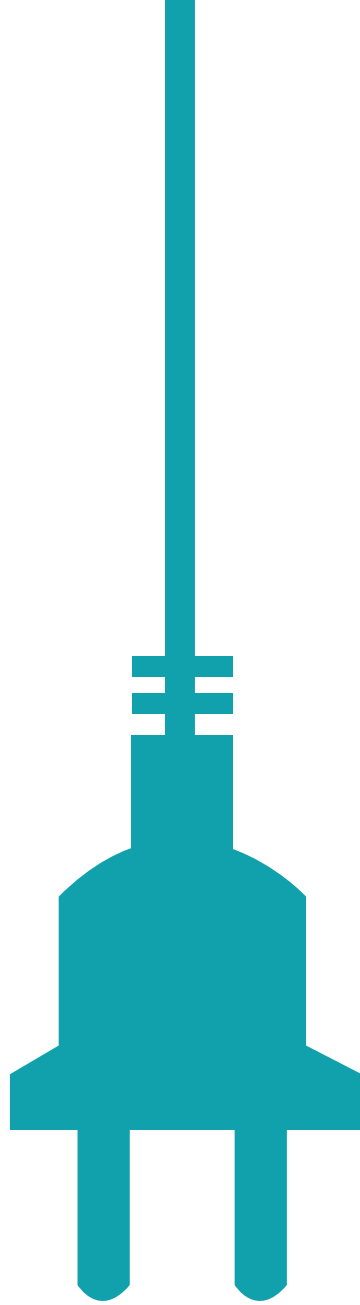


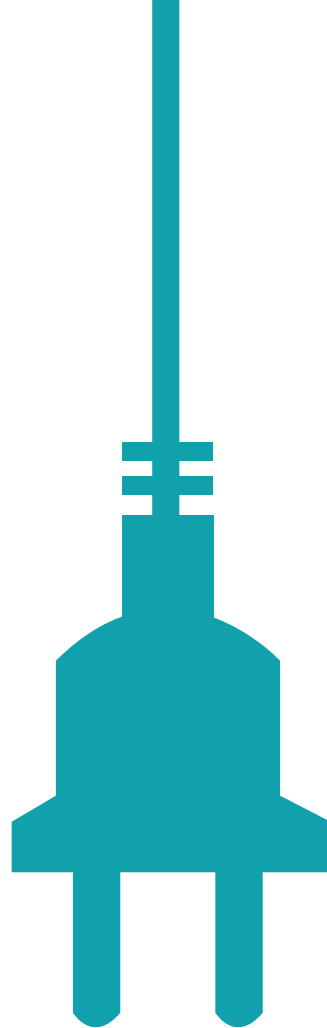


POWERING DOWN:

A TOOLKIT FOR BEHAVIOR-BASED
ENERGY CONSERVATION IN
K-12 SCHOOLS

THE CENTER
FOR GREEN SCHOOLS





POWERING DOWN:

■ A TOOLKIT FOR BEHAVIOR-BASED
ENERGY CONSERVATION IN
K-12 SCHOOLS

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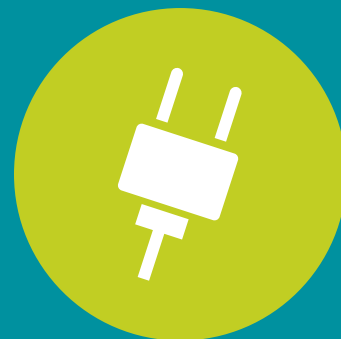
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TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
INTRODUCTION	2
SCHOOL ENERGY USAGE	3
BENEFITS OF ENERGY CONSERVATION STRATEGIES	3
MODELS OF SUCCESS: CASE STUDY SCHOOLS	5
SHARED CHARACTERISTICS OF EFFECTIVE PROGRAMS	6
TOOLKIT: CREATING AN EFFECTIVE ENERGY CONSERVATION INITIATIVE	8
PROFILES OF PARTICIPATING SCHOOLS	13
ENDNOTES	15
WORKS CITED	16
APPENDICES	17
ACKNOWLEDGEMENTS	23
ABOUT THE AUTHORS	23

EXECUTIVE SUMMARY



Energy conservation presents a compelling and rich opportunity for K-12 schools. Historically, energy expenses in schools have been treated as relatively fixed and inevitable, flowing steadily in the background as administrators concentrated on urgent needs and programmatic priorities. There is growing awareness, however, that a focus on energy use in schools yields an array of important rewards in concert with educational excellence and a healthful learning environment. And there is new interest in behavior-based initiatives through which faculty, staff and students can be significant players in changing a school's energy profile.¹

This report examines five public schools that have reduced their electricity use by an astonishing 20 to 37 percent through successful behavior-based strategies. These exemplar schools vary in their attributes and are spread across the United States, but their programs are linked and defined by shared elements and strategies. They have achieved these remarkable results while maintaining a strong commitment to a healthy and optimal learning environment in support of their central educational mission. Their successful experiences are reviewed in the following pages, and the strategies they have employed are synthesized into a "how-to" toolkit for schools everywhere.

The potential benefits of engaging faculty, staff and students in energy conservation initiatives are broad and substantial. The range includes significant cost savings, reduced environmental impact and expanded opportunities for student learning and leadership, in addition to positive effects extending beyond the immediate school community. These benefits are detailed in this report along with additional resources that clarify the case for energy conservation in K-12 schools.

INTRODUCTION

Energy costs loom large in school district budgets, comprising the second biggest operational expense after personnel.² Energy is a vital input in managing school buildings and optimizing the learning environment for students. Ensuring that lighting, indoor air quality and other needs are well provided for is essential. However, the U.S. Environmental Protection Agency (EPA) estimates that 25 percent of energy use in schools is wasted,³ and significant opportunities exist to reduce energy costs (Figure 1, Appendix B). A focus for astute administrators, then, is tapping these opportunities to save energy, thereby freeing up funding for educational resources that would otherwise be lost on utility bills.

THREE COMPLEMENTARY AVENUES LEAD TO ENERGY SAVINGS IN SCHOOLS:

1. Raising awareness among faculty, staff and students
2. Managing school building operations
3. Upgrading mechanical equipment and controls

The first two avenues are behavior-based, work synergistically with each other and can be implemented without capital investment. The first avenue is focused on shifting behavior among all building occupants, while the second is concerned more specifically with shifting awareness among facilities and custodial staff who manage building operations. A third important avenue, if funding is available, is investment in upgrading the efficiency of equipment and controls.⁴

Behavior-based strategies offer a rewarding pathway for energy conservation in K-12 schools. These strategies are both accessible and relatively inexpensive for schools to implement, and yet they are capable of yielding significant results. A key focus is on **raising awareness among faculty, staff and students** about energy-saving opportunities (see Figure 2, Appendix B). A simple and powerful example of an intervention is ensuring that lights get turned off in unoccupied classrooms and offices, since lighting alone can account for 25% or more of all electricity consumed in a school.⁵ Many additional strategies are detailed in the Toolkit included in this report.

