdoor-learning projects/practices	7.7%

Urban Heat Island reduction measures:

■ Use of “Cool Roofs” (light colors, heat-reducing material, etc)	81.3%
■ Increase of trees and vegetation in school grounds	56.3%
■ Use of “Green Roofs” (vegetation atop horizontal roof structures)	0.0%
■ Use of “Cool Pavements” (heat-reducing additives in pavements, etc)	0.0%

[Percentages refer to those school districts, from all survey respondents, that reported implementing a project or practice]

Practical Guidelines and Recommendations: Landscape and Outdoors

- Again, any school district or school that plans to incorporate outdoor spaces projects and practices should make sure of integrating them with the curriculum and communicating results and success.
- Learning in the outdoors can happen without the need for a formally dedicated space, so schools should make every effort to get their children outdoors to learn and enjoy.
- Schools that do incorporate dedicated space into their facilities seem to take more pride in their program and can find more creative ways to develop awareness of nature and ecosystems and to promote environmental stewardship in schoolchildren and the broader school community. Construct an argument based on this and on a clear integration of the space with academic activities and curriculum and with community participation. The space can thus become more institutionalized and safer from personnel and/or budget changes.
- Most curriculum-oriented references (Facing the Future, ProjectWET, GEF, etc.) offer a breadth of lesson plans related to landscape and environmental learning in the outdoors, standards-oriented and for all K-12 levels. ASU’s Ecology Explorers program offers excellent resources for teachers and students (<http://ecologyexplorers.asu.edu>).
- Consider that the incorporation of outdoor activities to the curriculum may not be limited to environmental- or science-related coursework. Schools should explore ways to creatively integrate other disciplines, including STEM, language, social sciences, etc.
- The survey did not show much activity regarding communication of results and success. Communicating and celebrating is again an important recommendation, and some schools have made an excellent effort in designing and providing informative signage in outdoor spaces. Davidson Elementary School (Tucson), for example, developed and obtained funds for a project that provides outdoor learning areas with labelled plants and trees.
- Though teachers and administrators may also find inspiration for learning activities and decision making, facilities personnel in particular should review material for the Sustainable Sites initiative (www.sustainable-sites.org) for suggestions and ideas about new and retrofit projects for school landscapes. Designed as a complement to LEED, the guidelines and performance benchmarks in Sustainable Sites provide information, suggestions, and examples regarding five major elements of landscape: (1) hydrology, (2) soils, (3) vegetation, (4) materials, and (5) human health and well being.

→ Other Sustainable “Features” and/or “Practices”

Current State Findings

Respondents were offered a list of other possible sustainability interventions. Many are rather commonplace or usual features in schools, but part of the objective here was to bring these issues to respondents’ attention as elements of a complete picture of sustainable and environmental supportive facilities. Further applications of this survey may gauge this better, particularly issues related to broader operational procedures at districts (e.g., purchasing and printing practices, which can have a direct positive impact on waste reduction).

Healthy food menu/options in cafeteria	83.3%
Dual or after-hours use of facilities (by own members or extended community)	77.8%
Bicycle racks	77.8%
Pest management practices in place (e.g., Integrated Pest Management or similar) [*]	72.2%
Indoor Air Quality practices in place [*]	72.2%
School bus upgrades to reduce emissions [*]	66.7%
Bus idling reduction program [*]	61.1%
Common space(s) that promote non-traditional modes of learning (e.g., collaborative learning, Problem-Based or Project-Based learning, etc.)	55.6%
Classroom or lab space(s) that promote non-traditional modes of learning (e.g., collaborative learning, Problem-Based or Project-Based learning, etc.)	50.0%
“Green cleaning” policy or practices	50.0%
Easy access to public transportation	50.0%
Chemical management practices in place (e.g., Chemical Management Plan or similar) [*]	38.9%
Other sustainable business practices in place (e.g., printing reduction, etc.).	38.9%
Sustainable purchasing practices in place	22.2%
Program to promote no idling zone(s) around school (including parents, etc) [*]	22.2%
Signage or similar exhibit that highlights any sustainable feature or practice	16.7%

[Percentages refer to those school districts, from all survey respondents, that reported implementing a project or practice]

Practical Guidelines and Recommendations: Other

- These and other sustainable features and practices are some that are becoming more common in all forms of institutions and academic settings. They respond to growing public choices and awareness regarding the balance between our environmental, economic, and social decisions and actions (for example, biking to school and choosing healthier or local foods). Schools that have already incorporated them (by choice or obligation) should communicate them in a manner that makes their community aware of their positive impact to sustainability.
- Time and budget will of course mark the limit for what school districts and schools are able to incorporate as generalized features or practices. Nevertheless, with creativity, student, parent, and community support, and clear arguments that can convince decision

makers, schools can reinforce current actions and keep other features and practices in their wishlist, to implement as time and budget permit.

- Some of the features and practices surveyed (marked [*] in the table above) point to fundamental health and quality of life issues, related to the provision of spaces that are conducive to learning and achievement. These issues should probably be considered obligations by the schools, and are thus specifically promoted by ADEQ's *Environmentally Healthy Schools* program and checklist and appear in some form in both LEED and Green Ribbon Schools assessment guidelines and benchmarks.
- The survey also asked about two possible features in school facilities: common space(s) and/or classroom or lab space(s) that promote non-traditional modes of learning (e.g., collaborative learning, Problem-Based or Project-Based learning, etc.). About half of the respondents answered in the affirmative. The importance of this issue resides in the fact that sustainability is a collaborative and solution-driven approach to environmental, economic, and social problems (cf. Wiek et al, 2011). Thus, schools that are designed with new forms of spaces that facilitate this type of learning process are moving positively in the direction of preparing their students to be sustainability change agents in their future lives and professions. Even if existing schools have not been designed in this way, they may be able to facilitate new learning processes by creative room, furniture, or activity arrangements and teacher commitment.
- Beyond concrete actions in the four systems analyzed in this study, school districts and schools should make every effort to make sustainability (broadly defined) an integral part of their operation and philosophy. This includes practices that did not score very high in the survey, for example: "green cleaning" policy, practices, and materials (50.0%), sustainable business practices such as printing reduction (38.9%) and sustainable purchasing practices in place (22.9%). These business practices in some cases will require information and training, but their implementation will not only help in the reduction of operation costs, but also in aligning the philosophy of the school or school district to a more integral view of sustainability and to teach by example.
- Though focused on the higher-education system, two of the references listed in section II can provide insight and inspiration into efforts to incorporate sustainable features and practices at all levels and areas of an educational institution:
 - *Association for the Advancement of Sustainability in Higher Education (AASHE)*
www.aashe.org
 - *Arizona State University*
<http://sustainability.asu.edu/practice/what-asu-is-doing>

➔ Noteworthy Examples

After naming those projects and practices that have been implemented in School Districts, survey respondents were asked to mention and describe any specific school and/or school project or practice that they consider noteworthy and of possible interest as an example or case studies. The responses are listed below as noted by some respondents, to serve as reference for others. They are not, by any means, an inclusive list of best practices, but only those noted by survey responses.

