Rebuild Hawaii
Energy Smart Schools 2002

Appendices to Final Report

Prepared for: State of Hawaii
Department of Business,
Economic Development and Tourism
Energy, Resources and Technology Division

Prepared by: Sam Nichols
Hawaiian Electric Company, Inc.
PO Box 2750, Honolulu HI 96840
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April 30, 2004

Energy Smart Schools

A program by Hawaiian Electric Company

Energy Smart Schools is a multi-disciplinary program designed to engage students in activities focused on energy efficiency. Students will:

- Gain career and life skills;
- Train to be lighting auditors;
- Develop presentations of their work; and
- Work with local companies to advance their experience.

The goal of the program is to get students to think about energy use and to find ways to be more energy-efficient. Students will learn about energy use and lighting, and gain experience in conducting energy audits (specifically no-cost, low-cost improvements and fluorescent T8 lighting retrofits). Students will take their knowledge and perform energy audits on their school buildings as well as in small businesses (such as their friend or family's place of business). Students will gather and analyze data then construct reports with suggestions on methods that will improve energy use in buildings. These reports will be presented accordingly to the school board and to the small business owners.

What will the program provide students?

The program will provide students with a multi-disciplinary approach to learning about energy, energy audits, and energy efficiency. Activities meet science, math, social studies, and language arts standards. Students will have the opportunity to use state of the art auditing, lighting and computer equipment (provided by HECO), including using audit software, lighting loggers, laptop computer and digital camera. Along with learning to perform audits students will gain background in energy, electricity, and lighting.

Additionally, HECO will reward the class/club/school with $50 for each of the first 10 business audits! **That's $500!**

Who instructs the classes?

Jennifer Webb, the program's school coordinator, will lead the classes and involve appropriate HECO engineers, marketing staff, and lighting industry professionals.

When will the program take place?

The program will run through the 2002/2003 school year. Currently the syllabus is set up for 1 hour of instruction once a week for 20 weeks. A flexible schedule will be set up with teachers to best fit their school schedule. Teachers are encouraged to discuss recommendations on how to integrate program activities into their curriculum.

Has This Been Done Before?

Yes! Waianae and Kalaheo High Schools participated in the successful pilot program.

This is a special program funded by Hawaiian Electric Company with an additional grant from Department of Business, Economic Development & Tourism (DBEDT).

For More Information Contact Jennifer Webb at 739-2217.

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840-0001

September 13, 2002

Ms. Jennifer Webb
4014 B [redacted] Drive
Honolulu, Hawaii 96816

Dear Ms. Webb:

Thank you for your interest in visiting Hawaiian Electric's Kahe Power Plant located at 92-200 Farrington Highway. We have confirmed your Power Plant Tour for:

Radford High School
Wednesday, October 9, 2002
9:00 a.m. – 12:00 p.m.
30 students

The tour and presentation takes approximately 2 hours to complete. The day will start with a presentation, then a mile walk through the facilities and end with questions. The tour does include some stair climbing. We would appreciate it if you would inform all participants of the following:

- Everyone must be over the age of 12 years old.
- Long pants and covered shoes are required. NO slippers, sandals, or high heel shoes. (soles of shoes must be made of non-slip material)
- T-shirt with sleeves (short okay) required. NO tank top or sleeveless.
- Hard hats will be provided and MUST be worn.
- Security guard will direct you to the parking area and where to meet your tour guide.

Enclosed for you and your students are the liability waiver forms that need to be filled out completely. The forms need to be turned in to your tour guide the day of the tour. Anyone without a completed form will not go on the tour.

If the tour needs to be rescheduled or the group attendance changes, please call Kim Ildefonso at 543-7968 within 3 working days prior to the tour date.

Thank you and we look forward to your visit!

Sincerely,

Ka'iulani de Silva

Ka'iulani de Silva, Director
Education & Consumer Affairs

Enclosures

Copy: Sam Nichols

PHOTO RELEASE FOR MINORS

In consideration of the photographing of _____, a minor, by Hawaiian Electric Company, Inc. ("Company") or anyone acting on Company's behalf, I, individually and as parent or guardian of said minor, hereby consent to the photographing and/or videotaping of said minor and/or to the recording of said minor's voice and do hereby authorize Company to use or cause to be used such photographs, either still or moving; videotapes; and/or to use said minor's name and the recordings of said minor's voice for advertising, publicity, commercial or other business purposes. The consent given herein is for use singularly or in conjunction with other photographs, videotapes, and sound effects or recordings.

I, individually and as parent or guardian of said minor, further authorize Company to reproduce or authorize the reproduction and use of such photographs, videotapes, and recordings of said minor's voice. The same may be exhibited on motion picture or television screens throughout the world. I understand that others may use such photographs, videotapes, or recordings and reproduce the same either with or without the consent of Company.

I, individually and on behalf of said minor, release Company and any of its associated or affiliated companies, their directors, officers, agents, employees and customers, and anyone acting on Company's behalf with respect to the photographing or videotaping of said minor and/or recording of said minor's voice, from all claims of every kind on account of such use.

Dated: _____

_____
Parent or Guardian Signature

_____
Parent Name (print)

I acknowledge that I have read the above and approve and agree with its provisions.

_____
Minor Signature

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What will the program provide you?

You will gain a background in energy, electricity, and lighting. Along with the opportunity to use state of the art auditing, lighting and computer equipment (provided by HECO), including using audit software, lighting loggers, laptop computer and digital camera.

Additionally, HECO will reward your class/school with $50 for each of the first 10 business audits! **That's $500!**

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Parent or Guardian Signature

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Parent Name (print)

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_____
Minor Signature

HECO Energy Smart Schools Program
Letter of Commitment

The undersigned supports the Hawaiian Electric Company's Energy Smart Schools Program as set forth in this Letter of Commitment.

_____agrees to become a participating party in Hawaiian Electric Company's Energy Smart Schools Program. _____ will be _____ participating teacher. Approximately _____ students will participate in the program.

This Letter of Commitment shall be effective upon date of this signature of the participating party and will be completed on or before June 6, 2003.

_____

Signature

_____

Print Name

_____

Title

_____

Date

YES!

We want to be an Energy Smart School.

School Name _____

Address _____

Phone Number _____

Principal _____

Our Energy Smart School teacher:

(One teacher and custodial staff person per school)

Name _____ Grade/Subject _____

Why we want to be an Energy Smart School:

Briefly describe why becoming an Energy Smart School is right for you.

Hawaiian Electric Company, Inc.

Rebuild America

DBEDT
THE DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
STATE OF HAWAII

Please fax to Jennifer Webb at 735-3521 or email to jenwebb@hawaii.rr.com.
Decisions will be made in June with announcements in early July.
If you have any questions contact Jennifer at 739-2217.

YES!
We want to be an Energy Smart School.

School Name _____

Address _____

Phone Number _____

Principal _____

Our Energy Smart School teacher:

(One teacher per school)

Name _____ Grade/Subject _____

Why we want to be an Energy Smart School:

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Energy Smart Schools Workshop Summary

Activity	**Program Introduction/ Pre Test**
Week	1
Subjects	Science, Social Studies
Standards	*Science:* Domain 2: 1. Understanding Scientific Inquiry *Social Studies:* Geography 5. Environment & Society
Summary	This class will provide an introduction of program to students and describe activities they will be participating in. The Pre Test will test students' current knowledge of energy. Students will begin to form questions on energy that they will find the answers to by the end of this program.
Expected Outcome	For students to start thinking about energy and to understand what is expected of them over the course of this program.
Materials	Handout: Student flyer about the program. Worksheet: Pre Test
Procedure	• Organize and print out needed handouts and/or worksheets. • Introduce yourself and program to students. • Discuss what they will be learning in the program and expectations you have of their work over the program period. • Ask them if they have questions or if there are any program activities they might feel unsure about. • Have students complete the Pre Test then go over answers together as a class.
Evaluation	Good -- students are excited to begin the program. The Pre Test is a great way to get them to start thinking about energy and energy use.
Recommendations	None

Activity	**Guest Speaker: HECO (speak about electricity)**
Week	2
Subjects	Science, Career & Life Skills
Standards	*Science:* Domain 2: 14. Energy, its transformation & matter *Career & Life Skills:* Technological Literacy
Summary	Guest speaker to talk about how HECO produces electricity and then delivers it to communities in Hawaii. The speaker will give students a background on why it is important to save energy from the consumer and utility standpoint.
Expected Outcome	For students to understand how electricity is produced in Hawaii and how it is delivered to their homes. Also, for students to meet a professional HECO worker and get exposure to a career path.
Materials	Model hydrogen fuel cell.
Procedure	• Contact someone qualified to talk about electricity and its production and who would like to work with high school students. • Schedule a date and time that works for both the speaker and the school. • Inform teacher and school administration of the guest visit. • Give students a little background on the guest speaker before the scheduled visit.
Evaluation	This is a great workshop and provides students with a nice opportunity to meet HECO professionals and ask them questions about their careers and learn about the utility. The hydrogen fuel cell model was very popular with both teachers and students.
Recommendations	Include demonstrations/models to give students an up-close look at an alternative source of energy.

Activity	**Motors**
Week	3
Subjects	Science
Standards	*Science:* Domain 2: 14. Energy, its transformation & matter *Science:* Domain 2: 15. Forces, motion, sound, & light
Summary	Students learn how to build motors and how to use a motor in reverse as a generator. This activity helps to demonstrate how electrical power plants generate electricity.
Expected Outcome	For students to learn about how a motor and generator works. Also, for them to understand how coil and magnet can make electricity.
Materials	Motor Supplies: D-cell batteries; thick rubber bands; 24 gauge magnet wire; ceramic magnet; wood dowel or marker; packaging foam; ruler; jumbo paper clips; sandpaper and connecting wire. Generator Supplies: motor; light bulb; bulb holder; and string.
Procedure	• Gather and organize the materials stated above. • Give students an overview of what they will accomplish during this workshop. • Break the class up into groups and distribute the materials for the motors. • Walk class through each step of the motor assembly process (for a list of steps refer to the Mr. Wizard ElectroWizard Inventions Kit or visit www.electrowiz.com). • While students spend time on each step of the assembly discuss the concepts you want them to walk away from this activity with (i.e. by spinning magnets or coils near each other generates electricity; the motor uses a coil and magnet to turn electricity into motion). • Ask students if they have questions and review concepts. • Have students clean up and return workshop materials to teacher.
Evaluation	Excellent workshop. Students really enjoy this project and will want to repeat it.
Recommendations	Provide enough materials so that the class can repeat it with their teachers. Repetition of the project will help to reinforce student learning.

Activity	**Home Energy Use & Knowing the Meaning of Electrical Terms (Quiz #1)**
Week	4 -5
Subjects	Science, Math
Standards	*Science:* Domain 1: 1. Doing scientific inquiry *Science:* Domain 1: 2. Living the values, attitudes, & commitments of the inquiring mind *Science:* Domain 1: 3. Using unifying concepts and themes. *Science:* Domain 1: 5. Relating the nature of technology to science *Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring. *Social Studies:* Geography 5. Environment & Society. *Social Studies:* Economics 1. Limited Resources & Choices.
Summary	Students will estimate how much energy their family uses. By identifying items in their home that use energy and estimating how much time each items is on a day they can calculate energy use. Students will learn to read nameplates of wattage ratings on appliances and how to convert watts to kWh. They will learn to read electric meters to compute energy use. Finally they will compare their results with other students and discuss reasons for differences.
Expected Outcome	For students to learn electrical terms and be able to calculate appliance operating costs, read meters, understand electric bills, and compute lifecycle cost of appliances. For students to find out how much energy they use and to identify wasteful energy situations in homes. They will make recommendations on energy saving actions. Also, for students to understand the important role that energy plays in our lives, and why energy demand has increased so much in the last twenty years.
Materials	Worksheets: Home Energy Survey, Wattage Ratings, Meter Reading, Home Appliance Survey Handout: Energy Saving Suggestions, Meaning of Electrical Terms, Anatomy of a Light Bulb and Quiz #1.
Procedure	• Gather and print out workshop handouts and worksheets. Review instructions/procedures provided on worksheets. • Give students an overview of what they will accomplish during this workshop and distribute materials to them. • Walk students through how to complete the worksheets and discuss homework. • Have students complete the Quiz then go over answers together as a class.
Evaluation	The workshops went well except for one homework assignment. One of our classes is made up of about 90% students from military housing. They were unable to complete the homework assignment on meter reading. Students checked the school meter to see if they could read that but the school meter had a digital display and no access without the teacher. Quizzes help to get the students to be attentive to what they are learning. Reviewing the answers together as a class refreshes their memories and reinforces learning.
Recommendations	Allow extra time to go over math equations. Before sending students home with the Meter Reading Handout worksheets as homework check with them to find out how many are from military housing. A majority of the students from one school are from families in the military. They have subsidized housing and do not pay for electricity bills nor have individualized electric meters on their houses. It is recommended to create in class meter reading test worksheets. This will teach students to read meters even if they don't have one at home. Another option would be to check to see if the students have access to read the school meters.

Activity	**Field Trip**
Week	6
Subjects	Science, Career & Life Skills
Standards	*Science:* Domain 2: 14. Energy, its transformation & matter *Career & Life Skills:* Technological Literacy
Summary	Student will take a field trip to one of HECO's Kahe Power Plant. Students will listen to a presentation about the power plant and watch a video on how the power plant operates. They will examine a sample of the Low Sulfur Fuel Oil. Students will then take a walking tour of the plant.
Expected Outcome	For students to learn how Hawaiian Electric Company produces and distributes power.
Materials	Bus reservations. Handout and Video: Welcome to Kahe Power Plant (HECO) Sample of Low Sulfur Fuel Oil
Procedure	• Coordinate with your local utility to schedule a tour of one of its power plants. • Make needed transportation arrangements, such as bus reservations. • Ask the utility and school administration about field trip forms that students may need to get signed by parents before they go on the field trip. • Discuss with students before the trip what they will be seeing and what you expect them to learn from this experience. Review any special requests, such as clothing requirements, which the utility may make. • Attend the field trip.
Evaluation	The field trip is highly recommended. Students have a chance to see where and how electricity is produced. Students also get to learn about the different professions in the utility.
Recommendations	When walking through the power plant tour have the tour leaders explain to students what they are about to see before entering into noisy sections.

Activity	**Guest Speaker from HECO (to speak on lighting)**
Week	7
Subjects	Science, Math, Social Studies, Career & Life Skills
Standards	*Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring. *Social Studies:* Geography 5. Environment & Society. *Social Studies:* Economics 1. Limited Resources & Choices. *Career & Life Skills:* Technological Literacy *Career & Life Skills:* Career & Life Planning
Summary	A guest speaker from HECO will talk about lighting and what the professionals look for during their audits. Also, for students to meet a professional HECO worker and get exposure to a career path.
Expected Outcome	For students to learn about different types of lighting. Also, for them to understand the energy used to operate lights and how much energy leaving on unnecessary lights wastes.
Materials	Lighting Board (HECO) Samples of Different Lamps Worksheets: Bright Ideas
Procedure	• Contact someone qualified to talk about lighting and who would like to work with high school students. • Schedule a date and time that works for both the speaker and the school. • Inform teacher and school administration of the guest visit. • Give students a little background on the guest speaker before the scheduled visit.
Evaluation	Great workshop. The guest speaker helped to reinforce how easy saving money and energy can be just through changing the types the lights they use.
Recommendations	None.

Activity	Lighting Audit Training
Week	8 -9
Subjects	Science, Math, Career & Life Skills
Standards	*Science:* Domain 2: 2. Interdependence of Science, Technology, & Society *Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring. *Career & Life Skills:* Technological Literacy *Career & Life Skills:* Career & Life Planning
Summary	Train students on how to perform lighting audits. They will start with their classroom then move on to their school library. They will learn how to record data on HECO Lighting Equipment Survey Sheets. Students will learn to use the digital camera to take pictures of fixtures.
Expected Outcome	For students to complete a lighting audit of their school library. Students will complete survey sheets on fixture types and counts, burn hours, potential energy and cost savings, cost to retrofit, and available rebates.
Materials	Worksheets: Lighting Equipment Survey Input Handouts: Wattage for Various T8 Lighting Systems, Savings Calculations, Lighting Equipment: Energy Conservation Measures, and Lighting Fixtures. Digital Camera Light Meters Flicker Checkers Monocular
Procedure	• Gather materials stated above and print out workshop handouts and worksheets. Review instructions/procedures provided on worksheets. • Coordinate with the school librarian to schedule a time when the class will be visiting the library to conduct their lighting audits. • Discuss with students what they will be doing in this workshop and what you expect them to learn. • Walk students through the steps of conducting a lighting audit (interview occupants, identification of lighting fixtures/ballasts, fixture/lamp counts, burn hours, etc.) in their classroom. • Break the class up into groups and take each group over to audit the library one at a time (how many groups go to the library at one time will depend on the number of instructors; one instructor per group). • Shadow groups as they conduct their audit and ask them questions about what they are doing and why they are doing it to help reinforce their audit skills. • Ask students if they have questions and go over audit skills/areas you noticed they did well and areas they need to improve.
Evaluation	These are important workshops for the students—they learn audit skills they will use for the rest of the program. The warm-up classroom audits were easy for students and can be completed within a single workshop. The library audits were more difficult due to limited time (about 40 minutes + travel time back forth from the classroom) in a larger space. Students were pressed to complete audits within a workshop period. Some students needed to return to the library the following week to finish up their audit.
Recommendations	It is important to spend extra time on this if you need to. Keep student groups to a maximum size of 3 students. With groups of 4 or more, some students will not get actively involved and just follow the others around.

Activity	**HECO Lighting Audit Software Training & History of School Energy Use**
Week	10-12
Subjects	Science, Math, Career & Life Skills
Standards	*Science:* Domain 2: 2. Interdependence of Science, Technology, & Society *Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring. *Career & Life Skills:* Technological Literacy *Career & Life Skills:* Career & Life Planning
Summary	Train students on how to use HECO T8 audit worksheets in Excel. Students will use data gathered in their library audits and generate reports on the laptop computer. Gather 3 years of school electricity bills and show students what they look like, teach them how to read the bills, and have them calculate energy use and cost for each year.
Expected Outcome	For students to complete audit reports on fixture types and counts, burn hours, potential energy and cost savings, cost to retrofit, and available rebates. Students should be able to read their school electricity bills to determine energy costs and examine history of energy use.
Materials	Worksheets: HECO Excel based T8 Audit, School Energy Use, History of School Energy Use and CO_2 Graph Handout: Directions for Audit Worksheets Laptop Computer (Excel) School Electric Bills (Past and current bills)
Procedure	• Coordinate with the school computer lab contact to schedule visits. Ask the computer lab teacher if they are willing to teach the class some Excel basics. • Gather school electric bills and print out workshop handouts and worksheets. • Give students an overview of what they will accomplish during these workshops and distribute materials to them. • Walk students through how to input data from their audit survey sheets into the Excel spreadsheets. • Discuss what kinds of information the audit report (spreadsheet) provides and how it is useful. • Have students print reports for their review later. • Students complete worksheets and examine history of energy use in their school. Discuss what their completed worksheets show them.
Evaluation	Students had an easy time with these workshops but they were time consuming. An additional workshop was needed in order to achieve the expected outcome stated above.
Recommendations	Check to make sure the school computers have Excel and that the student's have access to those computers.

Activity	**HECO Guest Speaker (to speak to students about marketing and presentation skills)**
Week	13
Subjects	Social Studies, Language Arts, Career & Life Skills
Standards	*Social Studies:* Economics: Limited Resources & Choice *Language Arts:* Oral Communication: 1. Range *Language Arts:* Oral Communication: 2. Communication Process *Language Arts:* Oral Communication: 3. Convention and Skills *Language Arts:* Oral Communication: 4. Rhetoric *Language Arts:* Oral Communication: 5. Attitudes and Engagement *Career & Life Skills:* Career & Life Planning
Summary	A guest speaker from HECO will talk about presentation skills and marketing to small businesses to get them to participate in audits.
Expected Outcome	For students to generate ideas on how they will market to small business. Also, for students to meet a professional HECO worker and get exposure to a career path.
Materials	NA
Procedure	• Contact someone qualified to teach marketing and presentation skills and who would like to teach his or her skills to high school students. • Schedule a date and time that works for both the speaker and the school. • Inform teacher and school administration of the guest visit. • Give students a little background on the guest speaker before the scheduled visit.
Evaluation	Excellent workshop. Students learned about marketing and presentation skills from a HECO guest speaker. Students will use these skills for their presentations and small business audits. This workshop also provides students with good exposure to a real life HECO job.
Recommendations	This workshop should be scheduled as close as possible to the actual date when the students will be conducting their small business audits. Otherwise, if a lot time goes by before they begin the audits, try to determine if students will need a refresher on this workshop. In this program, students spent a lot of time preparing their PowerPoint presentations and then needed to be reminded about how to approach small businesses.

Activity	**Prepare for Presentations**
Week	14 -19
Subjects	Social Studies, Language Arts
Standards	*Social Studies:* Economics: Limited Resources & Choice *Language Arts:* Oral Communication: 1. Range *Language Arts:* Oral Communication: 2. Communication Process *Language Arts:* Oral Communication: 3. Convention and Skills *Language Arts:* Oral Communication: 4. Rhetoric *Language Arts:* Oral Communication: 5. Attitudes and Engagement
Summary	Students will learn to use PowerPoint and develop presentations. They will make outlines to organize information. Student groups will gather information on their school's background by interviewing office and custodial staff. Students will practice making presentation with each other and in front of their class. They will observe one another during their presentations and make suggestions for improvement.
Expected Outcome	For students to complete PowerPoint presentations on their school audits and to feel comfortable speaking in front of their peers. Presentations will include their recommendations for school improvements.
Materials	Laptop Computer (PowerPoint) Handouts: Student Presentation on School Audits, Creating a PowerPoint Presentation, Basic Appleworks (for creating presentation slides in Appleworks), Quiz #2
Procedure	• Coordinate with the school computer lab teacher to schedule a block of visits and see if students can come in on their own during recess or lunch times. Ask the computer lab teacher if they are willing to teach the class some PowerPoint (or Appleworks) basics. Discuss what type of media storage you can use to save students work (floppy, compact, or Zip discs). • Gather materials stated above and print out workshop handouts. With the students, review the instructions provided on handouts and make sure they understand what is expected of them in these workshops. • Assign different groups to be responsible for interviewing staff and gathering background information for their presentations. Have them complete as homework. • After students have completed their presentations have them work on presenting to each other in groups and then to the whole class. • Have students provide feedback to each other on presentation skills and content. • Conduct mock question and answer sessions.
Evaluation	Students needed additional workshop time to prepare their PowerPoint presentations.
Recommendations	Check to make sure the school computers have PowerPoint and that the student's have access to those computers. Assess the students' proficiency with computers and determine how many workshops to schedule in the computer lab (in this program we used 4 workshops). Schedule more time than you think you may need; some students will finish early and some will need more time. Use a minimum of two workshops for all the students to practice presenting their presentations to the class. Schedule one workshop for the group of students who are making the actual presentations to rehearse together. Use this time to evaluate how confident and comfortable the students are with making the presentations. This will help you determine if they are ready for additional presentations to audiences outside of school such as the Board of Education or State Legislature.

Activity	**Presentations**
Week	20
Subjects	Social Studies, Language Arts
Standards	*Social Studies:* Economics: Limited Resources & Choice *Language Arts:* Oral Communication: 1. Range *Language Arts:* Oral Communication: 2. Communication Process *Language Arts:* Oral Communication: 3. Convention and Skills *Language Arts:* Oral Communication: 4. Rhetoric *Language Arts:* Oral Communication: 5. Attitudes and Engagement
Summary	Students will make presentations to other students, school administration, and PTSA.
Expected Outcome	For students to report to different parties on what they did in the program and make recommendations on how to improve schools. Also, for students to feel like they can be active participants in their schools and community and have the power to help implement change.
Materials	Student Presentations Laptop Computer and School Computers (PowerPoint)
Procedure	• Coordinate with teacher and school administration to schedule the student presentation. Check with school groups such as Parent, Teacher, Student Associations or Curriculum Departments. Ask students how they feel about presenting to groups outside of school to get an idea about their confidence level. If they are confidant look into having them present to the Board of Education or Legislature. • Make necessary arrangements to have a computer, projector, and screen available for the time of presentation.
Evaluation	Great. Students have the opportunity to shine and show off their hard work. • Radford High School: Students presented to the PTSA, school principal, parents, and representatives of HECO and U.S. Department of Energy. The principal was impressed with the student presentation and asked the students to make another presentation to a future parent luncheon. • McKinley High School: Students presented to Science Department teachers, and representatives of HECO, U.S. Department of Energy, Hawaii State Department of Business, Economic Development & Tourism. HECO filmed the students presenting their PowerPoint presentations. The footage will be included in HECO commercials and corporate communications.
Recommendations	School principals are typically very busy and may have a difficult time making it to a student presentation. Give them reminders when the presentation date gets near and make sure they know how much effort the students have put into developing the presentation. Students may have the opportunity to present to a lot of important people but they may still feel the principal is the most important for them.

Activity	**Prepare For Small Business Audits**
Week	21 - 24
Subjects	Social Studies, Language Arts
Standards	*Social Studies:* Economics: Limited Resources & Choice *Language Arts:* Writing: 1. Composing Processes
Summary	Students will organize how they plan to conduct the small business audits. They will design marketing flyers to attract the attention of small businesses interested in saving money by retrofitting their fluorescent lights. Students will design a static sticker to market their efforts.
Expected Outcome	For students to have a plan to use when going out to conduct the small business audits.
Materials	Laptop & School Computers (Word or Appleworks) Worksheets: Small Business Audit Plan, Designing Your Static Stickers
Procedure	• Gather materials and print out worksheets then distribute to students. • Review what you expect students to accomplish with this workshop. • Break students up into groups (audit team) and have them complete their audit plans. • Groups design marketing flyers and stickers then vote on one design (flyer, sticker) they want to use to represent their class. • Have students schedule a tentative date for when they plan to complete the audit and have them exchange phone numbers so they can contact each other for transportation/meeting arrangements.
Evaluation	Excellent time for students to apply their creative energy with designing static stickers and coming up with slogans for their marketing flyers. They formed their own groups and decided on what each of their roles would be in conducting the audits. Groups named at least three businesses they would market their audits to.
Recommendations	While students are brainstorming about which businesses to target make sure they understand that they will need to audit the entire business. So they should keep the size (square footage) of the businesses in mind when making their choices.

Activity	**Students Conduct Audits on Small Businesses**
Week	Various (students complete on their own time)
Subjects	Science, Math, Social Studies, Language Arts
Standards	*Science:* Domain 2: 2. Interdependence of Science, Technology, & Society *Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring. *Social Studies:* Economics: Limited Resources & Choice *Language Arts:* Oral Communication: 1. Range *Language Arts:* Oral Communication: 2. Communication Process *Language Arts:* Oral Communication: 3. Convention and Skills *Language Arts:* Oral Communication: 4. Rhetoric *Language Arts:* Oral Communication: 5. Attitudes and Engagement
Summary	Students will conduct lighting audits on small businesses.
Expected Outcome	For students to complete lighting audits on small businesses. Students will approach businesses with their flyers and speak with business owners/managers. They will coordinate a time to conduct the audit. They will interview the business contacts to determine hours of operation then walk around and gather data on fixture types and counts. Students will inform the contacts that they will be returning to present the results (audit reports) to the business.
Materials	Worksheets: Lighting Equipment Survey Input, HECO Excel based T8 Audit Flicker Checkers
Procedure	• Gather materials and print out worksheets then distribute to students. • Review what you expect students to accomplish with this workshop. • Have students report to about how their progress is going in completing the business audits and discuss any areas that they may want help with.
Evaluation	These are essential workshops for the students—they apply everything they have learned throughout the program to complete their business audits. HECO filmed a group of students conducting a lighting audit at one business. The footage will be included in HECO commercials and corporate communications. A Honolulu Star Bulletin photojournalist attended and took pictures and notes; one photo and caption were featured in the Bulletin.
Recommendations	Arrange a way to make sure the students deliver the audit reports back to the initial business contacts (owners/mangers) they worked with during their lighting audits. The initial contact may not be at work when the students return with the reports. Prepare a form for the contact to sign during audit and another form for when the students return; this way both contacts will be recorded and the audit verified. If students end up with a second contact then they should request that the second contact share the audit report with the initial contact.

Activity	**Guest Speaker: Entrepreneur in lighting industry**
Week	25
Subjects	Career & Life Skills
Standards	*Career & Life Skills:* Technological Literacy *Career & Life Skills:* Career & Life Planning
Summary	Guest speaker to talk about a career in the lighting industry. The speaker will give students background on how they became an entrepreneur in the field and lessons learned to become successful in business.
Expected Outcome	For students to meet an accomplished professional and get exposure to a career path.
Materials	None.
Procedure	• Contact someone in the lighting industry who is a good role model of success and is willing to talk about his or her experiences to high school students. • Schedule a date and time that works for both them and the school. • Inform teacher and school administration of the guest visit. • Give students a little background on the guest speaker before the scheduled visit.
Evaluation	This is a recommended workshop and provides students with the opportunity to meet a professional and ask them questions about their careers. Both teachers and students enjoyed this workshop and asked many questions of the guest speaker.
Recommendations	None.

Activity	Complete Reports on Small Business Audits
Week	26- 29
Subjects	Science, Math
Standards	*Science:* Domain 2: 2. Interdependence of Science, Technology, & Society *Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring.
Summary	Students will use information they gathered during their small business audits to complete the Excel audit reports.
Expected Outcome	For students to complete audit reports on fixture types and counts, burn hours, potential energy and cost savings, cost to retrofit, and available rebates. Students will return the reports to small businesses owners along with the static cling stickers they designed.
Materials	Laptop Computer (Excel) Worksheets: Lighting Equipment Survey Input, HECO Excel based T8 Audit, Business Confirmation Static Cling Stickers
Procedure	• Gather materials and print out worksheets then distribute to students. • Review what you expect students to accomplish with this workshop. • Have students enter data from their audit survey sheets into the Excel spreadsheets to generate the small business audit reports. • Students print reports and then, on their own time, deliver the reports back to the small businesses. • Students give the static cling stickers they designed to the small businesses and have their business contact sign a confirmation sheet to verify they received the report. • Students return signed confirmation sheets to teacher.
Evaluation	Important workshops for the students—they use information gathered from their small business lighting audits to generate reports that they will present back to the businesses.
Recommendations	Arrange a way to make sure the students deliver the audit reports back to the initial business contacts (owners/mangers) they worked with during their lighting audits. The initial contact may not be at work when the students return with the reports. Prepare a form for the contact to sign during audit and another form for when the students return; this way both contacts will be recorded and the audit verified. If students end up with a second contact then they should request that the second contact share the report with the initial contact.

LIABILITY WAIVER

I, _____ (Adult's name), waive any and all claims I may have against HAWAIIAN ELECTRIC COMPANY, INC. ("HECO") and its respective officers, agents and employees, and agree to defend, hold harmless and indemnify HECO and its respective officers, agents and employees from any suits, actions and claims arising out of or in any way connected with activities conducted as part of a TOUR OF HECO FACILITIES, including claims arising from my participation as a teacher or chaperone during a TOUR OF HECO FACILITIES.

Print name:_____

Signed: _____ Date: _____

This form must be completed and returned prior to a TOUR OF HECO FACILITIES.

STUDENT PARTICIPATION AND PARENTAL APPROVAL FORM: TOUR OF HECO FACILITIES

This form must be completed and returned prior to participation in a Tour of Hawaiian Electric Company.

Student's Name: _____ **School:** _____
Last First Middle Initial

Date of Activity: _____ **Sex:** Male / Female

Name of Activity: **TOUR OF HECO FACILITIES** Place of Activity: **HAWAIIAN ELECTRIC COMPANY**

This application to participate in the above activity is entirely voluntary on my part and is made with the understanding that I agree to obey all HAWAIIAN ELECTRIC COMPANY, INC. rules, policies and practices.

Signature of Student: _____ **Date:** _____

I (Parent/Guardian) hereby give my consent for the above Student to participate in a TOUR of at Hawaiian Electric Company. In the event of a minor injury, HAWAIIAN ELECTRIC COMPANY, INC. may render First Aid if an employee is so qualified to do so.