The efficacy of a behavior-based approach can be further enhanced when custodial staff members are actively included in fostering a culture of energy conservation. If empowered to do so, custodial staff can offer critical insights about ways to lower a building's energy footprint through effectively **managing building operations**.⁶

Electricity is often a major focus of behavior-based strategies because the draw for lighting and plug load equipment can readily be reduced through choices made by faculty and staff end users. Turning off lights when unneeded, turning off equipment when not in use and reducing standby power are accessible measures that can produce significant savings. As an initiative gains momentum and awareness builds, members of the school community can identify additional opportunities for reductions in both natural gas and electricity. Cost savings are further enhanced as the school minimizes wear and tear on equipment through reduced run time and as it decreases the building's cooling load as equipment and lights are powered down.⁷

Upgrading mechanical equipment and controls offers another important avenue for improving energy efficiency in a school building. Typically, however, these mechanical upgrades require substantial capital investment that poses a far steeper challenge for school districts than initiating a behavior-based program. Potentially, savings generated through a behavior-based program can subsequently be invested in funding mechanical efficiency upgrades, providing one option for financing these projects.

SCHOOL ENERGY USAGE

Energy use in schools falls into three main categories:

HVAC (heating, ventilation, air conditioning) is usually the largest component of energy consumption, with natural gas typically used for heating and electricity for cooling.⁸

LIGHTING accounts for 25 to 50 percent of total electricity use. Lighting tends to be overlooked, as it runs in the background, and yet it consumes significant energy. Strategies to reduce electricity used by lighting while maintaining safety and comfort are discussed in this report.⁹

PLUG LOAD is the electricity drawn by equipment powered through wall outlets and has been measured at approximately 25 percent of a school's total electricity use. Plug load encompasses a wide range of equipment, including computers and monitors, copiers and printers, projectors, audiovisual equipment, vending machines, microwaves, coffeepots and refrigerators.¹⁰

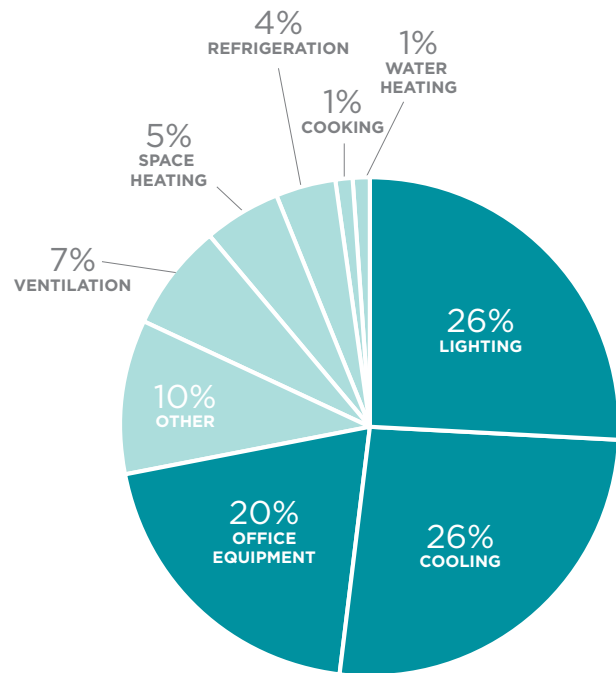


FIGURE 3 One example of electricity use within a school, though the profile will differ depending on a school's location and climate.

Credit: "E Source; from Commercial Building Energy Consumption Survey, 1999 data" in U.S. EPA, ENERGY STAR Building Upgrade Manual, 2008

BENEFITS OF ENERGY CONSERVATION STRATEGIES

The benefits that accrue through building an energy conservation initiative within a K-12 school can be broad and compelling. The review that follows includes significant findings by researchers from the non-profit, governmental and academic sectors.

COST SAVINGS

Energy costs are the second largest expenditure within school district budgets, exceeded only by personnel.¹¹ As a result, significant savings can be carved out for reallocation to needed services if energy consumption can be reduced. Notably, also, energy costs can be cut without reducing the quality of educational programming, in contrast to other budget categories. Implementing a behavior change initiative has been demonstrated to be a remarkably cost-effective pathway

toward capturing energy savings, since capital investment and mechanical retrofits are not required. Collectively, US schools spend \$8 billion each year on energy, a sum larger than that spent on textbooks and computers combined, and the U.S. EPA estimates that \$2 billion of that total can be saved through conservation and efficiency.¹²

REDUCED ENVIRONMENTAL IMPACT

Reducing wasted energy offers an excellent chance to shrink a school's environmental footprint. By turning off unneeded lights and cutting other wasted energy, students, staff and faculty can have an immediate impact. Reducing *electricity* consumption is especially meaningful, as the footprint of coal and gas-fired power plants is exaggerated by inherent system inefficiencies; approximately half of the fossil fuel consumed in power plants goes to losses within the plants themselves.¹³

A drop in electricity demand delivers these benefits:

- **REDUCED GREENHOUSE GAS PRODUCTION:** Fossil fuel combustion produces carbon dioxide and other greenhouse gases.¹⁴
- **REDUCED AIR POLLUTION:** Fossil fuel combustion produces sulfur and nitrogen oxides which form smog and acid rain, contributing to asthma, other respiratory illnesses and environmental degradation.¹⁵
- **REDUCED MERCURY IN THE ENVIRONMENT:** Coal-fired power plants release mercury that enters the food chain.¹⁶
- **REDUCED DISRUPTION OF AQUATIC ENVIRONMENTS:** In cases where large quantities of water are used for cooling, the contents of water discharge can disturb neighboring aquatic environments.¹⁷
- **REDUCED DISTURBANCE:** The extraction and transportation of fossil fuels are a source of significant environmental damage.¹⁸

LEARNING & LEADERSHIP OPPORTUNITIES FOR STUDENTS

Student participation in an energy conservation initiative can yield many positive outcomes for students. The experience offers rich opportunities for student learning through engagement with the design and operation of the school building. David Orr speaks to this when he writes, “Buildings have their own hidden curriculum that teaches as effectively as any course taught in them.”¹⁹ In a recent study published in the *Journal of Environmental Education*, researchers describe a “synergistic relationship” between enhanced student learning and an energy conservation focus.²⁰ In addition, students gain leadership skills and a valuable sense of efficacy as they make significant contributions in shifting school culture toward a higher level of sustainability.²¹

BENEFITS BEYOND THE SCHOOL SETTING

Research interviews conducted for this study made clear that energy conservation insights learned in school can be applied at home by students and their families, thus multiplying the benefits through residential energy conservation. More research about this effect is needed, but a number of studies document the ability of students to influence choices made at home by their families related to environmental issues.²² In evaluating a school-based energy conservation program, one group of researchers interviewed parents and confirmed that students had discussed information learned at school with their families, and in some cases had asked their families to “change their attitudes or household practices.”²³

MODELS OF SUCCESS

CASE STUDY SCHOOLS

The research that supports this report explores and documents five schools that have each created a behavior-based energy conservation program. Participating schools include elementary, middle and high schools and vary in size, geographic location and age of school building. Though they are “exemplar” schools in their energy conservation achievements, they otherwise resemble their peer institutions across the country (see Appendix A).