- *Davidson Elementary School is our first LEED Silver School (Tucson Unified SD).*
- *Green Schoolhouse Projects (two LEED Platinum) structures being built this fall (2011); geothermal pilot project on-going; gas HVAC unit pilot; net zero school design in process; energy behavior management program down 30% in electric use district-wide after three years (Washington Elementary SD).*
- *Energy conservation programs involving staff and students. Outdoor habitat classroom areas. Student involvement recycling programs (Humboldt Union SD).*
- *Conversion of three campuses from old roof top package HVAC units to high efficiency central plan operations with new EMS (Energy Management Systems) controls (Peoria Union SD).*
- *District-wide Energy Savings Project (primarily lighting, HVAC, and controls/sensors) followed by solar power / covered parking project (District name withheld).*
- *Our district is currently working with ASU and other businesses to develop a comprehensive sustainability program that is geared for the high school environment (Tempe Union High School District).*
- *A total of 5 mWh of solar at seven schools (Deer Valley Unified SD).*

2) Objectives, Goals, and Motivations

As has been stated before, educational facility projects are guided by diverse objectives and aspirations in their design, construction, and operation. A recent statement by CEFPI's "School of the Future" competition illustrates how these aspirations are both very elevated and broad:

"A school of the future conserves resources, saves energy and lowers operating costs, engages the community, and opens up new vistas for students and new visions of what schools can be, for educators, planners, architects, community stakeholders, everyone involved in building and using schools" (CEFPI, 2010).

To assess what is the moving force behind current state practices in environmentally supportive facilities, the survey focused on two questions related to general goals and motivations. Results indicate that school district respondents try to balance the three main threads of objectives stated in this study, but do so by placing cost reduction and savings as the top priority with environmental stewardship and academic performance behind. A first question (Q.05) focused on the general **goals** (or ends toward which efforts are directed) of sustainability, based on the "triple bottom line" concept and environmental education. A second question (Q.09b) proposed a long list of possible **motivations** (more specific stimuli, influence, or incentives) and asked respondents to rank the relative importance of each for their sustainable projects and practices.

Please note that questions numbers in the boxes below (e.g., Q.05) refer to the key used to identify the result spreadsheet for each question or survey section (see appendices.)

Q.05 If Sustainability has been defined by your School District / School as an important issue or objective (physically or operationally or both), please indicate which of the following concepts are considered as goals for your efforts (select all that apply):

Answer Options	Response Percent
Maintaining the environment	77.8%
Improving economic results and efficiencies	88.9%
Enhancing human/social well-being	55.6%
Improving children's environmental education and/or environmental awareness	77.8%

TABLE 3. Goals (General)

OTHER answers/comments provided by school districts (optional)

- *Provide living laboratories that will expose students to new innovative technologies and career opportunities (Tempe UHSD).*
- *We have recently completed a Facilities Master Plan the purpose of which is to: (1) look at District facilities use in terms of demographics, current and future use; (2) evaluate capital maintenance in terms of current and future needs; (3) look at energy use in terms of EMS, electricity, water sewer and waste; (4) look at 21st Century Best Practices in terms of current and future trends as they relate to design and technology; and (5) look at how design can impact human resource requirements for students and staff. In*

addition we have recently implemented a plan that defines what an efficient school is in terms of enrollment size, establishes a timeline for schools falling below the efficiency threshold to become efficient or look at the facility being repurposed (Paradise Valley USD).

Q.09b There may have been many reasons or motivations for these actors to pursue sustainability projects and/or practices. In the following table, please mark how important were each of the following issues as motivators for your projects/practices. Please rank from 1 (not at all important) to 7 (extremely important). Choose N/A if issue is not applicable.

Motivating Issues	1	2	3	4	5	6	7	N/A	Rating Average
To save costs on energy bills / budget reduction	0	0	0	0	1	2	15	0	6.78
To save costs on water bills / budget reduction	0	0	0	0	1	2	13	2	6.75
To ensure better conditions to support student learning	0	0	0	0	3	2	13	0	6.56
To ensure better conditions related to our children's health (e.g., nutrition, air quality, water quality, natural lighting...)	0	0	0	1	2	2	13	0	6.50
Because it is the right thing to do	0	1	0	0	2	1	14	0	6.44
To ensure better conditions to support personnel	0	0	0	2	2	4	9	0	6.18
Because it's important for our children's future	0	1	1	1	2	0	13	0	6.11
To improve student attendance	1	0	0	1	1	5	8	1	6.00
To improve faculty attendance	1	0	0	1	2	4	8	1	5.94
To preserve the environment / environmental stewardship	0	1	0	2	5	1	9	0	5.78
To promote environmental education and/or environmental awareness in our students	0	1	0	2	4	4	7	0	5.72
To attract and retain better teachers	1	0	0	1	6	1	8	0	5.71
To let others know that the School District is committed with environmental issues	0	1	0	3	4	4	5	0	5.47
To make sure that future generations don't inherit our environmental problems	0	2	0	4	3	0	8	1	5.35
To increase community's interest and support for the School(s)	0	1	0	3	6	4	3	0	5.24
To let others know that the School District is committed with social issues	0	2	0	3	5	3	3	0	5.00
To increase parental interest and support for the School(s)	1	1	0	4	6	2	3	0	4.82
To increase business community's interest and support for the School(s)	1	2	0	2	8	1	3	0	4.71
For marketing / recruitment purposes	1	5	0	2	5	1	3	0	4.18
For our national security (e.g., to keep us from being dependent on foreign oil)	2	6	1	1	2	1	3	1	3.63
To keep up with what others School Districts are doing	4	3	0	2	4	1	1	2	3.40

TABLE 4. Motivations (Detailed)

OTHER answers provided by school districts (optional)

- *Provide career opportunities for students in this area.*

Comments and Recommendations

- The survey attempted to assess a very broad suite of goals and motivations, based from a qualitative and (possibly) partial view of respondents. Nevertheless, results do indicate that the prime objective for action is economic (88.9% in Table 3) with academic, environmental, and other aspirations following. This is perhaps not surprising in the

current economic situation, but should be taken as an advantage to gain momentum for pursuing other objectives.

- Though a case-by-case analysis would be required to assess current practice, goals and aspirations may have been indicated as important by a district in the absence of concrete and formal projects to respond to them. On the other hand, case studies and other contacts show evidence of excellent work in this regard (for instance, Paradise Valley USD, Tucson USD, Tempe UHSD). In any event, school districts should evaluate their current goals and visions regarding sustainability and/or environmental learning, and align them with concrete plans and assessment (measurement and documentation). The survey attempted to assess this with a section related to *outcomes* (see below).
- Motivations related to how sustainable projects and practices may generally improve a school district's or a school's image (i.e., increase parental or business community interest and support, marketing or recruitment purposes) placed relatively low in the scale (see Table 4). While perhaps other levels of school district officials would have responded differently, it seems important to consider that communication of sustainable projects and practices, within school communities and beyond, may help to foster support, improved community perception, and recruitment efforts (not only of students, but also of faculty and staff who may be attracted to more sustainable organizations).
- The social dimension of sustainability seems to fare low in this initial, qualitative assessment, overshadowed by economic imperatives and by the general understanding of "sustainability" as related to environmental objectives. It would be important for school districts to consider this dimension in future projects and practices, particularly since it may prove beneficial to incorporate non-science disciplines in sustainability and environmental literacy efforts.
- In comments and interviews, several districts clearly identified motivations related to providing students with career opportunities related to sustainability. This is a very important effort and should be supported as possible.

