The Energy$mart Schools Program

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ABSTRACT

This paper presents an Energy$mart Schools Program designed to teach students about energy efficiency in their schools, small businesses, and their homes.

The Energy$mart Schools program works with high school students to introduce energy efficiency concepts. The program first teaches students to perform energy audits at home and in their schools; they then use their experience to perform audits in small businesses in their community. Students also participate in 'energy patrols' that are designed to change energy-use behaviors in their schools. Students give presentations on potential cost savings illustrated by the audits and patrols to a wide audience.

High school juniors and seniors are linked to set up and maintain their own 'energy patrols.' Continuity is built into the program as this year's juniors become next year's senior mentors to help the new group of high school juniors. With school district and teacher buy-in, the program can be replicated and sustained indefinitely through mentoring and continuously reaching more students.

In this program, students help school districts to create energy efficient buildings that help to improve their learning environments while saving energy and money. Schools that save money can reinvest it in educational resources. The program also provides an inroad into the hard-to-reach small business market. Students show small businesses ways to reduce costs. In addition, project-based learning experiences provide students with a higher level of education, reaching some students where standard education may not.

Introduction

Schools are often the focal point of many communities and can provide an excellent opportunity for outreach and education. Schools have a widespread trickle down effect, as information moves out of the classroom into homes and on to the community at large. This provides a perfect platform to move information on energy efficiency throughout a community. As students learn about energy efficiency and its relationship to cost savings and environmental improvement they begin to see how they have the power to create change. Involving schools and students in educational outreach will ensure that future generations make educated decisions about energy and energy use.

Programs to teach students about energy and the environment are being implemented in schools across the nation. A variety of social and economic factors have led to their popularity including school districts faced with rising operating expenses and at the same time looking at budget cuts. Two established programs have been providing schools with help, the U. S. Department of Energy's (DOE) Energy Smart Schools program (DOE 2002) and the Alliance to Save Energy's (ASE) Green Schools program (ASE 2002). The DOE

Energy Smart Schools program acts as a clearinghouse of information on educational tools and activities. Through this program schools are able to find information to create their own energy education programs to specifically fit their needs. The ASE Green Schools program provides training with its educational resources. Schools who have participated in Green Schools have reported energy savings of up to 20 percent through behavioral and operation changes (ASE 2000). These programs not only educate students about energy but they also exhibit the links between energy efficiency, cost savings, and improved learning environments to school decision makers.

A Hawaii utility company, Hawaiian Electric Company, Inc., wanted a similar program to engage school students in learning activities that would lead to an increased awareness of energy efficiency in schools and in their surrounding communities. Specifically, they wanted to develop a program that would help to increase the use of energy efficient fluorescent lighting in schools and in small businesses. The utility worked with a non-profit corporation, Strategic Energy Innovations (SEI), to develop a school program to meet this need. SEI staff had experience working with schools and community outreach programs addressing energy and environmental issues. SEI worked with the utility to help them develop the pilot Energy$mart Schools program ("Program"). The Program was funded through DOE's Rebuild America and Energy Smart Schools programs. It was conducted in two high schools over a 20-week period during the second semester of a school year.

SEI was happy with the outcome of the pilot in Hawaii and further developed the Program in California. The California Program used the Hawaii pilot as a foundation and built upon it to expand the Program's impact in schools. SEI was working with the City of Pinole and West Contra Costa Unified School District under the DOE Rebuild America program, in close partnership with Pacific Gas and Electric Company. Because of the District's strong commitment to energy efficiency, and the City's connection to several students from Pinole Valley High School, SEI was able to gain access to the school with very little marketing. Pacific Gas and Electric Company (PG&E) partnered with SEI to lend the Program technical assistance when needed. The Program was implemented entirely on a volunteer basis and was conducted over an academic year.