These schools have achieved dramatic reductions in electricity use—ranging from 20 to 37 percent—entirely through behavior-based strategies. The savings are the fruits of collaborative efforts among faculty, staff and students working to promote the adoption of energy-conserving behaviors, and they were achieved *without capital investment or mechanical upgrades*. Verification that these savings are indeed due to behavior-based strategies is an important element of this study. Schools were carefully screened for participation based on the clarity of their energy data; in each case, the data depict a clear story without confounding effects from renovations, new construction or upgrades to mechanical equipment. In addition, the length of the data sets (ranging from four to six years) speaks to persistent progress within these schools, indicating that the reductions achieved are not aberrations.

The percentage of annual cost savings is significantly lower than the actual electricity reduction in four out of the five cases documented. In these schools’ regions, rate increases by utilities have eliminated part of the cost savings that might have otherwise been expected. The substantial cuts in energy usage have allowed these districts to hold the line on energy costs that would otherwise have increased dramatically.

POWERING DOWN

DROP IN ELECTRICITY USE DUE TO BEHAVIOR-BASED ENERGY CONSERVATION STRATEGIES

SCHOOL	Annual Reduction in Electricity Usage vs. Baseline Year		Annual Cost Savings vs. Baseline Year		Length of Time Covered by Energy Data	Baseline Year
	%	kilowatt-hour (kWh)	%	\$		
Holston MS <i>Knoxville, TN</i>	-37%	-848,929	-12%	-\$19,816	6 years	Fiscal Year 2007
Rosa Parks ES <i>Lexington, KY</i>	-36%	-645,900	-20%	-\$24,500	4 years	Fiscal Year 2009
Laguna Creek HS <i>Elk Grove, CA</i>	-30%	-663,232	-19%	-\$47,704	4 years	Fiscal Year 2009
Henderson HS <i>West Chester, PA</i>	-30%	-1,359,672	-28%	-\$121,821	5 years	Calendar Year 2008
John Jacobs ES <i>Phoenix, AZ</i>	-20%	-250,797	-10%	-\$12,463	5 years	Mar., 2007 - Feb., 2008

SHARED CHARACTERISTICS OF EFFECTIVE PROGRAMS

The successful programs at these exemplar schools are built through a variety of pathways – no single recipe exists. In one case, the school’s program is constructed through an active dialog between district staff and school-based staff. In another, an experienced practitioner is contracted by the district to build and support the program. In a third, students and a faculty advisor provide the driving force in shaping and implementing the successful program.

Despite the varied approaches taken by the exemplar schools, shared characteristics show up across all five programs. Many of the faculty and staff interviewed reported that early successes were reached more easily than anticipated. The work, though substantial, typically consists of elevating awareness and overcoming inertia rather than opposition.

“To really get a successful conservation program in place, you have to engage with the children directly because they drive it every day—they practice it continuously.”

- Energy Manager, Knox County Schools

1 SCHOOL DYNAMICS AND LEADERSHIP

STAFF LEADERSHIP: One or more committed faculty and/or staff members provide leadership in implementing the initiative in each of the schools. These leaders are empowered to shape strategies and materials to make the program most effective within their own school community.

PRINCIPAL SUPPORT: The school principal provides essential support, highlighting the initiative and signaling commitment and endorsement to the school community. Communication is coordinated with the initiative leader(s) as needed.

STUDENT ENGAGEMENT: Faculty and/or staff leaders actively develop student participation in the initiative. Student engagement serves as a central driver in four of the exemplar programs and contributes significant value in all, generating momentum, creativity and a positive focus in fostering new norms.

INCLUSIVE TEAM: School-based custodial staff members are included as participants in the initiative (and provide primary leadership at one of the case study schools).

2

DISTRICT-LEVEL SUPPORT

DATA AND FEEDBACK: An Energy Manager or other point person at the district level provides the critical function of tracking energy data for the school and then communicating this information as feedback about progress (see Figure 4, Appendix B). This essential support is made available in all cases studied.

PROGRAM ASSISTANCE: In most of the programs studied, the school district (or third party partner) offers additional support beyond tracking energy data. The district support varies in depth and scope among the five programs, but can include the following: assistance with identifying priorities, signage, educational resources, recognition for successes and equipment loans such as watt meters or light meters.

ADDITIONAL PARTNERS: In two of the exemplar schools, the program is supported successfully with school district resources. A third party organization provides support in three of the exemplar schools. Where a third party organization is involved, the support is non-proprietary and emphasizes school-based empowerment and capacity-building. These organizations provide educational resources, energy data tracking and/or additional services. Cost savings generated through the energy conservation program are retained within the district.

3

PROGRAM MOMENTUM

PROGRESS REPORTS: Energy data illustrating a drop in the school's energy consumption as the program becomes established are repeatedly cited by faculty and staff as compelling and strongly motivating.

CLEAR COMMUNICATION: Cost savings associated with energy conservation are highly valued by faculty and staff and are understood as directly beneficial for educational programming.

AWARDS AND HONORS: Recognition of energy conservation successes provided within the school, at the district level and by other organizations is highly valued by faculty and staff (see Figure 5, Appendix B).

TOOLKIT: CREATING AN EFFECTIVE ENERGY CONSERVATION INITIATIVE

To create your own energy conservation initiative, start by following the steps in this toolkit. A range of successful strategies employed in the exemplar case study schools is presented here, as well as a few examples from other programs. Each case study school used their own mix of the steps in this toolkit, so it makes sense to pick and choose what is best suited for your community.