3) Planning and Implementation Process

In a first attempt to map important issues related to planning and implementation of sustainability efforts, various sections of the survey were dedicated to assessing respondent views about priorities, process, leadership, actors involved, and perceived or measured outcomes. The following parts of this report outline current state findings and recommendations in four broad areas: (a) Making sustainability a priority; (b) Leadership and support; (c) Use of guidelines; and (d) Measuring and documenting outcomes.

→ (a) Making Sustainability a Priority

Grand projects at institutions and organizations of all types generally succeed on the basis of fundamental elements, which include: vision statements that clearly define the way, leaders that coordinate and inspire, and groups of people and stakeholders supporting the cause. In this sense, the survey attempted a first assessment of how much sustainability has become a priority in planning and operation and if leaders and other actors are in place as teams to plan and guide the efforts. Though results are perhaps limited from the survey's scope and design, some initial insight can be gathered from questions that gauged how much sustainability has become a priority in school districts (Q.03) and whether or not some form of internal organizational structures are in place to "address sustainability issues" (Q.04a.)

Q.03 Considering the issue of Sustainability (as defined before), please tell us which of the following options describe the current situation in your School District / School (mark all that apply):

Answer Options	Response Percent
There is no awareness or discussion of the issue of sustainability	0.0%
There is some awareness of the issue of sustainability ("we know and/or talk about it")	50.0%
There is a formal policy to pursue sustainability in the School District / School	38.9%
School District / School has a working definition or mission related to sustainability	22.2%
There is one (or more) formal committee(s) to guide efforts related to sustainability	27.8%
There is a formal organizational position related to sustainability (e.g., "Chief Sustainability Officer", "Director of Sustainability", "energy efficiency leader", etc.)	22.2%

TABLE 5. General awareness of sustainability as an issue

OTHER answers/comments provided by school districts (optional)

- We have had a focus on sustainability for well over ten years that has increased markedly in the last five years. We have no one designated with that title nor do we have a policy regarding sustainability. Our five year plan deals with sustainability indirectly, but not specifically using those words (it deals with facility / staffing / energy efficiency, etc.)*

Q.04a If your School District / School has at least one formal committee to address issues related to Sustainability, which of the following best describes your efforts (select only one):

Answer Options	Response Percent
There is no such committee.	41.2%
There is one committee at the School District level, focused on diverse sustainability efforts in general	17.6%
There is one committee at the School District level, focused on a specific theme (e.g., purchasing, energy efficiency, teaching sustainability, etc.)	17.6%
There are several committees at the School District level, focused on specific themes (e.g., purchasing, energy efficiency, teaching sustainability, etc.)	11.8%
Each School has a single committee focused on diverse sustainability efforts in general	11.8%
Each School has a single committee focused on a specific theme (e.g., purchasing, energy efficiency, teaching sustainability, etc.)	0.0%
Each School has several committees, focused on specific themes (e.g., purchasing, energy efficiency, teaching sustainability, etc.)	0.0%

TABLE 6. Existence of sustainability-related committee

OTHER answers/comments provided by school districts (optional)

- *Some schools have one or more committees focused on a specific theme. At a School District level, committees are developed sometimes for only a specific length of time.*
- *We have a two-tiered process. There is one energy team at each campus and an overall District level energy team. None of the above answers reflect our process and situation. In addition, apart from the energy team at each school, several other club activities related to sustainability exist.*
- *There was a committee that helped establish district platform. Has not met in months.*
- *We have no standing committees of which I am aware, but we have had committees that have dealt with and made recommendations regarding facility use, energy management, renewable resources, staffing efficiencies, etc.*

Comments and Recommendations

Making Sustainability a Priority

- Listed responses and comments for both questions, as well as information from case studies, point to the variety of ways in which districts are striving to make sustainability a priority. Table 1 shows, in the estimation of survey respondents, that while there is some promise, sustainability is yet to become a major issue across schools and school districts. Less than a third of responding districts report that they have either a working definition or mission related to sustainability, formal committee(s) to guide efforts related to sustainability, or a formal organizational position related to sustainability (e.g., “Chief Sustainability Officer”, “Director of Sustainability”, “energy efficiency leader”, etc.).
- Some surveyed and interviewed school districts are exemplary in having a vision for sustainability in their operations and/or facilities. However, some of these visions are still partial, focused mostly on energy and/or resource efficiency and, less often, broader

environmental objectives. A first recommendation is to define a compelling vision for sustainability that: (a) incorporates economic, environmental, and social concerns and aspirations; (b) considers the three threads of objectives simultaneously; and (c) considers the links between the teaching-learning process and school facilities and operation.

- Formal positions in the organizational chart (at the district or school level) are not imperative, particularly in the current economic situation. However, the benefit from assigning a person is to focus efforts and to send a message to the organization. There are exemplary cases of such leaders at different levels not only of school district business or facilities departments (e.g., Bob Anderson at Tempe UHSD, Michael Green at Paradise Valley SD) but also in school and school district administrators.
- Though some may hold committees as synonymous with inaction and/or bureaucracy, well-led and administered work groups are key for successful implementation of sustainability efforts in school facilities and operation. They should include as many different members as possible from the school community (including students and teachers) and possibly some external stakeholders, if appropriate. Sustainability committees or working groups also send a message to the organization and are a testing ground (particularly for students) of “real-world”, collaborative problem solving (cf. Brundiers et al, 2010).
- Committees need real responsibilities and projects, timeframes with goals and measures, and accountability. They may be malleable and adapt to specific projects, budget or time constraints.

→ (b) Leadership and Support

Several survey questions addressed: what types of persons might be involved in school district and/or school committees (Q.04; Table 7); internal or external actors who might have been instrumental in initiating efforts (Q.09a; Table 8); perceived level of expertise (Q.09b; Table 9); and consultant involvement (Q.10a,b and c; Tables 10 and 11).

Q.04 If your School District / School has one or more formal committees to address issues related to Sustainability, do they include persons that are or represent... (mark all that apply):

Answer Options	Response Percent
Facilities Asst. Superintendent, Operators, and/or Managers	90.9%
School Administrators (e.g., Principal)	72.7%
District Administrators (e.g., Superintendent)	72.7%
Teachers / Faculty	72.7%
Students	45.5%

TABLE 7. Committee participants (actors)

OTHER answers/comments provided by school districts (optional)

- *Schools/Sites have varying degrees of participations for committees.*
- *Community; parents.*
- *No students on committee.*

Q.09a Please identify any category of actor that was or is influential in INITIATING sustainability projects and/or practices in your school district or school. Mark all that apply.