Program Description

The Program goal was to heighten awareness and increase energy-efficiency in schools and small businesses while simultaneously giving high school students hands-on training in the fields of energy and resource management, business, marketing, advertising and computer technology. Details on how the Program tried to meet this goal follow. The Hawaii pilot program will serve as the core model for this paper and will provide a comparison with the California Program (which was still underway at the time this paper was written).

Program Curriculum

The Hawaii Program developed a flexible 20-week multidisciplinary syllabus. Flexibility was built into the syllabus to allow teachers to decide what best complimented their regular class curriculum. The syllabus did not replace curriculum activities; instead it functioned as an addition to the curriculum. Teachers were able to review it and provide

input before the Program started and during implementation. The syllabus incorporated hands-on math, science, computer, marketing, and public speaking instruction. The school coordinator utilized energy conservation related lesson plans and worksheets available on the Internet from DOE Office of Energy Efficiency and Renewable Energy (DOE 2000) and the ASE Green Schools (ASE 2000) Web sites. The activities used meet national standards in science and mathematics. The syllabus included materials developed by the utility such as a lighting audit survey and training worksheets, which are used by utility professionals within their demand side management programs. Additional worksheets were developed to guide students on how to create marketing fliers, strategies for recruiting small businesses, and using PowerPoint. An energy demonstration kit was assembled for hands-on-learning and audit assistance. Students learned how to use kit items like a light meter, lighting loggers, flicker checkers, KW meter, digital camera, pocket monocular and a laptop computer.

A major portion of the syllabus involved contributions by HECO. Spreadsheet software that was developed by the utility's small business program helped students to calculate energy and cost savings. The spreadsheets calculated savings for retrofits that replace T12 lamps and magnetic ballasts with T8 lamps and electronic ballasts. The spreadsheets also calculated lighting retrofit costs, rebates, and potential payback times. Utility professionals visited the schools as guest speakers. They spoke about energy conservation, electrical generation and delivery, consumer utilization, and marketing and presentation skills.

The California Program used this syllabus as a baseline and modified it as necessary to meet the specific needs of California. For example, the curriculum included one class presenting an overview of the recent California energy crisis. New spreadsheets were created to calculate current energy usage and costs based on local utility pricing information. They model potential savings, greenhouse gas emission reductions, and potential payback times for different lighting retrofit options. Spreadsheets in the California Program calculated savings for replacing incandescent lamps in addition to T12 lamps. Also, the final reports included recommendations for no-cost behavioral measures and potential for savings when the measures were used. A representative from the Pacific Gas and Electric Company provided technical assistance during the audits, including reviews of the calculations, information about local utility rates, and provided T-shirts for the students which said "Energy Patrol." In addition, as the Program was volunteer based, SEI recruited a variety of professionals from the industry to give classroom presentations to the students.

There were two significant differences in curriculum design between the California and Hawaii programs. The California Program implemented 'energy patrols' designed to change behaviors in the school around energy use. In addition, a student mentor component was developed to ensure the continuity of the program.

A concern with the Hawaii Program was once it was over, the energy education ended. In order to answer this issue, a mentor program was designed for the second phase of the California Program. Five juniors who participated in the Program would be chosen to be mentors during their senior year to guide the next group of juniors through an energy project of their own design. The mentors would participate in a training program designed to help them develop the structure for bringing the energy message to their mentees and guiding them in the development of their own energy project. In addition, they would learn what it means to mentor and how to be a mentor.

There were two significant differences in the implementation of the two programs. First, unlike the Hawaii Program, the California Program was unable to be incorporated into the teacher class. The teacher decided to run the Program as an extracurricular activity. The school coordinator led a weekly class using the Program syllabus. The teacher was unable to attend the Program's weekly class sessions, which were not taught to his entire class; he taught a social studies class during that period, and not all of his student elected to participate in the program. Students who elected to participate worked with the school coordinator during class period, and also attended a weekly "club" meeting in which the teacher did participate. During this session, students discussed energy patrols and received advice and information from the school coordinator.