STEP 1. FIGURE OUT WHO'S ON THE TEAM



Identify key people who will provide support for the initiative within the school community. The exemplar programs in the study all include:

1. Leadership from one to three committed faculty or staff member(s)
2. Explicit, strong support from the principal
3. Support from the school district in tracking energy data, along with other programmatic or technical assistance that may be available

Identify ways in which students can be engaged with the initiative, and aim to include custodial staff early on. Custodial staff members can be key players, providing support and contributing ideas about how to modify building operations to conserve energy, such as reducing hallway lighting after the school day ends. Office staff and food services staff may have valuable suggestions and insights to contribute as well. Aim to build a team that is committed to staying involved over time to provide continuity.

STEP 2. GATHER INFORMATION AND IDENTIFY PRIORITIES



The exemplar schools have utilized one or a combination of the following basic strategies to shape their programs:

ENERGY CHECKUPS AND ENERGY PATROL

Create a student team to do checkups of classrooms and offices on a regular basis, leaving feedback for faculty and staff about whether lights are off in unoccupied spaces and equipment is powered down when not needed (see Figure 6, Appendix B). It is helpful to conduct an initial assessment without any publicity to create a baseline for measuring future progress. Checkups can be scheduled before or after school or during the school day as fits best, and they can happen on any frequency that is most helpful. One exemplar school found that student-led energy patrols were effective even when spaced as widely as a month apart. Students can track progress over time using a clipboard, computer, iPad or other device. The key element is providing clear, respectful feedback notes with plenty of praise when classrooms and offices are powered down.

Standby power, also called vampire power or phantom load, refers to equipment that draws electricity even when turned off. Examples include items with remote controls or digital displays, chargers, televisions, DVD players, powered speakers and coffee pots that keep water heated for brewing. Standby power can account for five percent or more of total electricity consumption in a school. It can be addressed by investigating the standby power of equipment before you buy it, by unplugging devices when not in use or by plugging into power strips so that the power can be entirely turned off when not needed. The best way to identify “vampires” around the school is by measuring devices with a simple tool such as a watt meter—a great opportunity to involve students.²⁴

ENERGY MAP

Work with a student team to map out energy use in the school using simple tools (e.g., watt meter, light meter) and then generate suggestions for conservation (see Figure 7, Appendix B). The team can identify high priority “energy hogs,” such as computer monitors and vending machines, calculate how much money can be saved by turning off equipment when not in use, identify “phantom load” equipment and/or identify spaces that are more brightly lit than needed. A mapping survey provides a tremendous learning opportunity for students and adults alike and transforms the team into hands-on energy experts.

BUILD ON PRIORITIES FROM FACILITIES STAFF

Take the time to find out what the district-level energy priorities are, highlight them and build on the system-wide momentum. In some cases, facilities staff may have already developed an energy conservation strategy with a behavior change emphasis, and a school-based team can focus their creative efforts on spreading the word. Rather than spending time to create something from the ground up, exemplar schools that used this strategy were able to put their energy into quick mobilization.

STEP 3. CREATE MOMENTUM



There are many methods to distribute information and generate momentum within a school community. Examples from the exemplar schools include:

CONSISTENT FEEDBACK

Write thank you and “oops” notes for individual classrooms and offices during energy checkups. Clear, specific, appreciative feedback for faculty and staff is tremendously effective. Pre-printed notes can work if time is short.

VISUAL RESULTS

Compile results of checkups and audits, and share them in a chart or spreadsheet with those interested.

PROMPTS AND REMINDERS

Create “prompts” in the form of small, visual reminders that are placed for maximum impact to motivate new behavior. Good examples include stickers on switch plates to encourage lights out or reminders on printers to encourage turning them off at day’s end. Making prompts can be another great opportunity to involve students’ creativity.

CLEAR ACTION STEPS

Make checklists to share with classrooms and offices as guidelines for energy-conserving actions (see Figure 8, Appendix B).

TIME-SENSITIVE GOALS

Focus on “Power Down Fridays” and vacation shut-downs to highlight the extra savings available when schools are unoccupied.

STUDENT INVOLVEMENT

Help students create presentations about energy team findings for the school community, faculty or the school board or committee.

SCHOOL-SPECIFIC SOLUTIONS

Use your own creativity, and pull in the strategies that you know will work in your own school posters, flyers, skits, faculty meetings, emails, morning announcements, bulletin boards, T-shirts, websites and more.

STEP 4. CELEBRATE SUCCESS AND PROVIDE RECOGNITION



Recognition is an essential element in all the exemplar programs, and it is also an opportunity for creativity and fun.

SCHOOL: An enthusiastic thank you note, an “energy star” on a classroom or office door or a handmade certificate of recognition can provide direct feedback to faculty and staff for excellence in powering down. Highlighting success stories with a hallway display is another avenue for feedback and encouragement.

DISTRICT: Energy use starts to shift downward in participating schools as the program gains traction. This downward trend in energy data is cited over and over again in study interviews with faculty and staff as highly motivating and rewarding – a striking finding. Make sure the good news gets out through posters, email, a website link and any other available communication channels. Several of the exemplar programs arrange for district-wide recognition at regular monthly events or at special events incorporated into a school district board meeting. In some cases, districts choose to employ competition in moderation by recognizing top-performing schools; in other cases, all schools that achieve a given mark, such as the EPA’s ENERGY STAR award, are recognized.

NATIONAL, REGIONAL, STATE: Seek out opportunities for recognition on a wider scale. The EPA awards ENERGY STAR plaques to schools achieving a score of 75 or above in energy efficiency nationally (a percentile rank within the ENERGY STAR Portfolio Manager program), and this achievement has been an important milestone to celebrate for some of the exemplar schools. Other recognition programs highlight student engagement and curriculum connections as well as energy savings, including the Eco-Schools USA “Green Flag” program through the National Wildlife Federation, the National Energy Education Development Project (NEED) Youth Awards, the “Greenest School on Earth” and “Best Of Green Schools” awards at the Center for Green Schools at USGBC, and the Green Ribbon Schools award program created by the U.S. Department of Education. As interest grows, explore additional activities.

Two key concepts that come from the field of social psychology can help encourage the adoption of new energy-conserving behaviors:

- Framing the initiative as an emerging “social norm” within the school is a powerful tool for increasing participation, since most people are strongly motivated to be part of a community and align with what others are doing. Highlight examples of people adopting new behaviors as a way of inviting others to join in.²⁵
- Emphasize personal contact in getting the message out. Information is not enough to create a shift in behavior. Analyze the specific barriers that make a change difficult and look for solutions that simplify shifting to a new behavior. Find ways to make it easy and appealing.²⁶

STEP 5. INITIATE SPECIAL PROJECTS



Check with the local utility company to see if funding or other support is available. Here are a few ideas to get you started:

LIGHT BULB EXCHANGE

Set up a light bulb exchange to give out free compact fluorescent light bulbs in exchange for energy-wasting incandescent light bulbs, and encourage staff and faculty to make the swap. Check with your facilities department to see if they can provide free CFLs. Learn more at sustainability.tufts.edu/get-involved/bulb-exchange/.