Answer Options	Response Percent
School District (i.e., Superintendent or other)	88.9%
School District Board / School Board	72.2%
Facilities Managers (at District Level)	72.2%
Arizona School Facilities Board	61.1%
Teachers	55.6%
Students	44.4%
School Parents	38.9%
Arizona Department of Education	27.8%
School Principal and/or other Administrator(s)	27.8%
Arizona Department of Environmental Quality	22.2%
Facilities Managers (at School Level)	22.2%
U.S. Department of Education	16.7%
Professional Consultant(s) (Specify in the space below)	16.7%
Volunteer organization(s) (Specify in the space below)	11.1%
Environmental organization(s) (Specify in the space below)	5.6%
Partner Institution(s) (Specify in the space below)	5.6%

TABLE 8. Influential Actors

OTHER answers/comments provided by school districts (optional)

- *Parent Teacher Organization (PTO).*
- *We currently are working with specialized consultants and engineers in this area. We are also evolving our utility companies, government agencies, universities and other business partners.*

Q.09b In your estimation, what is the level of expertise (training/knowledge) that members of the School District have regarding sustainability (in general). Please rank from 1 (inexistent) to 7 (outstanding).

Answer Options	1	2	3	4	5	6	7	N/A	Rating Average
Students	0	3	5	3	3	4	0	0	4.00
Teachers / Faculty	0	2	4	5	4	3	0	0	4.11
School Administrators	0	4	2	1	5	4	1	0	4.35
District Administrators	0	1	1	4	2	5	4	0	5.24
District Facilities Superintendent (or equivalent)	0	0	0	2	1	7	7	0	6.12
School Facilities Manager	0	0	2	1	4	6	4	0	5.53
Professional Consultants/Specialists	1	1	1	0	0	4	7	3	5.64
Others (per actors noted before)	2	0	0	1	0	3	0	3	4.00

TABLE 9. Expertise of Actors

Q.10 Are professional consultants or specialists participating as advisors or leaders in your projects and/or practices? [Y/N]

67% of responding districts report the use of one or various types of consultants or specialists, who participate as “advisors or leaders” in their projects and/or practices. Of those, 91.7% were reported to be outsourced work by the school district, and 16.7% reported to hire consultants as direct employees of the school district. Of responding districts, none the existence of consultants outsourced or employed at the school level.

Q.10a Please identify type of consultant (mark all that apply):

Answer Options	Response Percent
Architect or Designer	83.3%
Engineer (structural, mechanical, etc.)	75.0%
Energy or A/C expert	83.3%
Public Utility expert or advisor from SRP	25.0%
Public Utility expert or advisor from APS	33.3%
Other Public Utility expert or advisor	25.0%
Sustainability or “Green” consultant (in any field)	41.7%
Materials supplier	25.0%
Contractor	50.0%

TABLE 10. Type of Consultant employed

Q.10b Contractual arrangement with School District:

Answer Options	Response Percent
Consultant is an employee of the School District	16.7%
Consultant is an employee of a particular School	0.0%
Consultant work is outsourced by School District	91.7%
Consultant work is outsourced by a particular School	0.0%

TABLE 11. Consultant contractual arrangement types

Q.10c Please provide the name of one consultant who has made an important contribution to your projects and/or practices and a brief description of why [open-ended question]

- *ADM Group*
- *Swaim Associates Architects*
- *Design team from EMC2 along with CMR (McCarthy) worked with district team to design specific systems for each of the three campuses converted from package HVAC to CP. Team also replaced another campus with HE roof top units because numbers did not support conversion. Studied options and pursued rebates from utility companies to help with funding*
- *APSES (Arizona Public Service Energy Services) worked with us to develop the Energy Savings Project. Climatec worked with us to develop the Solar Power project.*

- *We are currently under contract Chevron energy solutions. We conducted a formal request for proposals for these services and advertise nationally. Thus far we are very pleased with their performance.*

Comments and Recommendations

Leadership and Support

- Of those districts that reported the existence of some form of committee, facilities administrators, managers or operators are the most represented (in 90.9% of committees), while administrators and teachers participate in 72.7% of reported committees. According to respondents, students participate in 45.5% and one district mentioned the involvement of parents. Again, bear in mind that survey respondents were, for the most part, business or facility administrators at the district level and that responses certainly obscure much richness and variation across the state.
- Regarding actors (individual or institutional) who were deemed “influential in initiating sustainability projects and/or practices”, it can be concluded from the sample that, generally, the motivating force is internal at the school district level and not at particular schools. More respondents mentioned as initiators the district superintendent level (88.9%), school district or school board and facilities personnel (both at 72.2%). Significant influence was reported of the AZSFB (61.1%), followed by teachers (55.6%) and students (44.4%). Other actors (below 30% and including parents, state and federal departments of education, school-level administrators and facilities people, consultants, volunteer and environmental organizations and partners) were mentioned only by some.
- Beyond the survey results, and supported by other elements in this research study, recommendations are: (1) change should have top-down commitment and energy, (2) projects and practices should be perceived as internal to the operation and decisions of the district, and (3) the support, creativity, and enthusiasm of teachers and students must be secured and incentivized (with some training and common definition of sustainability as a prerequisite).
- Perhaps because of the sample composition, the survey did not emphasize the role of principals and administrators at the school level. However, in practical experience, case studies and visits, it became evident that principals who are versant in and committed to sustainability and environmental learning are more able to implement and communicate change effectively.
- It is important to find support and align efforts with the priorities and concepts of government agencies, in particular AZSFB and other state-level instances.
- Regarding consultants, respondents emphasized that all interact at the school district level, not directly with schools (obviously per operational guidelines and decision structures). Most districts outsource consultant work, while only two of the responding districts reported having consultants who are directly employed by them. Most districts also reported consultants in specialized professions (architects, designers, engineers, and energy or A/C experts). Experts related to public utilities were reported in 25 to 33.3% of responses. In summary, districts should continue to interact with the growing number of sustainability-oriented experts, whose work and results are gaining in quality with experience. While there was some caution about avoiding “snake-oil salesmen” who promise results with no solid evidence or experience, across the interviews and visits the perception of consultant work was in general positive and enthusiastic.

→ (c) Use of Frameworks and Guidelines

As noted in the existing frameworks and references section (see Section II), there is in general no shortage of professional guidelines for implementing sustainability in school facilities or buildings/landscape. To assess the current state in the utilization of some of these guidelines, the survey consulted specifically on the use of LEED standards and criteria (Q.07a), because of its industry-wide presence and relevance. Question Q.07b (Table 12) assessed the use of other well-known frameworks or guidelines (please note that survey was deployed before the start of the U.S. Department of Education's Green Ribbon School program).

Q.07a Has School / Have Schools in the District been (a) designed and constructed or (b) remodeled using LEED Green School standards and criteria?

Of those school districts who responded this question, most responded that they have not used LEED standards in criteria for either design and construction or remodeling (26.3% answered YES, 73.7% answered NO). Respondent comments emphasize some of the reasons for not utilizing this resource.