Second, SEI expanded the scope of the audits to recommend savings for replacing various types of lighting, not just T12 replacement. Audits also provided recommendations for no-cost behavioral measures. Where it was applicable de-lamping was also recommended.

The California Program added an additional component of providing an educational trip to Massachusetts Institute of Technology (MIT) in Boston, MA for several of the students with the highest participation rate and interest. SEI chose MIT as a destination due to MIT's connection with the Program. MIT monitored two schools in the district to detail school energy use and the Professor conducting this research invited the students to participate in a class and view the laboratory that housed the energy monitoring equipment. To fund the trip, the students and the school coordinator created a fundraising plan, earning support and donations from the City, local Education Funds, several community organizations and small businesses. Part of the success of this Program has been the strong community involvement, as evidenced by the support for this aspect of the Program.

School Participation

The Hawaii Program needed two high schools to participate. Efforts to recruit the schools started at the beginning of the school year. Marketing efforts were focused on working with organizations already connected to schools, and distribution of a marketing flyer. The first method led to a connection to a Chemistry teacher at Waianae High School. Twenty-six high schools were contacted with the flyer, and two teachers responded. SEI selected the first teacher to respond to the flyer, a Physics teacher at Kalaheo High School.

As the California Program was volunteer based, there were no requirements on the number of schools needed to participate. SEI learned about five seniors in the Environmental Studies Academy at Pinole Valley High School who had been selected to work with the City of Pinole during the summer in various aspects of the City's energy and waste management divisions. After conversations with the City, the City Manager suggested SEI implement the Program with the Pinole Valley High School students. SEI met with the five students several times prior to the beginning of the school year. They were very excited about being the energy "pioneers" in their school.

Program Implementation

In the Hawaii Program the school coordinator met with both teachers to discuss how best to run the Program in their school, either after or during school. The coordinator thought

an after school format would be the popular choice but instead, both teachers chose to hold it during regular class sessions. When the teachers were asked "why," they both gave the same reason; *to provide students who were not considered "high achievers" a chance to learn through hands-on, practical experience.* Providing students with alternatives to the traditional classroom setting could increase their interest to learn; especially in those who perform at lower achievement levels. Students who do not typically participate in extracurricular activities would miss the opportunity to learn something new or discover a different career path. The school coordinator visited each school once a week and worked with a total of fifty-one students. Classes lasted between 1 to 1.5 hours, less time if students had a test coming up or term paper due. The amount of class time was designed to be very flexible so that the teachers could best meet their lesson plans.

As mentioned earlier, the California Program began to work with five seniors in the Environmental Studies Academy at Pinole Valley High School prior to the start of school in the fall. These students were very interested in the Program and would serve as ambassadors when educating other people who know little about energy efficiency. The Director of the Environmental Studies Academy said the seniors could not complete the Program as part of their Environmental Science Course, since it was a very structured AP course. He suggested SEI work with juniors instead. When the SEI school coordinator related this information to the seniors, they were very disappointed. The coordinator suggested they negotiate their participation with the Director of the Academy. The Director agreed that the seniors could continue in the Program, but they would work with the juniors in their Environmental Science Class. This created a strong ownership of the Program on the part of the seniors, and an excellent opportunity to create mentor teams. The mentor groups worked as teams on projects together.

On the other hand, the seniors were not free when the juniors' science class met. A social studies class was chosen instead; thus, incorporating the learning activities into the teacher's curriculum was not possible. In order to gain participation from the juniors, the school coordinator presented the Program to a class and asked for volunteers. A total of fifteen students signed up. Learning activities were first shared with the entire social studies class then the fifteen volunteers were allowed to leave class to participate in additional projects led by five senior mentors. These students were responsible for completing the material in the class they missed each week; however, the work they did during this Program fulfilled the requirement to complete an environmental project, which typically occurs after school hours. This core group conducted energy patrols and completed school and small business audits.