EQUIPMENT GIVE-AWAY

Offer to deliver free power strips to staff and faculty who express interest so that it's easier to power down equipment.

VENDING MACHINE AUDIT

Investigate options for cutting down power going to vending machines, such as installing Vending Misers. Measure and document the energy savings to inspire additional projects. Learn more at acespace.org/node/15305

COMPUTER POWER-DOWN

Work with the IT department to (1) make sure that computer screens power down after 10-15 minutes (screen savers do not save energy) and (2) maximize power down time for computers, especially on evenings and weekends.

DELAMPING

Use a light meter to look for areas that are more brightly lit than needed. With your facilities department, explore whether de-lamping is an option. Learn more at bu.edu/sustainability/what-were-doing/energy/delamping/

SCHOOL-WIDE EDUCATION

Put on an energy fair for the school or community. Learn more at need.org/needpdf/Energy%20Carnival.pdf.

GHG INVENTORY

Create a substantive greenhouse gas (GHG) inventory for the school using the EPA's Climate CHECK software, recommended for high school students. Learn more at epa.gov/climatechange/wycd/school.html.

PROFILES OF PARTICIPATING SCHOOLS

ROSA PARKS ELEMENTARY SCHOOL

Fayette County Public Schools, Lexington, KY

rosaparks.fcps.net | sustainability.fcps.net/sustainability

An active student recycling club was the launching point for a new “Energy Stars” club at Rosa Parks. The Energy Stars conduct once-a-month checkups in classrooms to assess if lights are out and computers are turned off via power strip, leaving thank you notes or reminder notes for teachers. They also meet monthly with their two faculty advisors to tackle other projects, including developing energy conservation checklists for each classroom, launching a “No Idling” campaign and helping to organize a Sustainability Fair. The team’s efforts are part of a school-wide energy efficiency commitment, which is supported through the robust “E=USE2” sustainability program developed by the district (including web-based resources). Cost savings support the general school district budget; the program does not include a direct financial incentive to the school. Rosa Parks received an ENERGY STAR award from the EPA and was one of the inaugural “Green Ribbon Schools” recognized by the U.S. Department of Education in 2012.

HOLSTON MIDDLE SCHOOL

Knox County Schools, Knoxville, TN

holstonms.knoxschools.org | knoxschools.org

The Green Team at Holston Middle School collaborates with the nonprofit Alliance to Save Energy and their PowerSave Schools program. The Alliance provides a toolkit to the team (including a Kill A Watt® meter, light meter, an infrared thermometer and other tools) and guidance on how to use the tools to analyze energy use and develop recommendations. The student team and their faculty advisors have created energy checklists for classrooms as well as a school-wide education program, and they have also used the data available to them to understand and respond to energy demand at their school. The head custodian is part of Holston’s Green Team and coaches students about energy conservation in addition to implementing efficiency measures in school operations. Faculty advisors from nine schools in the district are working with the Alliance. They meet three times a year to share ideas and practices related to energy conservation, and students attend the final meeting of the year to share information as well. Holston receives a small financial incentive for participating in the program, which is not tied directly to energy savings. Alliance to Save Energy – PowerSave Schools: ase.org/programs/powersave-schools

JOHN JACOBS ELEMENTARY SCHOOL

Washington Elementary School District, Phoenix, AZ

johnjacobs.wesdschools.org | wesdschools.org/Page/1

Momentum on energy conservation at John Jacobs has been spurred by the school-based facility manager, whose interest and enthusiasm have grown into a school-wide team effort. As part of the initiative, student council members check on classrooms once a week at the end of the school day to see if they can “catch” any lights or computers left on so that they can leave a “watt ticket” as a reminder to power down. Students in each class make sure lights are turned out when it is time for the class to go to lunch or gym. Other measures include ensuring that outside doors stay shut during the long cooling season and reducing the use of personal equipment, such as mini-fridges. Cost savings support the general school district budget; the program does not include a direct financial incentive to the school. Pierce Energy Planning provides support to the district in energy data tracking and program development. John Jacobs received an ENERGY STAR award from the EPA. Pierce Energy Planning: energyplanning.org

LAGUNA CREEK HIGH SCHOOL

Elk Grove Unified School District, Elk Grove, CA

lchs.schoolloop.com | egusd.net/energy

The energy conservation initiative at Laguna Creek has been led by a faculty member and the head custodian. A major focus has been on asking faculty to treat their classrooms as they would their homes, turning off lights when leaving the room and turning off equipment at the end of each day. Students have helped with a campaign to place green tape over one of the multiple light switches in each classroom as a reminder to reduce unneeded lighting. They have also given away raffle tickets for prizes when they have found classrooms powered down during checkups. The head custodian and her staff have been very active in reducing unneeded lighting and ensuring that equipment is turned off when not in use. Laguna Creek receives a modest financial incentive from the district for attaining energy conservation goals set for each school by district staff. The district has developed a rich framework of web-based resources to support the efforts at Laguna Creek and other district schools.

HENDERSON HIGH SCHOOL

West Chester Area School District, West Chester, PA

edline.net/pages/henderson_high_school | home.wcasd.net/pages/West_Chester_Area_SD

A longstanding Environmental Club at Henderson turned its focus to energy conservation when the principal met with the group to ask them to consider becoming leaders on the issue. Student brainstorming led to the development of “Power Down Friday,” in which hallway lights are minimized and attention is focused on powering down the building ahead of the weekend. One of their advisors, an art teacher, has supported the students in producing original “Power Down” artwork and silk-screened T-shirts and distributing bookmarks crafted from handmade paper during classroom checkups. A \$150,000 Climate Showcase Community grant to the district from the EPA was used to develop a Student Conservation Corps through which students learned more about energy conservation by providing energy audits for area businesses. Cost savings from efforts at Henderson support the general school district budget; the program does not include a direct financial incentive to the school. Practical Energy Solutions supports the district by tracking energy data and collaborating on presentations about energy conservation opportunities. Practical Energy Solutions: practicalenergy.net

ENDNOTES

¹ Baker, Conserving watts by watching; Cross, Shifting organizational culture - Innovation for energy conservation; Schelly et al., Reducing energy consumption and creating a conservation culture in organizations; Schelly et al., How to go green: Creating a conservation culture in a public high school through education, modeling and communication.

² US EPA, *Energy Star Building Upgrade Manual*.

³ US EPA, *Energy Efficiency Programs in K-12 Schools*.

⁴ Cross, Shifting organizational culture - Innovation for energy conservation; Foraker, Zane, interview; Pierce, Sue, interview.