Q.07b From the following list, please indicate any guidelines that have been used by your District / School, at least partially, to guide any sustainability project or practice (select all that apply):

Answer Options	Response Percent
None	17.6%
Arizona School Facilities Board "energy and sustainability" guidelines or checklist	76.5%
Arizona School Facilities Board "21st Century Schools" recommendations	47.1%
Arizona Dept. of Environmental Quality self-evaluation for "Healthy Schools"	41.2%
LEED for Schools New Construction and Major Renovations	47.1%
LEED for Existing Buildings: Operations and Maintenance	29.4%
CHPS (Collaborative for High Performance Schools)	5.9%
Best Practices Manuals or tools	

TABLE 12. Use of LEED or other frameworks

OTHER answers/comments provided by school districts (optional)

- *None of these listed. Without money to remodel or rebuild, we have focused on energy behavior management and none of the above address that effectively.*
- *We use them as guidelines only.*
- *Over the past four years we have not had the opportunity to conduct any significant remodeling projects.*

Comments and Recommendations

Use of Frameworks and Guidelines

- Again, knowledge about and use of the two most relevant AZSFB documents and criteria is important and recognized by school districts. Use of ADEQ's Environmental Quality self-evaluation was also reported by more than 40%, a testament to efforts led by that state government agency. LEED for New Buildings was identified by nearly half of the respondents, but the EBOM was reported as used by less than one third of the respondents.
- The major recommendation here is, as one respondent's answer suggests, to use frameworks and guidelines at least as references. As evidenced by some interviews, some districts have shied away from using specific frameworks because of added cost and effort (particularly in the case of LEED). In addition, some districts ignore the existence of LEED for EBOM and may not have considered using LEED criteria as guidance for decision making in design and construction, even if certification was not to be pursued.
- Many frameworks and guidelines offer insights and tools not only for new construction, but also for additions and existing facility renovation and improvement. This is also true in the case of recommendations for facility operations and maintenance.
- In particular, LEED is predicated on the concept that "green building" does not cost more. According to the USGBC (2011), "green buildings do not have to cost a penny more. LEED certified projects to date demonstrate that you can achieve LEED certification and reap its many benefits with a common-sense approach to design with no additional dollars. Depending on your green building strategy and the level of certification your project is targeting, there may be mid- and long-term ROI associated with additional green features that merits an investment in first costs" (USGBC, 2011). However, respondents and practitioners interviewed agreed that LEED does have a higher initial price tag (in terms of materials, honorariums, and certification costs), accepting that it may be offset over the lifetime of the project.
- The U.S. Department of Education has included criteria from various relevant frameworks (including LEED, CHPS, and various federal programs) as non-mandatory examples of possible benchmarks for assessing and documenting sustainable projects and practices (i.e., as suggested ways that "schools might demonstrate progress" toward the program's goals).

→ (d) Measuring and Documenting Outcomes

Beyond qualitative goals and aspirations, projects require data tracking and threshold definitions to assess progress and success. The survey posed two questions related to possible outcomes of school district sustainability projects and practices. A first set of possible outcomes was mapped on the basis of the motivations that had been previously listed (Q.11; Table 13); respondents were asked to indicate whether they tracked outcomes qualitatively and/or quantitatively, or if they had no results. A second set of possible outcomes (Q.06; Table 14) was qualitatively assessed by asking respondents to "estimate" how much sustainability has become a distinguishing characteristic in their district (physically, operationally, and in curriculum/teaching).

Due to survey limitations (technical) it was not possible at this time to pair each particular district's initial responses on motivations with the reported outcomes. This could be a worthwhile endeavor in future research.

Q.11 Think of those projects or practices that have been completed or that are showing some outcomes (in relation to the above stated goals or motivators). Please identify if you track these outcomes, considering the following types of measures: (a)"QUALITATIVE" (e.g., opinion surveys, casual comments or anecdotes, etc.) and/or (b)"QUANTITATIVE" (e.g., documented budget savings, energy use history, etc.) If you do not track or have no evidence of outcomes, please mark "NO RESULTS".

Answer Options	Qualitative	Quantitative	No Results
Saved costs on energy bills	3	18	1
Saved costs on water bills	4	13	4
Meet budget constraints in the face of reductions	4	16	0
Improved conditions related to our children's health (e.g., nutrition, air quality, water quality, natural lighting...)	13	3	3
Improved conditions to support student learning	14	2	3
Improved conditions to support personnel performance	13	2	4
Improved student attendance	10	2	6
Improved faculty attendance	10	2	6
Attracted and retained better teachers	10	1	7
Contributed to preserve the environment / environmental stewardship	10	3	5
Surpassed other School Districts / Schools in similar projects	7	4	7
Demonstrated School District/School commitment w/ environmental issues	12	1	4
Demonstrated School District/School commitment w/ social issues	12	1	4
Promoted environmental education and/or environmental awareness in our students	13	0	5
Contributed to / was utilized in marketing or recruitment strategies	7	0	9
Increased parental interest and support for the School(s)	9	0	7
Increased community's interest and support for the School(s)	10	0	7
Increased business community's interest and support for the School(s)	9	0	8
Other (specify below)	0	0	3

TABLE 13. Outcomes

OTHER answers/comments provided by school districts (optional)

- *Three school districts marked "Other" outcomes, but none specified them in writing.*
- *Another school district commented: "Our green school and indoor air quality efforts are just starting so there is not much data to provide one way or the other. We have just awarded our custodial contract with the focus of using green chemicals, providing cleaner schools in the hopes of driving down student and faculty absences and thereby increasing test scores. We have implemented solar at 8 sites and are in the process of putting solar into an additional 15 sites, but again we are so early we do not yet have data."*

Q.06 In your estimation, to what extent is sustainability a distinguishing characteristic of your District / School? Rank from 1 (“not at all”) to 7 (“we are a sustainable district / school”). “Physically” means facilities or features that are visually evident; “Operationally” means administrative or facility management practices. “Curriculum/Teaching” means academic practices inside or outside the classroom.

Answer Options	1	2	3	4	5	6	7	N/A	Rating Average
Physically	0	2	1	1	7	3	5	0	5.21
Operationally	0	1	1	5	5	3	2	0	4.82
Curriculum/Teaching	0	4	4	2	2	3	2	2	4.12

TABLE 14. Sustainability as a distinguishing feature (respondent estimation)

Comments and Recommendations

Measuring and Documenting Outcomes

- As can be seen in Table 13, survey results show that hard data measurement and documentation are more feasible and common in those areas that (a) are traditionally considered as first steps toward sustainability (energy, water, budget efficiencies) and (b) defined by school district priorities and/or visions. Most of the other considered outcomes are reported as showing results, but these are consistently specified as qualitative. This is perhaps not a surprising result, and again emphasizes the importance of defining and implementing ways to measure progress. Further study can look deeper into each particular case and find evidence of good practice and innovation.
- On the other hand, a few of the districts indicated that they do have quantitative results for some of the more “intangible” outcomes, such as improved conditions in children’s health, learning, and performance. Further study may analyze these cases in more depth and identify what forms of documentation and analysis are being used.
- As echoed in a comment by the comment of one district regarding their ongoing efforts and the process of generating data, measuring and documenting progress will need to adapt and evolve as schools and districts embark on more projects. Sharing experiences and know-how across districts will be highly beneficial for the construction of more robust forms of measuring and documenting outcomes.
- The survey’s focus on school districts results in a very high-level picture of measurement and documentation. While districts of course will want to be able to compare results across different school sites, outcomes should also be monitored and communicated at the particular school level.
- It is important to emphasize that the perception of a school or district as “sustainable” may be an asset in terms of image, marketing, and recruitment. Such a perception will come from (a) real and significant action and (b) good communication and celebration of success. Proper measurement and documentation of progress and outcomes will provide material for both.