In addition to the weekly class, students participated in the "Watt Cops' Energy Council," a club in which students met during a lunch hour and prepared for energy patrols and other projects. The students that participated in this Energy Council divided into their mentor teams, each conducting an energy patrol once a week after school hours. It was difficult to sustain the after hours patrols due to additional student commitments, jobs, or other activities that arose during the course of the year. In addition, we had difficulty in coordinating with custodial cleaning schedules.

School Audits

After first familiarizing themselves with sources of energy use in their homes students looked at their schools. In the Hawaii Program, students learned first to audit their classrooms and libraries before moving on to audit the entire school. Students recorded data on the number of fluorescent light fixtures, number of lamps, and operating hours. They input their data into Excel worksheets to calculate energy and cost savings (see Table 1 for results of audits). The Excel worksheets calculate savings for replacement of T12 fluorescent lamps and magnetic ballasts with T8 lamps and electronic ballasts. To understand the energy and electrical costs at their schools, students gathered data on their schools' historic energy use. Students reviewed energy bills for the schools over the previous two years. Using all the data they found, students generated audit reports and discussed what the results revealed.

Table 1. Results of Students' School Audits: Potential Savings After a Lighting Retrofit

School	Square Footage	Potential Annual Energy Savings (kWh)	Potential Annual Cost Savings ($)
Kalaheo High	122,952	161,619	16,323
Waianae High	101,080	217,046	21,922
Total	224,032	378,665	38,245

The California Energy Commission had already completed an investment-grade audit of Pinole Valley High School for the District. We wanted the students to have the experience of doing an energy audit and calculating how much could be saved by replacing the current fixtures with more efficient lights, but did not feel it was necessary to complete an entire school audit. We used *Lighting In the Library* (DOE 2001), a student workbook put together by the Office of Energy Efficiency and Renewable Energy found on the compact disc *Get Smart About Energy* (DOE 2001) compiled by the U. S. Department of Energy to train the students to conduct lighting audits in high energy use areas, the library and the cafeteria. They counted fixtures, number and type of lamps, operating hours, and the total area of the two spaces being audited (see Table 2 for results of audits).

Table 2. Results of Students' Lighting Audits of Pinole Valley High School's Library and Cafeteria

Room	Square Footage	Potential Annual Energy Savings (kWh)	Potential Annual Cost Savings ($)
Library	4,693	16,736	1,753
Cafeteria	12,086	25,369	2,516

Small Business Outreach

Students in Hawaii needed to find twenty small businesses that would participate in a free energy audit. They worked in groups to design marketing flyers to deliver to small businesses. Students delivered the flyers to businesses they liked to shop at and wanted to audit, like a surf shop or candy store (see Table 4 for types of small businesses audited). Other students chose a business that was either owned by a relative or had a relative working there. Both marketing approaches worked; they easily found twenty businesses to participate.

Students conducted the lighting audits then generated reports highlighting how much the businesses could save annually if they retrofitted their lighting. The businesses also got an estimated cost for project, payback period, and utility rebates available to them (see Table 3 for results of small business audits). Each report was checked by the project coordinator for accuracy. Students delivered the reports back to the small businesses. As added incentive for students, and to make the experience more like a real job, they were offered $50 from the utility for each small business audit. The money went to the school and the students decided how the school should spend it.

The school coordinator made follow up calls to businesses for feedback on student conduct and the program in general. The calls revealed that businesses were more interested in helping the students with their project than receiving a free lighting audit and report. The businesses were engaged because the students were learning "real life" skills. Although the business said the audit reports were informative none of the businesses committed to a retrofit, but the link with the community was a valuable experience for both the students and businesses. The follow up was conducted very shortly after the student visits; additional follow-up has not been done to determine if the businesses implemented measures.