⁵ US EPA, *Energy Star Building Upgrade Manual*.

⁶ Cross, Shifting organizational culture - Innovation for energy conservation; Schelly et al., Reducing energy consumption and creating a conservation culture in organizations; Schelly et al., How to go green: Creating a conservation culture in a public high school through education, modeling and communication.

⁷ US Department of Energy, *EnergySmart Schools tips: Retrofitting, operating, and maintaining existing buildings*.

⁸ Alliance to Save Energy, Energy saving tips for schools; Schoff, Energy cost cutting strategies in K-12 operations and maintenance; US EPA, *Energy Star Building Upgrade Manual*.

⁹ Schoff, Energy cost cutting strategies in K-12 operations and maintenance; US Department of Energy, *Guide to Operating and Maintaining EnergySmart Schools*; US EPA, *Energy Star Building Upgrade Manual*.

¹⁰ Schoff, Energy cost cutting strategies in K-12 operations and maintenance; US Department of Energy, *Guide to Operating and Maintaining EnergySmart Schools*.⁷ NEEDED

¹¹ US EPA, *Energy Star Building Upgrade Manual*.

¹² US EPA, *Energy Efficiency Programs in K-12 Schools*.

¹³ Natural Resources Defense Council, Air Pollution: Smog, Smoke and Pollen, n.d., <http://www.nrdc.org/health/climate/airpollution.asp>.

¹⁴ US Energy Information Administration, *Annual Energy Review 2011*.

¹⁵ US EPA, *Energy Efficiency Programs in K-12 Schools*.

¹⁶ Natural Resources Defense Council, Air pollution: Smog, smoke and pollen.

¹⁷ US EPA, Mercury: Basic Information.

¹⁸ US EPA, Clean energy: Water discharge.

¹⁹ US EPA, How does electricity affect the environment?

²⁰ Orr, *Earth in Mind: On Education, Environment and the Human Prospect*, 113.

²¹ Schelly et al., How to go green: Creating a conservation culture in a public high school through education, modeling and communication, 29.

²² Schelly et al., How to go green: Creating a conservation culture in a public high school through education, modeling and communication; Schunk, Self-efficacy and academic motivation.

²³ Ballantyne, Fien and Packer, Program effectiveness in facilitating intergenerational influence in environmental education; Duvall and Zint, A review of research on the effectiveness of environmental education in promoting intergenerational learning; Evans and Gill, Schoolchildren as educators: The indirect influence of environmental education in schools on parents' attitudes towards the environment; Osbaldiston and Schmitz, Evaluation of an energy conservation program for 9th grade students; Volk and Cheak, The effects of an environmental education program on students, parents, and community.

²⁴ Ballantyne, Fien and Packer, Program effectiveness in facilitating intergenerational influence in environmental education.

²⁵ Stewart, Vampire power is scary all year round.

²⁶ Nolan et al., Normative social influence is underdetected.

WORKS CITED

An asterisk (*) indicates highly relevant reading for further information about energy conservation strategies in K-12 schools.

* Alliance to Save Energy. (2011). Energy saving tips for schools. Retrieved from <http://www.ase.org/resources/energy-saving-tips-schools>

* Baker, K. (2007). Conserving watts by watching. *American School Board Journal*, 194(3), 52-53.

Ballantyne, R., Fien, J., & Packer, J. (2001). Program effectiveness in facilitating intergenerational influence in environmental education. *The Journal of Environmental Education*, 32(4), 8-15.

* Cross, J. (2012). Shifting organizational culture - Innovation for energy conservation. Garrison Institute. Retrieved from <http://www.garrisoninstitute.org/2012-05-14-14-59-40/cbb-video-presentations/2012/1461-jeni-cross>

Duvall, J., & Zint, M. (2007). A Review of research on the effectiveness of environmental education in promoting intergenerational learning. *Journal of Environmental Education*, 38(4), 14-24.

Evans, S. M., & Gill, M. E. (1996). Schoolchildren as educators: The indirect influence of environmental education in schools on parents' attitudes towards the environment. *Journal of Biological Education (Society of Biology)*, 30(4), 243 - 249.

Flippen, P. (2010, August 11). Benchmarking your building's energy using EPA's Energy Star Portfolio Manager. Retrieved from http://www1.eere.energy.gov/solutioncenter/benchmarking_your_buildings_energy_using_epa's_energy_star_portfolio_manager_%20slides.pdf

* McKenzie-Mohr, D. (2000). Fostering sustainable behavior through Community-Based Social marketing. *American Psychologist*, 55(5), 531-537.

* McKenzie-Mohr, D., & Smith, W. (1999). *Fostering sustainable behavior: An introduction to Community-Based Social Marketing* (1st ed.). New Society Publishers.

Natural Resources Defense Council. (n.d.). Air pollution: Smog, smoke and pollen. Retrieved from <http://www.nrdc.org/health/climate/airpollution.asp>

* Nolan, J. M., Schultz, P. W., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2008). Normative social influence is underdetected. *Personality and Social Psychology Bulletin*, 34(7), 913-923.

Orr, D. (1994). *Earth in mind: On education, environment and the human prospect*. Washington, DC: Island Press.

Osbaldiston, R., & Schmitz, H. (2011). Evaluation of an energy conservation program for 9th grade students. *International Journal of Environmental & Science*, 6(2), 161-172.

* Schelly, C., Cross, J. E., Franzen, W. S., Hall, P., & Reeve, S. (2011). Reducing energy consumption and creating a conservation culture in organizations: A case study of one public school district. *Environment and Behavior*, 43(3), 316-343.

* Schelly, C., Cross, J. E., Franzen, W. S., Hall, P., & Reeve, S. (2012). How to go green: Creating a conservation culture in a public high school through education, modeling and communication. *Journal of Environmental Education*, 43(3), 143-161.

Schoff, L. (2009, October 20). Energy cost cutting strategies in K-12 operations and maintenance. Presented at the Texas Facility Masters Conference. Retrieved from http://www.e2energysolutions.com/Resources/Facility%20Masters%20Conf_%20ESS%20OM%20Texas%202009.pdf

Schunk, D. (1991). Self-efficacy and academic motivation. *Educational Psychologist*, 26(3 & 4), 207-231.