In case of Accident or Serious Illness, notify:

Name of Person to Contact: _____ **Phone:** _____

In an emergency, I give permission for HAWAIIAN ELECTRIC COMPANY, INC. to contact the following Physician, if I cannot be notified, or to take other appropriate action as may be necessary to respond to a medical emergency:

Physician's Name: _____ **Phone:** _____

I have the following insurance which covers any injury incurred in the Student's participation in this activity.

Health and Accident Insurance Carrier: _____ **Policy No.:** _____

Subscriber's Name: _____ **Group Number:** _____

Effective Dates: _____

In consideration of the granting by HAWAIIAN ELECTRIC COMPANY, INC. ("Company") of permission for _____ to go on or use the premises of Company, _____, through his/her parents or legal guardians, hereby waives any and all rights that he/she or anyone claiming by, through or because of him/her might now or in the future have to claim or bring an action against Company, its officers, directors, employees, agents and successors, on account of personal injury or death, or damage to or loss of property, arising out of, incident to, or resulting directly or indirectly from his/her presence on Company's premises whether such an injury, death, damage, or loss is contributed to by the negligence of Company, its officers, directors, employees, agents or servants, and whether due to the imperfections of the premises themselves, or any equipment thereon.

Furthermore, _____, through his/her parents or legal guardians, does hereby agree to defend, indemnify, and hold harmless Company, its officers, directors, employees, agents and successors against any and all actions, causes of action, suits, liabilities, claims, demands, damages, losses, costs or expenses, including but not limited to reasonable attorneys' fees and costs, arising out of, incident to, or resulting directly or indirectly from his/her presence on the Company's premises.

It is intended that the obligations agreed to herein shall be binding on _____, guardians, relatives, personal representatives, heirs, successors and assigns.

Signature(s) of Parent(s) or Legal Guardian:

Mother: _____ Work Phone: _____ Date: _____

Father: _____ Work Phone: _____ Date: _____

Address: _____ Home Phone: _____
Zip Code

(NOTE: This form is to be completely filled out and signed by the Student's Parent(s) or Legal Guardian. It must be returned to HAWAIIAN ELECTRIC COMPANY, INC. before the Student is allowed to participate in a TOUR OF HECO FACILITIES. The Student is required to have insurance coverage before permission to participate in the program.)

2/2001

Dear HECO,

Thank you for providing our class with the opportunity to participate in your Energy Smart Schools program. I found it a great learning experience for me, and enjoyed participating in many of the activities. It was really fun learning something I never really thought I would learn about. I enjoyed learning how to do lighting audits, it helps us to improve our "people skills", and to be more confident in front of people, while doing something we've just learned. OH! And thanks for giving us great instructors like Ms. Jennifer, Ms. Claudia, and others who had given their time to teach us something new, with one of their cool presentations. I'm very positive our class enjoyed it, and were motivated by them. I just wanted to say THANK YOU! We really appreciate it! The next school to be visited will be lucky to have this experience!

Aloha, and Mahalo,
Antje Gamundoy

antje gamundoy

Dear Hawaiian Electric Company,

Thank you for selecting our class of McKinley High School to be part of the energy smart school program 2003. I really appreciate the time and effort you guys spent to teach us about energy efficiency. I gained knowledge and some auditing skills too. Since the energy smart school program, I am more aware with the amount of electricity I use daily.

I mostly want to thank you for the $50 rebate I received. I enjoyed auditing the restaurant and I hope that all the small and big businesses will eventually see the great values of T8 lights.

Sincerely,
Amanda Wang

Kit U Ieong
McKinley High School
1039 South King St. Honolulu, Hawaii 96814

July 6, 2003

To Hawaiian Electric Company,

Thank you very much for giving me the great opportunity to participate in the Energy Smart School Program. I enjoyed learning the technical skills and how to use electric energy efficiently, which I never considered before. It was a very worthwhile experience.

The lessons were interesting and very helpful. The instructors, Ms. Jennifer Tosaki and Ms. Claudia, were very thorough and well-prepared. I especially liked the presentations of plenary speakers. I gained different kinds of skills from them.

Energy Smart School Program is a recommendable program in our society. I am so glad that I could enroll in this program and entered for the Small Business Lighting Audit. I am very thankful for the opportunity and awards.

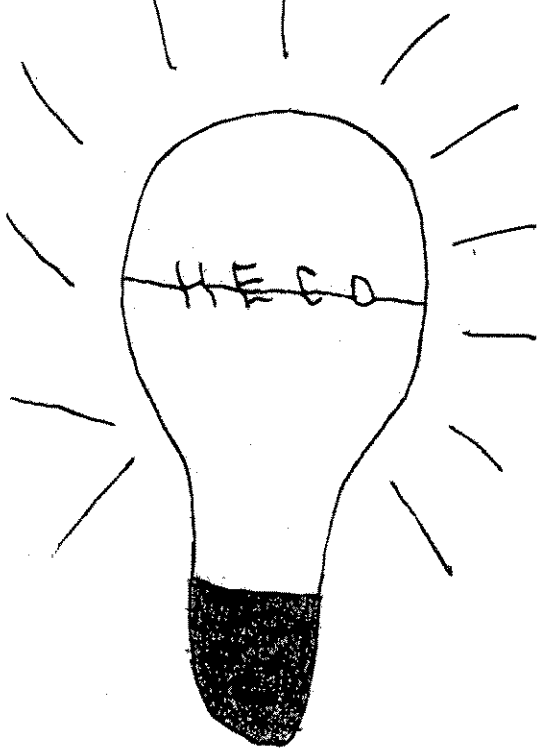
Mahalo!

Sincerely,

Kit U Ieong

Kit U Ieong

McKINLEY IS A



ENEGY SMART SCHOOLS

2/07/2003

TO ALL THE SPONSORS OF HAWAIIAN ELECTRIC COMPANY,

I WOULD LIKE TO SAY THANK YOU VER MUCH FOR THE MONETARY GIFT (CHE THAT I WILL BE RECIEVING FROM DOING THE BUSINESS AUDITS, WHICH I HAVE DONE.

GOODLUCK TO THE FUTURE OF ELECTRICITY!

SINCERELY,

ALVIN PENAFLORIDA

PS: I REALLY LEARNED ALOT ABOUT ELECTRICITY USAGE. AND ABOUT T8 & T12 LAMPS AND ALSO THE MONEY WILL REALLY HELP ME ALOT. THANK YOU VERY MUCH AGAIN.

Energy Smart Schools – Video Script

Rebuild Hi Version

Audio

SOT – Hawaiian Electric Company, U.S. Department of Energy,and the Department of Business & Economic Development and Tourism have a very strong commitment to education programs for Hawaii's youth. In the Rebuild Hawaii Energy Smart Schools program, students at McKinley and Radford High Schools on Oahu are learning first hand the importance of energy conservation and how to cut energy costs by replacing old lighting equipment with newer, energy efficient lighting.

During the weekly class students first learned about energy use in their homes, they expanded to study energy consumption within the school, and eventually they headed out in to the community to conduct lighting/energy audits in small businesses.

As a foundation to their future workshops, students built motors to see how coils and magnets help create electricity.

As special guests speakers, Hawaiian Electric Company engineers would visit the Energy Smart Schools classes. HECO presented a fuel cell demonstration project where the students had a great opportunity to see an alternative energy source. The HECO engineers gave talks about generation, lighting and no-cost, low cost energy conservation measures. They also provided energy audit training to prepare students to conduct lighting audits.

HECO marketing professionals taught the students about sales and marketing and how to communicate with small businesses. After they conducted lighting audits on the businesses they generated calculation reports showing how businesses can save energy and money by retrofitting their lights.

Some other projects the students worked on included reading meters… not just their home electric meters, but watt meters, voltage meters, lighting meters and lighting loggers. They learned how much energy different appliances use and how to calculate the life cycle costs of those appliances.

The school lighting audit segment was a big part of the Energy Smart Schools program. Students started with their own classrooms, and then moved to the library (which is the perfect challenge for the auditing teams). Eventually they audited the entire school and logged the data on Excel spreadsheets.

Narration – "The students practiced what they learned about public speaking and conveyed the schools' energy savings possibilities in a PowerPoint presentation program to their principals and PTSA.

Pick up at … In the Final segment

:NTS CONDUCTING
;Y AUDIT AT PRECISION

NARRATION - "In the final segment of the yearlong class, the students conduct energy audits at small businesses in their communities. They calculate the amount of energy savings a business owner can receive by converting to energy efficient lighting. Students can also calculate the rebate money HECO pays its customers for taking steps to save energy. They also show how long it will take for the costs of the renovation to pay for itself in lower electric bills.

Students gain self-confidence and real business experiences by working with local businesses, and showing them how HECO's energy efficiency programs can help to lower their electricity costs. And as businesses reduce their energy consumption, they help reduce the demand for electricity and that benefits everyone."

)N CAMERA

SOT – "Energy Smart Schools is funded by Hawaiian Electric Company and Rebuild America, a U. S. Department of Energy voluntary community effort that promotes energy-saving programs. Energy Smart

Schools is administered by the Department of Business, Economic Development and Tourism with oversight from the U.S. Department of Energy."

# # #

Energy Smart Schools – video script

HECO Electric Kitchen Infomercial

VIDEO	AUDIO
SAM NICHOLS ON CAMERA	**SOT** – "Hawaiian Electric Company, Maui Electric and Hawaii Electric Light Company have a very strong commitment to education programs for Hawaii's youth.
SHOTS OF STUDENTS IN CLASSROOM	In our Energy Smart Schools program, students at McKinley and Radford High Schools are learning firsthand the importance of energy conservation and how to cut energy costs by replacing less efficient lighting equipment with newer high efficiency lighting."
JENNIFER TOSAKI, SCHOOL COORDINATOR FOR ENERGY SMART SCHOOLS PROGRAM.	**SOT** – "They first learn about energy use in their homes, they then move in and start to practice audits within the school, and eventually they'll head out into the community and do lighting audits in small businesses.
SHOTS OF STUDENTS WORKING ON ELCTRIC MOTORS	Some of the projects they've been working on so far is putting together motors, to see how coils and magnets help create electricity or do create electricity. We've had Hawaiian Electric Company engineers come out to the schools and talk to the students. We've had a fuel cell

demonstration project come in and the students had a great opportunity to see an alternative energy source.

SAM TALKING TO CLASS AT RADFORD SHAKING HANDS WITH STUDENT

We've had engineers come in and talk about lighting they provided a little bit of training for the students to prepare them for their energy audits. We're going to have someone come in and talk about marketing skills and how to communicate with small businesses, building a rapport, and then they're going to generate reports after they do lighting audits on the businesses that will the show businesses how they can save energy and money.

SHOTS OF KIDS WITH LIGHT METERS

Some of the other projects they've worked on… they've learned how to read meters, so they've done a lot of meter reading a lot of work sheets that taught them about different appliances, life cycle costs of appliances, and now currently they're doing lighting audits in their classrooms and moving into the library and doing a lighting audit in the library. Eventually once they build their skills, they'll do an audit on the entire school."

(SHOTS FROM THE ENERGY AUDITS)

NARRATION – "The students practice what they've learned about public speaking and how to explain the benefits of converting to energy efficient lighting by

presenting their findings to their school's PTSA."

(NSOT OF PRESENTATION)

STUDENTS CONDUCTING ENERGY AUDIT AT PRECISION RADIO

NARRATION - "In the final segment of the yearlong class, the students conduct energy audits at small businesses in their communities. They calculate the amount of energy savings a business owner can receive by converting to energy efficient lighting. Students can also calculate the rebate money HECO pays its customers for taking steps to save energy. They also show how long it will take for the costs of the renovation to pay for itself in lower electric bills.

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SAM ON CAMERA

SOT – "Energy Smart Schools is funded by Hawaiian Electric Company and Rebuild America, a U. S. Department of Energy voluntary community effort that promotes energy-saving programs. Energy Smart

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# # #

Fall 2002
Number 11

Rebuild Hawaii

Partnering with Rebuild America

Working together for energy and resource efficiency

Steve Holmes Wins RBA Award

Councilmember and Rebuild Hawaii President Steve Holmes won Rebuild America's *Partnership Leader of the Year* award. He was honored with the award at the 2002 Rebuild America National Forum held in New Orleans. This is the fourth Rebuild America award won by Rebuild partners within the Hawaii consortium.

Steve Holmes was recognized for his efforts to promote growth of the Rebuild program in Hawaii and support partnership members throughout the state. To expand and diversify the Rebuild Hawaii Consortium membership, Steve is working to bring in representatives from the local building industry association, property management companies, hotels, unions, and local businesses. He is developing actions to foster peer exchange opportunities, provide support to Rebuild Hawaii Consortium members' projects, and assist in the development of energy conservation projects in federal, state and city facilities.

Holmes advocates the establishment of "demonstration projects" to highlight the effectiveness of new energy conservation technologies. These projects help to convince decision-makers that new technologies bring many benefits. In a sluggish Hawaii economy, the new job creation aspects of these projects are significant and have a multiplier effect throughout the local economy. When budgets are constrained due to economic slumps, energy financing allows for greater leveraging of resources, and provides stimulation for the local economy. The projects become a tool for job generation and economic development. They also serve to broaden awareness of the importance and efficacy of energy conservation projects.

Here is a quick look at some energy conservation projects and legislation that Steve Holmes has championed during his entire 12-year tenure at the Honolulu City Council.

- Introduced and got support for the city's adoption of the Building Energy Efficiency Standards in 1994 and shepherd updates to those standards through the Council. This legislation alone will save the state over $300 million dollars over the next 20 years. This legislation alone will save the state over $300 million dollars over the next 20 years.
- Spearheaded the Honolulu Hale energy retrofit program, which is estimated to save $125,000 annually in energy costs.
- Lead the city to retrofit its traffic lights to LED lights. This will reduce electrical costs by approximately 74% or about $398,000 annually.
- Initiated the Kaneohe District Park Heat Pump Project to replace an aged gas water heater system. The energy savings paid for the retrofit in 3.5 years with utility rebates.
- Passed legislation establishing an Energy-Star procurement policy for the city, and resolutions for the city's participation in the ICLEI campaign and the EPA's Green Lights Program.

Continued on page 3

Inside This Issue

Rebuild Hawaii Consortium President Steve Holmes (right) accepting the Partnership Leader of the Year award from John Milhone, Director of the Office of Weatherization and Intergovernmental Programs, (left).

Check out the other Rebuild America Energy Champions at www.rebuild.org

President's Corner

Rebuild Hawaii Consortium President Steve Holmes

The results of the September elections are in, and it is clear that the November elections will result in remarkable leadership changes at both the state and county levels. This is an unusual opportunity for members of the Rebuild Hawaii Consortium, in their individual capacities, not only to get the candidates on record regarding energy issues, but also to take the opportunity to educate them on energy use and choices.

When I ask the average person on the street about energy, they often speak of alternative energy development and don't seem to recognize the importance of energy efficiency efforts. The efforts of the consortium are a testament to the fact that energy efficiency retrofits have a substantial role to play in decisions about energy--and often make the most sense, economically.

Dr. Amory Lovins of the Rocky Mountain Institute has coined the expression "negawatts," which is a concept where we recognize energy efficiency as a form of new energy generation, and one which has the lowest cost and the highest environmental benefit. The marketplace needs to recognize and value this "negawatt" concept. We need to make sure city and state legislative efforts and policies for alternative energy development recognize the importance of energy efficiency efforts---retrofitting and efficient equipment for new structures.

Requiring energy efficient equipment in all new structures also has a strong impact on energy use. The Building Energy Efficiency Standards adopted on Oahu are projected to save over $300 million dollars over 20 years by mandating energy efficient equipment in all new structures. Some of the neighbor islands have also adopted comparable energy codes and will also see significant savings. The savings are not only to the property owner, but also represent avoided new generation costs and related impacts. The success of these efforts is evidenced by Hawaiian Electric's recent announcement that because of lower than expected growth demand, construction of a new power plant on Oahu will be deferred.

Educating both candidates and voters on these energy issues is key. Our energy future is, in many ways, in their hands.

New Round of Energy Smart Schools on Oahu & Hawaii

Guest speaker Steve Luckett, HECO, explains to Energy Smart School students how this demonstration hydrogen fuel cell works.

Hawaiian Electric Company's Energy Smart Schools program is underway for the 2002 to 2003 school year. The program is working with 60 ninth graders from McKinley and Radford High Schools. Students are participating in project based learning activities that teach them about energy, energy efficiency, business and marketing. They have started to learn how power plants generate and distribute electricity; and how motors and generators work. Further into the program they will receive training on how to conduct lighting audits on their schools and small businesses in the community. Using information the students compile from their audits students will make recommendations to the schools and business on how they can save money through lighting retrofits. This is the second time the program is being implemented on Oahu and it builds upon the successful pilot program.

On the Big Island the County of Hawaii is partnering with West Hawaii Explorations Academy (WHEA) to start an Energy Smart Schools program. The Academy is located at the Natural Energy Laboratory of Hawaii, (NELHA), which presents students with many exciting opportunities to learn about renewable energy. Training students to be energy auditors is an important component of the program. They will focus on energy used by various water-pump systems that sustain the extensive aquaculture projects that the Academy has already developed. NELHA plans to build a distributed generation testing facility that will be LEEDS certified and the WHEA classrooms will be relocated close to that new building. Students will take this opportunity to get involved in the design of their future campus. They will plan on making design recommendations for building new classrooms that are energy and resource efficient. WHEA is the process of developing a curriculum to begin this fall.

Cont...RBA Award for Holmes

Continued from page 1

Currently, through his efforts, the City and County of Honolulu is forging ahead on several fronts to increase energy efficiency. For the fiscal year 2003, the Council budgeted a $500,000 fuel differential so that the city can purchase bio-diesel for use in our entire diesel fleet (excluding buses). He also proposed that the city reduce the county fuel tax on bio-diesel from 16.5¢ to 8.25¢ to promote this locally-produced alternative fuel. The city is also pursuing a biogas utilization project at the Kailua Wastewater Treatment Plant, which will drastically reduce and/or eliminate $1 million dollars of annual energy costs at the plant. The engineering report shows a 34% return on investment.

Hana Hou Steve!

CHP Workshops for Neighbor Islands

Register today for the Combined Heat and Power Workshops scheduled for early December.

If you want to learn more about Combined Heat and Power then get ready--CHP workshops are scheduled for early December on the Neighbor Islands. The workshops are jointly sponsored by the respective counties, The Gas Company, DBEDT, Rebuild America and the Rebuild Hawaii Consortium. There will be a registration fee.

Big Island:"Combined Heat and Power - The Big Island's Emerging Energy Efficiency Resource"
Tuesday, December 3, 2002 from 9AM to 4PM
Orchid at Mauna Lani
Contact Ray Carr 808.961.8497 or Charlie Senning 808-594-5517

Kauai:"Combined Heat and Power: Kauai's Untapped Energy Efficiency Resource"
Wednesday, December 4, 2002 from 9AM to 3:30PM
Radisson Kauai Beach Resort
Contact Glenn Sato 808-241-6393 or Charlie Senning 808-594-5517

Maui:"Combined Heat and Power: Maui's Untapped Energy Efficiency Resource"
Friday, December 6, 2002 from 9AM to 3PM
Grand Wailea
Contact Kal Kobayashi (808) 270-7832 or Charlie Senning 808-594-5517

Upcoming Meetings and Events

2002 Efficient Electro Technology Exposition & Conference
October 23 & 24, 2002
Sheraton Waikiki
For more information contact
Ms. Sam Nichols at snichols@hei.com
or phone 808-543-4753.

Tour de Trash
November 13, 2002
9:15 AM to 5:00 PM
Aloha Tower Marketplace
For more information or to register
online visit www.opala.org
or phone 808-692-5410

Brownfields 2002
November 13-15, 2002
Charlotte, North Carolina
For more information visit
www.brownfields2002.org
or contact the Charlotte Housing
Bureau at 704-331-2741.

2002 AIA/CSI Building Trade Expo
November 20, 2002
Hawaii Convention Center
For more information contact
Barbie Rosario at bkcorp@gte.net
or phone 808-845-4994

Life-Cycle Costing Workshops
February 4 & 5, 2003
February 6 & 7, 2003
Honolulu, Hawaii
For more information contact
Eileen Yoshinaka at
eileen.yoshinaka@ee.doe.gov
or phone 808-541-2564

Rebuild Hawaii

Rebuild Hawaii is a statewide consortium dedicated to promoting efficient energy and resource utilization.

Rebuild Hawaii is working with Rebuild America, a U.S. Department of Energy program, to help community partnerships make profitable investments in existing buildings through energy-efficient technologies.

The partnering of public and private business interests enables Rebuild Hawaii to employ innovative solutions to promote economic growth, lower energy costs, create jobs, and protect the environment.

There is opportunity for anyone to join Rebuild Hawaii. It is a voluntary program with no membership fee.

For more information contact:

Rebuild Hawaii
c/o Department of Business, Economic Development & Tourism
Energy, Resources, and Technology Division
State Office Tower
235 South Beretania Street, Room 506

Mailing Address:

P.O. Box 2359
Honolulu, Hawaii 96804-2359
Telephone: 808-587-3806
Facsimile: 808-587-3820

Or contact:

Jennifer Webb at
jenwebb@hawaii.rr.com

Visit our web site at:

www.hawaii.gov/dbedt/ert/rebuild/index.htm

Rebuild Hawaii Projects

Rebuild Hawaii currently supports the following projects:

- University of Hawaii School of Architecture Portable Classroom Cooling Design Guidelines
- Hawaiian Electric Company Energy Smart Schools project to increase awareness of energy efficiency in schools and communities on the islands of Oahu and Maui
- Hawaii County Energy Smart Schools project
- Kauai Lagoons Golf Course Energy Audit
- Na Makani Energy initiative, a community-sponsored rural project in North Kohala, Hawaii, that is planning for a "soft energy path" in the 21st century based on energy conservation and renewable resources
- Greening The Campuses, a project to implement resource efficiency at the community colleges
- Green Office exhibit and awareness program
- Workshops and technical seminars
- Multi-disciplinary programs to teach energy and resource management skills at universities and schools

Consortium Members

City & County of Honolulu
County of Hawaii
County of Kauai
County of Maui
Department of Business, Economic Development and Tourism
Department of Education
The Gas Company/Citizens Energy Service
Hawaii Army National Guard
Hawaiian Electric Company, Inc.; Hawaii Electric Light Co., Inc.; Maui Electric Company, Inc.
Housing and Community Development Corporation of Hawaii
Judiciary
Kauai Electric/Citizens Energy Services
Hawaii Public Library System
University of Hawaii Community Colleges
University of Hawaii at Hilo
University of Hawaii at Manoa, School of Architecture
U.S. Department of Energy, Pacific Liaison
U.S. Department of Housing and Urban Development

Affiliates

Eco-Lite
Energy Conservation Hawaii
Hawaii Society for Healthcare Engineering
SSFM Engineers International

Rebuild America Business Partner

Academic Capital

Meetings

Next Meeting

November 14, 2002
7:30-12:00
HEI Training Room #2
8th Floor Pacific Tower

Previous Meetings

June 2002

Bill Mixon, Rebuild Program Manager, and Ron Shelton, Technical Assistance Coordinator, spoke about products and services available through Rebuild America. David Menicucci and Bill Black, Sandia National Laboratories, presented Federal Energy Management Program (FEMP) products and services related to security and distributed energy resources. Jim Maskrey, HECO, spoke about HECO's PowerTrax. Steven Golden and Keith Yoshida, GASCO and Tim Blume, Kauai Electric overviewed products and services offered by GASCO/Kauai Electric.

For a copy of minutes
Telephone: (808) 587-3806
Facsimile: (808) 587-3820
Email: eraman@dbedt.hawaii.gov

UH marks Earth Day wi

The Manoa campus will host a teach-in to demonstrate alternate sources of energy

By Diana Leone
dleone@starbulletin.com

The city, the University of Hawaii and student groups are hoping to celebrate Earth Day Tuesday by teaching people about alternative energy and conservation.

A free "Sustainability Workshop, Teach-in and Expo" is planned for the Manoa campus from 8 a.m. to 3 p.m.

Organizers say the purpose of the forum is to stimulate public discussion on energy use in Hawaii.

"Hawaii is 91 percent oil dependent," said Bruce Miller, UH's Office of Sustainability director. "We'd like to demonstrate that there are ways of getting off oil."

More than 40 booths will be set up, displaying energy-related items such as electric or hybrid cars, solar power technologies, and the like, Miller said.

One demonstration will be a 10-foot-tall geodesic dome that students have constructed. Solar photovoltaic panels will provide electricity to operate a television and video player inside, which will show videos about how students (or anyone) can change their energy

CRAIG T. KOJIMA / CKOJIMA@STARBULLETIN.COM

Ninth-graders at McKinley High School have been studying how to save money on electric bills. Antje Gamundoy, above, holds up a simple top-like device that tells whether the ballast on a fluorescent light is magnetic or electronic, which could make a big difference in a company's electric bill.

***NOTE**: The first small business energy audit will be conducted at Precision Radio, 1160 S. King Street on Thursday, April 17, 2003 at 9:00 a.m. by the McKinley High **Energy Smart Schools** team. HECO B-roll of this presentation will also be available for media use by calling the contact numbers below.*

- For immediate release -

Contact: Sam Nichols, 543-4753
Likelike Davis-Nutt, 543-4441 Date: April 11, 2003

Students develop energy-saving plans for small businesses

Radford and McKinley High 9th grade students are gearing up to show small businesses how to save money on their electric bills, thanks to a very successful hands-on learning program that was introduced locally in 2000. The **Energy Smart Schools** program is funded by HECO and Rebuild Hawaii, a U. S. Department of Energy consortium of organizations that promotes energy-saving programs.

"The Energy Smart Schools program offers our students a 'soup-to-nuts' learning experience," says Jennifer Tosaki, the Energy Smart Schools instructor. "In addition to the classroom work, what's equally important is the chance students get to apply what they've learned to helping the small business community."

Students first learn how electricity is produced and transmitted. HECO instructors share ways to save energy using efficient lighting and conservation methods and teach students how to perform energy audits in their homes and schools. After classroom studies, they will conduct lighting audits at nearby small businesses, return to class and calculate the energy consumption and prepare energy efficiency reports for the businesses. The audit team will show the small business owners how they can save money by adopting energy efficient lighting technology in their buildings.

Victor Rapoza, owner of Waianae Ice House, was impressed with the class of 2000's Energy Smart Schools students from Waianae High School who conducted an energy audit at his small ice-producing business and convenience store on the Leeward

- more -

Coast. "These students knew what they were doing! They came prepared with information about my current energy use and skillfully conducted a lighting energy audit, applying the techniques they learned, to show me how I could save money using energy efficient lighting," said Rapoza.

Typically, small businesses, as well as schools, can save up to 30% of their lighting bill by changing from old fluorescent lamps (T-12 with magnetic ballasts) to more energy-efficient T8 lamps with electronic ballasts. A fast-food restaurant, for example, could save up to $2,000 to $3,000 a year in lighting costs. An office building with 168 fixtures could cut $4,000 a year. The HECO rebate program helps to reduce purchase installation costs of energy efficient lights and other equipment.

As a member of the Rebuild Hawaii Consortium, HECO developed the concept for the Smart Schools program as part of its community-building activities. The national organization, Rebuild America, provided a $50,000 grant. HECO also provides assistance with teaching materials, instructors and other services.

Grants for Rebuild America Partners in Hawaii, such as for HECO's Smart Schools program, are administered by DBEDT with oversight from the U.S. Department of Energy.

# # #

CONSUMER Lines

HECO • VOLUME XXI • NO. 10 CONSUMER LINES OCTOBER 2002

Hands-on energy lessons

What better way to learn than through "hands-on" experience? For the second year, HECO is sponsoring **Energy Smart Schools**, offering students the chance to apply classroom experiences to the real world. After an energy education module that incorporates math, science, computer, marketing, advertising and public speaking, students market that know-how by offering lighting audits to small businesses.

This year, **Radford** and **McKinley High** 9th graders will begin by learning how electricity is produced and transmitted. A power plant tour will give students a 'front and center' opportunity to see how this is done. HECO instructors will share ways to save energy using efficient lighting and conservation methods and teach students how to perform the energy audits in their homes, schools and at small businesses in their communities.

Bill Lane of HECO's Energy Services Department gives Kalaheo students some pointers on energy efficient lighting.

"The **Energy Smart Schools** program offers our students a 'soup-to-nuts' learning experience," says Jennifer Webb, the **Energy Smart Schools** instructor at McKinley. "In addition to the classroom work, what's equally important is the chance they get to sharpen marketing and presentation skills."

And there's an added incentive. HECO offers $50 for each energy audit completed. Students from last year's **Energy Smart Schools**, **Kalaheo** and **Waianae High**, completed a total of twenty audits and, by all reports, did a great job of researching, organizing and presenting the results of their studies.

Funding for the **Energy Smart Schools** program comes from HECO and Rebuild Hawaii, a U.S. Department of Energy program dedicated to encouraging energy-saving partnerships involving local government and the public and private sector. The partnership includes the State Department of Business, Economic Development & Tourism and the Department of Education. HECO is also providing assistance with teaching materials, instructors and other services.

Free trees on Arbor Day

HECO and its partners will be giving away more than 2,000 trees and shrubs at five sites on Oahu on **Saturday, November 2**. The give-away is part of a statewide program to educate the public about the importance of trees to the environment as well as how to select and plant the right tree in the right place.

Co-sponsors of the HECO Arbor Day Program are the Honolulu Botanical Gardens, the Urban Garden Center of the University of Hawaii and the Kaulunani Urban Forestry Program of the State Department of Land and Natural Resources and the U.S. Department of Agriculture Forest Service.

Experts in tree selection, planting and maintenance will be available at each site to offer free advice. Besides a free tree, attendees will receive

Continued on back page

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Lab: Making A Motor

Problem: Using household materials, will we be able to produce energy in a form of motion.

Hypothesis: I predict this is going to be a hard lab.

Materials: ① magnet wire (green) 2 magnets
2 connecting wire 2 paper clips
1 foam 1 rubber band
1 battery (D battery) 1 wooden dowel
1 piece of sand paper

Procedure:
1) Take materials out of bag
2) Unravel green magnet wire
3) Wrap~~ped~~ the magnet wire around the dowel, leaving 2 inches on each side
4) Take the magnet wire off, pinching it and wrap the two ends in and out.
5) Unwine each paper clips on one side
6) ~~Wrap each connecting wire with each paper clips with one bla~~ Stick each paper clips in the foam
7) Wrapp~~ed~~ ~~the~~ each connecting wire with one of the black ends off, to each paper clip
8) Wrap the battery 2 times with the rubber band
9) Put the magnet between the paper clips.
10) Place the coiled magnet wire between the paper clips making it hang.

11) ~~Connect the~~ Place each of the connecting on each side of the battery.

Data: The more magnets the faster the coiled magnet wire moves

Analysis: The battery and the magnets were the forces that made the wire move. The connecting wire connects the battery ~~to the coil~~ through the paper clips to the coil.

Conclusion: My hypothesis was correct. Doing this lab was tough. The ~~coil~~ magnet wire wouldn't spin; it would just rock back and forth. The generater uses motion to make electricity and the motor uses electricity to make motion. Now I know how people ~~uses~~ make motors.

Making a Motor

Problem - using houshold materials, will we be able to produce energy in the form of motion?

Hypothesis - I predict this is going to be a little complicated but fun.

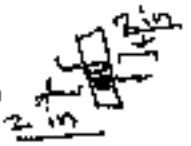
Stuff

(1) magnet wire
(2) connecting wire
(1) foam
(1) battery (D size)
(2) magnets
(1) rubber band
(1) wooden dowel (1) sand paper

purpose: see electricity-made motors

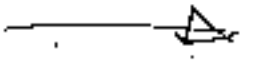
Step

1. take materials out of back
2. unwind the green metal wire
3. wrap the wire around the wooden dowel (leave 2 in. of wire on each end)

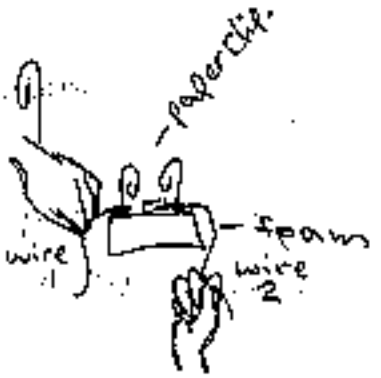


4. wrap the 2 in. of excess wire around the circle until its about 1 in. left

5. sand one side of the two little wires



6. unwind the paperclips
7. stick the paperclips to foam
8. connect one wire at the base of the paperclips.