4) Challenges and Opportunities

Though some of these points have been made earlier in this report, a few final comments and recommendations can be emphasized about several important challenges and opportunities, based on current state analysis and best practices. While each of these issues would merit another specific research study, the following parts of this report outline current state findings and recommendations in four areas (a) Financing sustainability in school facilities; (b) Linking facilities and learning; (c) Student, parent, and community involvement; and (d) Integration of other issues: Health, Transportation, and Supply Stream.

→ (a) Financing Sustainability in School Facilities

While it may be an encouragement that the inspiration and enthusiasm for sustainable projects seems to be strong and eager for financial support to catch up, possibly the single most critical challenge in the current economic situation is precisely the procurement of necessary resources to implement and sustain change. An issue that constantly appeared throughout the survey, interviews, and visits, it would require another research project to assess this challenge with justice and depth. For the purposes of this study, survey respondents reported generally on their sources of financing for current and on-going projects and practices (Q.08; Table 15).

Q.08 Considering the process of implementing the/these project(s) and/or practice(s), please specify sources of FUNDING that were utilized (mark all that apply):

Answer Options	Response Percent
School District's own funds	88.9%
School's own funds	0.0%
Federal Government Funds / Incentives	66.7%
State Government Funds / Incentives	38.9%
Local Government Funds / Incentives	16.7%
Loan (private or government)	22.2%
Grant from a public or private organization or fund	16.7%
Tax Credit	16.7%
Bond issue	66.7%
Special funding campaign (donations from private business, community, etc.)	5.6%
Utility Incentives (e.g., APS or SRP rebates).	83.3%

TABLE 15. Financing sources for projects and/or practices

OTHER answers/comments provided by school districts (optional)

- *AZ School Facilities Board*
- *Solar Serving Agreements (SSA)*

Comments and Recommendations

Financing Sustainability in School Facilities

- Major sources of financing for all types of facility and capital projects (not only sustainability-related) are the school district's own funds and bond issues (backed by local property tax revenue). Both sources are of course limited, as some districts are

demographically more favored than others and taxpayers may eventually challenge more requests coming their way. There is concern that “this heavy reliance on local property taxes has often produced inequity in school facilities among districts and has also led to concern (and lawsuits) about the adequacy of school facilities in poorer districts” (Gurley, 2002).

- As mentioned before, the Arizona School Facilities Board (AZSFB) has the authority to allocate General Fund resources for: (a) new school facilities; (b) building renewal; and (c) emergency deficiencies correction. Schools are generally aware of this and should make their case for possible projects under these conditions. However, as AZSFB’s share of the State’s General Fund has decreased in recent years, school districts have seen this source diminish (Olson, 2009).
- Public policy groups, including the Morrison Institute, have pointed out that Arizona’s system of taxing and spending needs an overhaul for the state to meet 21st Century challenges for education (cf. <http://morrisoninstitute.asu.edu/publications-reports>). Review Olson (2009) for a full analysis of the Arizona school finance situation and possible alternatives moving forward.
- In the short term, and absent these reforms, moving sustainability forward in school facilities will require other forms of funding. Though they have also been challenged recently to provide sufficient levels of funding, utility incentives as well as federal, state and local incentives have held and should continue to hold a primary position in a school district’s list of funding sources. Consultants are generally aware of these sources and are well-versed in procuring them.
- Some schools, particularly charter schools, could benefit from exploring outside funding from foundations, private donors, and other sources (e.g., NCB Capital Impact’s forms of “community lending” – see Reference list in section II). Student, parent, business and partner involvement may be harnessed to this effect.
- As a good school is an asset for a residential community, from both a social and a commercial perspective, real estate developers are also potential participants in funding sustainable and performance practices. Two examples in Arizona are Davidson Elementary School (Tucson) and Verrado High School (Buckeye), both designed and constructed to comply with LEED accreditation.

→(b) Linking Facilities and Learning

An issue that is accepted universally is that the quality of school facilities affects the academic outcomes of students (among other possible outcomes like health, student and faculty retention and attendance, etc.) This has been studied and documented elsewhere (cf. Schneider, 2002 as well as numerous resources by CEFPI, USGBC and other scholars and organizations). The pursuit of sustainable projects and practices in schools supports these efforts by providing more comfortable and adequate spaces for teaching and learning. Although this research study did not assess this in particular, important recommendations should be considered and studied further.

Comments and Recommendations

Linking Facilities and Learning

- Each and every intervention in a school facility holds the promise of being integrated to both behavioral change and learning opportunities.

- It has been shown that behavioral change should preferably precede physical interventions (e.g., Washington Elementary SD, mentioned in case studies and Section IV.A.1.a). Schools should continue this effort through activities such as resource use campaigns with student/teacher participation and sustainable procedure guidelines for staff in all departments (regarding purchasing, printing, cleaning, etc.)
- Curriculum and teaching activities are, in some cases, lagging behind physical adaptations in schools. Every effort should be made to integrate them and make this integration a significant element in the distinguishing features of a school or district.
- As mentioned before, common space(s) and/or classroom or lab space(s) should promote non-traditional modes of learning (e.g., collaborative learning, Problem-Based or Project-Based learning, etc.). Sustainability as a collaborative and solution-driven approach to environmental, economic, and social problems requires students who are prepared in collaborative and problem-oriented settings (cf. Wiek et al, 2011). This should be a priority in new school design, but can also be considered in existing schools by different means (creative room, furniture, or activity arrangements and teacher commitment).

➔ (c) Student, Parent, and Community Involvement

Briefly assessed in the survey in various ways, the challenge of involving students, parents, and community in sustainability efforts is important for both practical reasons (buy-in and support) as well as environmental literacy interests. In this sense, it should be seen by school district administrators and facilities personnel as an opportunity for achieving long-lasting success and procuring external funds and goodwill.

Comments and Recommendations

Student, Parent, and Community Involvement

- Though it varies case by case, student and parent involvement in sustainability projects and practices is relatively low. While some districts cannot or may not want to involve them directly in committees, the energy, creativity, and participation of students and parents should be considered and harnessed. In the case studies, comments, and observations there has been evidence of productive involvement of students clubs and PTO's for fund procurement, project design and implementation, etc. More of this participation, defined and implemented correctly, should provide opportunities for success and learning in the process.
- Student and parent participation should be based on the school district's and/or school's definition and vision of what sustainability is and what it may be possible to achieve.
- In assessing both motivations and outcomes, the survey inquired about the role that sustainability projects and practices may have on impacting the interest and support of parents, the business community, and/or the community in general. While this varies from case to case and there is anecdotal evidence of good practices in comments and case studies, these motivations and outcomes were on average at the bottom end of the list in terms of positive responses. Perhaps in a second effort towards sustainable practices, school districts may be more able to define specific activities to both involve in and communicate their efforts to external constituents and interested parties. This holds the possibility of image improvement, funding procurement, and improved interaction with important stakeholders.