Stewart, C. (2010, November 8). Vampire power is scary all year round. Retrieved from <http://energy.gov/energysaver/articles/vampire-power-scary-all-year-round>

* U.S. Department of Energy. (2010). *Guide to operating and maintaining EnergySmart schools*. Retrieved from http://apps1.eere.energy.gov/buildings/publications/pdfs/energysmartschools/ess_o-and-m-guide.pdf

U.S. Information Administration. (2011). *Annual Energy Review 2011*. Retrieved from <http://www.eia.gov/totalenergy/data/annual/pdf/aer.pdf>

U.S. Environmental Protection Agency. (2008). *Energy Star Building Upgrade Manual*. Retrieved from http://www.energystar.gov/ia/business/EPA_BUM_Full.pdf

* U.S. Environmental Protection Agency. (2011). *Energy Efficiency Programs in K-12 Schools*. Washington, DC: US Environmental Protection Agency. Retrieved from http://www.epa.gov/statelocalclimate/documents/pdf/k-12_guide.pdf

* U.S. Environmental Protection Agency. (2012a). Energy use in K-12 schools. Retrieved from http://www.energystar.gov/ia/business/downloads/datatrends/DataTrends_Schools_20121006.pdf?b282-bf2d

U.S. Environmental Protection Agency. (2012b). How does electricity affect the environment? Retrieved from <http://www.epa.gov/cleanenergy/energy-and-you/affect/index.html>

US Environmental Protection Agency. (2012c). Clean energy: Water discharge. Retrieved from <http://www.epa.gov/cleanenergy/energy-and-you/water-discharge.html>

U.S. Environmental Protection Agency. (2013). Mercury: Basic information. Retrieved from <http://www.epa.gov/hg/about.htm>

Volk, T. L., & Cheak, M. J. (2003). The effects of an environmental education program on students, parents, and community. *The Journal of Environmental Education*, 34(4), 12-25.

APPENDIX A:

CASE STUDY SCHOOL CHARACTERISTICS

▼ POWERING DOWN (p. 5):

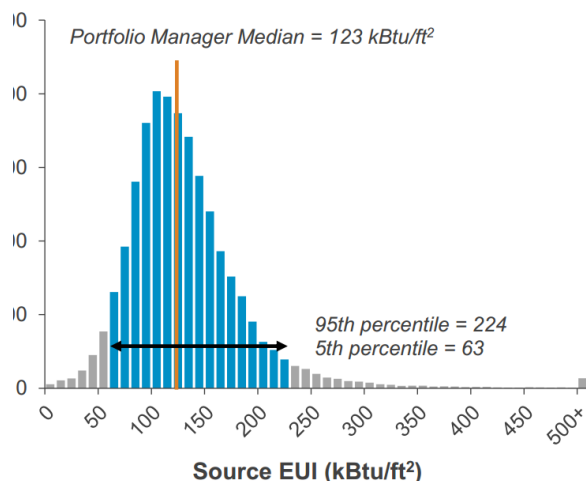
Case Study School Characteristics

School	Grades Served	School Enrollment	Date of Construction or Renovation of School Building	District	District Enrollment
Holston MS <i>Knoxville, TN</i>	6 - 8	833	1956 construction 2006 renovation & addition	Knox County Schools	56,000
Rosa Parks ES <i>Lexington, KY</i>	K-5	765	1997	Fayette County Public Schools	38,000
Laguna Creek HS <i>Elk Grove, CA</i>	9 - 12	1,640	1994	Elk Grove Unified School District	62,000
Henderson HS <i>West Chester, PA</i>	9 - 12	1,260	1954 construction 2006 addition	West Chester Area School District	11,800
John Jacobs ES <i>Phoenix, AZ</i>	PK-6	613	1980	Washington Elementary School District	22,335

APPENDIX B:

IMAGES

▼ **FIGURE 1 (p. 2):** This chart, from the U.S. EPA's 2012 document *Energy Use in K-12 Schools*, displays energy use intensity (EUI) in K-12 schools. The figure is based on data reported by schools through EPA's free Portfolio Manager online tool. The least efficient school buildings use four times more energy per square foot than the most efficient ones. Notably, older schools can sometimes be very energy efficient - the way in which a school building is managed has a big influence on how it stacks up. (Flippen 2010)



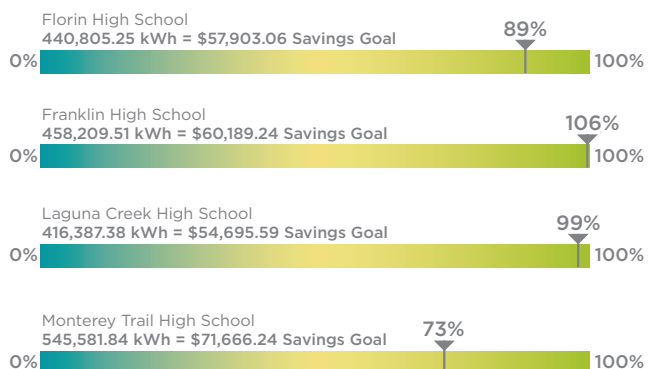
▼ **FIGURE 2 (p. 2):** Student artwork used to raise awareness about a school “lights out” campaign.

Credit: Graphic Design class at Henderson High School, West Chester Area School District



▼ **FIGURE 4 (p. 7):** Energy data and progress toward energy conservation goals are displayed in this web-based format developed by Elk Grove Unified School District.

Credit: Elk Grove Unified School District

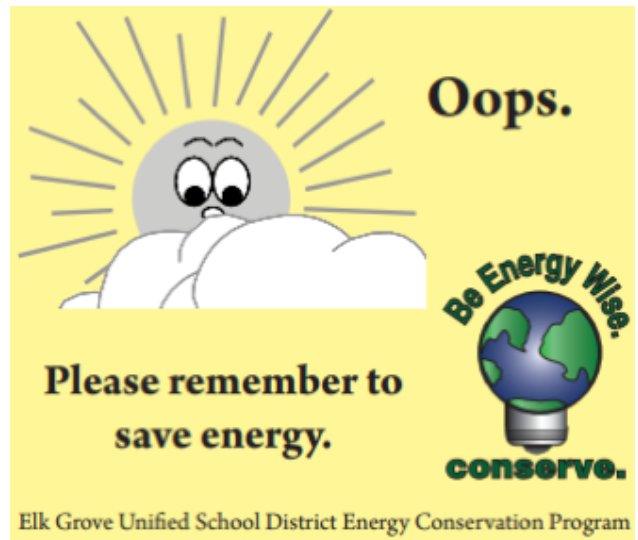


APPENDIX B: IMAGES



▲ **FIGURE 5 (p. 7):** Fayette County Public Schools in Kentucky holds a monthly recognition ceremony for the schools with the largest drop in energy use.