9. wrap battery with rubber band

10. attatch one end of a wire to the ends of the battery.
11. put the magnets between the paperclip.
12. put the magnetic wire in between the two paperclips.

13. watch it spin.

Data— the more magnets, the faster it moves.
analysis— the magnet and the battery creates an electrical force and the magnetic wire, with one side sanded, moves because the green side cuts off the energy and the silver side reconnects them which makes it spin.
Conclusion— making the mini motor was easier than I thought. It wasn't that hard trying to make it spin. but what I think was the hard part was keeping the wires still at both ends of the battery.

Highlight of talk given for the Smart Schools Program.
By Derrick Sonoda

- The speed of changing technology.
- What energy is used for.
- Why everyone is using more energy and on what items.
- Why saving energy is so important.
- How old is the incandescent lamp?
- Introduced CFLs.
- Demonstrated an electric meter.
- How old is the T12 lamp?
- New technology for lamps.
- Why is it called a T12 and T8.
- Why do people use old technology? Would you wear clothes from the 17th century?
- New designs of T8s. – Broke a T8 tube.
- Explained how a T8 lamp works.
- Explained why T8 use less power with electronic ballast.
- Explained CRI.
- Explained frequency.
- Explained how to use a flicker checker.
- Heat reduction from new ballast.
- Explained how to approach doing a lighting audit.

Rachel LaJoie
October 09
Per. 6

Thank you Mr. Maurice for EXPlaining about the kahe Power Plant. I saw a generator, Boilers, stake, transformers, condvnsor, operator, control room, Fish, Voltage, Furnase, svlfer tanks, Pipelines. I learned how Electricity is spread out through all of Oahu. its spread out by Pipes/tubes. they heat oil until its liquid and they spread it out through a fan like object. they Recycle it. It concerns us because We are using the electricity. IF we didn't have a power plant, We wouldn't have Any energy/electricity. nothing would generate/operate. there is only 3 Powerplants in Oahu. You can tell how much electricity has been used by reading meters. It was a very interesting field Trip. thank you for letting us come to the kahe power plant.

Jonathan Slater
Per 6
10/9/02

Kahe station units use No. 6 heavy oil. The fuel has no sulfur in it. There are 250,000-300,000 barrels of oil on station, which is about 17-20 day supply. Each barrel contains 42 gallons. The total storage capacity is 490,000 barrels.

Kahe boilers consume about 14,000-21,000 barrels of oil per day. It is about $30/barrel, and plants invest up to 7.5-9.0 million dollors.

There are 6 primary generating units, having a combined capacity of 635 MW. Electricity leaving the station is raised to 138,000 volts for transmission.

Generating units are steam turbine powered. The units are classified as "Reheat units". The largest turbine produces about 190,000 horsepower. Steam is delivered to their turbines at a pressure of 1800 Pound/Square Inch, at a temp. 1000°F

Their tallest stack is 475 feet high. Kahe station site is on 485 acres of land, and about 4,400 feet of water front. There are two General Motors EMD diesel generators, which are used to start up the steam units if they shut down. No less than 11 people run the plant 24 hours a day, 7 days a week.

Charlene Choy
10.09.02
period 6

Dear Lief,

Thank you for being our group leader. I learn that the cold water from the ocean is to cool the hot steam in the boiler.

We saw the turbine repairing room. To transport the turbine to repair it, all the pieces come out. Then you remove the ceiling in the repair room and bring in the pieces.

Some floors that we visited was very loud and hot. I could feel the heat just by standing next to the machine. I saw flames in the furnace. But there was one that was white.

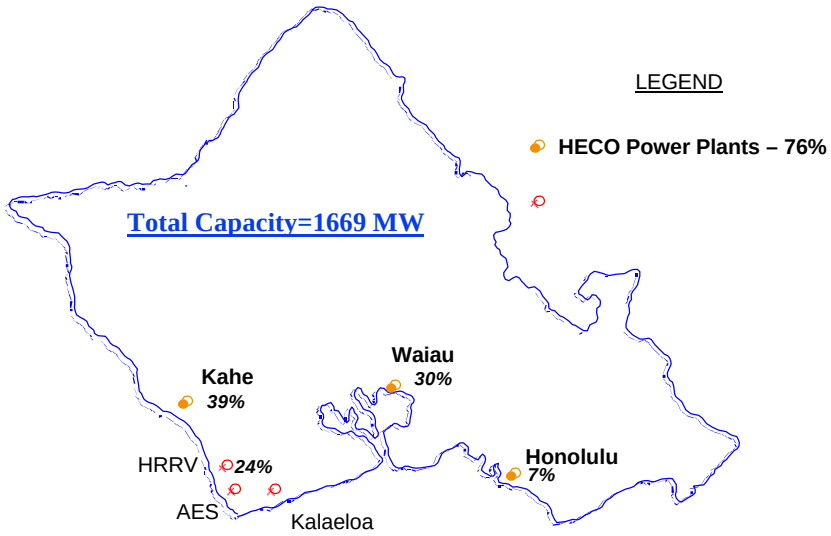
The control room was cool. I got to see all the equipments and how they operate the plant. When one of the machines or equipment isn't working, the computer has a small red box that will be blinking.

From,
Charlene Choy

Energy Smart Schools Presentation
by Dean Oshiro
Customer Efficiency Engineer - HECO

Hawaiian Electric Kahe Power Plant

Oahu's Electric Generating Plants

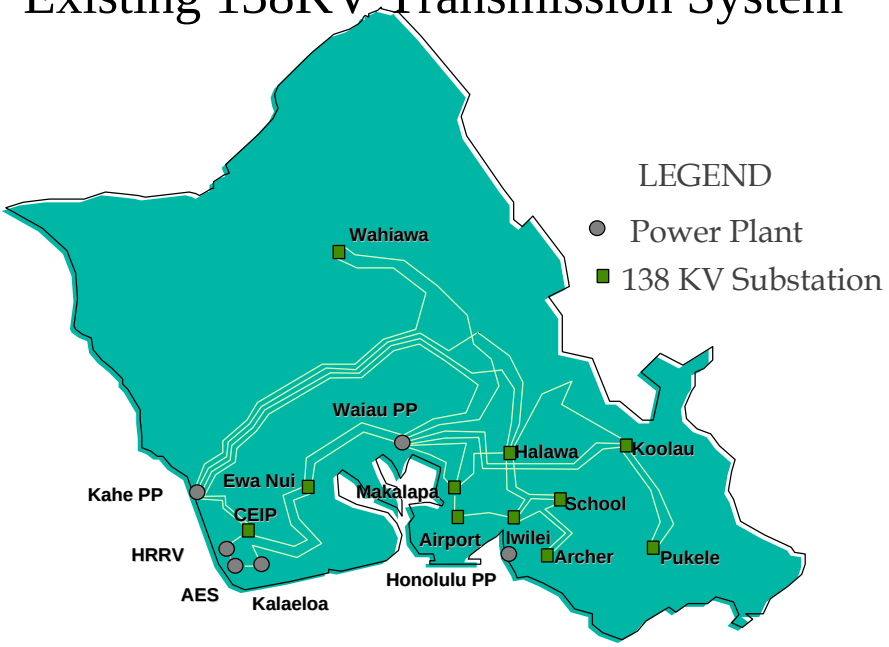


H-Power

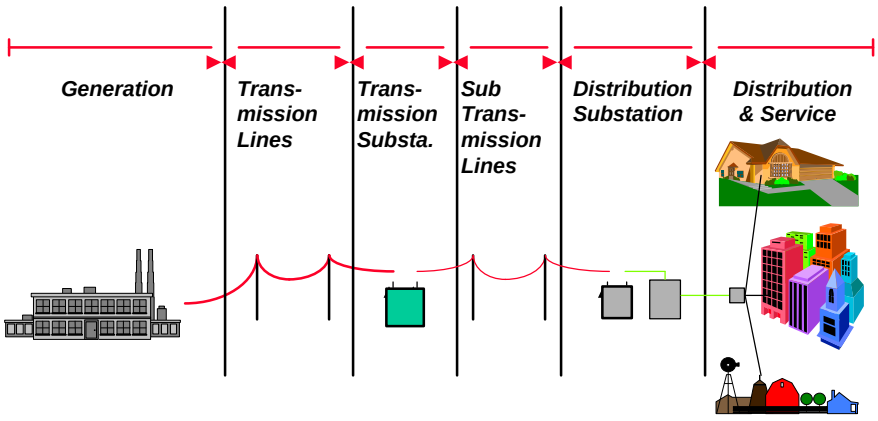
AES

138KV Transmission Line

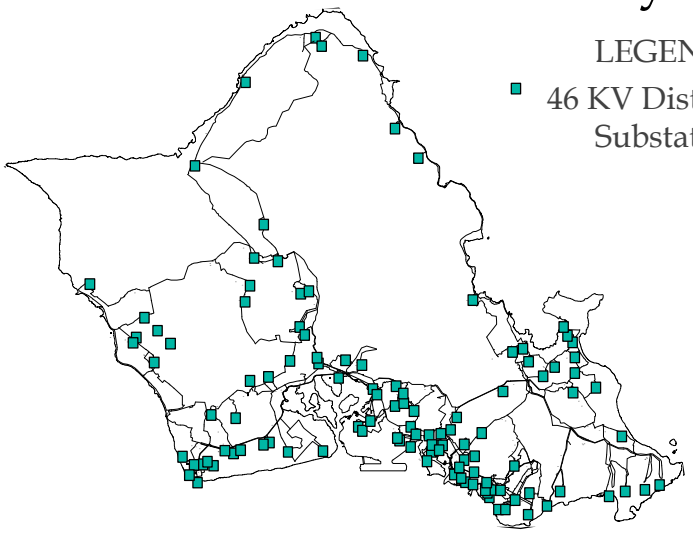
Existing 138KV Transmission System



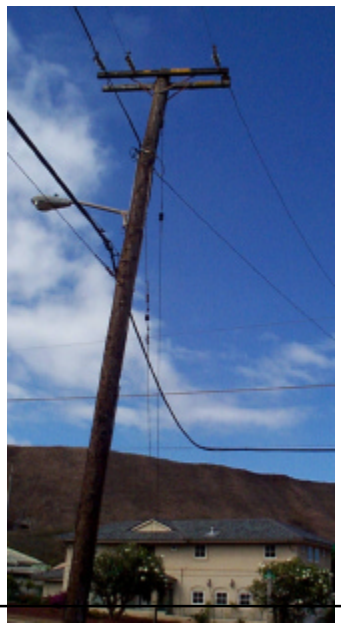
Hawaiian Electric System



46KV Sub-Transmission System



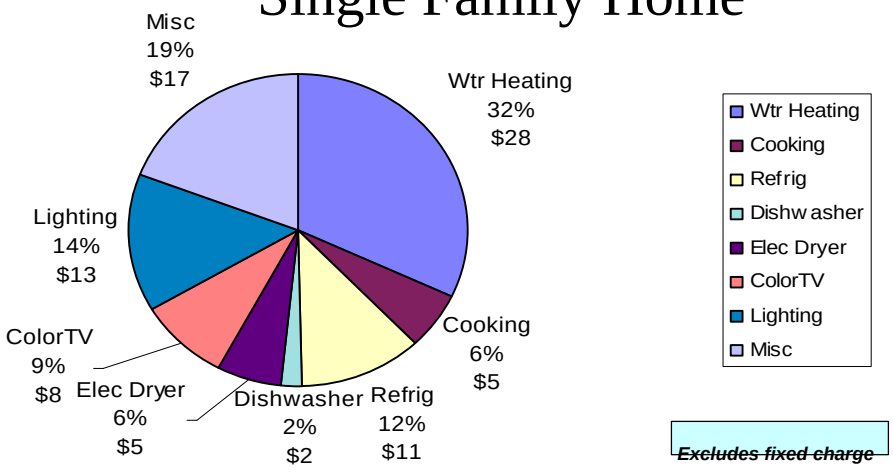
12KV Distribution Line



Electric Delivery System

- Transmission Lines (138,000 Volts)
- Sub-Transmission Lines (46,000 Volts)
- Distribution Lines (12,000 Volts)
- Service Lines (120 Volts)

Electrical Load in an Oahu Single Family Home



Fuel Cell Demonstration

Everyone gather around lecturn.

Energy Smart Schools Workshop Summary

Activity	**Program Introduction/ Pre Test**
Week	1
Subjects	Science, Social Studies
Standards	*Science:* Domain 2: 1. Understanding Scientific Inquiry *Social Studies:* Geography 5. Environment & Society
Summary	This class will provide an introduction of program to students and describe activities they will be participating in. The Pre Test will test students' current knowledge of energy. Students will begin to form questions on energy that they will find the answers to by the end of this program.
Expected Outcome	For students to start thinking about energy and to understand what is expected of them over the course of this program.
Materials	Handout: Student flyer about the program. Worksheet: Pre Test
Procedure	• Organize and print out needed handouts and/or worksheets. • Introduce yourself and program to students. • Discuss what they will be learning in the program and expectations you have of their work over the program period. • Ask them if they have questions or if there are any program activities they might feel unsure about. • Have students complete the Pre Test then go over answers together as a class.
Evaluation	Good -- students are excited to begin the program. The Pre Test is a great way to get them to start thinking about energy and energy use.
Recommendations	None

Activity	**Guest Speaker: HECO (speak about electricity)**
Week	2
Subjects	Science, Career & Life Skills
Standards	*Science:* Domain 2: 14. Energy, its transformation & matter *Career & Life Skills:* Technological Literacy
Summary	Guest speaker to talk about how HECO produces electricity and then delivers it to communities in Hawaii. The speaker will give students a background on why it is important to save energy from the consumer and utility standpoint.
Expected Outcome	For students to understand how electricity is produced in Hawaii and how it is delivered to their homes. Also, for students to meet a professional HECO worker and get exposure to a career path.
Materials	Model hydrogen fuel cell.
Procedure	• Contact someone qualified to talk about electricity and its production and who would like to work with high school students. • Schedule a date and time that works for both the speaker and the school. • Inform teacher and school administration of the guest visit. • Give students a little background on the guest speaker before the scheduled visit.
Evaluation	This is a great workshop and provides students with a nice opportunity to meet HECO professionals and ask them questions about their careers and learn about the utility. The hydrogen fuel cell model was very popular with both teachers and students.
Recommendations	Include demonstrations/models to give students an up-close look at an alternative source of energy.

Activity	**Motors**
Week	3
Subjects	Science
Standards	*Science:* Domain 2: 14. Energy, its transformation & matter *Science:* Domain 2: 15. Forces, motion, sound, & light
Summary	Students learn how to build motors and how to use a motor in reverse as a generator. This activity helps to demonstrate how electrical power plants generate electricity.
Expected Outcome	For students to learn about how a motor and generator works. Also, for them to understand how coil and magnet can make electricity.
Materials	Motor Supplies: D-cell batteries; thick rubber bands; 24 gauge magnet wire; ceramic magnet; wood dowel or marker; packaging foam; ruler; jumbo paper clips; sandpaper and connecting wire. Generator Supplies: motor; light bulb; bulb holder; and string.
Procedure	• Gather and organize the materials stated above. • Give students an overview of what they will accomplish during this workshop. • Break the class up into groups and distribute the materials for the motors. • Walk class through each step of the motor assembly process (for a list of steps refer to the Mr. Wizard ElectroWizard Inventions Kit or visit www.electrowiz.com). • While students spend time on each step of the assembly discuss the concepts you want them to walk away from this activity with (i.e. by spinning magnets or coils near each other generates electricity; the motor uses a coil and magnet to turn electricity into motion). • Ask students if they have questions and review concepts. • Have students clean up and return workshop materials to teacher.
Evaluation	Excellent workshop. Students really enjoy this project and will want to repeat it.
Recommendations	Provide enough materials so that the class can repeat it with their teachers. Repetition of the project will help to reinforce student learning.

Activity	**Home Energy Use & Knowing the Meaning of Electrical Terms (Quiz #1)**
Week	4 -5
Subjects	Science, Math
Standards	*Science:* Domain 1: 1. Doing scientific inquiry *Science:* Domain 1: 2. Living the values, attitudes, & commitments of the inquiring mind *Science:* Domain 1: 3. Using unifying concepts and themes. *Science:* Domain 1: 5. Relating the nature of technology to science *Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring. *Social Studies:* Geography 5. Environment & Society. *Social Studies:* Economics 1. Limited Resources & Choices.
Summary	Students will estimate how much energy their family uses. By identifying items in their home that use energy and estimating how much time each items is on a day they can calculate energy use. Students will learn to read nameplates of wattage ratings on appliances and how to convert watts to kWh. They will learn to read electric meters to compute energy use. Finally they will compare their results with other students and discuss reasons for differences.
Expected Outcome	For students to learn electrical terms and be able to calculate appliance operating costs, read meters, understand electric bills, and compute lifecycle cost of appliances. For students to find out how much energy they use and to identify wasteful energy situations in homes. They will make recommendations on energy saving actions. Also, for students to understand the important role that energy plays in our lives, and why energy demand has increased so much in the last twenty years.
Materials	Worksheets: Home Energy Survey, Wattage Ratings, Meter Reading, Home Appliance Survey Handout: Energy Saving Suggestions, Meaning of Electrical Terms, Anatomy of a Light Bulb and Quiz #1.
Procedure	• Gather and print out workshop handouts and worksheets. Review instructions/procedures provided on worksheets. • Give students an overview of what they will accomplish during this workshop and distribute materials to them. • Walk students through how to complete the worksheets and discuss homework. • Have students complete the Quiz then go over answers together as a class.
Evaluation	The workshops went well except for one homework assignment. One of our classes is made up of about 90% students from military housing. They were unable to complete the homework assignment on meter reading. Students checked the school meter to see if they could read that but the school meter had a digital display and no access without the teacher. Quizzes help to get the students to be attentive to what they are learning. Reviewing the answers together as a class refreshes their memories and reinforces learning.
Recommendations	Allow extra time to go over math equations. Before sending students home with the Meter Reading Handout worksheets as homework check with them to find out how many are from military housing. A majority of the students from one school are from families in the military. They have subsidized housing and do not pay for electricity bills nor have individualized electric meters on their houses. It is recommended to create in class meter reading test worksheets. This will teach students to read meters even if they don't have one at home. Another option would be to check to see if the students have access to read the school meters.

Activity	**Field Trip**
Week	6
Subjects	Science, Career & Life Skills
Standards	*Science:* Domain 2: 14. Energy, its transformation & matter *Career & Life Skills:* Technological Literacy
Summary	Student will take a field trip to one of HECO's Kahe Power Plant. Students will listen to a presentation about the power plant and watch a video on how the power plant operates. They will examine a sample of the Low Sulfur Fuel Oil. Students will then take a walking tour of the plant.
Expected Outcome	For students to learn how Hawaiian Electric Company produces and distributes power.
Materials	Bus reservations. Handout and Video: Welcome to Kahe Power Plant (HECO) Sample of Low Sulfur Fuel Oil
Procedure	• Coordinate with your local utility to schedule a tour of one of its power plants. • Make needed transportation arrangements, such as bus reservations. • Ask the utility and school administration about field trip forms that students may need to get signed by parents before they go on the field trip. • Discuss with students before the trip what they will be seeing and what you expect them to learn from this experience. Review any special requests, such as clothing requirements, which the utility may make. • Attend the field trip.
Evaluation	The field trip is highly recommended. Students have a chance to see where and how electricity is produced. Students also get to learn about the different professions in the utility.
Recommendations	When walking through the power plant tour have the tour leaders explain to students what they are about to see before entering into noisy sections.

Activity	**Guest Speaker from HECO (to speak on lighting)**
Week	7
Subjects	Science, Math, Social Studies, Career & Life Skills
Standards	*Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring. *Social Studies:* Geography 5. Environment & Society. *Social Studies:* Economics 1. Limited Resources & Choices. *Career & Life Skills:* Technological Literacy *Career & Life Skills:* Career & Life Planning
Summary	A guest speaker from HECO will talk about lighting and what the professionals look for during their audits. Also, for students to meet a professional HECO worker and get exposure to a career path.
Expected Outcome	For students to learn about different types of lighting. Also, for them to understand the energy used to operate lights and how much energy leaving on unnecessary lights wastes.
Materials	Lighting Board (HECO) Samples of Different Lamps Worksheets: Bright Ideas
Procedure	• Contact someone qualified to talk about lighting and who would like to work with high school students. • Schedule a date and time that works for both the speaker and the school. • Inform teacher and school administration of the guest visit. • Give students a little background on the guest speaker before the scheduled visit.
Evaluation	Great workshop. The guest speaker helped to reinforce how easy saving money and energy can be just through changing the types the lights they use.
Recommendations	None.

Activity	Lighting Audit Training
Week	8 -9
Subjects	Science, Math, Career & Life Skills
Standards	*Science:* Domain 2: 2. Interdependence of Science, Technology, & Society *Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring. *Career & Life Skills:* Technological Literacy *Career & Life Skills:* Career & Life Planning
Summary	Train students on how to perform lighting audits. They will start with their classroom then move on to their school library. They will learn how to record data on HECO Lighting Equipment Survey Sheets. Students will learn to use the digital camera to take pictures of fixtures.
Expected Outcome	For students to complete a lighting audit of their school library. Students will complete survey sheets on fixture types and counts, burn hours, potential energy and cost savings, cost to retrofit, and available rebates.
Materials	Worksheets: Lighting Equipment Survey Input Handouts: Wattage for Various T8 Lighting Systems, Savings Calculations, Lighting Equipment: Energy Conservation Measures, and Lighting Fixtures. Digital Camera Light Meters Flicker Checkers Monocular
Procedure	• Gather materials stated above and print out workshop handouts and worksheets. Review instructions/procedures provided on worksheets. • Coordinate with the school librarian to schedule a time when the class will be visiting the library to conduct their lighting audits. • Discuss with students what they will be doing in this workshop and what you expect them to learn. • Walk students through the steps of conducting a lighting audit (interview occupants, identification of lighting fixtures/ballasts, fixture/lamp counts, burn hours, etc.) in their classroom. • Break the class up into groups and take each group over to audit the library one at a time (how many groups go to the library at one time will depend on the number of instructors; one instructor per group). • Shadow groups as they conduct their audit and ask them questions about what they are doing and why they are doing it to help reinforce their audit skills. • Ask students if they have questions and go over audit skills/areas you noticed they did well and areas they need to improve.
Evaluation	These are important workshops for the students—they learn audit skills they will use for the rest of the program. The warm-up classroom audits were easy for students and can be completed within a single workshop. The library audits were more difficult due to limited time (about 40 minutes + travel time back forth from the classroom) in a larger space. Students were pressed to complete audits within a workshop period. Some students needed to return to the library the following week to finish up their audit.
Recommendations	It is important to spend extra time on this if you need to. Keep student groups to a maximum size of 3 students. With groups of 4 or more, some students will not get actively involved and just follow the others around.

Activity	**HECO Lighting Audit Software Training & History of School Energy Use**
Week	10-12
Subjects	Science, Math, Career & Life Skills
Standards	*Science:* Domain 2: 2. Interdependence of Science, Technology, & Society *Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring. *Career & Life Skills:* Technological Literacy *Career & Life Skills:* Career & Life Planning
Summary	Train students on how to use HECO T8 audit worksheets in Excel. Students will use data gathered in their library audits and generate reports on the laptop computer. Gather 3 years of school electricity bills and show students what they look like, teach them how to read the bills, and have them calculate energy use and cost for each year.
Expected Outcome	For students to complete audit reports on fixture types and counts, burn hours, potential energy and cost savings, cost to retrofit, and available rebates. Students should be able to read their school electricity bills to determine energy costs and examine history of energy use.
Materials	Worksheets: HECO Excel based T8 Audit, School Energy Use, History of School Energy Use and CO_2 Graph Handout: Directions for Audit Worksheets Laptop Computer (Excel) School Electric Bills (Past and current bills)
Procedure	• Coordinate with the school computer lab contact to schedule visits. Ask the computer lab teacher if they are willing to teach the class some Excel basics. • Gather school electric bills and print out workshop handouts and worksheets. • Give students an overview of what they will accomplish during these workshops and distribute materials to them. • Walk students through how to input data from their audit survey sheets into the Excel spreadsheets. • Discuss what kinds of information the audit report (spreadsheet) provides and how it is useful. • Have students print reports for their review later. • Students complete worksheets and examine history of energy use in their school. Discuss what their completed worksheets show them.
Evaluation	Students had an easy time with these workshops but they were time consuming. An additional workshop was needed in order to achieve the expected outcome stated above.
Recommendations	Check to make sure the school computers have Excel and that the student's have access to those computers.

Activity	**HECO Guest Speaker (to speak to students about marketing and presentation skills)**
Week	13
Subjects	Social Studies, Language Arts, Career & Life Skills
Standards	*Social Studies:* Economics: Limited Resources & Choice *Language Arts:* Oral Communication: 1. Range *Language Arts:* Oral Communication: 2. Communication Process *Language Arts:* Oral Communication: 3. Convention and Skills *Language Arts:* Oral Communication: 4. Rhetoric *Language Arts:* Oral Communication: 5. Attitudes and Engagement *Career & Life Skills:* Career & Life Planning
Summary	A guest speaker from HECO will talk about presentation skills and marketing to small businesses to get them to participate in audits.
Expected Outcome	For students to generate ideas on how they will market to small business. Also, for students to meet a professional HECO worker and get exposure to a career path.
Materials	NA
Procedure	• Contact someone qualified to teach marketing and presentation skills and who would like to teach his or her skills to high school students. • Schedule a date and time that works for both the speaker and the school. • Inform teacher and school administration of the guest visit. • Give students a little background on the guest speaker before the scheduled visit.
Evaluation	Excellent workshop. Students learned about marketing and presentation skills from a HECO guest speaker. Students will use these skills for their presentations and small business audits. This workshop also provides students with good exposure to a real life HECO job.
Recommendations	This workshop should be scheduled as close as possible to the actual date when the students will be conducting their small business audits. Otherwise, if a lot time goes by before they begin the audits, try to determine if students will need a refresher on this workshop. In this program, students spent a lot of time preparing their PowerPoint presentations and then needed to be reminded about how to approach small businesses.

Activity	**Prepare for Presentations**
Week	14 -19
Subjects	Social Studies, Language Arts
Standards	*Social Studies:* Economics: Limited Resources & Choice *Language Arts:* Oral Communication: 1. Range *Language Arts:* Oral Communication: 2. Communication Process *Language Arts:* Oral Communication: 3. Convention and Skills *Language Arts:* Oral Communication: 4. Rhetoric *Language Arts:* Oral Communication: 5. Attitudes and Engagement
Summary	Students will learn to use PowerPoint and develop presentations. They will make outlines to organize information. Student groups will gather information on their school's background by interviewing office and custodial staff. Students will practice making presentation with each other and in front of their class. They will observe one another during their presentations and make suggestions for improvement.
Expected Outcome	For students to complete PowerPoint presentations on their school audits and to feel comfortable speaking in front of their peers. Presentations will include their recommendations for school improvements.
Materials	Laptop Computer (PowerPoint) Handouts: Student Presentation on School Audits, Creating a PowerPoint Presentation, Basic Appleworks (for creating presentation slides in Appleworks), Quiz #2
Procedure	• Coordinate with the school computer lab teacher to schedule a block of visits and see if students can come in on their own during recess or lunch times. Ask the computer lab teacher if they are willing to teach the class some PowerPoint (or Appleworks) basics. Discuss what type of media storage you can use to save students work (floppy, compact, or Zip discs). • Gather materials stated above and print out workshop handouts. With the students, review the instructions provided on handouts and make sure they understand what is expected of them in these workshops. • Assign different groups to be responsible for interviewing staff and gathering background information for their presentations. Have them complete as homework. • After students have completed their presentations have them work on presenting to each other in groups and then to the whole class. • Have students provide feedback to each other on presentation skills and content. • Conduct mock question and answer sessions.
Evaluation	Students needed additional workshop time to prepare their PowerPoint presentations.
Recommendations	Check to make sure the school computers have PowerPoint and that the student's have access to those computers. Assess the students' proficiency with computers and determine how many workshops to schedule in the computer lab (in this program we used 4 workshops). Schedule more time than you think you may need; some students will finish early and some will need more time. Use a minimum of two workshops for all the students to practice presenting their presentations to the class. Schedule one workshop for the group of students who are making the actual presentations to rehearse together. Use this time to evaluate how confident and comfortable the students are with making the presentations. This will help you determine if they are ready for additional presentations to audiences outside of school such as the Board of Education or State Legislature.

Activity	**Presentations**
Week	20
Subjects	Social Studies, Language Arts
Standards	*Social Studies:* Economics: Limited Resources & Choice *Language Arts:* Oral Communication: 1. Range *Language Arts:* Oral Communication: 2. Communication Process *Language Arts:* Oral Communication: 3. Convention and Skills *Language Arts:* Oral Communication: 4. Rhetoric *Language Arts:* Oral Communication: 5. Attitudes and Engagement
Summary	Students will make presentations to other students, school administration, and PTSA.
Expected Outcome	For students to report to different parties on what they did in the program and make recommendations on how to improve schools. Also, for students to feel like they can be active participants in their schools and community and have the power to help implement change.
Materials	Student Presentations Laptop Computer and School Computers (PowerPoint)
Procedure	• Coordinate with teacher and school administration to schedule the student presentation. Check with school groups such as Parent, Teacher, Student Associations or Curriculum Departments. Ask students how they feel about presenting to groups outside of school to get an idea about their confidence level. If they are confidant look into having them present to the Board of Education or Legislature. • Make necessary arrangements to have a computer, projector, and screen available for the time of presentation.
Evaluation	Great. Students have the opportunity to shine and show off their hard work. • Radford High School: Students presented to the PTSA, school principal, parents, and representatives of HECO and U.S. Department of Energy. The principal was impressed with the student presentation and asked the students to make another presentation to a future parent luncheon. • McKinley High School: Students presented to Science Department teachers, and representatives of HECO, U.S. Department of Energy, Hawaii State Department of Business, Economic Development & Tourism. HECO filmed the students presenting their PowerPoint presentations. The footage will be included in HECO commercials and corporate communications.
Recommendations	School principals are typically very busy and may have a difficult time making it to a student presentation. Give them reminders when the presentation date gets near and make sure they know how much effort the students have put into developing the presentation. Students may have the opportunity to present to a lot of important people but they may still feel the principal is the most important for them.

Activity	**Prepare For Small Business Audits**
Week	21 - 24
Subjects	Social Studies, Language Arts
Standards	*Social Studies:* Economics: Limited Resources & Choice *Language Arts:* Writing: 1. Composing Processes
Summary	Students will organize how they plan to conduct the small business audits. They will design marketing flyers to attract the attention of small businesses interested in saving money by retrofitting their fluorescent lights. Students will design a static sticker to market their efforts.
Expected Outcome	For students to have a plan to use when going out to conduct the small business audits.
Materials	Laptop & School Computers (Word or Appleworks) Worksheets: Small Business Audit Plan, Designing Your Static Stickers
Procedure	• Gather materials and print out worksheets then distribute to students. • Review what you expect students to accomplish with this workshop. • Break students up into groups (audit team) and have them complete their audit plans. • Groups design marketing flyers and stickers then vote on one design (flyer, sticker) they want to use to represent their class. • Have students schedule a tentative date for when they plan to complete the audit and have them exchange phone numbers so they can contact each other for transportation/meeting arrangements.
Evaluation	Excellent time for students to apply their creative energy with designing static stickers and coming up with slogans for their marketing flyers. They formed their own groups and decided on what each of their roles would be in conducting the audits. Groups named at least three businesses they would market their audits to.
Recommendations	While students are brainstorming about which businesses to target make sure they understand that they will need to audit the entire business. So they should keep the size (square footage) of the businesses in mind when making their choices.