Table 3. Results of Students' Business Audits: Potential Savings After a Lighting Retrofit

Total Small Businesses Audited	Potential Annual Energy Savings (kWh)	Potential Annual Cost Savings ($)	Utility Rebates ($)	Estimated Cost to Retrofit After Rebates ($)	Estimated Payback Period (years)
20	103,054	10,417	3,663.60	18,221.64	2.7

Table 4. Types of Small Businesses Audited by Students in the Hawaii Program

Business Type	Number
Church	1
Gas Station	1
Health Service (Dental, Physical Therapy, General Health)	4
Market	4
Restaurant	1
Retail	5
Service (Wireless Phones, Laundromats, Key and Shoe Repair)	4

In California, the school coordinator and students worked with the City of Pinole Redevelopment Agency who agreed to give the students $150 for each audit they conducted which was applied toward financing their trip to MIT. To receive the maximum amount of money allotted by the City for these audits, the students needed to find 15 businesses to audit and present retrofit recommendations. Students, accompanied by their teacher, designed flyers and distributed these to a mall two blocks from the school. Only two businesses, a barbershop and video store, agreed to participate. After some research, we discovered that the mall was coming under new management and the rent was being raised. Many small business owners were not sure they would remain in the same location so were not willing to participate in an audit; some even felt that the audit was something offered by the new management to make businesses feel better about the rent increase.

Since time was short, the school coordinator went to small businesses around City Hall to ask if they would participate in an audit conducted by Pinole Valley High School

students. Recruiting the businesses often required multiple in-person visits to be able to coordinate with the store manager. Eleven businesses agreed to participate. Most businesses expressed the same sentiment as in the Hawaii Program. They agreed initially to help students in a "real-life" learning project; however, it was only after the audits were completed that they expressed interest in the audit recommendations. Students accompanied by their teacher walked several blocks to these businesses and in their mentor teams audited three to four businesses each (see Table 5 for types of small businesses audited). The City recommended we audit the Post Office since it was about to undergo retrofits. They agreed that this audit would count as two since the facility was large. After the audit the students presented the business with a flyer to post in the window announcing that "Pinole Valley High School students helped me save energy and money".

Table 5. Types of Small Businesses Audited by Students in the California Program

Business Type	Number
Restaurant (Bakery and Sit-Down Restaurants)	3
Financial Service (Mortgage, Insurance, and Banks)	6
Service (Barbershop, Travel Agency, Real Estate Agency)	3
Government Facility (Post Office)	1
Retail	1

Student Presentations

Students in Hawaii prepared PowerPoint presentations to share their audits and results, and to show how their schools could save money. Students presented at two Parent, Teacher, Student Association meetings, and a year-end Hawaiian Studies Awards meeting. Three more meetings were held during summer months where students were not available to present; information was presented instead by the school coordinator and a utility Program Manager. These presentations were to a Honolulu district principals and vice-principals meeting, to the Board of Education, and to the Legislature. In addition, the teacher and one student from Waianae High School presented at a Regional Rebuild America Peer Forum in San Diego, California. This presentation by the teacher and student had tremendous impact on the audience; this is in part what led to the West Contra Costa Unified School District's interest in the program.

In California, students prepared a PowerPoint presentation for the School Board during the Fall 2001 semester to provide an overview of their audit and patrol activities. The students also presented their work to teachers and representatives from twenty different schools. They discussed their energy patrol observations, the small business audit process and summarized their findings. Students who visited MIT shared their experience with professors and college students. One student highlighted that a key takeaway from this program is that "when I grow up, I want an energy efficient house because I learned how important energy efficiency is to saving our environment." She has already encouraged her family to use compact fluorescent lamps in her home. A follow-up presentation to the School Board, City representatives, rotary clubs, Chamber of Commerce and business sponsors is planned for the Spring 2002 semester.

Retrofit Donations

In Hawaii, Energy Conservation Hawaii (ECH) donated products and services to retrofit one classroom to serve as model for the rest of the school. They retrofitted the lights in one classroom at Kalaheo High. ECH donated time and labor and recruited GE Lighting Hawaii and Graybar Electric Supply Company Hawaii to donate T8 lamps and electronic ballasts. This one classroom alone with only 44 fixtures will save 3,600 kWh and $360 annually. The school also received a $246 energy efficient rebate from the utility.