Credit: Fayette County Public Schools



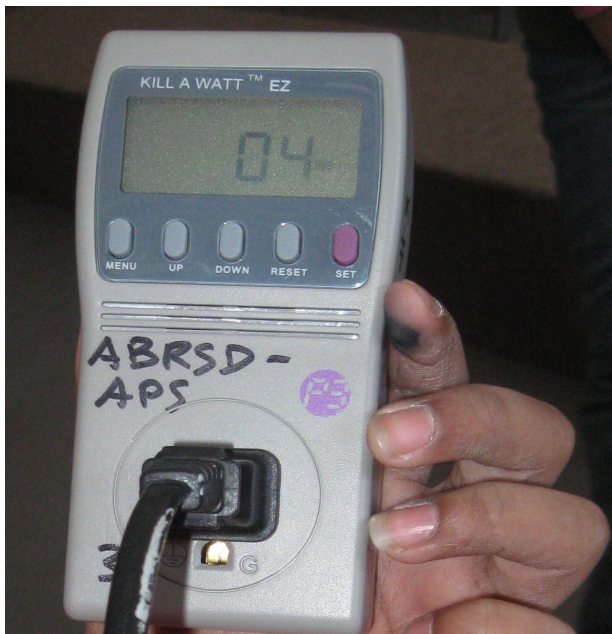
▲ **FIGURE 6 (p. 9):** Energy checkup notes for classrooms and offices

Credit: Elk Grove Unified School District

APPENDIX B: IMAGES

▼ **FIGURE 7 (p. 9):** Students can measure the power draw of various devices with hand-held meters to help establish energy conservation priorities.

Credit: Kate Crosby



▼ **FIGURE 8 (p. 10):** Classroom checklist developed by the “Energy Stars” team at Rosa Parks Elementary School in Kentucky. “Watty” is an energy superhero created by a Rosa Parks parent.

Credit: Fayette County Public Schools

E=USE ² Classroom Checklist	
	Lights out ▪ Before school ▪ After school ▪ Recess ▪ Lunch
	Computer monitors & printers off ▪ when not in use
	Personal appliances off ▪ when not in use
	Doors closed ▪ During class ▪ When room is unoccupied
	Windows closed When heat or cooling on
	WATTY says . . . ▪ Lights off when sun provides enough light ▪ Blinds closed to reduce heat from sun on warmer days ▪ Blinds open to admit heat from sun on cooler days ▪ Thermostat No electronic equipment within five feet

APPENDIX C:

ADDITIONAL RESOURCES

USGBC RESOURCES

- The Center for Green Schools at the U.S. Green Building Council: centerforgreenschools.org
- Green Existing Schools Toolkit: centerforgreenschools.org/k12toolkit
- Energy Efficiency Strategies for Schools: Top Ten No-Cost Ways to Lower Your School's Utility Bills (Powerpoint): centerforgreenschools.org/toolsandpresentations
- Top 11 Ways to Green Your School (Powerpoint): centerforgreenschools.org/toolsandpresentations
- Green Existing Schools: Energy Management (Web Training): centerforgreenschools.org/utility-nav/resources/webtrainings/greenexistingschools.aspx

PUBLICATIONS

- Alliance to Save Energy: PowerSave Schools. (2012). Energy saving success stories from Southern California 2011-2012. Retrieved from ase.org/sites/default/files/powersave_schools-success_book_2011-12.pdf
- Bin, Shui. (2012). Greening work styles: An analysis of energy behavior programs in the workplace. Washington, DC: American Council for an Energy-Efficient Economy. Retrieved from aceee.org/research-report/b121
- Hartzell, P. (2011). A Power Down Friday handbook. Publisher: Author. blurb.com/b/2388761-a-power-down-friday-handbook
- Hu, W. (2011, August 14). With Post-Its and checklists, schools cut their energy bills. New York Times. Retrieved from nytimes.com/2011/08/15/education/15energy.html?_r=0
- Pierce, S. (2011). School cents...The energy behavior management guide. Publisher: Author. energyplanning.org/media/publications.html
- Roberts, D. (2010, January 13). Never mind what people believe – how can we change what they do? A chat with Robert Cialdini. Retrieved from grist.org/article/2010-01-12-never-mind-what-people-believe-how-can-we-change-what-they-do/
- Watt Watchers of Texas, University of Texas at El Paso. (n.d.). Watt Watchers of Texas program manual. Retrieved from wattwatchers.org/Assets/manual.pdf

WEB-BASED RESOURCES

- School Energy and Recycling Team (SERT), Montgomery County Public Schools (how-to resources for behavior-based program): montgomeryschoolsmd.org/departments/facilities/greenschoolsfocus/sert.shtm
- Oklahoma Green Schools (toolkit list for energy investigations): okgreenschools.org/ogsp/wp-content/uploads/2011/04/toolkitinventory.pdf
- Oklahoma Green Schools (instructional video on how to use tools for energy investigations): youtube.com/watch?v=kbVYc5N_E4g&feature=youtu.be
- National Energy Education Development Project (curriculum resources): need.org
- U.S. Department of Energy: energy.gov
- Energy Information Administration: eia.gov
- Kids Saving Energy, U.S. Department of Energy: eere.energy.gov/kids/
- Energy Kids, U.S. Department of Energy: eia.gov/kids/
- Lawrence Berkeley National Lab (explanation of standby power): standby.lbl.gov/standby.html
- Energy Quest, California Energy Commission: energyquest.ca.gov/index.html
- California Energy Commission ("Energy Patrol" guide): energy.ca.gov/2007publications/CEC-180-2007-001/CEC-180-2007-001.PDF

APPENDIX D:

STUDY METHODOLOGY

Case study methodology was used to examine five schools with exemplar behavior-based energy conservation initiatives. Threshold elements for case selection included an established energy conservation initiative focusing on behavior change strategies, an ongoing practice of tracking energy data and the ability to provide clear documentation of energy data demonstrating a drop in energy consumption without confounding effects from mechanical projects, renovations or new construction. The U.S. Green Building Council served as a key informant, providing access to schools and guiding case selection. Three or more interviews were conducted at each site with staff, faculty and administrators. Energy data was collected along with other supporting material (such as flyers, photos and artwork).

Qualitative analysis of the interviews was performed, and findings for each case were corroborated across multiple interviews and through supporting material. Characteristics common to multiple cases were identified and described. Energy data was evaluated through quantitative and qualitative analysis and was reliably tied to behavioral change through the report of the energy manager associated with each school district as well as through interviews. A literature review of benefits associated with behavior-based energy conservation strategies was developed, and strategies used in the exemplar schools were synthesized into a “toolkit.” An interim report was presented at the National Green Schools conference in February, 2012.

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Anisa Baldwin Metzger oversaw the final content, editing and production of this report for the Center for Green Schools. In her role as School District Sustainability Manager at the Center, she connects school staff with the resources and research they need to maintain healthy, efficient and sustainable schools.