Activity	**Students Conduct Audits on Small Businesses**
Week	Various (students complete on their own time)
Subjects	Science, Math, Social Studies, Language Arts
Standards	*Science:* Domain 2: 2. Interdependence of Science, Technology, & Society *Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring. *Social Studies:* Economics: Limited Resources & Choice *Language Arts:* Oral Communication: 1. Range *Language Arts:* Oral Communication: 2. Communication Process *Language Arts:* Oral Communication: 3. Convention and Skills *Language Arts:* Oral Communication: 4. Rhetoric *Language Arts:* Oral Communication: 5. Attitudes and Engagement
Summary	Students will conduct lighting audits on small businesses.
Expected Outcome	For students to complete lighting audits on small businesses. Students will approach businesses with their flyers and speak with business owners/managers. They will coordinate a time to conduct the audit. They will interview the business contacts to determine hours of operation then walk around and gather data on fixture types and counts. Students will inform the contacts that they will be returning to present the results (audit reports) to the business.
Materials	Worksheets: Lighting Equipment Survey Input, HECO Excel based T8 Audit Flicker Checkers
Procedure	• Gather materials and print out worksheets then distribute to students. • Review what you expect students to accomplish with this workshop. • Have students report to about how their progress is going in completing the business audits and discuss any areas that they may want help with.
Evaluation	These are essential workshops for the students—they apply everything they have learned throughout the program to complete their business audits. HECO filmed a group of students conducting a lighting audit at one business. The footage will be included in HECO commercials and corporate communications. A Honolulu Star Bulletin photojournalist attended and took pictures and notes; one photo and caption were featured in the Bulletin.
Recommendations	Arrange a way to make sure the students deliver the audit reports back to the initial business contacts (owners/mangers) they worked with during their lighting audits. The initial contact may not be at work when the students return with the reports. Prepare a form for the contact to sign during audit and another form for when the students return; this way both contacts will be recorded and the audit verified. If students end up with a second contact then they should request that the second contact share the audit report with the initial contact.

Activity	**Guest Speaker: Entrepreneur in lighting industry**
Week	25
Subjects	Career & Life Skills
Standards	*Career & Life Skills:* Technological Literacy *Career & Life Skills:* Career & Life Planning
Summary	Guest speaker to talk about a career in the lighting industry. The speaker will give students background on how they became an entrepreneur in the field and lessons learned to become successful in business.
Expected Outcome	For students to meet an accomplished professional and get exposure to a career path.
Materials	None.
Procedure	• Contact someone in the lighting industry who is a good role model of success and is willing to talk about his or her experiences to high school students. • Schedule a date and time that works for both them and the school. • Inform teacher and school administration of the guest visit. • Give students a little background on the guest speaker before the scheduled visit.
Evaluation	This is a recommended workshop and provides students with the opportunity to meet a professional and ask them questions about their careers. Both teachers and students enjoyed this workshop and asked many questions of the guest speaker.
Recommendations	None.

Activity	Complete Reports on Small Business Audits
Week	26- 29
Subjects	Science, Math
Standards	*Science:* Domain 2: 2. Interdependence of Science, Technology, & Society *Science:* Domain 2: 3. Sustainability *Math:* Measurement 1. Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring.
Summary	Students will use information they gathered during their small business audits to complete the Excel audit reports.
Expected Outcome	For students to complete audit reports on fixture types and counts, burn hours, potential energy and cost savings, cost to retrofit, and available rebates. Students will return the reports to small businesses owners along with the static cling stickers they designed.
Materials	Laptop Computer (Excel) Worksheets: Lighting Equipment Survey Input, HECO Excel based T8 Audit, Business Confirmation Static Cling Stickers
Procedure	• Gather materials and print out worksheets then distribute to students. • Review what you expect students to accomplish with this workshop. • Have students enter data from their audit survey sheets into the Excel spreadsheets to generate the small business audit reports. • Students print reports and then, on their own time, deliver the reports back to the small businesses. • Students give the static cling stickers they designed to the small businesses and have their business contact sign a confirmation sheet to verify they received the report. • Students return signed confirmation sheets to teacher.
Evaluation	Important workshops for the students—they use information gathered from their small business lighting audits to generate reports that they will present back to the businesses.
Recommendations	Arrange a way to make sure the students deliver the audit reports back to the initial business contacts (owners/mangers) they worked with during their lighting audits. The initial contact may not be at work when the students return with the reports. Prepare a form for the contact to sign during audit and another form for when the students return; this way both contacts will be recorded and the audit verified. If students end up with a second contact then they should request that the second contact share the report with the initial contact.

Hawaiian Electric Co., Inc.
PO Box 2750 Honolulu, HI 96840-0001

Date: July 25, 2003

Ms.

Dear ,

Thank you for participating in the HECO Energy Smart Schools Program this past year. You are a forerunner in exposing students to new and interactive ways of learning. The program would not have succeeded without a teacher like you.

We at Hawaiian Electric believe this was a successful program and wish to know your thoughts. As with any program, we realize that the procedure is a learning experience and we can only improve by your suggestions and guidance. Please fill out the following questionnaire and return it to me by August 4, 2003.

Cordially,

SAM

Sam Nichols
Customer Efficiency Program Analyst

HECO Energy Smart Schools
Teacher Survey Questions

1. Do you feel students who participated in this program gained additional experience/skills not currently found in the school curriculum?

2. Which subject areas should be greater emphasized?

3. Which subject areas should be less emphasized?

4. Do you know of any additional material that would enhance the program?

5. Do you think the program should be conducted throughout the entire school year or for two quarters?

6. Should the program have more or less classroom time? How often (once a week, once every two weeks, once a month)?

7. What grade level do you feel would best benefit from this program? Please rank your choices 1 to 4, one being the first choice.

Grade	Rank
9th	
10th	
11th	
12th	

8. Would you recommend this program to other teachers/schools?

9. What did you like about this program?

   Material Content:
   Lectures:
   Activities:
   School Audits:
   Small Business Audits:

10. What suggestions do you have for improving the program?

    Material Content:
    Lectures:
    Activities:
    School Audits:
    Small Business Audits:

11. Other comments or recommendations?

HECO Energy Smart Schools
Teacher Survey Questions

Mrs. Hu – McKinley High School

1. Do you feel students who participated in this program gained additional experience/skills not currently found in the school curriculum?

   Definitely! Beneficial to the students--- computer skills (some students never touched a computer before, never saved a document on a disk)--- oral presentation skills, interview/auditing skills.

2. Which subject areas should be greater emphasized?

   Content wise, the program is more related to Physical science than Biology (which was the subject that I taught last year), so it is based on which class we were using. If it were a Physical science class then no problem. But since I used Biology class, the students lacked E&M *(electromagnetism)* background.

3. Which subject areas should be less emphasized?

4. Do you know of any additional material that would enhance the program?

5. Do you think the program should be conducted throughout the entire school year or for two quarters?

   Just right pace for low-level Biology students. But if it is offered through Physical science class, then it can be concentrated into 1 semester.

6. Should the program have more or less classroom time? How often (once a week, once every two weeks, once a month)?

7. What grade level do you feel would best benefit from this program? Please rank your choices 1 to 4, one being the first choice.

Grade	Rank	9th/10th graders better
9th		
10th		
11th		
12th		

8. Would you recommend this program to other teachers/schools?

   Of course!

9. What did you like about this program?

   Most useful: resource speakers, fuel cell demos, building motors, power plant field trip, once per week instructions with computer practice on data entry/ power point, all gadgets/ pens/pencils from HECO--- all activities have enriched my science curriculum+ $ 500 as motivation for students.

   Material Content:
   Lectures:
   Activities:
   School Audits:
   Small Business Audits:

10. What suggestions do you have for improving the program?

    Material Content:
    Lectures:
    Activities:
    School Audits:
    Small Business Audits:

11. Other comments or recommendations?

HECO Energy Smart Schools
Teacher Survey Questions

Mrs. Harbottle – Radford High School

1. Do you feel students who participated in this program gained additional experience/skills not currently found in the school curriculum?

   Yes I do feel that students gained additional experience not offered in the school curriculum.

2. Which subject areas should be greater emphasized?

   I believe that the subject matter presented to the students was a challenge but it was clear, concise and basically easy for the students to comprehend. Such as how to read a meter, conduct audits, how energy is moved from power plants, the cause and effects of improper use of energy, variety of lights that's used to provide efficient energy use and the list goes on. Therefore I would not change the emphasis of the subject matter.

3. Which subject areas should be less emphasized?

4. Do you know of any additional material that would enhance the program?

   Besides additional reading I am unaware of any supplemental material that would be able to enhance the program to fit a variety of students needs.

5. Do you think the program should be conducted throughout the entire school year or for two quarters?

   No I do not feel that the program should be conducted throughout the entire school year. I do feel that if the program was conducted within two quarters of the year students would participate in discussions a lot more.

6. Should the program have more or less classroom time? How often (once a week, once every two weeks, once a month)?

   If possible for the teacher and the presenter it would be great to have class time twice a week in order to enhance the recall of what's discussed.

7. What grade level do you feel would best benefit from this program? Please rank your choices 1 to 4, one being the first choice.

   Honestly this depends on the subject matter offered in the school, not necessarily grade level of the student. Meaning that the subject matter presented may not coincide with the content being taught and this varies from school to school with in the DOE.

Grade	Rank
9th	
10th	
11th	
12th	

8. Would you recommend this program to other teachers/schools?

   Yes, I would recommend this program to other teachers.

9. What did you like about this program?

   Thinking about this and looking at the breakdown of specific areas I must say it all went together like a cumulating event. Discussions rather than lectures were used to create a basic understanding of first what energy is, how it is transported, used, and then how it effects the environment. From there the students were given a hands experiences to enforce what was taught (Worksheets, building a machine that produced energy, a chance to perform an audit etc.). Next students had to use the tools and work with in the community to conduct audits, and then explain the information gained and what it meant in regards to the business owners and their energy efficiency.

   Material Content:
   Lectures:
   Activities:
   School Audits:
   Small Business Audits:

10. What suggestions do you have for improving the program?

    Material Content:
    Lectures:
    Activities:
    School Audits:
    Small Business Audits:

11. Other comments or recommendations?

Energy Smart Schools
Teacher Survey Overview
Ms. Peggy Harbottle, Radford High School
Ms. Sophia Hu, McKinley High School

Upon review of the teachers' survey it is without question that the Energy Smart Schools (ESS) project was greatly appreciated by the two participating high school teachers. They recognized the additional curriculum ESS has to offer as a definite asset to the students. ESS brought special speakers, hands-on and inter-active activities and excursions that could not be gained from any other program offered in the schools today.

The first ESS session in 2000 was conducted over one semester with 2-hour classes once a week. The latest 2001/02 sessions lasted the entire school year with 1-hour classes once a week. Both teachers indicated that condensing the time span would help the students to retain information and remain focused on the lessons. Having 2 lessons per week may prove an advantage.

The students may better understand the class if they were to have had, or were currently enrolled in a physical science class. It would certainly be better for teacher so they may incorporate ESS lessons with their standard lesson plans.

When asking for improvement suggestions, the teachers unfortunately had no direction as to how we can do things differently or better the next time.

2004

Business Name	Address	Number of Fixtures	Operating Hours per Day	Operating Days per Week	Operating Hours Per Year	Total kWh Saved Per Year	Annual Estimated Savings	Total Estimate	HECO Rebate	Net Project Cost	Estimated Payback Period *yrs*	Contact Name/ End Customer Results and Phone Number
21 Mart	1135 N. School St. Honolulu, HI 96817	16	15	7	5,460	6,115	$ 739.94	$ 737.83	$ 179.20	$ 558.63	0.75	Contact: Jung Kim ph: (808) 845- 0447
808 Hula Mart	1027 Pensacola St. Honolulu, HI 96814	9	14	7	5,408	1,606	$ 194.35	$ 297.97	$ 50.40	$ 247.57	1.27	Contact: Sunny Cordill ph: 593-9998
Aloha Petroleum	1132 Bishop St. Honolulu, HI 96813	11	24	7	8,736	6,727	$ 813.93	$ 507.26	$ 123.20	$ 384.06	0.47	Contact: John Youngren ph: 522-9700
Alpha Video	555 N. King St. Honolulu, HI 96817	18	12	7	4,368	5,504	$ 665.95	$ 830.06	$ 201.60	$ 628.46	0.94	Contact: Young In Song ph: 847-8445
Asian Grocery	1319 S. Beretania St. Honolulu, HI 96814	9	9	6	2,808	834	$ 100.91	$ 297.97	$ 50.40	$ 247.57	2.45	Contact: Selena Khanthayavong ph: 593-8440
The Book Rack	4510 Salt Lake Blvd. Honolulu, HI 96818	14	9	7	3,276	2,447	$ 296.11	$ 562.88	$ 120.40	$ 442.43	1.49	Contact: Vernon Harrison ph: 487-8350
Cheapo Music & Books	98-199 Kamehameha Hwy. Honolulu, HI 96701	73	12	7	4,368	22,329	$ 2,700.78	$ 3,366.34	$ 817.60	$ 2,548.74	0.94	Contact: Lisa Morisheta ph: 486-5600
ColorTyme	1279 S. Beretania St. Honolulu, HI 96814	23			2,756	4,437	$ 536.90	$ 1,060.63	$ 257.60	$ 803.03	1.5	Contact: Chris Finch ph: 596-7070
Cookie Corner	98-1005 Moanalua Rd. Aiea, HI 96701	5	10	7	3,640	601	$ 72.67	$ 224.66	$ 28.00	$ 196.66	2.71	Contact: Kristen M. ph: 483-0491
Corner Market	517 N. Vineyard Blvd Honolulu, HI 96817	5	12	6	3,744	618	$ 74.75	$ 165.54	$ 28.00	$ 137.54	1.84	Contact: Mah ph: 545-1231
CR Newton	1575 Beretania St. Honolulu, HI 96826	58	6	6	1,976	6,971	$ 843.53	$ 2,807.06	$ 593.60	$ 2,213.46	2.62	Contact: David Rothenberg ph: 949-8389
Dragon City	1428 Liliha St Honolulu, HI 96817	16	12	5	3,120	3,949	$ 422.82	$ 737.83	$ 179.20	$ 558.63	1.32	Contact: Hellen ph: 536-1278
Fuji's	652 N. King St. Honolulu, HI 96817	11	15	7	5,460	1,982	$ 239.82	$ 364.18	$ 61.60	$ 302.58	1.26	Contact: Vicky ph: 845-6984
House of Health	1541 S. Beretania St. Honolulu, HI 96814	35	9	7	3,276	3,050	$ 369.04	$ 1,076.00	$ 156.80	$ 919.20	2.49	Contact: Pam Fellon ph: 955-6168
Latin America Market	1315 S Beretania St. Honolulu, HI 96814	7	9	5	2,340	541	$ 65.41	$ 231.75	$ 39.20	$ 192.55	2.94	Contact: Martha S.Minn ph: 593-2226
Newtown Dental	98- 1247 Kaahumanu St. Aiea, HI 96782	23	8	6	2,496	1,894	$ 229.23	$ 761.48	$ 128.80	$ 632.68	2.76	Contact: Sarah Baumholtz ph: 487-5595
Orange Julius and Dairy Queen	1450 Ala Moana Blvd. # 1705 Honolulu, HI 96814	6	12	7	4,368	1,188	$ 143.76	$ 224.66	$ 44.80	$ 179.86	1.25	Contact: Kong Lu ph: 946-6693
Precision Radio	1160 S. King St. Honolulu, HI 96814	27	9	5	2,340	2,232	$ 270.12	$ 1,294.75	$ 186.40	$ 1,108.35	4.1	Contact: Kim Hironaka ph: 593-9473
Properties Unlimited	4510 Salt Lake Blvd. # B-4 Honolulu, HI 96818	23	12	7	4,368	7,032	$ 850.93	$ 1,060.63	$ 257.60	$ 803.03	0.94	Contact: Carol S. Hagiwara ph: 488-3037
Royal Palace Restaurant	4510 Salt Lake Blvd. Honolulu, HI 96818	17	12	7	4,368	5,198	$ 628.95	$ 783.94	$ 190.40	$ 593.40	0.94	Contact: Judy Lee ph: 487-6662
Sears Flower Shop	1450 Ala Moana Blvd. # 1000 Honolulu, HI 96814	32	14	7	5,096	11,415	$ 1,381.32	$ 1,475.66	$ 358.40	$ 1,117.26	0.81	Contact: Wesley Akiyoshi ph: 949-2634
Singer of Hawaii	98-199 Kamehameha Hwy. Aiea, HI 96701	11	9	6	2,808	2,162	$ 261.62	$ 507.26	$ 123.20	$ 384.06	1.47	Contact: Rose V. Castillo ph: 488-8889

Mahalo Nui Loa for allowing students from *name of high school* to conduct a lighting audit on your business. Included are the audit results showing your business's estimated energy savings, project costs, and HECO rebates if you retrofit to energy-efficient T8 lights with electronic ballasts.

If you would like more information on the Energy $mart Schools Program or T8 lighting, please call Sam Nichols at 543-4753, or Jennifer Tosaki at 739-2217.

Hawaiian Electric Company, Inc. Rebuild America DBEDT THE DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM STATE OF HAWAII

Business:_____

Business Contact:_____ Initial:_____
(print name)

Address:_____

_____

_____

Designing Static Stickers

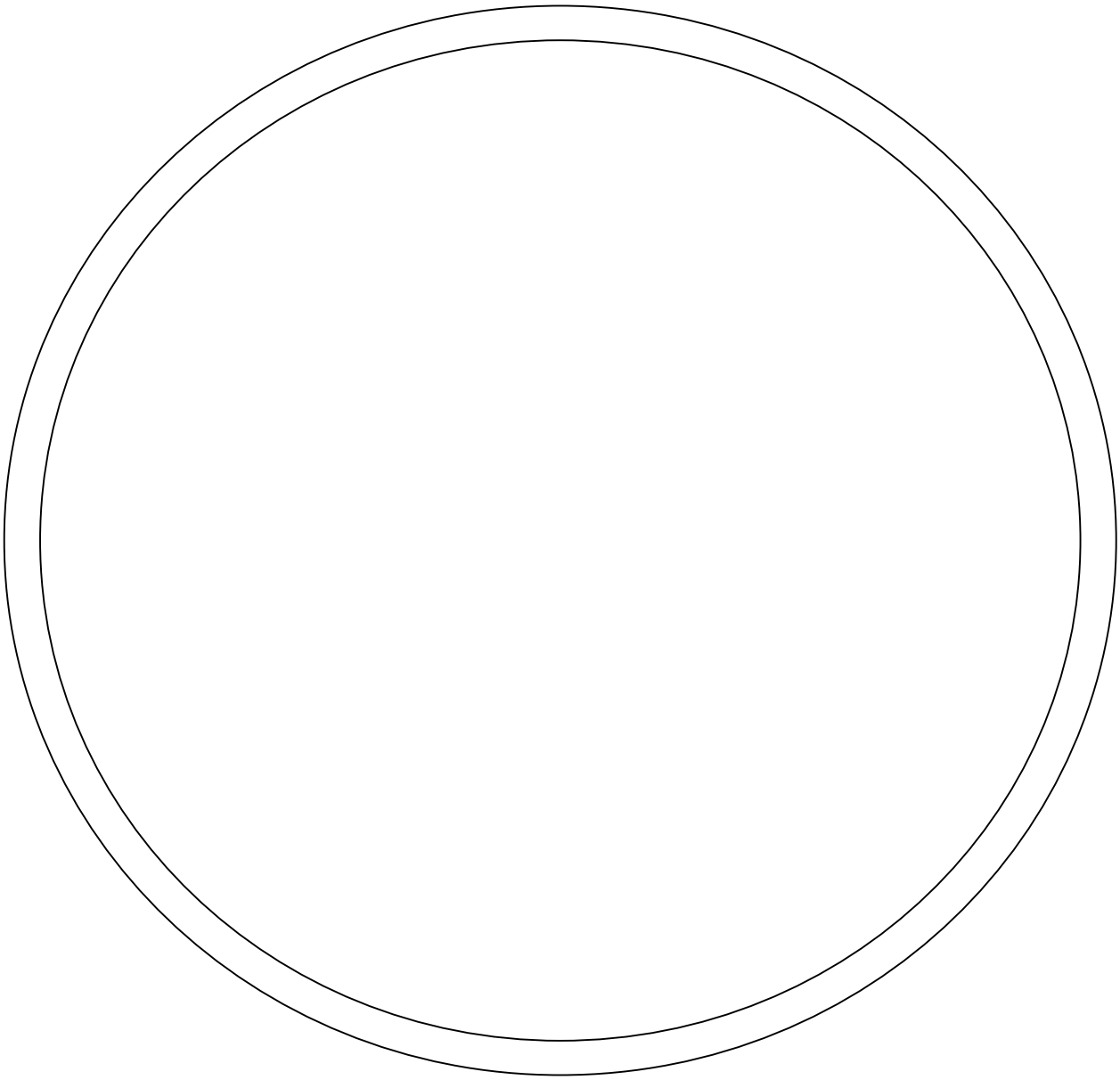
Take a few minutes to think about answers to the following questions. Write a paragraph length answer for each question.

Why should my family reduce its energy use?

Why should my school reduce its energy use?

Why should a small business reduce its energy use?

Use the information you generated from your answers to design your static sticker.



Be Bright
Change Your Lights!

McKinley High School wants to help you reduce your electricity bill

Lighting Audit Team

Marketer:
Auditor:
Engineer:
Computer Tech:
Team Manager:

FREE lighting audit conducted by McKinley High School student auditors

FREE audit report on how your business can **SAVE MONEY**

The lighting audit report shows you:

- Amount of money you will save if you change to energy-efficient T-8 fluorescent lights
- Money obtainable from HECO rebates
- Length of payback period

For more information and appointments please call
Jennifer Tosaki at 739-2217

DBEDT
STATE OF HAWAII

Rebuild America

Hawaiian Electric Company, Inc.

Save Money Now!

Lighting Audit Team
Marketer:
Auditor:
Engineer:
Computer Tech:
Team Manager:

Radford High School wants to help you reduce your electricity bill

Our audit team will conduct a **FREE** lighting audit to help show you how your business can save money and improve its lighting.

The free lighting audit report will show you:

- Amount of money you will save if you change to energy-efficient T-8 fluorescent lights
- Money obtainable from HECO rebates
- Length of payback period

For more information and appointments please call
Jennifer Tosaki at 739-2217

DBEDT STATE OF HAWAII
Rebuild America
Hawaiian Electric Company, Inc.

Small Business Audit Plan

Assign a role for each member in your group.

1. Marketer:
2. Auditor:
3. Engineer:
4. Computer Tech:
5. Team Manager:

Name 3 businesses your group will attempt to audit.

1.
2.
3.

Small Business Audit Plan

Assign a role for each member in your group.

6. Marketer:
7. Auditor:
8. Engineer:
9. Computer Tech:
10. Team Manager:

Name 3 businesses your group will attempt to audit.

1.
2.
3.

McKinley High

Energy Smart Schools Program

McKinley High School

Rebuild America

Hawaiian Electric Company, Inc.

DBEDT
THE DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
STATE OF HAWAII

Ms. Sophia Hu's Class

McKinley High School

Program Goals

1. To increase awareness in Hawaii's schools and communities on the benefits of using energy efficient lighting.

2. To show schools and businesses how to decrease their electricity costs while improving the quality of lighting.

3. For students to gain career and life skills.

Student Activities

Throughout the year we participated in various activities to complete our goals.

Guest speakers from HECO gave us a brief background on electricity, energy efficiency, types of lighting, and presentation skills.

McKinley High School

Student Activities

Field trip to Kahe Power Plant to learn how a power plant works and how electricity is distributed to our homes.

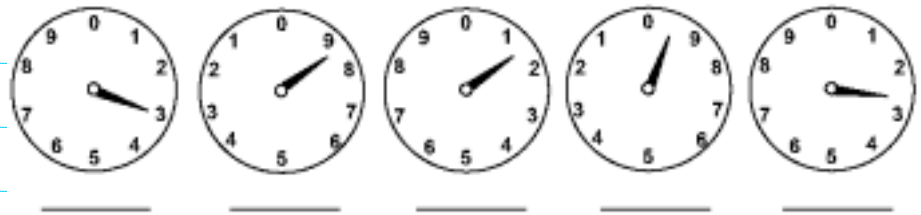
Student Activities

Built motors and…

…had the opportunity to see a demonstration hydrogen fuel cell.

Student Activities

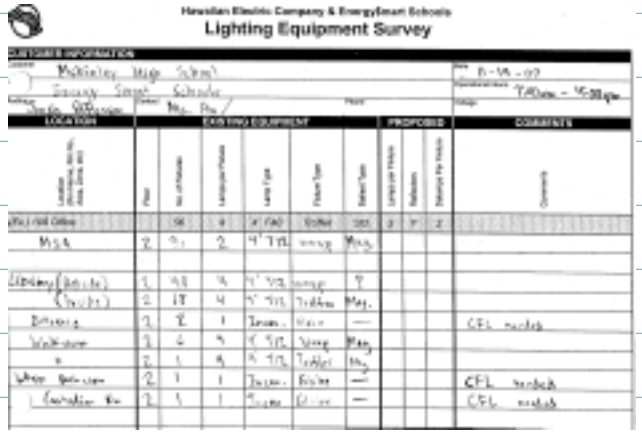
Learned how to read our electric meters and bills. Figured out the amount of kWh and cost to operate appliances.



Learned about different types of fluorescent lighting and conducted lighting audits in our school classrooms and library

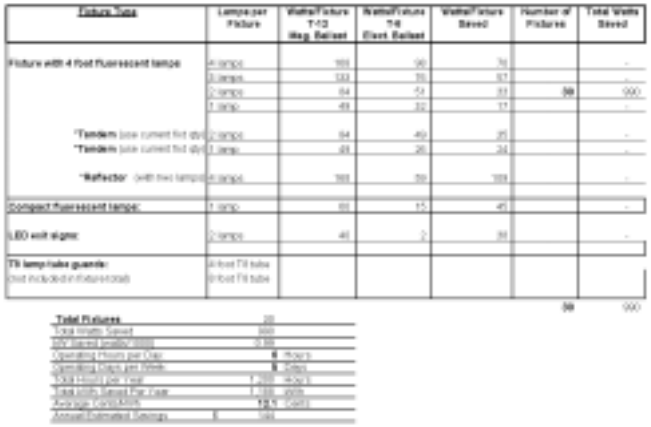
Student Audit

We counted the number of fixtures, number of lamps per fixture, and recorded the lamp/ballast type (T-12/Magnetic or T-8/Electronic).



Hawaiian Electric Company & EnergySmart Schools

Lighting Equipment Survey



We typed in all this information into an Excel spreadsheet on the computer and calculated how much energy and money we would save by changing the types of the lamps and ballasts inside the fixtures.

McKinley High School

School Background

School established in 1865 in downtown

School established in present location in 1923

Buildings range in age from 10 to 80 years old

What type of fluorescent lights are currently in the classroom?

The types of fluorescent lights we have in our classrooms are the T-12 lamps with magnetic ballasts; usually placed in a wrap or troffer type of fixture.

What is the average number of fixtures in a classroom?

The average amount of fixtures per classroom is 30.

Gadgets

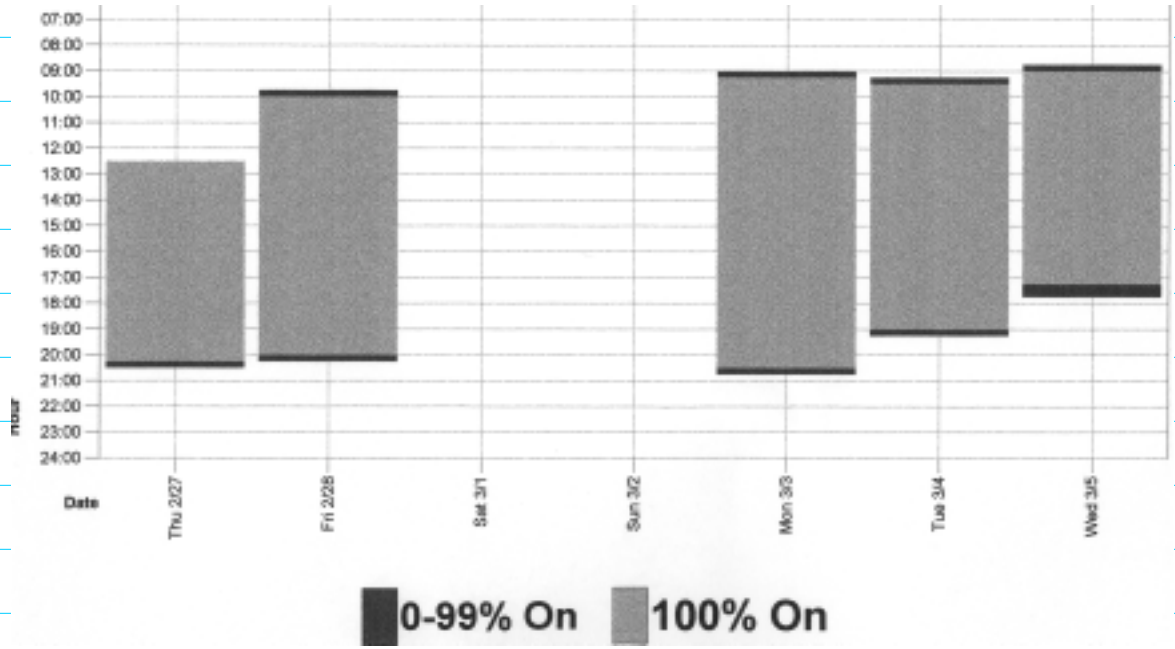
WE USED GADGETS SUCH AS:

FLICKER CHECKER: A tool used to check the fixture's ballast type. (magnetic, electronic)

LIGHT METER: A tool used to measure amount of light coming from the fixture. (foot candles)

Gadgets

LIGHT LOGGER: A tool placed in the fixture to record the amount of time the lights are on. (burn hours)



MS-9 Audit

Total Fixtures	30	
Total Watts Saved	**990**	
kW Saved (watts/1000)	0.99	
Operating Hours per Day:	**6**	Hours
Operating Days per Week	**5**	Days
Total Hours per Year	1,200	Hours
Total kWh Saved Per Year	1,188	kWh
Average Cents/kWh	**12.1**	Cents
Annual Estimated Savings	**$ 144**	

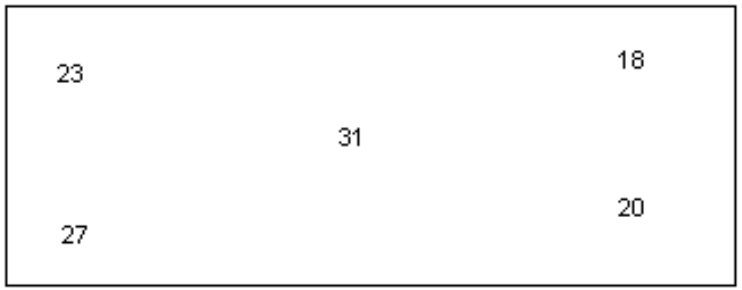
Based on a 40 week school year

McKinley High School

MS-9 Audit

Light Meter Readings

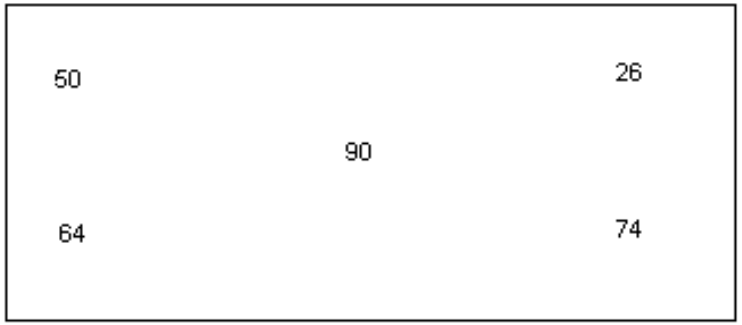
MS-9's lighting meter (T12 lamps)



Total:
23+27+31+18+20=119

Average:
119/5=23.8

New Classroom's lighting meter (T8 lamps)



Total:
50+64+90+26+74=304

Average:
304/5=60.8

Library Audit

Total Fixtures	125	
Total Watts Saved	**8,686**	
kW Saved (watts/1000)	8.69	
Operating Hours per Day:	**8**	Hours
Operating Days per Week	**5**	Days
Total Hours per Year	1,600	Hours
Total kWh Saved Per Year	13,898	kWh
Average Cents/kWh	**12.1**	Cents
Annual Estimated Savings	**$ 1,682**	

Based on a 40 week school year

McKinley High School

School Audit

Total Fixtures	2,844	
Total Watts Saved	**111,019**	
kW Saved (watts/1000)	111.02	
Operating Hours per Day:	8	Hours
Operating Days per Week	5	Days
Total Hours per Year	1,600	Hours
Total kWh Saved Per Year	177,630	kWh
Average Cents/kWh	12.1	Cents
Annual Estimated Savings	**$ 21,493**	

Based on a 40 week school year

How did we do the entire school audit?