→ (d) **Integration of Other Issues: Health, Transportation, Supply Stream**

As they are very broad and not uniquely related to facilities, three issues fell beyond the scope of the present research project. However, and due to the systemic nature of sustainability, these issues are intrinsically related to the success of efforts to support environmental literacy practices in K-12 physical settings. Briefly hinted at in part of the survey (see “Other” projects and practices in section IV.A.1.e above), all have to do with processes, practices, and/or activities that may, in general, fall under the supervision of business or facility managers in school district offices; however, they all have the potential and need to involve other areas (academic as well as operative) for their success. To emphasize their relevance, a few final recommendations follow regarding: (a) student and staff health, well-being, and safety; (b) transportation; and (c) supply stream and school procurement.

Comments and Recommendations

Integration of Other Issues

- School districts are required and/or encouraged to pursue relevant practices that promote health, well-being, and safety. These include procuring proper nutrition in school cafeterias, opportunities for exercise, cleaning and inspection procedures, etc. It is clear that some of these activities can be related and/or encouraged by physical spaces and facilities. However, many are operational procedures that should be reviewed and, if necessary, modified or created by the appropriate district departments. As mentioned before in this report, school districts should follow ADEQ’s *Environmentally Healthy Schools* program and checklist. They should also consult both LEED, CHPS, and Green Ribbon Schools assessment guidelines and benchmarks with respect to procedures and practices regarding indoor air quality procedures, integrated pest management, lead testing in drinking fountains and water supply, chemical management, etc.).
- Transportation to and from school (e.g., bus idling reduction, alternative modes of transportation, etc.) is determinant in the environmental impact of the school system and in promoting sustainable lifestyles. Again, ADEQ provides specific programs and support to promote no-idling zones around schools (not only for school buses but also for parents during drop-off and pick-up). Other recommendations are widely available, regarding the upgrade of school buses to reduce emissions, the placement of air intakes in relation to bus stops, etc.
- As mentioned before, school districts and schools should invest every effort to make sustainability (broadly defined) an integral part of their operation and philosophy. This includes defining “green cleaning” policies, practices, and materials, and sustainable purchasing practices. These business practices in some cases will require information and training, but their implementation will not only help in the reduction of operation costs, but also in aligning the philosophy of the school or school district to a more integral view of sustainability and to teach by example. Suppliers are transforming their operations, products and services to offer more sustainable options, and school districts should try to favor purchasing from them.

Final Survey Respondent Comments

Finally, as the last question in the survey, respondents were asked for an open-ended response to the following:

“Do you have any additional thoughts about Sustainability in your School District / School? What would it take your School District or Schools to take sustainability to a higher level? (overall experience, challenges, need for additional funding and/or training, etc.). What is important to you?”

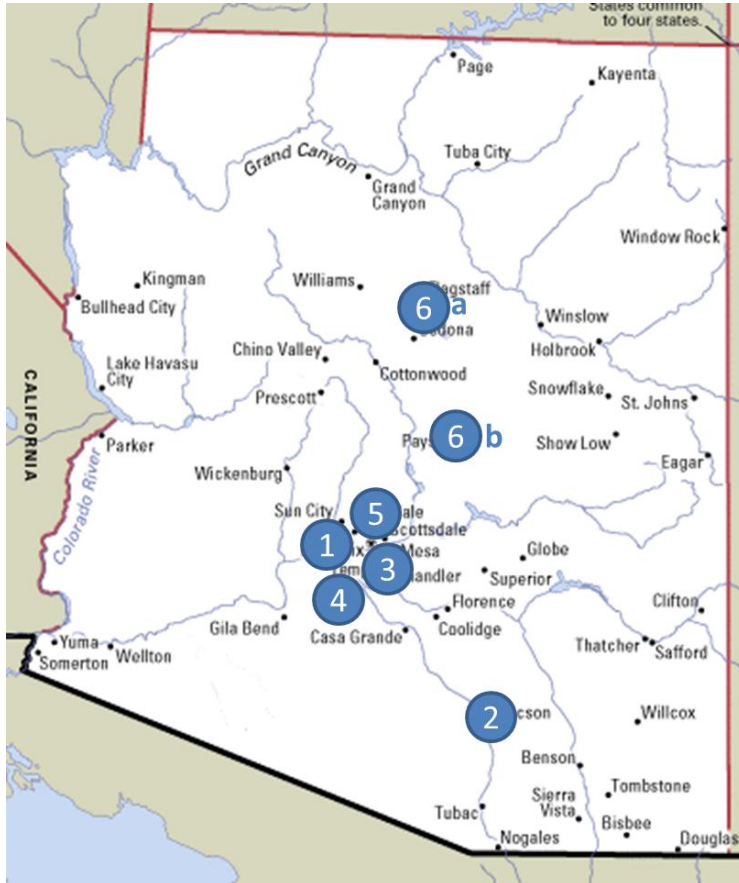
The candid answers are reported here verbatim and anonymously. Please keep in mind that respondents are, for the most part, facilities-related personnel, and may be biased towards their own perspective regarding sustainability in school facilities.

- *MONEY MONEY MONEY MONEY MONEY.*
- *Probably training for teachers.*
- *The District strongly supports sustainability. The State of Arizona says they support sustainability but does not provide the funding to make effective change.*
- *Allocation of state funds to improve sustainability efforts.*
- *Our desire to take sustainability to another level outweighs our ability to accomplish more. Our two biggest constraints are time and money. We believe that we've picked all of the low hanging fruit when it comes to sustainability in our schools. In order to take our efforts to the next level we need funding.*
- *We are funding-challenged to go much farther. We are planning for another local bond to keep the improvements coming. Teachers still ignore many of the common saving goals of simply closing their classroom doors. Next level of offenders are the coaching staffs. Fields are over watered / seeded and gyms are left on hours after use.*
- *Eliminate School Boards.*
- *As stated earlier we have just started this comprehensive program and are working with a number of dedicated institutions and businesses to achieve a model program that will far exceed any other high school level sustainability education program.*
- *School districts need facility directors like [Name] who has the vision, expertise and the drive to bring sustainability initiatives to the district. More money would allow us to accelerate our efforts....the concern is if it is marginally more expensive on the operational side will school districts move toward sustainability?*
- *Monetize tax credits for those entities with no tax liability.*

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
- 3) **Tempe Union High School District** (Tempe)
- 4) **Gila Crossing Community School** (Laveen)
- 5) **Washington Elementary School District** (Glendale and Phoenix)
- 6) **Northern Arizona**
 - Flagstaff Unified School District (Flagstaff)
 - Payson Unified School District (Payson)



Conclusions and General Recommendations

Over the past two hundred years, human society has developed exceptional ingenuities, proficiencies, organizations and systems for the task of making things – from steam engines to microchips. Going forward, we must learn to be equally adept at the task of making change.

Eric Young, Social Projects Studio

Management is about coping with complexity... Leadership, in contrast, is about coping with change.