Based in part on the information presented by the California students at a School Board meeting, the WCCUSD district plans to retrofit the entire school. At the end of the spring semester, students will present again at a Board meeting, further encouraging them to incorporate their recommendations in the upcoming school renovation as well as in other planned school renovation projects in the district. Currently, Pinole Valley High School uses 651,862 kWh a year. If they proceed with the recommended energy efficiency retrofits they will use 401,145 kWh, saving 250,717 kWh which represents a savings of 38.5 percent (California Energy Commission 2001). Savings are based on lighting retrofits that include the following measures: replacing T12 lamps and magnetic ballasts with T8 lamps and electronic ballasts; replacing incandescent fixtures with fluorescent fixtures; replacing mercury vapor fixtures with metal halide; installing switch controls (ability to turn off half the lights or 50 percent dim capacity) and occupancy sensors.

Lessons Learned

School Participation

In order for this type of program to be completely effective teacher buy-in was critical. The involvement of teachers in the Hawaii Program was the main reason for its success. They were the primary decision makers on whether or not the school participated in the Program. The schools principals supported what the teachers felt was a worthwhile program for their students. This was not just another program handed to them from higher up in the school system, they believed in the Program from the outset.

There was less direct involvement from the teacher in the California Program. The teacher, due to the regular class he taught during the time of our Program, attended few of the class periods and did not show as much overall interest as hoped. Since the teacher was not directly involved in this class it was often difficult for the teacher to follow up on student homework assignments and questions. This also made it difficult to take the necessary time needed to arrange student audits and field trips. It is possible that some students did not think the class was valued by the teacher so did not place as much value in it themselves. Without the teacher directly involved the students have had trouble making the connection between their work in this Program and receiving class credit. Given that this class was in addition to their full class schedule, homework was often perceived as a lower priority. While most students in the California Program showed a strong desire to be in the Program, only a core group of roughly ten students participated in activities outside the class period. In addition, there were several high achievers that participated in the class. While they were very engaged, their schedules often overlapped with other activities, so their attendance was

somewhat limited. Given these issues, we recommend running the Program within a teacher's regular class, as was done in the Hawaii Program.

Program Implementation

Holding the Program in a regular class during school hours involves students who may not otherwise participate in a program like this. If the Program is set up as an extra-curricular activity during recess or after-school it will attract students who are already high achievers and regularly participate in a variety of programs. Both Hawaii teachers wanted to include the Program in their regular classes to motivate students who would not normally participate in extra-curricular activities. Some of their students were likely to not go to college so this provided them with real-life work experience and a look at a possible career path.

The student mentors were five high achieving seniors, with busy schedules. Only three of the seniors participated regularly, making it more difficult to implement a mentor team concept for all of the students. The three instead became the mentors to the entire group of juniors, breaking into teams when necessary, but primarily helping to direct and maintain the Program.

Small Business Outreach

A challenge for this Program is to get small businesses to commit to retrofits. Although the businesses liked helping the students and receiving a free audit report, they still were hesitant to commit to doing a lighting retrofitting. In Hawaii the school coordinator conducted follow up phone calls to find out what the businesses thought about the Program. It was originally planned that the utility would also conduct follow up calls to offer assistance with lighting retrofits. This was delayed due to concerns whether small businesses might feel pressured to retrofit since they participated in the free student audits; the follow up calls have yet to be performed.

The Hawaii school coordinator found that the small businesses valued having the utility provide the Program to students. The businesses saw this as not just a benefit to students in learning job skills but also a benefit to them in learning about energy savings. They saw the utility as making a contribution to their community.

The challenge now is to get students to take their real-life job experience further by having them champion efforts to encourage businesses to implement energy efficient measures. The California Program will implement this aspect into the work students do with small businesses.

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