We counted the lights in our classrooms then figured out the average amount of fixtures per classroom. Then we multiplied the average number of fixtures per classroom by the number of classrooms in the school. This gave us an estimated number of lights in our school.

McKinley High School

School Audit

Cost to retrofit classrooms

Totals	2844	$ 93,500.14	
Sales Tax		$ 3,895.22	
PUC Tax		$ 6,218.69	
Total Estimate *		$ 103,614.05	
HECO REBATE		$ 18,089.60	
Net Project Cost		**$ 85,524.45**	
ESTIMATED ANNUAL SAVINGS		$ 21,493.28	
Estimated Payback Period		**$ 3.98**	**Years**

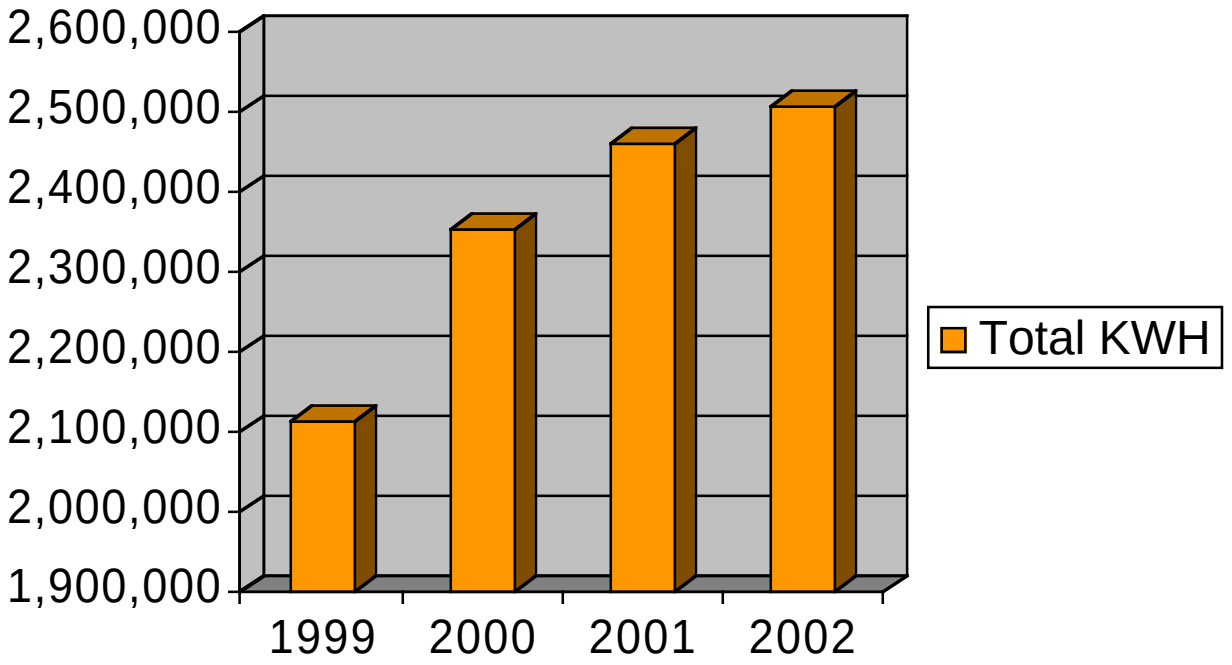
McKinley High School

MHS Electric Bill

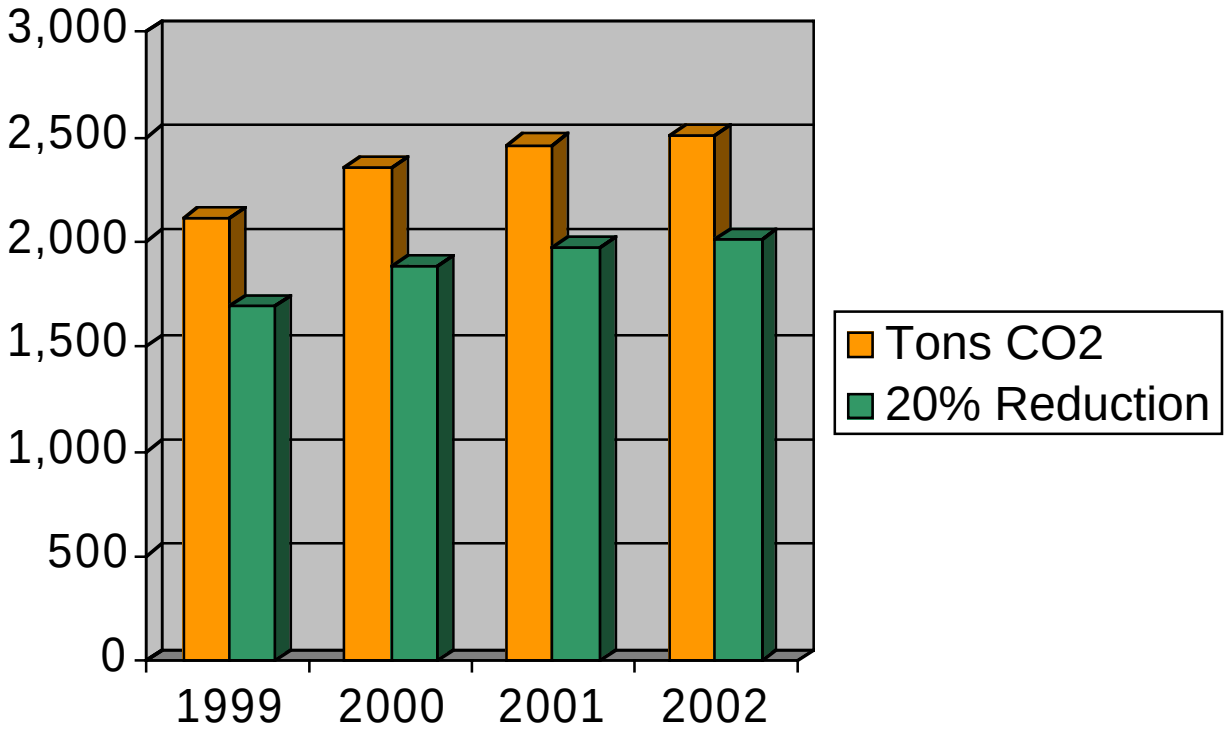
Year	Total Bill Amount		Total With Energy Efficient Lighting	Savings
2002	$ 304,886		$ 243,909	$ 60,977
2001	$ 367,657		$ 294,126	$ 73,531
2000	$ 294,913		$ 235,931	$ 58,982
1999	$ 229,016		$ 183,213	$ 45,803

Total savings is estimated at 20% if the school retrofitted to T-8 lamps/electronic ballasts

Total kWh Used



CO_2 Released



Benefits of T-8 vs. T-12

T-8 lamps (with electronic ballasts) are more energy efficient than the T-12 lamps (with magnetic ballasts) saves money on electricity costs. It may take a little while to pay off the cost of retrofitting but you could save money in the long run.

Money saved could be used to fund various school programs and activities. Schools could use the extra cash to fix anything that needed repair. They could replace older textbooks or purchase new computers and equipment.

Installing T-8 lamps could reduce maintenance costs because the lamp life is longer so custodians will spend less time on changing out burnt out lamps.

Benefits of T-8 vs. T-12

T-8 lamps can provide better lighting and truer colors in our classroom

Installing T-8 lamps could reduce maintenance costs because the lamp life is longer so custodians will spend less time on changing out burnt out lamps.

Other Ways To Save $

How else do we save money on our school's electricity bill?

- **Turn off the lights when not in use**
- **Turn off the AC and open up the windows on cooler days**
- **Turn off computer monitors when you are away from your computer**

Current Status

Completing Small Business Audits!

Generating Reports Of Data!

Presenting Audit Reports!

For more Information contact:

Jennifer Tosaki at 739-2217

RADFORD HIGH SCHOOL

Radford High School Energy Smart Schools Program

Sponsored by

Hawaiian Electric Company, Inc.

Rebuild America

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THE DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
STATE OF HAWAII

RADFORD HIGH SCHOOL

Energy Smart Schools at Radford High

- Through the years our schools of Hawaii have been using a lot more energy then needed so a group of organizations got together and designed the Energy Smart Schools program.
- Energy Smart Schools came to Radford to help students learn about saving energy and money for student's homes, Radford High School, and small businesses.

Ms. Harbottle's Class

RADFORD HIGH SCHOOL

Program Goals

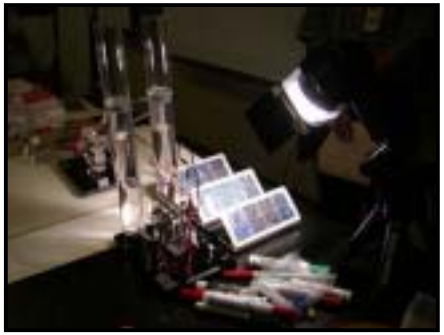
- To learn about energy and the benefits of being energy efficient
- To show our homes, schools, and businesses how to save money on their electric bill
- To learn about different types of fluorescent lights and how they can save energy
- To learn how to conduct a lighting audit
- To gain career and life skills

RADFORD HIGH SCHOOL

Activities

Guest Speakers

Built Motors



Hydrogen Fuel Cell Demonstration

RADFORD HIGH SCHOOL

Activities

Trip to Kahe Power Plant

RADFORD HIGH SCHOOL

Activities

Electric Meters and Bills

Conducted School Lighting Audits

T-12 lamp (1.5 inch diameter) works with a magnetic ballast

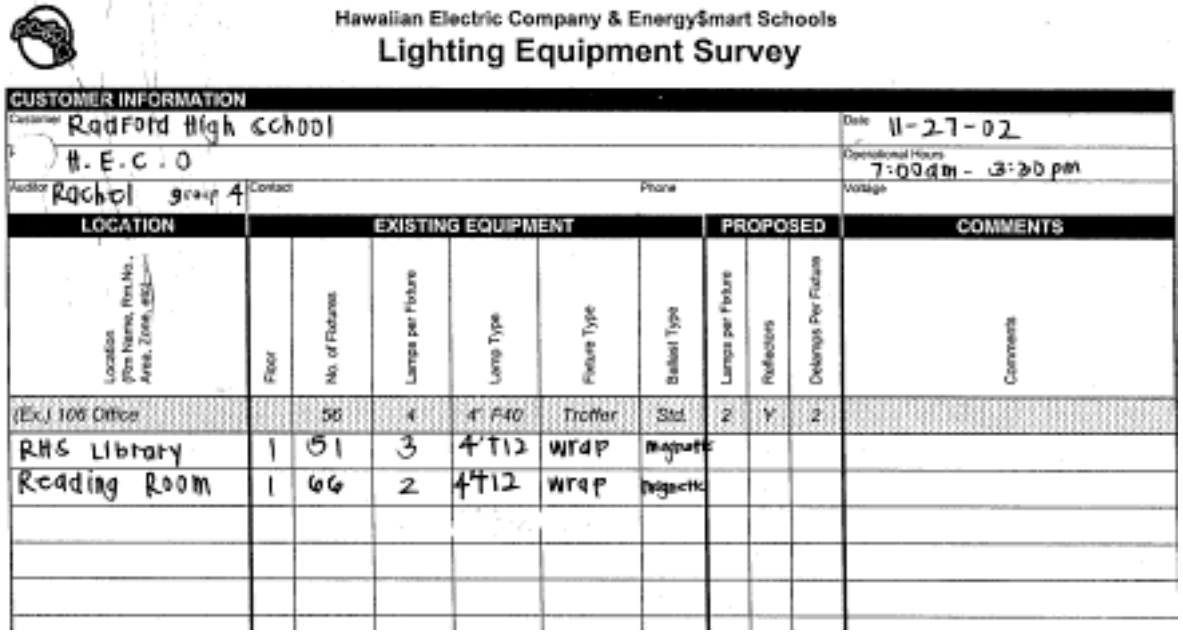
T-8 lamp (1 inch diameter) works with an electronic ballast

RADFORD HIGH SCHOOL

Light Audits

Completed a Lighting Equipment Survey

- **Counted fixtures and number of lamps per fixture**
- **Recorded ballast and fixture type**
- **Determined burn hours**



Hawaiian Electric Company & Energy$mart Schools

Lighting Equipment Survey

CUSTOMER INFORMATION

Customer: Radford High School — Date: 11-27-02

H.E.C.O — Operational Hours: 7:00am - 3:30 pm

Auditor: Rachel group 4 — Contact — Phone — Voltage

LOCATION	EXISTING EQUIPMENT						PROPOSED			COMMENTS
Location (Rm Name, Rm No., Area, Zone, etc.)	Floor	No. of Fixtures	Lamps per Fixture	Lamp Type	Fixture Type	Ballast Type	Lamps per Fixture	Reflectors	Delamps Per Fixture	Comments
(Ex.) 106 Office		56	4	4' F40	Troffer	Std.	2	Y	2	
RHS Library	1	51	3	4'T12	wrap	Magnetic				
Reading Room	1	66	2	4T12	wrap	Magnetic				

RADFORD HIGH SCHOOL

Light Audits

Entered information into an Excel spreadsheet and calculated how much energy and money is saved when T-12 lights (with magnetic ballasts) are replaced with T-8 lights (with electronic ballasts).

RADFORD HIGH SCHOOL

Gadgets

To conduct the lighting audits we used the following gadgets

Flicker Checker: A tool used to check the fixtures ballast type (magnetic, electronic). Determining the type of ballast will help you figure out what type of lamp is in the fixture.

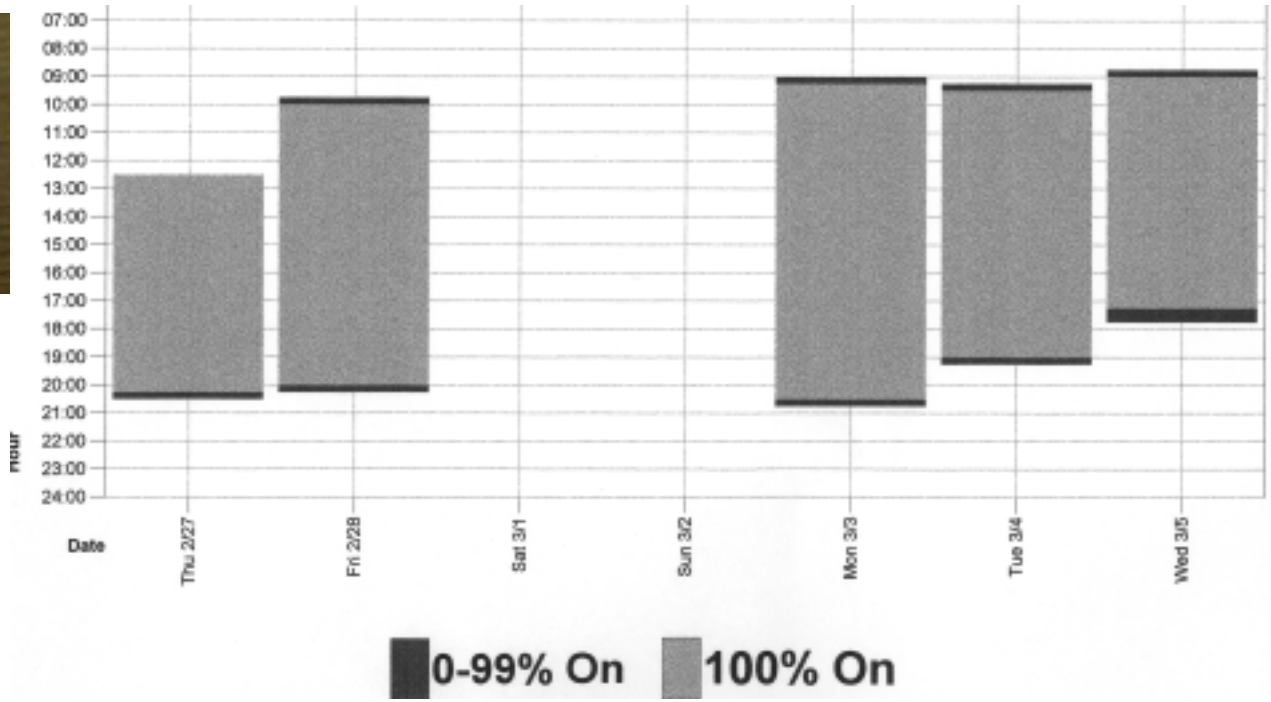
Light Meter: A tool used to measure amount of light coming from the fixture (foot candles)

RADFORD HIGH SCHOOL

Gadgets

Light Logger: A tool placed in the fixture to record the amount of time the lights are on (burn hours).

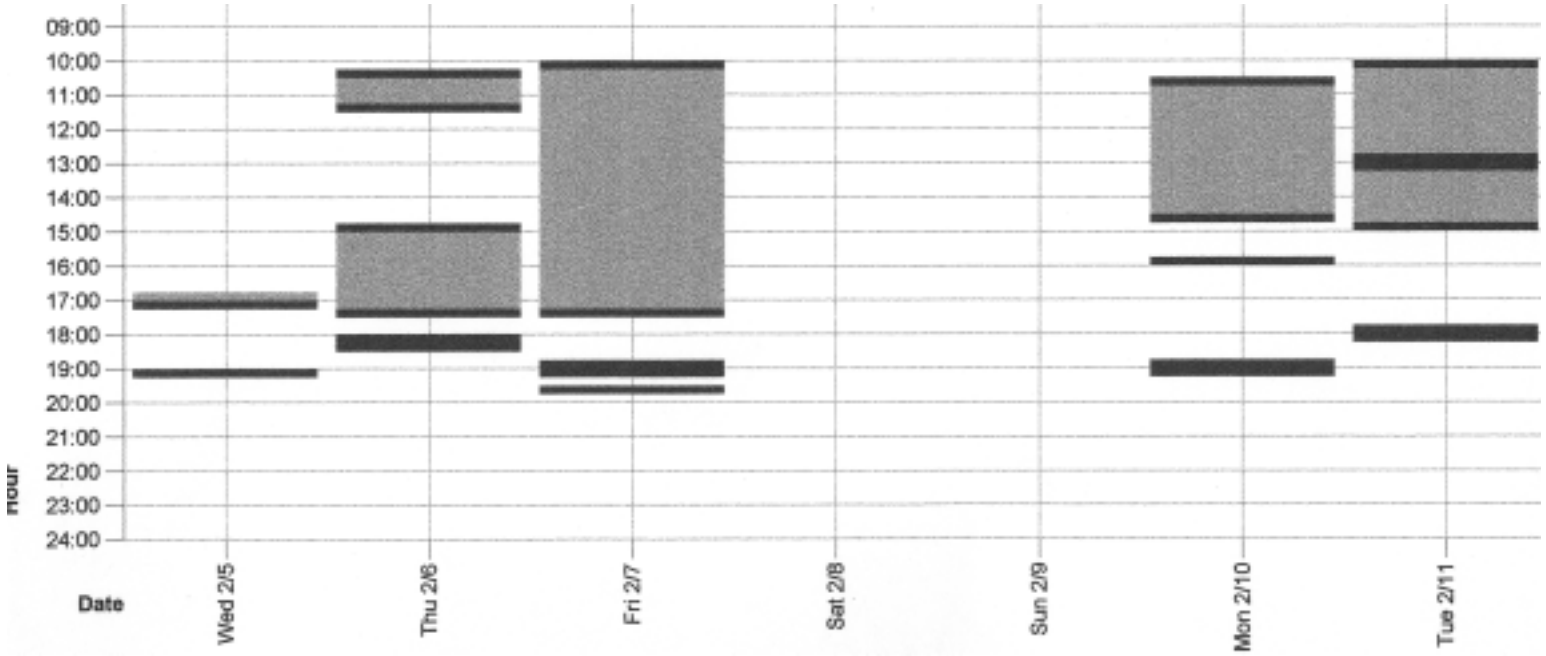
RHS Office



RADFORD HIGH SCHOOL

Gadgets

Light Logger data from Ms. Harbottle's Classroom



RADFORD HIGH SCHOOL

School Background

- **Radford High School was established in 1957 after Admiral Arthur W. Radford of the U.S Navy.**
- **Radford's mission is to provide students with the knowledge and tools to prepare them for adulthood.**
- **The buildings are 46 years old.**
- **Radford has 105 rooms including classrooms, bathrooms, and storage rooms.**
- **Radford has energy efficient T-8 lights**

RADFORD HIGH SCHOOL

Library Audit

Total Fixtures	121	
Total Watts Saved	**5,256**	
kW Saved (watts/1000)	5.26	
Operating Hours per Day:	**8.5**	Hours
Operating Days per Week	**5**	Days
Total Hours per Year	1,700	Hours
Total kWh Saved Per Year	8,935	kWh
Average Cents/kWh	**12.1**	Cents
Annual Estimated Savings	**$ 1,081**	

Calculation of Total Hours per Year is based on a 40 week school year.

RADFORD HIGH SCHOOL

Library Audit

Totals	$ 4,079.14
Sales Tax	$ 169.94
PUC Tax	$ 271.30
Total Estimate *	$ 4,520.38
HECO REBATE	**$ 806.40**
Net Project Cost	**$ 3,713.98**
ESTIMATED ANNUAL SAVINGS	$ 1,081.16
Estimated Payback Period	**3.44 Years**

RADFORD HIGH SCHOOL

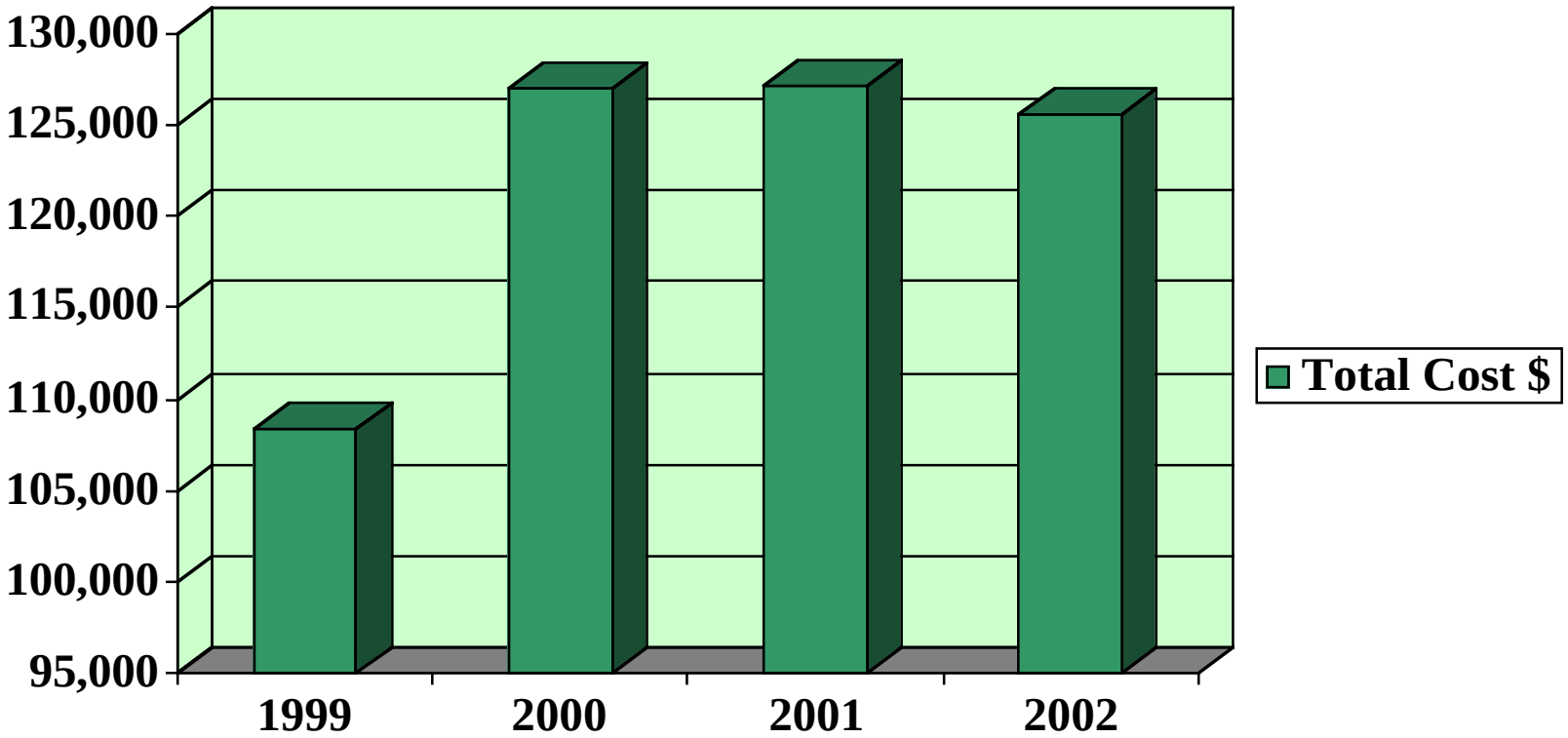
School Audit

Buildings B, C, G, I, L, M, Gym & Lockers

Total Fixtures	1,265	
Total Watts Saved	**70,277**	
kW Saved (watts/1000)	70.28	
Operating Hours per Day:	**7**	Hours
Operating Days per Week	**5**	Days
Total Hours per Year	1,400	Hours
Total kWh Saved Per Year	98,388	kWh
Average Cents/kWh	**12.1**	Cents
Annual Estimated Savings	**$ 11,905**	

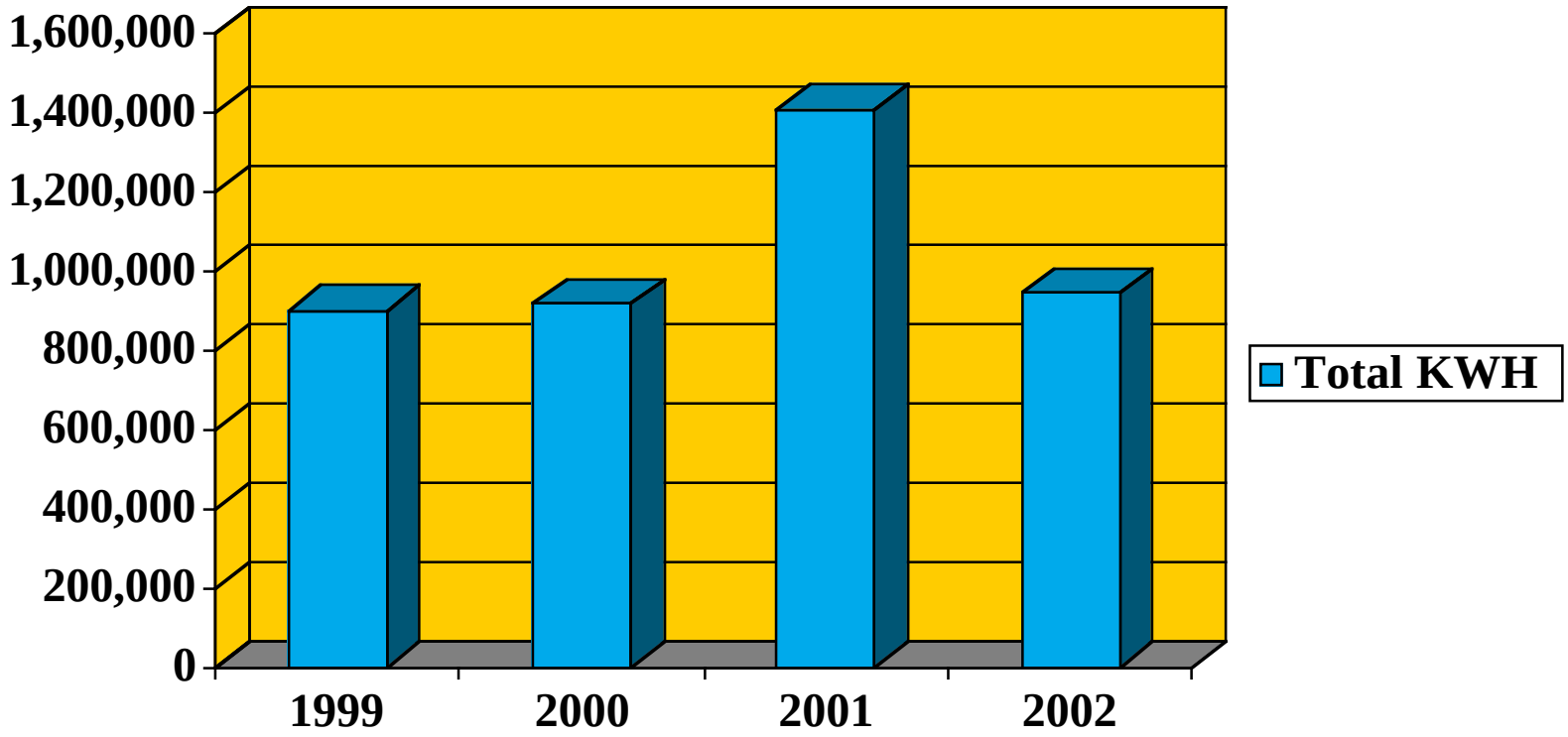
RADFORD HIGH SCHOOL

RHS Electric Bill



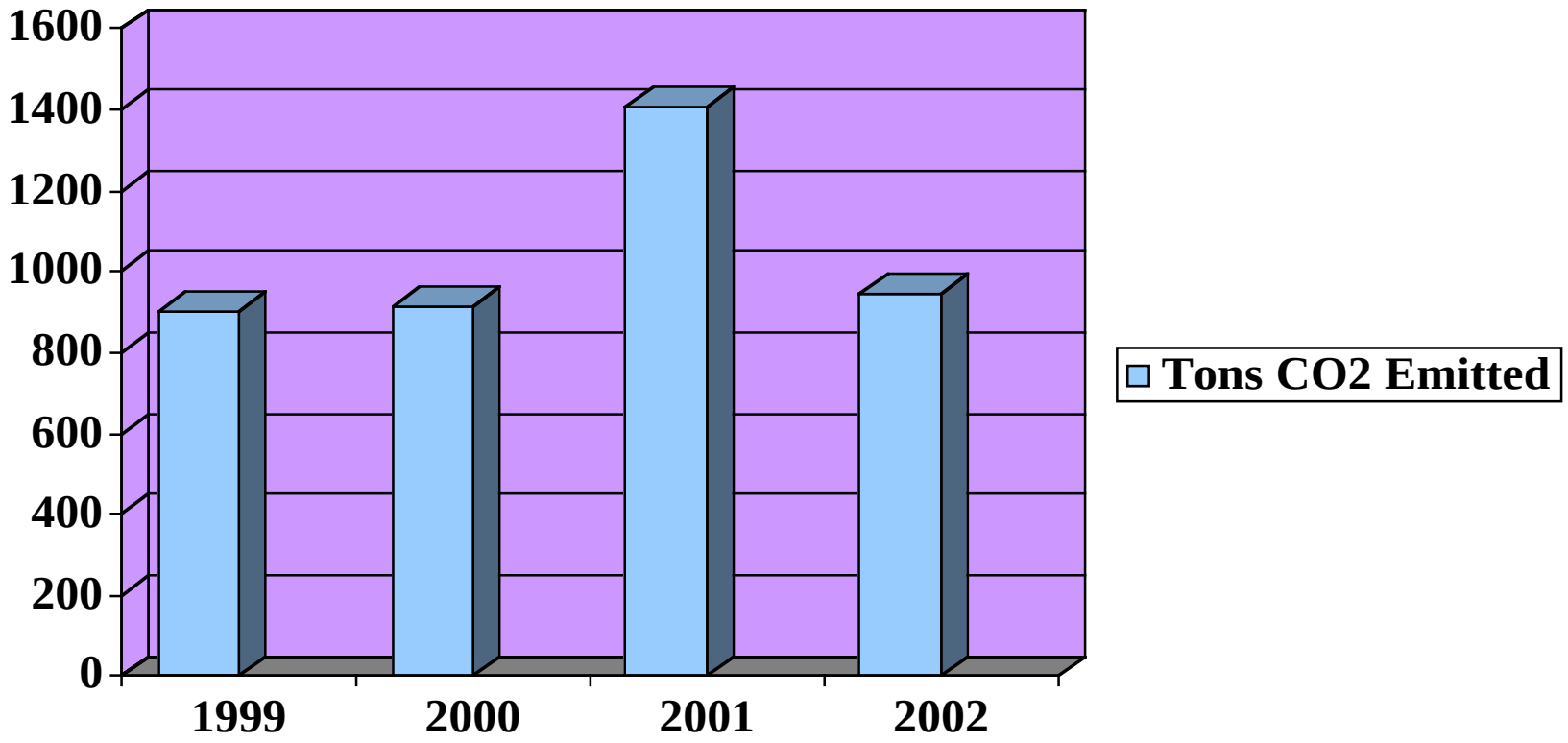
RADFORD HIGH SCHOOL

History Of Electricity Use At Radford High School



RADFORD HIGH SCHOOL

CO_2 Greenhouse Gas



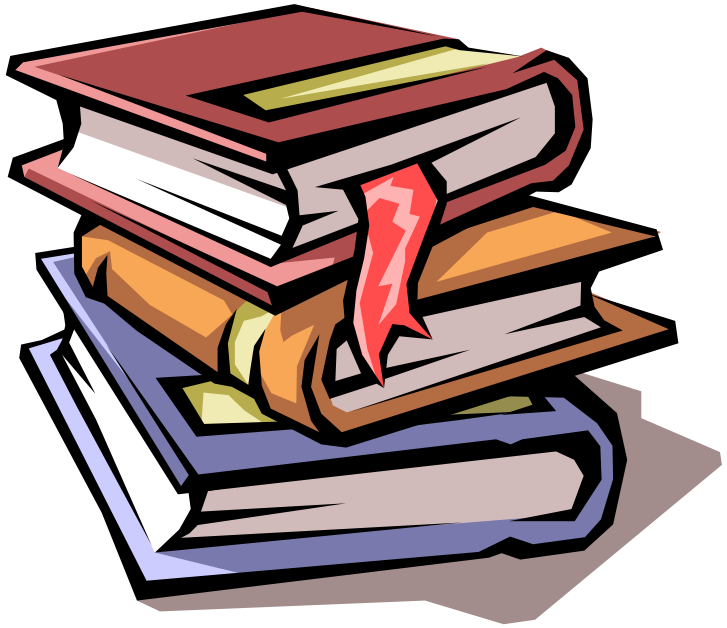
RADFORD HIGH SCHOOL

Radford is Energy Efficient

Our school is already benefiting from retrofitting to T-8s.