John P. Kotter

This research project has provided an initial picture of what the current state of practice is in the State of Arizona' public school system regarding the implementation of sustainable and environmentally supportive facilities. Concurrent research on existing frameworks permitted the elaboration of a set of concrete, practical guidelines and recommendations not only for those who are yet to initiate projects and practices, but also to guide future work and provide new ideas for schools and school districts that have already succeeded in implementing the first steps towards their visions and ideas. The energy and enthusiasm for change are there, so there is reason to be hopeful that more creativity and execution will happen in the current decade.

Beyond the specific, system-related and general guidelines and recommendations that have formed the core of this report, this final section provides a few additional thoughts and final recommendations. These have to do with proposing a vision for change and a call for systemic breadth regarding sustainability, as well as a reflection on the arguments that may be made to support implementation. In addition, a brief outlook on future research and opportunities will hopefully open the way to new insights. Finally, the report closes with a set of ten general principles as an executive reminder of key issues for decision makers, officials, and supporters.

Conclusions and General Recommendations

The management guru John Kotter recommends that the most important task of a leader is to cope with and manage change. In this sense, the path towards transforming learning facilities into more sustainable places will require leaders who recognize the importance of moving from “low-hanging-fruit” solutions to lasting, systemic change in their organizations. Sustainability provides the unique opportunity of integrating physical interventions in facilities with a broader, more responsible view of operations and learning. This report will provide some inspiration for that to happen by supporting leaders within schools and school districts in the creation of broad and exciting visions for sustainability in their academic communities.

In this sense, and with an understanding of the relevance of a systemic vision as a destination, three important points should be emphasized. The first point is to praise the value of

present interventions and experiments in the process of transitioning and achieving a vision: the current state of practice is evidence that school districts in Arizona are moving forward and learning from successes and failures. The second point is to insist on a deeper understanding of sustainability in school facilities, one that integrates physical interventions with the learning process and the broader community (working across the three C's of campus, curriculum and community). Finally, the third point is to understand sustainability as much more than “green” building and teaching, despite the weight and ubiquity of the term. On the one hand, and as exciting as it is, the concept may come across well in some contexts but not in others, particularly in the current economic and political environment; on the other, it is important to make sure that, even if the concept is used, it does not limit or obscure a fuller conception of sustainability, particularly in its social and community components.

A final conclusion has to do with the fundamental role of partner organizations and other promoters of sustainable transitions in school settings. Hopefully this report can provide a baseline for their intervention, supporting efforts to sensitize school officials, teachers and staff, students and parents, and the community in general about a broader understanding of sustainability in order to justify the implementation of these types of projects and practices. That being said, in the current context of severely limited financial resources, the economic objective for projects has to be understood and addressed, in an intelligent manner, and used as support for the pursuit of the academic performance and environmental stewardship goals.

Future Research and Opportunities

Throughout the report and particularly in the methodology and study approach section, some limitations of the research project and its implementation have been acknowledged and are briefly listed below. In addition, a few areas of opportunity for future research are also discussed, which will hopefully provide the foundation for future endeavors and further lines of inquiry.

Regarding Project Improvement

- (1) Continue documenting projects and practices through periodical application of survey, provided that its timing and structure are improved (mid-way through the school year);
- (2) Consider future opportunities to recruit the support of key agencies and players who can promote a broader response (including, as mentioned in Section III, ADEQ and AZSFB);
- (3) Continue constructing links with districts and schools (both AAEE and ASU-GK12); and
- (4) Improve the structure and documentation of the “teaching objective” of the survey itself.

Regarding Future Research Opportunities

- (1) Explore more deeply the drivers and indicators for successful outcomes and document in more detail how leading districts and schools are measuring progress;
- (2) Explore the link between positive outcomes (qualitative and quantitative) and the planning and implementation process (including leadership, supporting actors, institutional structures, etc.);
- (3) Document and analyze more deeply issues related to financing sustainability in school facilities and operation, to document current success and future opportunities and needs; and
- (4) Support the focus of this research project with studies on the learning outcomes of sustainable facilities (with measures of performance that include not only traditional academic disciplines, but also environmental literacy).

➔ Summary: 10 Principles for Sustainable Schools

In closing this research report, what follows is an executive reminder of ten general recommendations and words of advice for those who want to make lasting change in sustainable and environmentally supportive school facilities.

1. Start wherever you are. The process of transitioning is as important as the destination. Frameworks or guidelines are your learning tools.
2. Test through pilot projects and experiments. Explore interventions in curriculum and operations as much as those in physical facilities and landscape.
3. Benchmark energy and other utility use with Energy Star or other widely available tools. Document and register information, for reference and for making the case for further change. Explore other forms of measurement and documentation. Remember that savings from efficiency provide resources to explore other sustainable initiatives.
4. Change behavior. Savings from behavior change, even before physical improvement, can provide proof and resources for further effort and investment.
5. Walk the transition path in good company. Identify stakeholders and their motivations. Make sustainability something owned by the whole school, from the board and the administration to staff, teachers, students, parents, and the community. Involve those who can make the case, those who make the decisions, and those who get things done.
6. Integrate. Explore the opportunity to link any facilities projects and practices to academic performance and environmental stewardship objectives, considering state standards and specific courses (not only environmentally related, but also STEM, language, social sciences, etc.).
7. Communicate your actions, internally and externally. Signs and displays are a must and should not be limited to administrative offices, they should be visible. Show what you are doing, to teach children and to communicate with parents and school constituents.
8. Celebrate. Foster success as a community, recognize the leading individuals, departments, and schools.
9. Believe that transitioning towards a more sustainable vision is a smart way to plan for your school's future. It makes academic, environmental, social, and economic sense.
10. Keep a systemic perspective of sustainability in schools, balancing society, environment, and economy and integrating campus, curriculum, and community.

[Based on USGBC Green School Strategies and Gutter & Knupp, 2010]



Appendices

School District Contact Information

- List of Case Study contacts
- Database of School Districts who provided their contact information:
 1. Tucson Unified School District
 2. Washington Elementary School District
 3. Littleton Elementary
 4. San Fernando SD #35
 5. Vail School District
 6. Humboldt Unified #22
 7. Cave Creek Unified School District No. 93
 8. Dysart Unified Schools
 9. Peoria Unified School District
 10. Pinon Unified School District #4
 11. Tempe Union High School District
 12. Mesa Unified School District
 13. Paradise Valley USD
 14. Deer Valley Unified School District
- Full School District Directory (Spreadsheet File)

Sample Criteria from selected references

- LEED New and EBOM Checklists
- Green Ribbon Schools categories and recommendations (subject to change)
- AZSFB Sustainability Checklists
- ADEQ Environmentally Healthy Checklist
- ASU Sustainable Design Policy and Guidelines

Case Study Documents and Photographs

- Case Study photographs and Illustrations [*CD Only*]
- Agua Fria Union High School District Energy Conservation Ideas
- Desert Edge High School example (Energy Smart case study and LEED checklist)
- Gila Crossing Community College *Garden and Agriculture* Program curriculum
- Washington Elementary School District Final Year Two Energy Report

Study Process and Survey Material

- IRB approval material
- Interview Question Guide
- Survey document (as deployed in Survey Monkey)
- Set of Survey Results (as reported by Survey Monkey)
- Full Set of Survey Results (Spreadsheet Files) [*CD Only*]



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