Money saved on the electricity bill can go toward other needs such as:

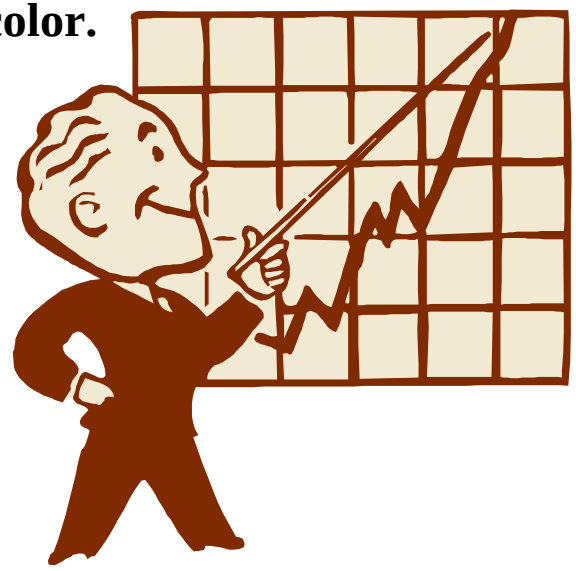
- **School repairs**
- **Text books**
- **Computers**
- **Teacher wages**



RADFORD HIGH SCHOOL

Benefits of T-8 Lights

- **An advantage of retrofitting from T-12 to T-8 lights is that you save money because they are more energy efficient.**
- **T-8 lights last longer than T-12 lights so the custodians will spend less time replacing them.**
- **T-8 lights are also brighter and show truer color.**



RADFORD HIGH SCHOOL

More Solutions

Radford can save even more money by:

- **Getting into the habit of turning off lights and appliances when not in use**
- **Using the natural lighting from outside if it's sunny**
- **Instead of using AC teachers can just open the windows**

RADFORD HIGH SCHOOL

Status

We are going to conduct lighting audits on small business in our community and inform them about how they can save money on their electricity bills.

For more information about this program you can call Jennifer Tosaki at 739-2217

Hawaiian Electric Company
Energy Smart Schools 2002

List of School Building Audits by Students

School Building	Address	Number of Fixtures	Condition of Fixtures	Operating Hours per Day	Operating Days per Week	Total Hours Per Year *(40*	Total kWh Saved Per Year	Annual Estimated Savings	Total Estimate to Retrofit	HECO Rebate	Net Project Cost	Estimated Payback Period *yrs*	SQ. Footage *	Contact Name/ Phone
Student Audit Reports:														
McKinley High School	1039 S.King Honolulu, HI												281,894	Teacher: Sophia Hu Principal: Milton Shishido (808) 594-0400
Library		125	poor	8	5	1600	13,898	$ 1,682	$ 5,835	$ 1,378	$ 4,458	2.65	13,810	
Sample Classroom MS-9		30	good	6	5	1200	1,188	$ 144	$ 993	$ 168	$ 825	5.74	1,710	
Entire school		2844	good	8	5	1600	177,630	$ 21,493	$ 103,614	$ 18,090	$ 85,524	3.98	281,894	
Radford High School	4361 Salt Lake Bl. Honolulu, HI												175,055	Teacher: Peggy Harbottle Principal: Robert K. Stevens (808) 421-4200
Library		121	good	8.5	5	1700	8,935	$ 1,081	$ 4,520	$ 806	$ 3,714	3.44	6,759	
Sample Classroom N-184 (T-8s w/electric ballasts)		27	good	6	5	1200	1,069	$ 129	$ 894	$ 151	$ 743	5.74	1,328	
Buildings B, C, G, I, L, M, Gym & Lockers *		1265	good	7	5	1400	98,388	$ 11,905	$ 51,464	$ 10,268	$ 41,196	3.46	83,927	
***other buildings already retrofitted to T8's**														
Totals														
McKinley Entire School		2844					177,630	$ 21,493	$ 103,614	$ 18,090	$ 85,524	3.98	281,894	
Radford (Various Bldgs. + Library)		1386					107,323	$ 12,986	$ 55,984	$ 11,074	$ 44,910	3.46	90,686	
Two Schools' Totals		**4230**					**284,953**	**$ 34,479**	**$ 159,598**	**$ 29,164**	**$ 130,434**	**3.78**	**372,580**	
													x	

* Accumulated from Department of Education-Facilities Inventory System (may not be complete)

Equipment Used In Energy Smart Schools Program

Light Meter
The light meter measures ambient light levels.

Flicker Checkers
Students used the flicker checkers to determine if the ballasts in the light fixtures are magnetic or electronic. It is spun like a child's spinning top. The pattern on the top of the top is different when spun under lights with magnetic or electronic ballasts.

Data Loggers
The data loggers attach to light fixtures to monitor energy usage. Students download information from the logger to a computer where energy usage is displayed in a graph format.

Pocket Monocular
The monocular is used to identify lamp markings and configurations if one does not have a ladder to use.

Laptop Computer
Students used the laptop computer in class for audit calculations in Excel and Power Point presentations.

KW Meter
The KW meter visually demonstrates efficient vs. inefficient products.

Other Equipment	Function
Digital Camera	Students used the digital camera to record actual examples of various lighting systems and fixtures found in their schools. Also used to take pictures to place in their PowerPoint presentations.
Printer	The printer was used to print out color and black & white marketing materials, classroom documents, and audit reports.
Mr. Wizard Invention Kit	The kit was used for the motor workshop project to demonstrate electricity.
3' Ladder	Used in demonstrations by HECO personnel in workshops. Used to aid in reaching the ceiling fixtures to open fixture for examination.
Hardware: pliers, screwdrivers	Used in demonstrations by HECO personnel in workshops
T8 & T12 lamps	Used in demonstrations by HECO personnel in workshops. Used to demonstrate light levels and color rendition.
Misc. CFLs	Used in demonstrations by HECO personnel in workshops. Used to demonstrate light levels and color rendition.

Quiz #2

1) Which residential task uses the most energy?
   - lighting
   - heating water
   - heating rooms
   - cooling rooms

2) Most energy conservations produce…
   - light
   - heat
   - motion
   - sound

3) What is the definition of watt?

4) Write the formula that converts wattage to kilowatts.

5) Electricity is measured in:
   - Amperes
   - Volts
   - Kilowatt-hours
   - Current

6) Write the formula of the cost of operation for appliances operating at full load.

7) Calculate the cost of operation for an air conditioner (1500 watts) running for 8 hours a day for one month. The cost of electricity is 0.11$ kWh.

   Calculate for one year.

8) Based on your knowledge, list some of the appliances that use the most electricity.

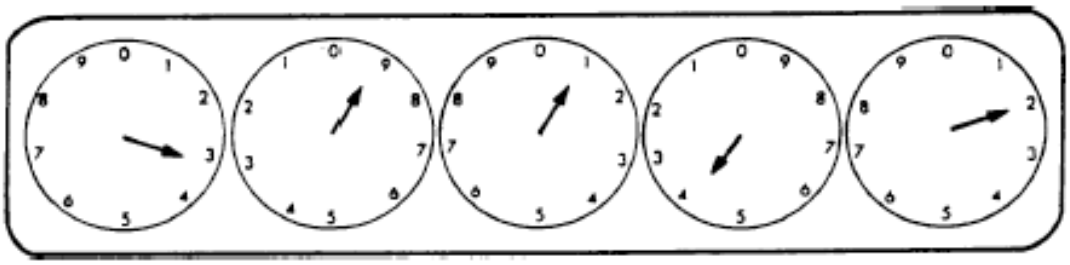
9) Compared to incandescent light bulbs, fluorescent light bulbs…
   - Use more energy
   - Use less energy
   - Use the same amount of energy

10) Read the electric meter pictured below.

Practice Worksheet
Reading an Electric Meter

Electric meters measure electricity in kilowatt-hours (kWh). The meters are usually read monthly (or bimonthly) by a representative from your local electric company so that the company knows how much to bill you for your electric use.

To learn how to read an electric meter yourself, look at the sample meter shown below.



Notice that some of the dials read clockwise and some read counterclockwise. Start at the left and read the number to which the needle points. If the needle is between two numbers, read the *lower* number.

What is the number of kilowatt-hours shown on the dial above?

_____ _____ _____ _____ _____ kWh

11) What are some changes your family could make to reduce the amount of energy it uses?

Energy Smart Schools Quiz #1

1. The marvel of the motor is that a coil and a magnet turn electricity into _____.
2. A motor in reverse is a _____.
3. By moving a coil near a _____, electrical current will flow in the coil.
4. When the sanded side of the coil ends touched the paper clip the coil became an _____.
5. Kahe Power Plant burns _____ to generate electricity.

Energy Smart Schools Quiz #1

6. The marvel of the motor is that a coil and a magnet turn electricity into _____.
7. A motor in reverse is a _____.
8. By moving a coil near a _____, electrical current will flow in the coil.
9. When the sanded side of the coil ends touched the paper clip the coil became an _____.
10. Kahe Power Plant burns _____ to generate electricity.

Lighting Equipment

Description

Lighting equipment is highly dependent upon customer's facility but generally consumes about 20-35% of the total energy.

Equipment

Lamps
Ballasts
Controls

Energy Conservation Measures

- Turn off lighting systems when not in use. Turning off equipment (use only when it is needed) can save about 10 percent or more of the lighting energy requirements.
- Reduce or eliminate general lighting where natural light provides sufficient illumination. Limit higher lighting levels to task areas only. On sunny days, turn off office light switches to take advantage of outside natural lighting.
- Raise blinds and turn off lights in offices that have one full wall of windows.
- Turn off lights whenever a room is unoccupied. In general, considering fluorescent tube life expectancy, energy savings, and group relamping cost, the "lights-on lights-off" break-even point is about 4 to 7 minutes.
- Turn off all lights when cafeteria/lunchroom areas are unoccupied. Switch on by sections when cleaning or for coffee breaks. If possible, arrange coffee breaks close to vending machines.
- If cleaning is done by contract personnel, insist on a clause requiring cleaning personnel to operate lights only in the section being cleaned and to turn off all lights in areas which have been completed.
- Locate energy conservation reminders, such as posters and individual decals, next to light switches and on bulletin boards to alert personnel that turning off lights is their responsibility.
- Eliminate inefficient electric lamps from plant stocks and catalogs.
- Replace burned out lamps as soon as possible to avoid ballast damage.
- Reduce exterior building and grounds illumination to minimum safe level.

- Keep outside windows clean.
- When refurbishing office areas, use light-colored paint on walls and ceilings and light-colored tile or carpet on floors.
- Install timers or occupancy sensors on light switches in little-used areas.
- Lower light fixtures in high ceiling areas.
- Convert to fluorescent, mercury, sodium, or high intensity discharge (HID) lighting.
- Use separate switches on perimeter lighting that may be turned off when natural light is available.
- Minimize illuminated signage hours by using time switches to shut down sign lighting at night after street/highway traffic has decreased.
- Consider installing improved switching capability in offices so that small groups of lights can be used as needed.
- If feasible, install two-level switching to achieve reduced lighting levels during low- or non-use periods.
- Use high efficiency reflectors and lenses in luminaries.
- Investigate feasibility of using automatic light level meter control of fluorescent or mercury vapor wattage to reduce fixture wattage on sunny days and increase it at night.

Student Presentation on School Audits

Before we begin designing our PowerPoint presentation let's answer the following questions:

1. What is the purpose of our presentation?
2. Who is our audience?
3. What do we want them to know?
4. What do we want them to do?

Which one of the following sections will you gather and develop information on? You will be in charge of designing your section into a PowerPoint slide.

Section 1. Student Activities:

- List the goals of the program
- Describe program activities that students have done or are doing
- Show completed student audit results on school. Insert Excel audit reports.

(Next sections, 2 and 2a, require interviews with custodial or office staff to get numbers)

Section 2. School Background:

- Age of school buildings
- Number of classroom
- Average cost of electricity bill costs per month/and year
- Insert graph of energy usage from 1999 until 2002 and average monthly bill

Section 2a. School Background (lighting):

- Type of fluorescent lights currently in classroom (show photo)
- Average number of fixtures in a classroom/ or average square footage
- Show light logger data, light meter, and flicker checker
- Average number of fluorescent lamps changed per week/or month

Section 3. Challenges and Solutions

- How do we save money on our school's electricity bill?
- How do we persuade decision-makers to retrofit to energy efficient lights?
- What steps can our school take to save money?

Section 4. Benefits

- Of retrofitting from T12 to T8 lights
- Of energy cost savings
- Show gallons of oil saved per year and tons of CO_2 reduction (graph)

Creating a PowerPoint Presentation

1. START POWER POINT
2. Choose FILE, and NEW PRESENTATION
3. Click on TITLE SLIDE, and press ENTER. The slide will appear. Type in your text.
4. To add another slide, Choose INSERT and click on NEW SLIDE. You are back to the slide layout screen.
5. Click on the next slide or the slide you desire and press ENTER
6. To delete a slide, go to EDIT and click on DELETE SLIDE
7. To add a table, display the slide, choose INSERT and click on TABLE. Click on up and down arrows to increase the number of columns and rows. Then O.K.
8. To insert a chart, display the slide that contains the CHART. You'll make changes in the datasheet window to make changes in the chart. Change the text and values in the cells of the datasheet as needed. Your text and values will display.
9. To insert an excel sheet, start Excel and Open the WORKSHEET you want to place in the power point.
10. Drag the mouse on the section you choose. This will be highlighted. Then click on COPY BUTTON.
11. Open the POWER POINT presentation and display the slide. Choose EDIT and click on the PASTE BUTTON.
12. To view a slide, click on VIEW and choose SLIDE.
13. To view all the slides in presentation, click on SLIDE SORTER

Appleworks Basics

Start

1. START Appleworks
2. Select new document type: choose DRAWING
3. Go to FILE, then PAGE SETUP, and change orientation to landscape

Add Text

4. To type in your text, click on the capital A on the menu bar
5. Place cursor on the page and type in text. While typing in the text, Appleworks creates a text box around your text. If you want to move the text box, click on the ARROW on the menu bar, then click on the text box to move it around.

Add Clipart Image

6. To add a picture click on FILE, then LIBRARY, and choose an image.

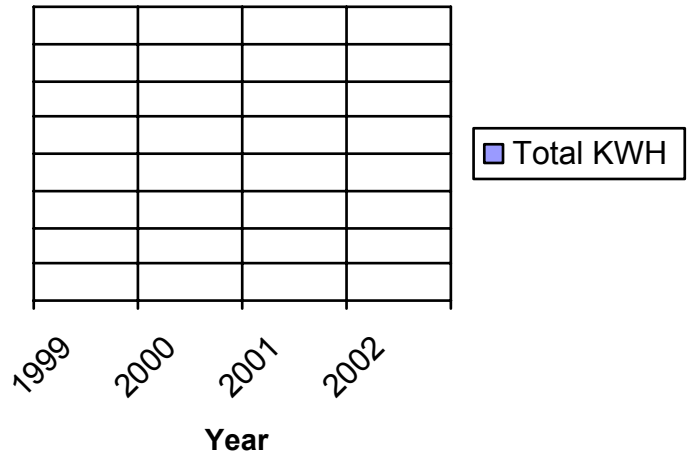
History of school electricity use

Year	Total Cost for Year	Average Monthly Bill	Total KWH	Average Monthly KWH
2002				
2001				
2000				
1999				

History of greenhouse gas (CO_2) released into the atmosphere

Year	Total KWH used for year	**X 2 lbs.** CO_2 per KWH	**/ 2000 lbs. =** tons CO_2
2002			
2001			
2000			
1999			

Make a graph for Total KWH used during the years 1999-2002.



Make a graph for tons of CO_2 released into the atmosphere during the years 1999-2002.

High School Electricity Use/Cost during 12/01 to 11/02

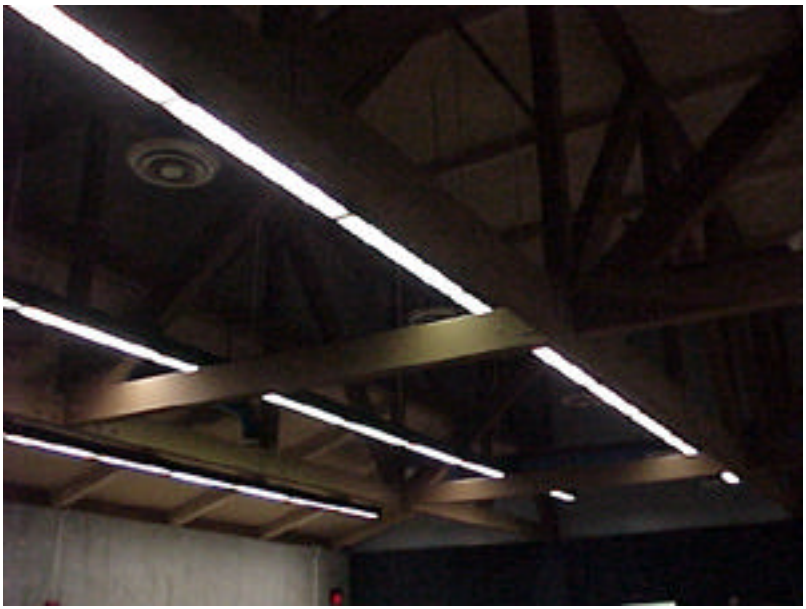
_____ *has _#_ Electric Meters*

Bill Date	# Days in Bill Period	KWH use per day	Cents per KWH	Bill Amount
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
Total			**Total**	

2.1 Lighting Fixtures

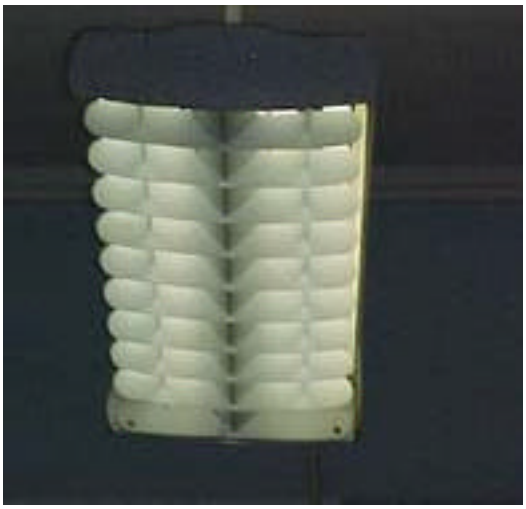
Wrap: Displayed is a 4-foot T-12, 2-lamp wrap fixture with one 2-lamp magnetic ballast mounted in the fixture and the fixture is surface mounted. The retrofit for this type of fixture is 2–T8 lamps and one 2-lamp low wattage electronic ballast. The current condition as displayed in this digital photograph is typical of T12-lamp Magnetic ballast burnout. In a magnetic ballasted fixture as one lamp goes bad the other lamp automatically cuts out. Electronic fixtures will allow the still working lamp to stay illuminated.

Strips: Displayed is a 4-foot T-12, 2-lamp strip fixture with one 2-lamp magnetic ballast mounted in the fixture. These fixtures are mounted back to back on a uni-strut beam is hung by a pendant stem secured to the ceiling of this classroom. The retrofit for this type of fixture is 2–T8 lamps and one 2-lamp low wattage electronic ballast.



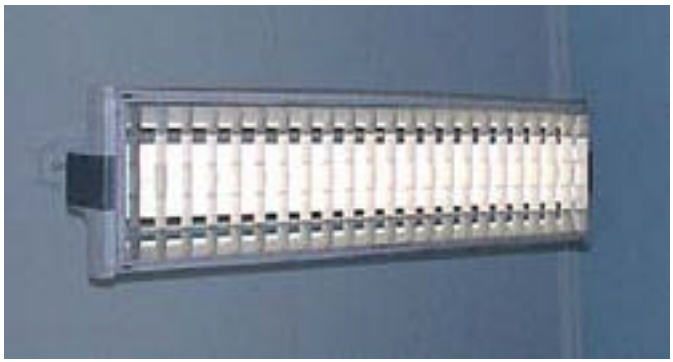
Troffer: Displayed is a 4-foot T-12, 2x4 4-lamp lay-in troffer. It is designed to "lay" into a drop or suspended ceiling. The retrofit for this type of fixture is 4-T8 lamps and one 4-lamp low wattage electronic ballast.

Vapor: Displayed is a 4-foot T-12, 2-lamp strip fixture with one 2-lamp magnetic ballast mounted in the fixture. This fixture has a vapor tight enclosure designed to resist moisture. This type of fixture will most commonly be found in locker rooms and in exterior applications. The retrofit for this fixture is 2–T8 lamps and one 2-lamp low wattage electronic ballast.



4 Foot Ice Fixture: Displayed is a 4-foot T-12, 4-lamp schoolhouse fixture with two 2-lamp magnetic ballasts. This fixture is hung by a pendant stem secured to the ceiling of this classroom. The term "Ice" fixture has been designated by the Maui Community College surveyors to this fixture because of its appearance to an ice-tray. This fixture is recommended for replacement by a 4-foot T-8, 4-lamp wrap fixture with one 4-lamp low wattage electronic ballast.

8 Foot Ice Fixture: Displayed is a 8-foot T-12 8-foot magnetic ballasts mounted in the fixture and is hung by a pendant stem secured to the ceiling of this classroom. This fixture is recommended for replacement by a 8foot long T-8, four foot 4-lamp wrap fixture with one 4-lamp low wattage electronic ballast.



Electronic 4 Lamp Troffers: Displayed is a 4-foot T-8, 2x4 4-lamp surface mount troffer. By design this fixture is mounted to a solid surface. This fixture is typical of those found in most new portable structures. The fixture displayed is already energy efficient and requires no further retrofit.

2x2 Fixture: Displayed is a 4-foot T-12, 2-lamp U-bend fixture with one 2-lamp magnetic ballast mounted in the fixture. The retrofit for this fixture is 2–T8 lamps and one 2-lamp low wattage electronic ballast.

ENERGY $OLUTIONS
FOR SMALL BUSINESS

LIGHTING SERVICES WORKSHEET
2004 ENERGY SAVINGS

CUSTOMER NAME:

HECO ACCOUNT NUMBER:

COMPLETED BY: Date

Fixture Type	Lamps per Fixture	Watts/Fixture T-12 Mag. Ballast	Watts/Fixture T-8 Elect. Ballast	Watts/Fixture Saved	Number of Fixtures	Total Watts Saved
Fixture with 8 foot fluorescent lamps	4 lamps	284	220	64		-
	3 lamps	227	180	47		-
	2 lamps	142	110	32		-
	1 lamp	85	70	15		-
***Tandem** (use current fixt qty)	1 lamp	85	55	30		-
Fixture with 8 foot High Output	4 lamps	454	320	134		-
fluorescent lamps:	3 lamps	337	247	90		-
	2 lamps	227	160	67		-
	1 lamp	110	87	23		-
Fixture with 4 foot fluorescent lamps	4 lamps	168	98	70		-
	3 lamps	133	76	57		-
	2 lamps	84	51	33		-
	1 lamp	49	32	17		-
8' I lamp to 4' 2 Lamp conversion	2 lamp	85	51	34		-
8' I lamp to 4' 2 Lamp conv with Reflector		85	51	34		-
8' 2 lamp to 4' 4 Lamp conversion	4 lamp	142	98	44		-
8' 2 lamp to 4' 4 Lamp conv with Reflector		142	98	44		-
Fixture with 4 foot fluorescent lamps						-
						-
***Tandem** (use current fixt qty)	2 lamps	84	49	35		-
***Tandem** (use current fixt qty)	1 lamp	49	26	24		-
Delamping 4 foot fixtures						
From 4 lamp to 2 lamp	4 lamp	168	51	117		-
From 3 lamp to 2 lamp	3 lamps	133	51	82		-
4 lamp to 2 lamp w/ reflector	4 lamps	168	59	109		-
4 lamp to 3 lamp w/ reflector	3 lamps	133	51	82		-
Fixture with U-Bend fluorescent lamps	2 lamps	84	51	33		-
(install 2x 2' lamps w/reflector includes delamping)	2 lamps	84	34	50		-
Fixture with 3 foot fluorescent lamps	4 lamps	162	85	77		-
	3 lamps	126	70	56		-
	2 lamps	81	46	35		-
	1 lamp	45	24	21		-
Fixture with 2 foot fluorescent lamps	4 lamps	100	62	38		-
	3 lamps	75	52	23		-
	2 lamps	50	34	16		-
	1 lamp	25	22	3		-
Fixture with 4 foot fluorescent lamps	2 lamps	84	51	33		-
and emergency ballast	1 lamp	49	32	17		-
LED exit signs:	2 lamps	40	2	38		-
T8 lamp tube guards:	4 foot T8 tube					
(not included in fixture total)	8 foot T8 tube					
					-	-

Total Fixtures	-	
Total Watts Saved	-	
kW Saved (watts/1000)	-	
Operating Hours per Day:		Hours
Operating Days per Week		Days
Total Hours per Year	-	Hours
Total kWh Saved Per Year	-	kWh
Average Cents/kWh	12.1	Cents
Annual Estimated Savings	$ -	

HECO Energy Smart Schools Program

How To Enter Data Into The Excel Audit Worksheets

1. Open the Excel T8 worksheet.
2. Look on bottom left hand corner for titled worksheet tabs.
3. Choose the worksheet tab titled **Savings (input sheet)**.
4. Review the rows in the worksheet to identify **Fixture Types** and **Lamps per Fixture** found on your audit.
5. Under column I, **Number of Fixtures**, enter totals from your tally sheet.
6. To enter a number just click on the box, type in your number, and press enter.
7. When you enter a number under column I another number will pop up in column J. This number displays the total watts saved if you converted T12 lamps with magnetic ballasts to T8 lamps with electric ballasts.
8. When you are finished entering the fixture totals off your tally sheet scroll down to the bottom of the page.
9. Review the number given for **Total Fixtures**. Does this total match the number on your tally sheet?
10. Scroll down the bottom of the page and enter the operational hours in column E next to **Operating Hours per Day** and **Operating Days per Week**.
11. The worksheet will calculate and display **Annual Estimated Savings**.
12. Look on bottom left hand corner for worksheet tab titled **Project Cost**. Choose this tab to review the calculated retrofit costs, energy savings, and HECO rebates.

Hawaiian Electric Company Energy$olutions℠ for Business Program

Lighting Equipment Survey

CUSTOMER INFORMATION

Customer

Date

Project

LOCATION	EXISTING EQUIPMENT				COMMENTS
Location (Rm Name, Rm.No., Area, Zone, etc)	No. of Fixtures	Ballast Type	Lamp Type	Lamps per Fixture	Comments
(Ex.) 106 Office	*56*	*Std. Mag.*	*4' T12 34W*	*2*	*Proposed tandem wired*

Notes: Please enter only one (1) fixture type per line.

Conducting A Lighting Audit

Record the following information on your *Lighting Equipment Survey* worksheet.

1. Ask the librarian/teacher for permission to conduct a lighting audit. Explain what you are going to be doing and why.
2. Ask the librarian/teacher questions about types of lights and hours of operation.

    a. Do they know what kinds of lamps they have? *Do they have T12 or T8 fluorescent lamps? Have they done a lighting retrofit recently?*
    b. What are the hours of operation? *What time does the first person enter the building and turn on the lights? What time does the last person leave and turn off the lights?*

3. Look around and choose which room you will start your audit in.
4. Identify and count the number of fixtures and lamps.
5. Count the number of exit signs. Are they LED signs?
6. Are there any incandescent lights?

Make three recommendations on ways to reduce the lighting's energy use at this location.

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    a. Do they know what kinds of lamps they have? *Do they have T12 or T8 fluorescent lamps? Have they done a lighting retrofit recently?*
    b. What are the hours of operation? *What time does the first person enter the building and turn on the lights? What time does the last person leave and turn off the lights?*

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6. Are there any incandescent lights?

Make three recommendations on ways to reduce the lighting's energy use at this location.

LIGHTING SURVEY SHEET

Bulb type	Wattage	Average lumens per watt	Average lifetime in hours	Electricity consumption in kWh = hours x $\frac{\text{wattage}}{1000}$	Lifetime cost = cost of bulb + electric rate x kWh

LIGHT TYPE INFORMATION GUIDE

BULB TYPE	WATTAGE	AVERAGE LUMENS PER WATT	AVERAGE LIFETIME IN HOURS
COMPACT FLUORESCENT	7W–32W	65	10,000
COOL WHITE FLUORESCENT (4')	40W	46	16,000
WARM WHITE FLUORESCENT (4')	40W	46	16,000
INCANDESCENT	20W–1500W	18	1,025
ROUGH DUTY INCANDESCENT	20W–1500W	10	750
HIGH PRESSURE SODIUM	70W–1000W	104	22,000
LOW PRESSURE SODIUM	18W–180W	100	14,000
MERCURY VAPOR	50W–1000W	33	20,000

Student Sheet
APPLIANCE ENERGY USE

Think about burning ten 100-watt light bulbs for one hour. That's the amount of electricity equivalent to one kilowatt-hour. Just as you pay for gallons of gas, quarts of milk, and loaves of bread, you pay for kilowatt-hours of electricity.

The chart below shows the average number of kilowatt-hours of electricity that various appliances use.* If you are interested in how much it costs to operate one of these appliances for a month or a year contact your local utilities company.

	Average kWh Used	
Kitchen Appliances	Anually	Average kWh Used Monthly
Range w/self-cleaning oven	1224	102
Range w/oven	1152	96
Microwave oven	300	25
Frying pan	190	16
Coffee maker	110	9
Toaster	40	3
Mixer	10	1
Food disposer	30	3
Dishwasher	1560**	130
	2160	180
Refrigerator/freezer 16-25 cu ft side-by-side model, automatic defrost		
Refrigerator/freezer 14 cu ft automatic defrost	1800	150
Refrigerator/freezer 14 cu ft manual defrost	1200	100
Refrigerator/freezer 17 cu ft, 2-door, high efficiency, automatic defrost	1200	100
Freezer, 15 cu ft automatic defrost	1200	150
Freezer, 15 cu ft manual defrost	1800	100
Laundry Appliances		
Clothes dryer	1000	83
Clothes washer	624**	52
Hand iron	150	13
Other Appliances		
Quick recovery water heater	5400***	450
Vacuum cleaner	50	4
Clock	18	2
Toothbrush	0.5	0.04

DAILY USE OF ELECTRICITY IN MY HOME

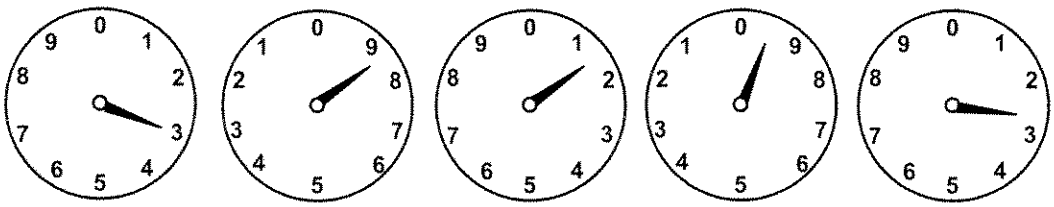
DATE	TIME	READING	kWh USED DAILY	COST (kWh X____ *)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				

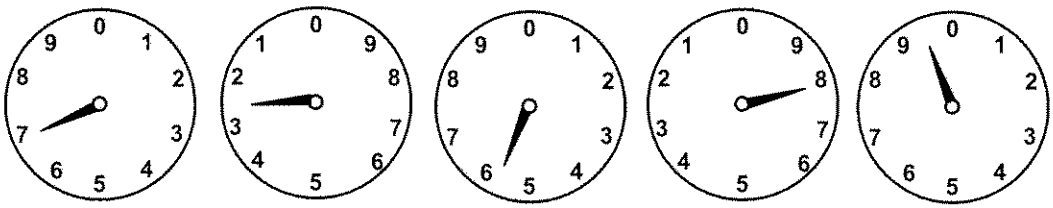
* Current kWh cost; e.g. $0.056 per kWh in 1990.

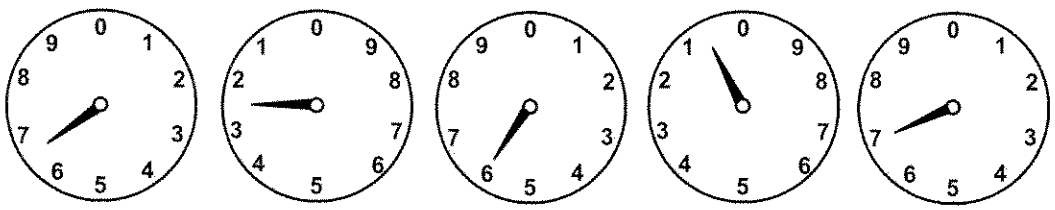
METER READING WORKSHEET

Read the following meters and write your answer in the space below each dial face.

Electric Meters

1. 

2. 

3. 

Student Sheet

HOW TO READ YOUR METER

In order to read an electric meter you must read from left to right. You must also determine which way the hands are turning on each dial.

Example:

The 1 is to the left side of the dial. This would indicate the hand is turning counter-clockwise.

Here the 1 is the right side of the dial, indicating the hands turns clockwise.

Write down the number each hand has passed. This may not be the number nearest the hand. For instance, if the hand has passed the 4 and is almost to the 5, you still read it as 4. Write down the numbers in the same order as you read the dials from left to right.

In the example given, the reading is 46372. If the last reading was 45109, subtract 45109 from 46372. This will give you the number of kWh used.

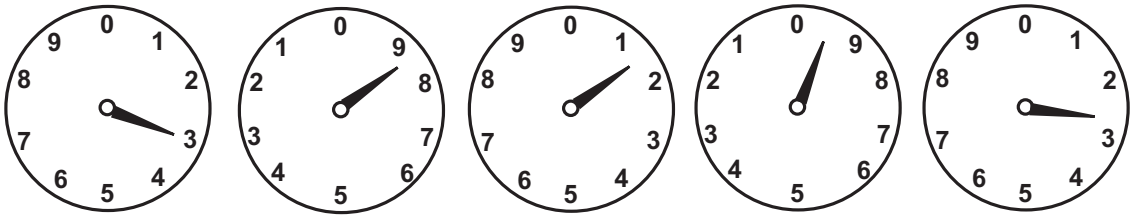
That is all there is to reading a meter, with one exception. If a hand points straight at a number and you do not know if it has passed the number or not, then look at the dial to the right. Has its hand passed zero?

To analyze your family's electricity use, read your meter daily for about two weeks, at approximately the same time each day. Record the readings on the following table.

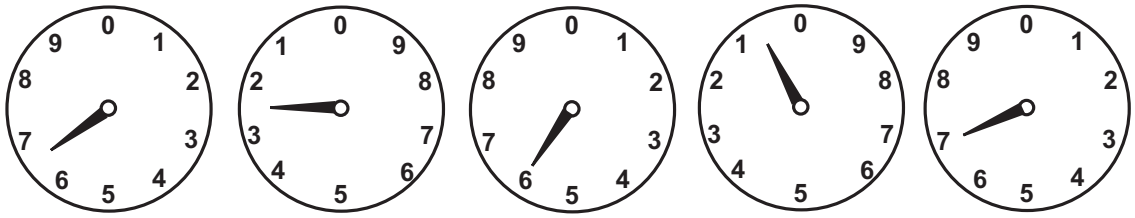
METER READING WORKSHEET

Read the following meters and write your answer in the space below each dial face.

Electric Meters

1. 

2. 

3. 

DAILY USE OF ELECTRICITY IN MY HOME

DATE	TIME	READING	kWh USED DAILY	COST (kWh X____ *)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				

* Current kWh cost; e.g. $0.056 per kWh in 1990.

Student Sheet

WATTAGE RATINGS

Check four different appliances for their wattage ratings. Using the conversion to kilowatt-hours(kWh) calculate the electricity usage for each appliance.

Appliance: _____

_____watts/1000 watts/kWh per hour of operation = _____ kWh

Appliance: _____

_____watts/1000 watts/kWh per hour of operation = _____ kWh

Appliance: _____

_____watts/1000 watts/kWh per hour of operation = _____ kWh

Appliance: _____

_____watts/1000 watts/kWh per hour of operation = _____ kWh

Appliance: _____

_____watts/1000 watts/kWh per hour of operation = _____ kWh

ELECTRICAL APPLIANCE ENERGY TABLE

Appliance Wattage Rating	Kilowatt-hours of Electricity Used per Hour	Ounces of Oil Burned per Hour	Ounces of Coal Burned per Hour
10	0.01	0.01	0.13
25	0.025	0.025	0.33
40	0.04	0.4	0.5
60	0.06	0.6	0.8
100	0.1	1	1.33
150	0.15	1.5	2
200	0.2	2	2.66
300	0.3	3	4
500	0.5	5	6.66
750	0.75	7.5	10
1000	1	10	13.33
1500	1.5	15	20
2000	2	20	26.66
5000	5	50	66.66
10000	10	100	133.33

Student Sheet
APPLIANCE ENERGY USE

Think about burning ten 100-watt light bulbs for one hour. That's the amount of electricity equivalent to one kilowatt-hour. Just as you pay for gallons of gas, quarts of milk, and loaves of bread, you pay for kilowatt-hours of electricity.

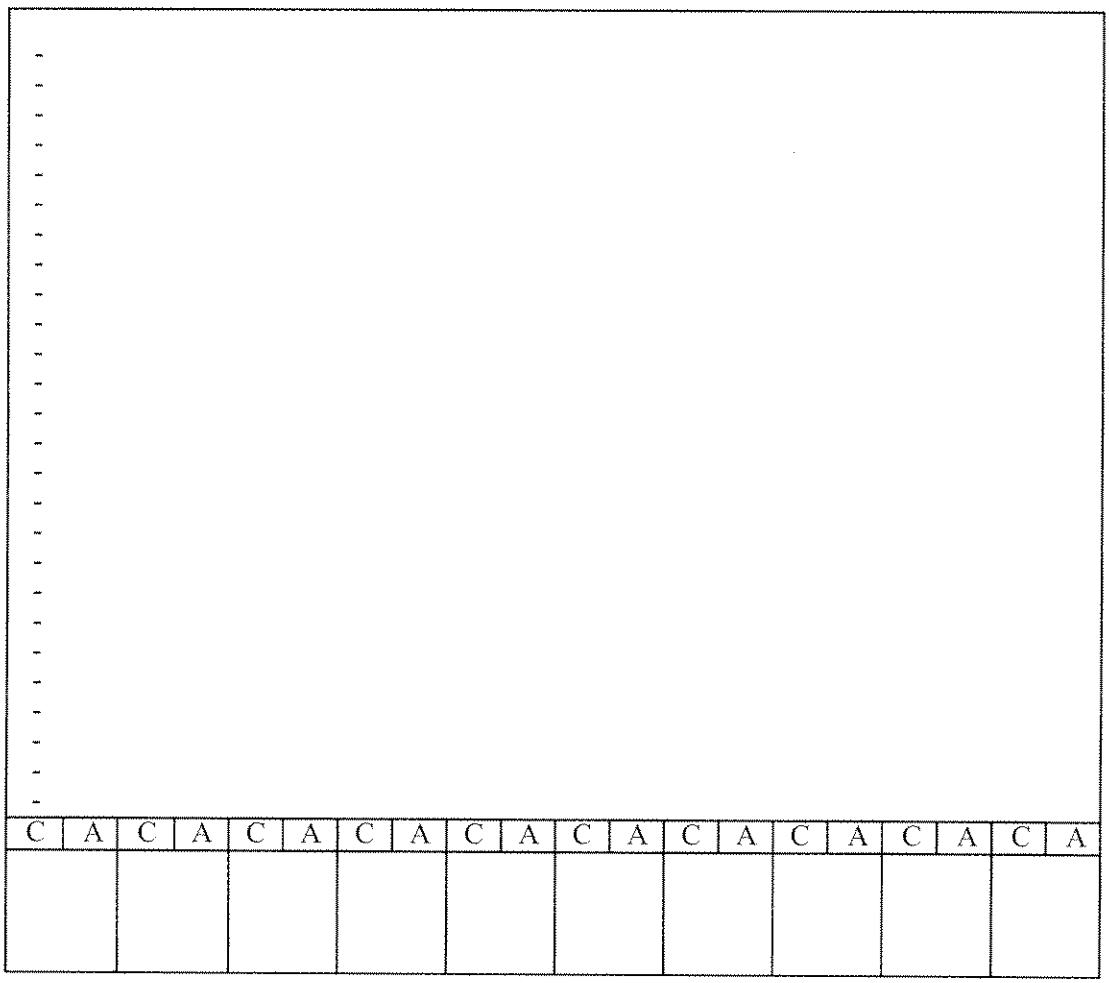
The chart below shows the average number of kilowatt-hours of electricity that various appliances use.* If you are interested in how much it costs to operate one of these appliances for a month or a year contact your local utilities company.

	Average kWh Used	
Kitchen Appliances	Anually	Average kWh Used Monthly
Range w/self-cleaning oven	1224	102
Range w/oven	1152	96
Microwave oven	300	25
Frying pan	190	16
Coffee maker	110	9
Toaster	40	3
Mixer	10	1
Food disposer	30	3
Dishwasher	1560**	130
	2160	180
Refrigerator/freezer 16-25 cu ft side-by-side model, automatic defrost		
Refrigerator/freezer 14 cu ft automatic defrost	1800	150
Refrigerator/freezer 14 cu ft manual defrost	1200	100
Refrigerator/freezer 17 cu ft, 2-door, high efficiency, automatic defrost	1200	100
Freezer, 15 cu ft automatic defrost	1200	150
Freezer, 15 cu ft manual defrost	1800	100
Laundry Appliances		
Clothes dryer	1000	83
Clothes washer	624**	52
Hand iron	150	13
Other Appliances		
Quick recovery water heater	5400***	450
Vacuum cleaner	50	4
Clock	18	2
Toothbrush	0.5	0.04

Home Appliance Use

Directions:

1. In the ten spaces at the bottom of the graph, write the names of ten different appliances.
2. Using the large floor plans on the class display, observe how many class members and adults owned each of the ten appliances.
3. Decide on what would be an appropriate number scale for "Number of Appliances" and fill in the numbers to make the scale.
4. Above each of the ten appliances, mark the number owned by class members and the number owned by adults. Draw bars to represent these numbers.



y axis: Number of appliances

C= Class
A= Adults

Home Appliance Survey

Directions: In Column 1, write the numbers of each kind of appliance you have in your home. Then have an adult fill in Column 2 for when he/she was your age. Total the number of appliances listed for each column.

	1	2		1	2
Air Conditioner, Central			Air Conditioner, Home Unit(s)		
Automatic Bag Sealer, Electric			Automatic Egg Cooker		
Automatic Timer, 24 hour			Battery Charger, Electric		
Baby Bottle Warmer			Beanpot, Electric		
Blanket, Electric			Blender		
Broiler, Electric, Portable			Broom, Electric		
Bun Warmer, Electric			Calculator with Adapter		
Can Opener, Electric			Coffeemaker, Electric		
Comb, Electric			Cookie Maker, Electric		
Clock, Electric			Crepe Maker		
Defroster for Refrigerator			Dehumidifier		
Dishwasher			Disposer, Food Waste		
Door Bell, Electric			Doughnut, Maker		
Drill, Electric			Dryer, Clothes (Electric/Gas)		
Fan, Electric			Fingernail Buffer, Electric		
Floor Waxer			Fondue Pot, Electric		
Food Dryer, Dehydrator			Food Processor		
Food Slicer, Electric			Food Warmer Tray		
Foot Whirlpool, Electric			Freezer, Independent Unit		
Fryer, Deep Fat, Electric			Frypan, Electric		
Furnace (Electric/Oil/Gas/Wood)			Garage Door, Electric		
Griddle, Electric			Griddle, Electric		
Grill, Outdoor (Electric/Gas)			Guitar, Electric		
Hairbrush, Electric			Haircurlers, Electric		
Hair Curling Iron, Electric			Hair Dryer, Standing/Portable/Blower		
Hamburger Maker, Electric			Heater, Room, Electric		
Heating Pad			Hedge Trimmer, Electric		
Hot Dog Cooker, Electric			Hot Pot, Electric		
Humidifier			Ice Cream Maker, Electric		
Ice Crusher, Electric			Intercom		
Iron, Regular or Steam			Kiln, Ceramic, Electric		
Knife, Electric			Knife Sharpener, Electric		
Lamp, Standard			Lamp, Heat		
Lamp, Sun			Lawn Edger & Trimmer, Electric		
Lawnmower, Electric			Light, Indoor Night or Ceiling		
Light, Outdoor Lawn			Manicure Set, Electric		
Massager, Electric			Meat Grinder, Electric		
Mirror, Lighted for Make-up			Mixer, Electric		
Organ, Electric			Oven, Dutch, Electric		
Oven, Portable			Oven, Toaster		

Peanut Butter Machine, Electric			Peeling Wand, Electric		
Pencil Sharpener, Electric			Pizza Maker, Electric		
Popcorn Popper, Electric			Portable Buffet Ranges, Electric		
Projector, Movie			Projector, Slide		
Radio, Clock			Radio, Standard		
Range, Kitchen, Electric/Gas			Rotisserie		
Router, Electric (Tool)			Rug Shampooer		
Sander, Electric			Saw, Electric		
Scissors, Electric			Sewing Machine		
Shoe Polisher, Electric			Slow Cooker, Electric		
Soldering Kit, Electric			Tape recorder, Electric		
Television			Thermostat (Oil/Gas)		
Toaster			Toothbrush, Electric		
Train Set, Electric			Typewriter, Electric		
Vacuum Cleaner			Vaporizer		
Waffle Iron			Washing, Clothes		
Water Heater (Electric/Oil/Gas)			Water Pik		
Whirlpool, Electric			Wok, Electric		
Woodburning Set, Electric			Yogurt Maker, Electric		
Other _____			Other _____		
Other _____			Other _____		
Other _____			Other _____		
Other _____			Other _____		

Year in which the adult was your age: _____

Total of Column 1 _____

Total of Column 2 _____

Home Appliance Use

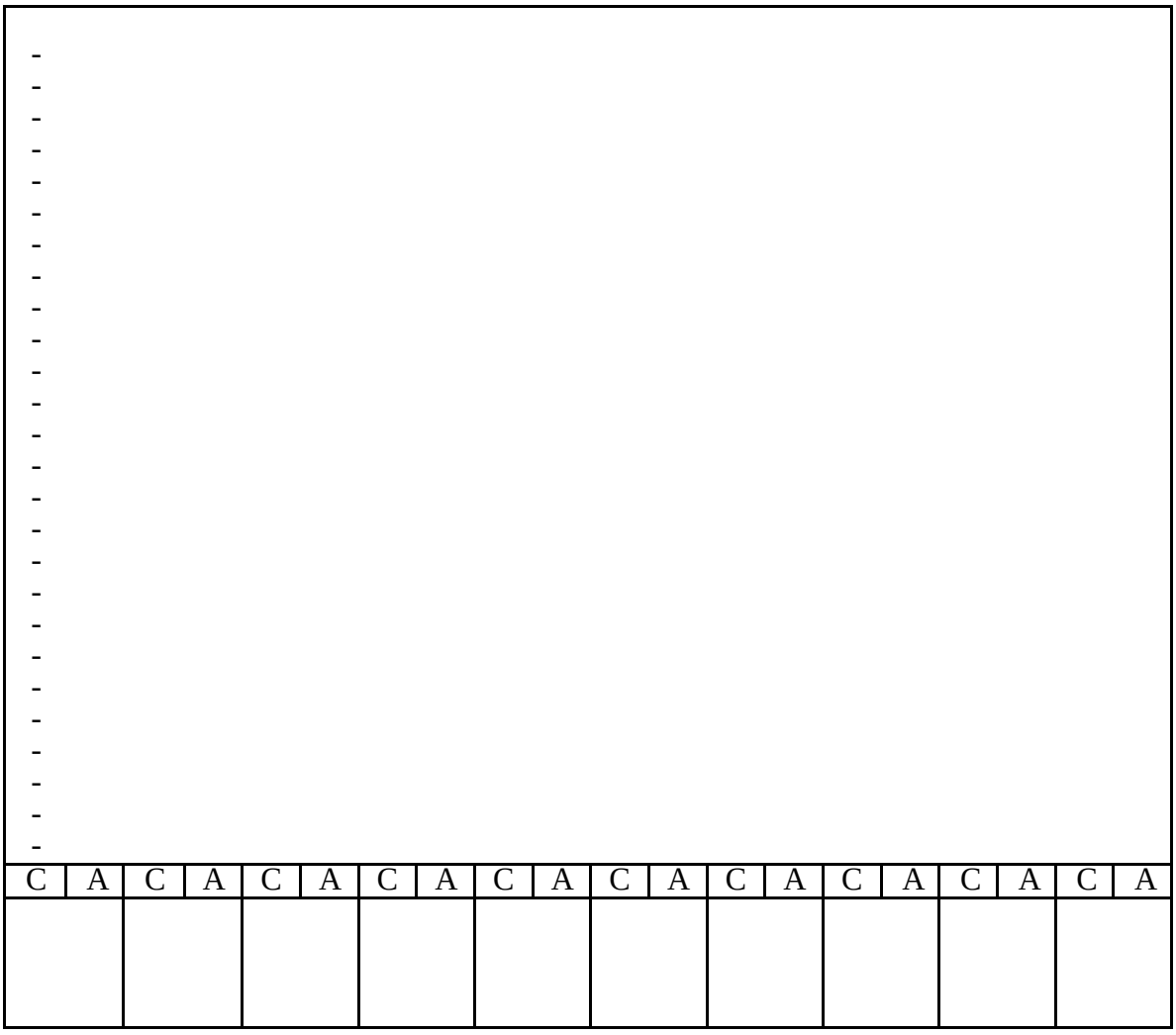
Directions:

1. In the ten spaces at the bottom of the graph, write the names of ten different appliances.

2. Using the large floor plans on the class display, observe how many class members and adults owned each of the ten appliances.

3. Decide on what would be an appropriate number scale for "Number of Appliances" and fill in the numbers to make the scale.

4. Above each of the ten appliances, mark the number owned by class members and the number owned by adults. Draw bars to represent these numbers.



y axis: Number of appliances

C= Class
A= Adults

STUDENT HANDOUT

ENERGY SAVING SUGGESTIONS

Name_____ Date_____ Period_____

1. Don't leave lights during or electric heaters operating in unoccupied rooms.

2. Turn out yard lights during the day.

3. Don't leave water running while brushing your teeth or washing dishes.

3. In the winter, open the blinds or curtains during the day so the sun's rays can shine through the windows and heat the rooms. The sun's heat will help cut down on the amount of gas, oil, or electric heat used in your house.

5. At night, when the sun has set, close the blinds and curtains to keep heat inside the rooms.

6. Close the door tightly when you enter or leave the house. Remind others in your house to do this too. In the winter, this will keep heat in the house. This will also keep an air conditioned house cool during the summer.

7. Before you open the refrigerator door, decide which food and drink you will take out. Try to open the door only once to get what you need. Why does closing the refrigerator and freezer doors tightly and quickly save energy?

8. Check the bathroom and kitchen hot water faucets to be sure they are not dripping. It takes a great deal of energy to heat water. A single dripping hot water faucet can waste 212 gallons of water a month!

9. Take a short shower instead of a tub bath because it uses less water. By using less water, you use less energy to heat the water.

10. Don't leave appliances running when they're not in use.

11. Insulate the hot water heater. Do laundry using a cold wash followed by a cold rinse.

12. Turn the thermostat on the water heater down to 120°F (48.8°C) or if your home has an electric dishwasher to 140°F (60C).

13. Turn your house thermostat to 65°F or lower in the winter and 78°F or higher in summer. This will affect the meter reading more noticeably if a house is heated electrically. Three to 5 percent more energy is used for each degree the furnace is set above 65°F and for each degree the air conditioner is set below 78°F.

14. Do only full loads when using your clothes washer and dryer. Clean the dryer's lint trap after each use. On sunny days, hang the clothes out to dry.

15. If your home has an electric dishwasher, open the door and air dry the dishes instead of using the drying cycle. Also, wash only full loads and use the shortest cycle that will get the dishes clean.

16. Replace high wattage light bulbs with bulbs of lower wattage.

17. If your house has a furnace with a fan or blower, keep the air filter clean and adjust the fan belt regularly to eliminate slippage.

18. When purchasing new appliances, check Energy Efficiency Rating.

Bright Ideas

OBJECTIVES

Students will gain an understanding of the energy used to operate lights.

SUMMARY

Given information on lighting types, students will compute how much electricity and money it takes to provide lights in their homes and classrooms.

GROUPS

Divide students equally into as many groups as you have sample lighting types.

TIME

30 MIN.

SUBJECTS

Math, science, critical thinking.

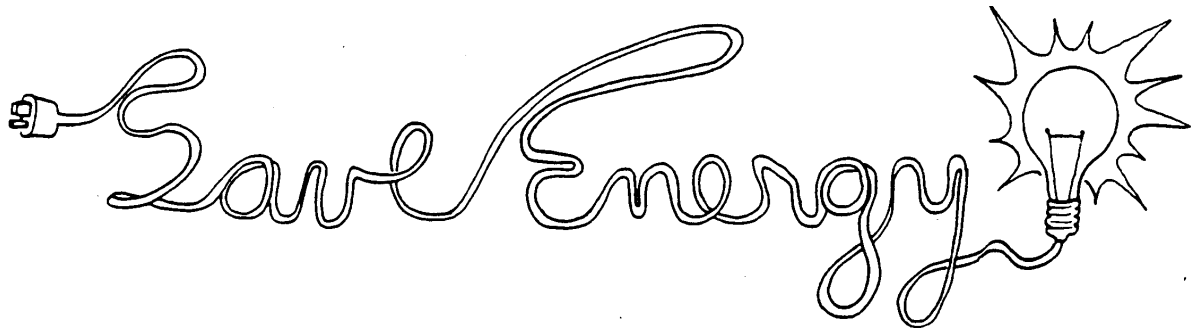
VOCABULARY

Compact fluorescent, lumen, watt, efficient.

MATERIALS

Copies of lighting survey sheet
Overhead transparency of "Anatomy of a Light Bulb." You could draw it on the board or make handouts.
As many of the light bulb types listed on the survey sheet as you can find and borrow, hopefully with the boxes they came in.
The rate charged for electricity in your area.
Light Type Information Guide: use this only if you can't gain access to varied bulb types.

PREPARATION & BACKGROUND: Collect all your materials and familiarize yourself with the diagram of a light bulb and the Light Type Information Guide. Incandescent bulbs work by applying electricity to the filament. The filament slows the progress of the charge, thus emitting light and heat. Fluorescent bulbs apply the electricity to a contained gas; its electrons use electrical energy to jump up, then re-emit that energy as light, when they fall back towards their nuclei. Recently developed compact fluorescent bulbs have the ability to replace ordinary incandescent bulbs and operate much more efficiently. they have been improved so they give good color rendition and don't flicker or hum at all. The compact fluorescent last about nine times as long and use a fourth of the energy as incandescence!
Try to get at least one of these compact fluorescents, a rough-duty incandescent, a fluorescent tube, and a regular incandescent, each with the packaging material so the students can read the information from the real thing. (If you have trouble finding a compact fluorescent, call the S.S.U. Energy Center 664-2577.) Make a note of the various bulb prices on the "Light Type Information Guide."



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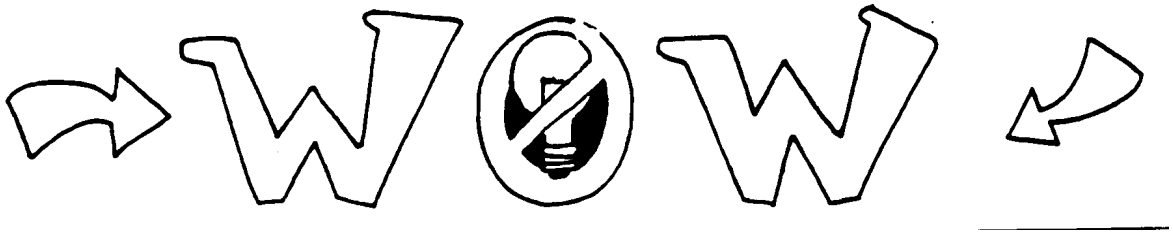
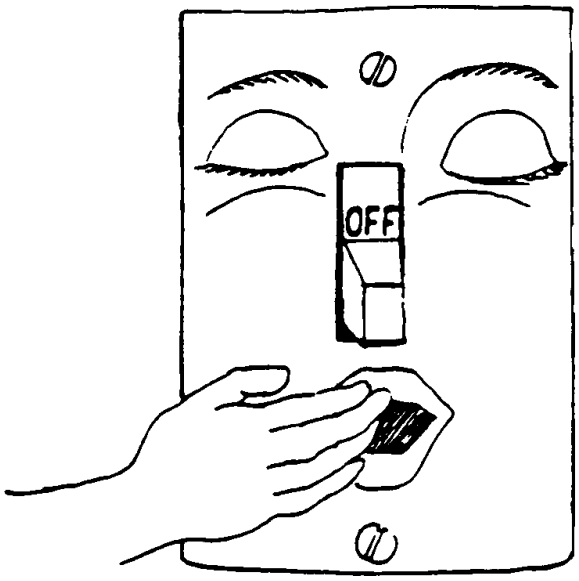
1. Use the picture on the light bulb to explain to students how different light bulbs work. Split the class into groups and have a couple of bulb types at several different stations. Have each group move from station to station, filling out the lighting survey sheet for each bulb type. They will complete the type, wattage, lumens per watt, and lifetime columns. Ideally, they will have an actual bulb in its packaging to collect the information from. If the bulbs are not available, you might have students go shopping and look at different bulb types at a building supply or lighting store. As a last resort, you can use the "Light Type Information Guide."
2. Next you can demonstrate for the whole class how to compute Electricity Consumption:
   kWh = hours of use x (wattage of bulb divided by 1000); and
   Lifetime Cost: cost of bulb + (electric rate x kWh).
3. Have students finish the survey sheet by doing the computations with their data.

If everyone in the U.S.A. replaced one, 100-watt with a compact fluorescent, it would save as much energy as is produced by one, Chernobyl sized nuclear power plat! (A. Lovins, Rocky Mountain Institute)





EXTENSIONS: 1. Have students do the same computations on home lighting (don't forget the fridge light!).
2. Do a comparison of cost between existing lighting in the classroom (or home) and what might be spent with different bulbs. If you discover a potential savings, present your findings to the principal and/or board members.
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FOR DISCUSSION

1. Which bulbs use the most and least energy?
2. Which bulb has the shortest lifetime? The longest?

ANATOMY OF A LIGHT BULB

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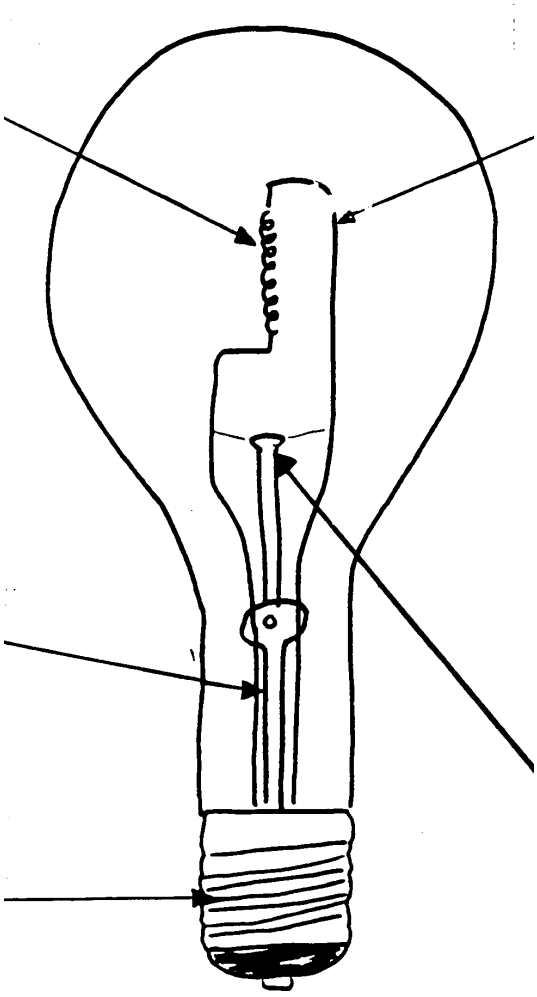
FILAMENT
The filament is where electricity is changed into heat and light. The filament is made of wire that is very tiny and coiled very tightly.

FUSE
If there is ever too much electricity in the bulb the fuse will melt and keep that electricity from damaging the lamp or the household circuit.

BASE
Electricity comes through the lamp and is transferred to the bulb by the base



WIRES
The wires carry electricity from the base of the bulb to the filament and then back to the base.

BUTTON
The wires inside the bulb are very thin and need support so they won't shake around too much or fall into each other. The button supplies this support.

LIGHT TYPE INFORMATION GUIDE

BULB TYPE	WATTAGE	AVERAGE LUMENS PER WATT	AVERAGE LIFETIME IN HOURS
COMPACT FLUORESCENT	7W–32W	65	10,000
COOL WHITE FLUORESCENT (4')	40W	46	16,000
WARM WHITE FLUORESCENT (4')	40W	46	16,000
INCANDESCENT	20W–1500W	18	1,025
ROUGH DUTY INCANDESCENT	20W–1500W	10	750
HIGH PRESSURE SODIUM	70W–1000W	104	22,000
LOW PRESSURE SODIUM	18W–180W	100	14,000
MERCURY VAPOR	50W–1000W	33	20,000

LIGHTING SURVEY SHEET

Bulb type	Wattage	Average lumens per watt	Average lifetime in hours	Electricity consumption in kWh = hours x $\frac{\text{wattage}}{1000}$	Lifetime cost = cost of bulb + electric rate x kWh

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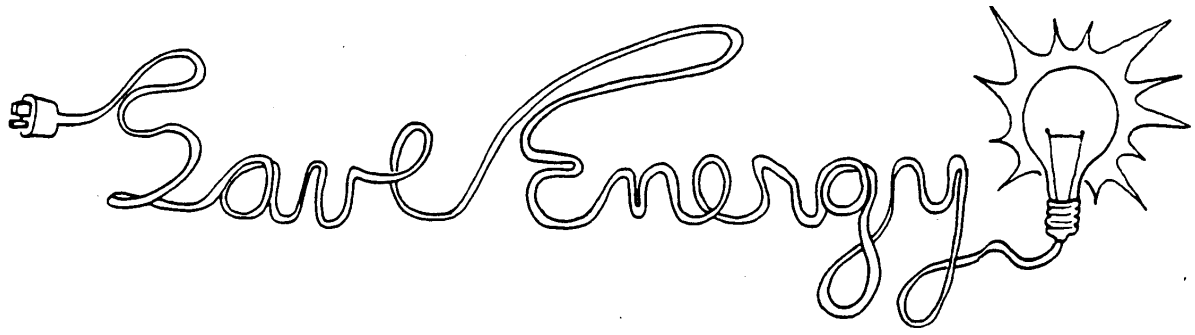

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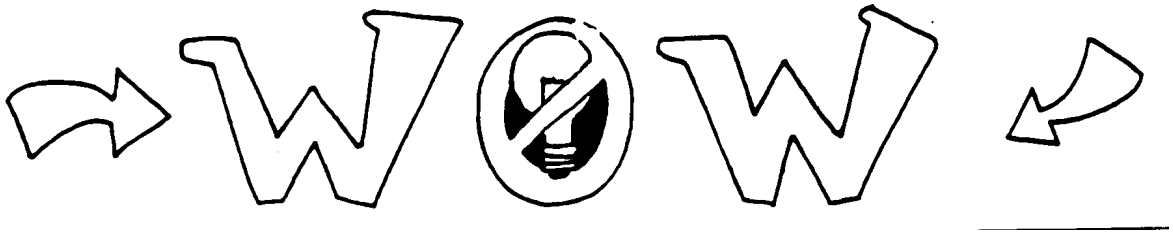

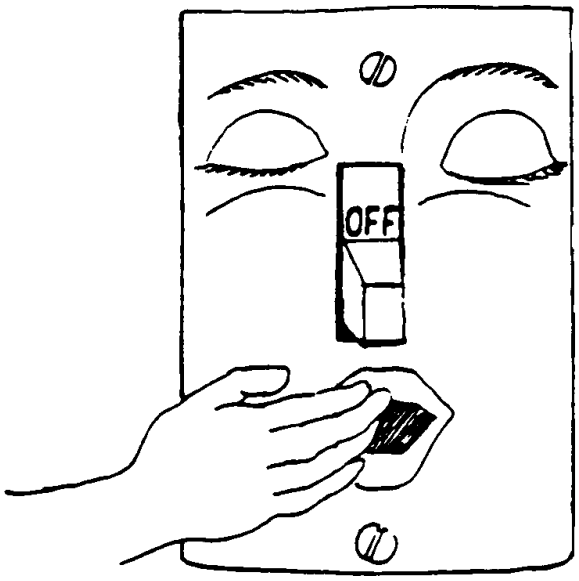

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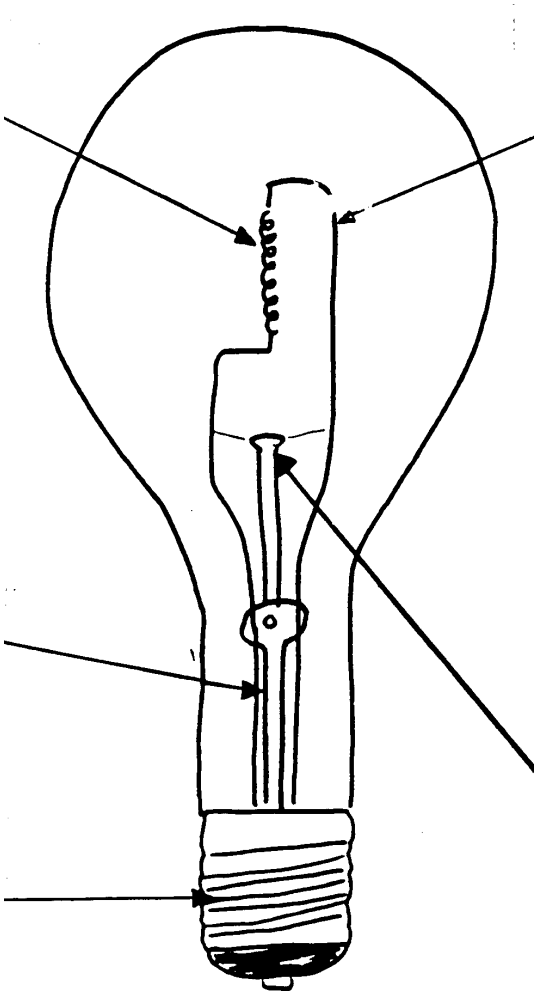

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Knowing the Meaning of Electrical Terms

Watt: A watt is a unit of electrical power. It represents the amount of electricity required to power a light bulb, an appliance, or other electrical equipment. It is the product of amperes (current flowing through the wire) time volts (electrical pressure).

Kilowatt: A kilowatt is a unit of electrical power equal to 1000 watts. (The prefix "kilo" is the Greek word for 1000.) A kilowatt tells you the rate at which energy is being used or the sizes of the electrical load.

Kilowatt-hour (kWh): A kilowatt-hour is a unit of electrical energy equal to one kilowatt used for one hour. For example, a 1000-watt appliance running continually at full load for one hour will consume one kWh of energy; a 100-watt light bulb left on for ten hours will consume one kWh of energy.

Calculating Appliance Operating Costs

Formula for Calculating Costs

An appliance's wattage is usually stamped on a metal plate called the "name plate," or in the plastic covering somewhere on the back or bottom of the appliance.

- Since you pay for electricity in kWh, you must first convert the wattage to kilowatts. To do this, divide the wattage by 1000.

  $\frac{\text{wattage}}{1000}$ = kilowatts *(example:* $\frac{1500}{1000}$ *= 1.5 kilowatts)*

- Then to figure out how many kWh an appliance uses, multiply the kilowatts the appliance uses by the number of hours the appliance is on (or operating at *full* load). To figure their energy use, you have to estimate the amount of time they are actually using energy.

  Kilowatts x hours on = kWh *(example: 1.5 kilowatts x 4 hours = 6 kWh)*

- Next, multiply kWh used by the cost per kWh. This will give the operating cost. The current cost of a kWh is at the bottom of your electric bill.

  kWh x cost per kWh = operating cost *(example: 6 kWh x .10/kWh = .60 cents)*

- Here's a simple formula you can use for appliances operating at full load:

  Cost of Operation = $\frac{\text{wattage}}{1000}$ x hours used x cost per kWh

Pre Test

1. The energy in fossil fuels such as coal is stored as…

    a. Chemical energy
    b. Electrical energy
    c. Thermal energy
    d. Nuclear energy

2. Which energy source provides the nation with the most energy?

    a. Coal
    b. Natural gas
    c. Petroleum
    d. Electricity

3. Which residential task uses the most energy in Hawaii?

    a. Lighting
    b. Heating water
    c. Cooling rooms
    d. Heating rooms

4. Most energy conversions produce…

    a. Light
    b. Heat
    c. Motion
    d. Sound

5. The major use of coal in the U.S. is to…

    a. Fuel trains
    b. Heat homes and buildings
    c. Make chemicals
    d. Generate electricity

6. What percentage of the energy we use comes from renewable energy sources?

    a. 4 percent
    b. 8 percent
    c. 16 percent
    d. 25 percent

7. Compared to incandescent light bulbs, fluorescent bulbs…

    a. Use more energy
    b. Use less energy
    c. Use the same amount of energy

8. Which sector of the economy consumes the most energy?

    a. Transportation
    b. Commercial
    c. Industrial
    d. Residential

9. Which greenhouse gas is considered the most significant to global climate change?

    a. Sulfur dioxide
    b. Methane
    c. Ozone
    d. Carbon dioxide

10. Electricity is measured in…

    a. Amperes
    b. Volts
    c. Kilowatt-hours
    d. Current

11. The average cost of a kilowatt-hour of electricity in the U.S. is…

    a. 8 cents
    b. 25 cents
    c. 1 dollar
    d. 5 dollars

12. Every day the average American uses about as much energy as is stored in…

    a. 1 gallon of gasoline
    b. 3 gallons of gasoline
    c. 7 gallons of gasoline

13. Incandescent light bulbs convert about ___ percent of the electricity they use to produce light.

    a. 10
    b. 20
    c. 40
    d. 80

14. Name three energy sources. Hint- coal is an energy source.

    a. _____
    b. _____
    c. _____

15. Why are some energy sources called renewables?

    _____
    _____
    _____
    _____
    _____

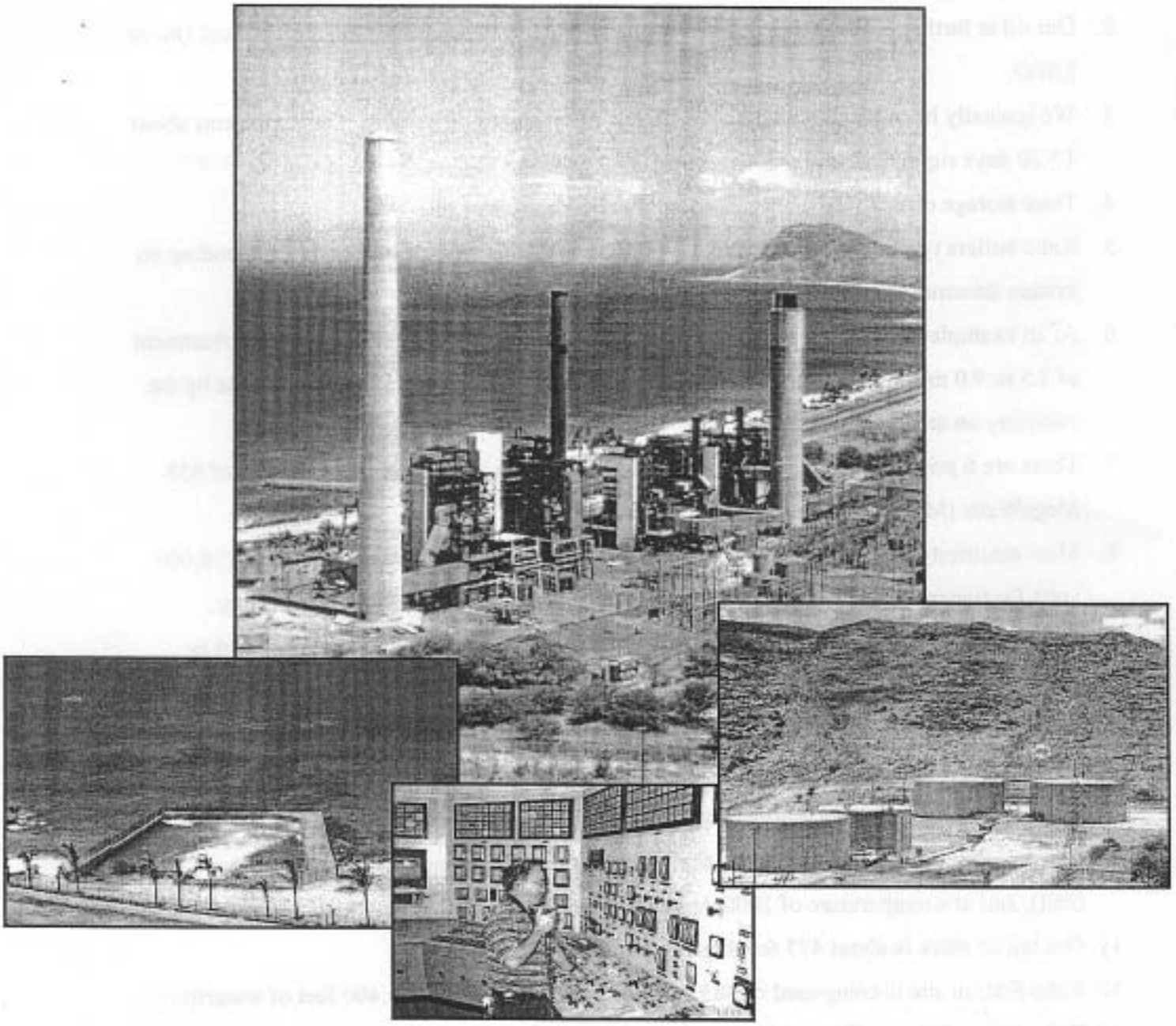
16. U.S. schools spend around _____ dollars each year on energy.

    a. 10 million
    b. 500 million
    c. 1 billion
    d. 6 billion

17. How much does your school spend on electricity a month?

    a. $500
    b. $1,000
    c. $8,000
    d. $12,000

Welcome!



To Kahe Power Plant

Hawaiian Electric Co., Inc.

Kahe Station Facts Sheet

1. All units at Kahe Station are fueled by No. 6 heavy oil. This oil is often referred to as residual oil, because it is comprised of what is left from the refining process after the lighter fuels have been distilled.
2. Our oil is further processed to remove sulfur, and is therefore called Low Sulfur Fuel Oil, or LSFO.
3. We typically have 250,000 to 300,000 barrels of oil stored on station. This represents about 17-20 days supply. A barrel of oil contains 42 gallons.
4. Total storage capacity on station is about 490,000 barrels of oil.
5. Kahe boilers typically consume about 14,000 to 21,000 barrels of oil per day, depending on system demand.
6. At an example market fuel price of $30./barrel, this fuel inventory represents an investment of 7.5 to 9.0 million dollars. Fuel is the single most expensive commodity purchase by the company on an annual basis.
7. There are 6 primary generating units at Kahe Station, having a combined capacity of 635 MegaWatts (MW).
8. Most electricity leaving Kahe station for distribution across the island is raised to 138,000 volts for transmission. Some areas are supplied using a 43,000 transmission voltage.
9. Our generating units at Kahe are all steam turbine powered. Our units are classified as "Reheat" units because we use the steam in part of our turbines, send the steam back to our boilers to be reheated, and then return it to the turbines to complete the cycle. This process increases our unit efficiencies dramatically, saving on fuel consumption over "Non Reheat" units. Our largest turbine produces about 190,000 horsepower.
10. Steam is delivered by our boilers to our turbines at a pressure of 1800 Pounds / Square Inch (PSI), and at a temperature of 1000 degrees Fahrenheit.
11. Our tallest stack is about 475 feet high.
12. Kahe Station site is comprised of 485 acres of land, and has about 4,400 feet of waterfront.
13. Kahe station has two General Motors EMD diesel generators, each having a capacity of 2.4 MW, and are used to provide startup power for our steam units in the even all units have tripped off line and there is no other power source on the island.
14. Typically, a crew of no less than 11 Plant Operators staff our generating units 24 hours a day, 7 days a week.

POWER PLANT CYCLE – MAJOR COMPONENTS

The letter designations below refer to those on drawing entitled "SIMPLIFIED POWERPLANT DRAWING", which outlines the workings of our "Energy Conversion" process.

A - Chemical energy is stored in the form of "Fuel Oil" which is maintained on the station in large quantities inside steel tanks. These tanks are designed to safely contain the oil and to keep it hot enough to allow pumping or gravity flow to the various generating units. The fuel oil tanks are surrounded by concrete or earthen dams called berms, which are designed to contain the entire contents of a full tank if there were a major rupture or leak in the tank wall.

B - Pumps called "Primary Fuel Oil Pumps", located on the fuel oil supply header, raise the pressure of the oil to 50 to 100 pounds per square inch (PSI).

C - Another pump called the "Secondary Fuel Oil Pump" takes the 50 - 100 PSI from the discharge of the primary pump and further raises the pressure of the fuel oil to 450 PSI, and in some cases 1000 PSI. The fuel oil temperature is raised in the fuel oil heater on the way to the burners.

D - The "Burners" convert the chemical energy of the fuel to heat energy in the "Furnace" section of the boiler.

E - The boiler water wall tubes absorb the heat energy, converting the water in the tubes to steam. The steam collects in the "Drum" at the top of the boiler.

F - Air needed to burn the fuel oil in the boiler furnace is supplied by "Forced Draft Fans". Oxygen is needed in exact quantities to burn all of the fuel. Since only 21% of the air is oxygen, large amounts of air must be delivered to the furnace by the fans. About 77% of the air is nitrogen, which does not take part in the combustion process, but passes through the boiler anyway. Some heat energy is lost to warming the nitrogen as it passes through.

G - Hot combustion gases (CO_2, water vapor, and lots of nitrogen) leave the boiler through the "Stack". Monitoring instruments give operators indication in the control room of what is coming out the stack.

H - Steam from the boiler is delivered through piping to the "High Pressure Turbine". Here, some of the heat energy of the steam is converted into rotating mechanical energy. On some generating units, steam leaving the high-pressure turbine (called "Cold Reheat") returns to the boiler to be reheated. The steam (now Hot Reheat) then goes back to the "Intermediate Turbine" where additional heat energy is converted to rotating mechanical energy. The generating turbine of this type is called a reheat unit, and represents our most fuel efficient unit design.

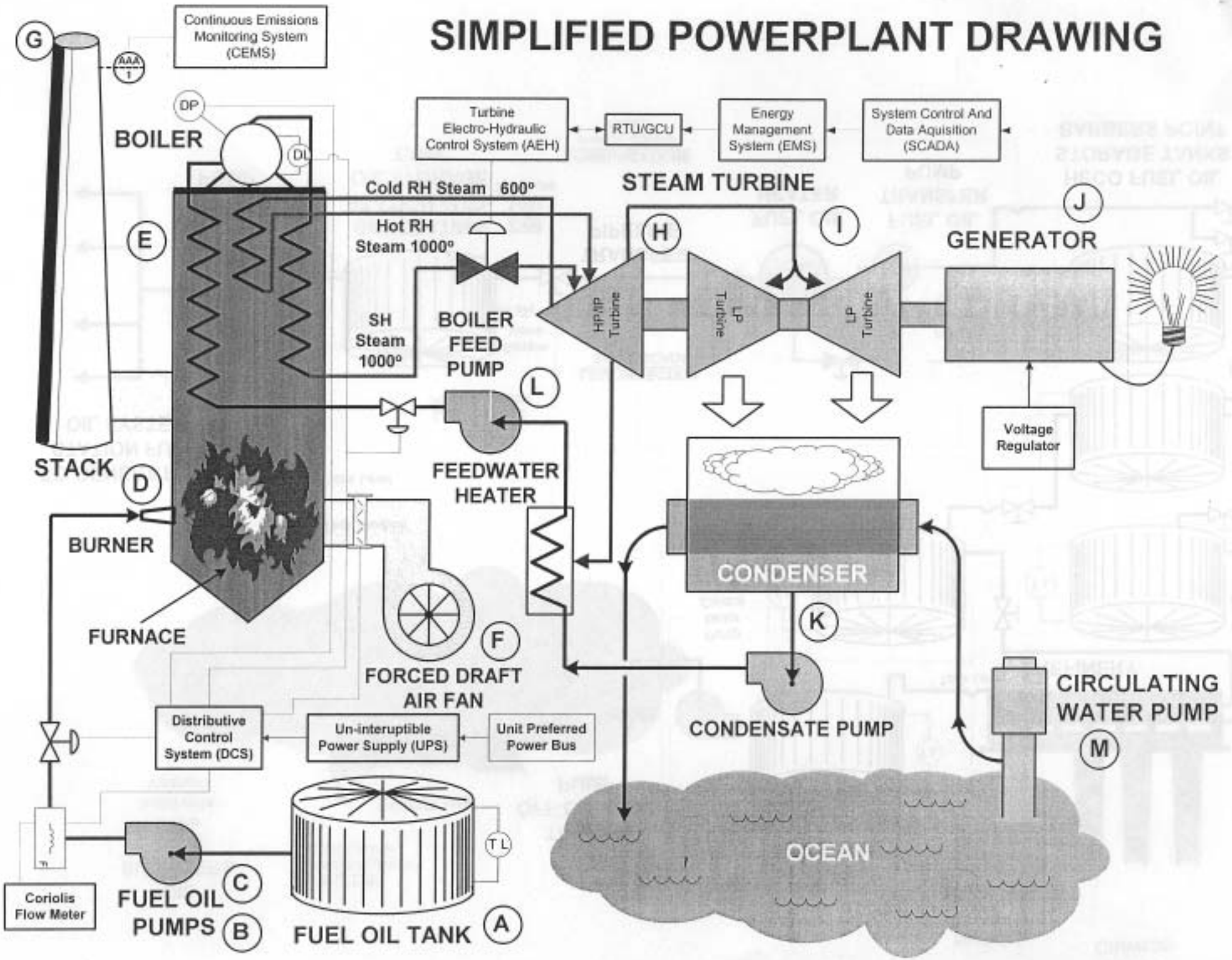
I - On all units, steam leaving the intermediate or high-pressure turbine now enters the "Low Pressure Turbine". This is the final step in converting the energy of the steam to rotating mechanical energy.

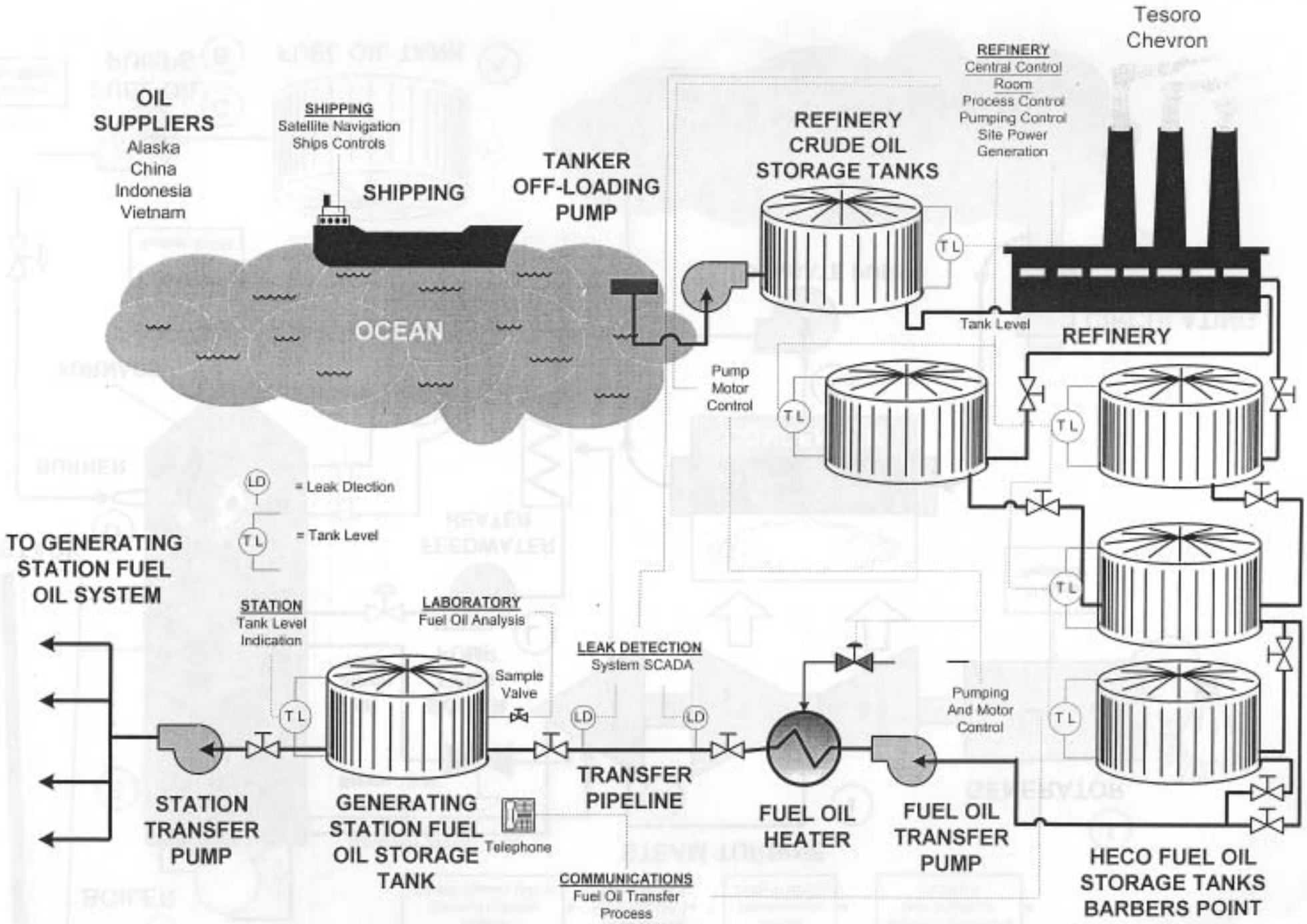
J - The rotating mechanical energy of the turbine is converted into electrical energy in the "Generator".

K - Steam leaving the low-pressure turbine enters the "Condenser", where the remaining heat energy is extracted. This causes the steam to condense back into water. The condensed water can then be pumped out of the condenser "hot-well" by the "Condensate Pump", to begin its return trip to the boiler, where it will converted into steam again.

L - Steam condensed back into water is delivered by the condensate pumps to the "Boiler Feedwater Pumps". The boiler feedwater pump takes the discharge water from condensate pump (K) and raises its pressure to 2500 – 3000 PSIG to force water back into the drum. This function is critical to the continuous operation of the boiler, since the amount of water in the boiler will go down as steam is produced and sent to the turbine. For the boiler to operate, the water turned into steam must be replaced on a continuous basis.

M - Cooling water delivered to the condenser by the "Circulating Water Pumps" is used to extract the remaining heat energy from the low-pressure turbine exhaust steam so it can be converted back into water, and start its trip back to the boiler to be used over again. The source of cooling water for the condenser may be the ocean, a river, or a harbor.


SIMPLIFIED POWERPLANT DRAWING
Continuous Emissions Monitoring System (CEMS)
G
AAA
1
DP
BOILER
DL
E
STACK
D
BURNER
FURNACE
Turbine Electro-Hydraulic Control System (AEH)
RTU/GCU
Energy Management System (EMS)
System Control And Data Aquisition (SCADA)
STEAM TURBINE
Cold RH Steam 600°
Hot RH Steam 1000°
SH Steam 1000°
BOILER FEED PUMP
H
I
J
GENERATOR
HP/IP Turbine
LP Turbine
LP Turbine
Voltage Regulator
L
FEEDWATER HEATER
CONDENSER
K
F
FORCED DRAFT AIR FAN
CONDENSATE PUMP
CIRCULATING WATER PUMP
M
Distributive Control System (DCS)
Un-interuptible Power Supply (UPS)
Unit Preferred Power Bus
OCEAN
TL
Coriolis Flow Meter
FUEL OIL PUMPS
C
B
FUEL OIL TANK
A


Tesoro
Chevron
OIL
SUPPLIERS
Alaska
China
Indonesia
Vietnam
SHIPPING
Satellite Navigation
Ships Controls
SHIPPING
TANKER
OFF-LOADING
PUMP
OCEAN
REFINERY
Central Control
Room
Process Control
Pumping Control
Site Power
Generation
REFINERY
CRUDE OIL
STORAGE TANKS
TL
Tank Level
REFINERY
Pump
Motor
Control
LD = Leak Dtection
TL = Tank Level
TO GENERATING
STATION FUEL
OIL SYSTEM
STATION
Tank Level
Indication
LABORATORY
Fuel Oil Analysis
LEAK DETECTION
System SCADA
Sample
Valve
LD
LD
Pumping
And Motor
Control
STATION
TRANSFER
PUMP
GENERATING
STATION FUEL
OIL STORAGE
TANK
Telephone
TRANSFER
PIPELINE
FUEL OIL
HEATER
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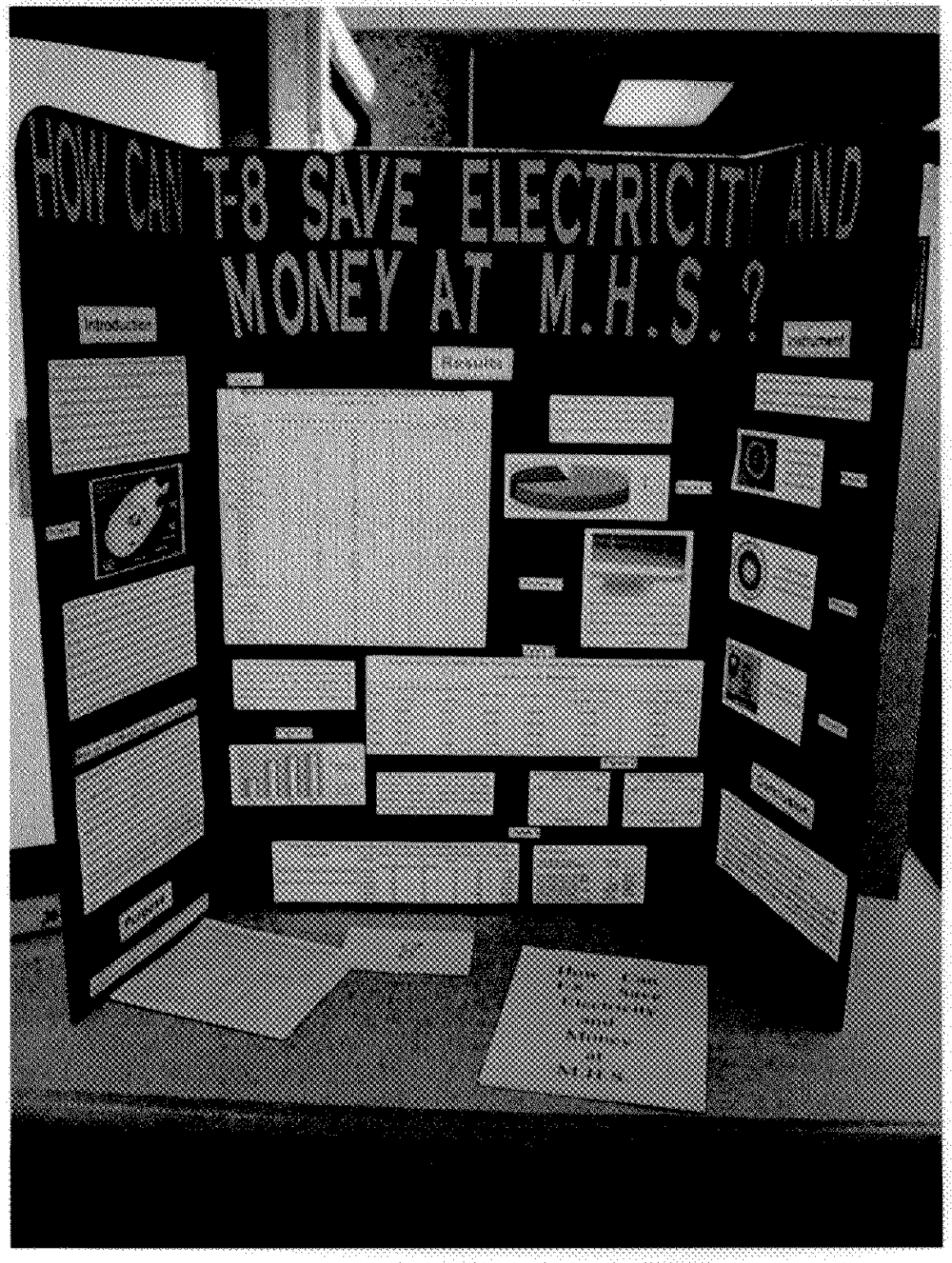
TRANSFER
PUMP
HECO FUEL OIL
STORAGE TANKS
BARBERS POINT
COMMUNICATIONS
Fuel Oil Transfer
Process


HOW CAN T-8 SAVE ELECTRICITY AND
MONEY AT M.H.S.?