Report Submitted to:

Susan Vernon-Gerstenfeld, Ph.D., WPI Professor

Arthur Gerstenfeld, Ph.D., WPI Professor

Melbourne, Australia Project Center

By

Rachel Ryznal

Anthony Montano

Ryan Petti

In Cooperation With

Megan Broome, Assistant General Manager

Todd Lucas, Senior Project Officer

Department of Education and Training, Facilities Division

SPECIFICATIONS FOR AN ENERGY EFFICIENCY AND SUPPORTING RESOURCES WEB PAGE FOR VICTORIAN SCHOOLS

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ABSTRACT

This report, prepared for the Victorian Department of Education and Training, provides the specifications of an energy efficiency and supporting resources webpage for Victorian schools. The webpage will encourage Victorian schools to become energy efficient, detail the process in doing so, and provide energy audit and curricula resources. A student team from Worcester Polytechnic Institute conducted interviews with selected school principals, energy managers, and teachers to provide insight as to the information that should be included on the webpage. Analysis of these interviews led to the recommendations concerning the contents of the webpage.

EXECUTIVE SUMMARY

In recent years, environmental scientists have identified the need to address the issue of global warming. A growing group of scientists recognise greenhouse gases as the primary cause of increasing atmospheric temperatures and rising sea levels. Humans burn fossil fuels that cause the emission of greenhouse gases. Countries around the world are designing programs to reduce the emission of greenhouse gases by increasing energy efficiency. In response to global warming and the increased awareness for energy conservation, the Victorian government has proposed a 15 percent energy reduction in the public sector by the year 2005. The Victorian Department of Education and Training (DE&T) intends to meet this projected goal by developing a strategy to raise the energy awareness and efficiency in primary and secondary schools across Victoria.

As part of the energy reduction strategy, DE&T has proposed to create an energy efficiency and supporting resources webpage. This webpage will provide schools with resources to implement an energy efficiency program, perform energy audits, incorporate energy education into curriculum, and make energy efficiency a permanent feature of school culture. Furthermore, it would act as an instrument to encourage schools to participate in energy efficiency programs. The Worcester Polytechnic Institute project team provided DE&T with the specifications for this proposed website.

Initially in the United States, we created a literature review to identify existing resources concerning the project and its goals. The literature review addresses and clarifies the topics of energy efficiency and conservation, existing audit processes and practices, available energy efficiency teaching materials, government organisations providing energy efficiency programs, and methods to make energy efficiency a

permanent feature of school culture. This information was used to help facilitate a better understanding of the project and provide background information for future reference. In addition to repeating this research in an Australian domain, we gathered field data from those involved in implementing energy efficiency programs in Victorian schools.

The methodology identifies the process we used to gather field data while in Australia. Along with interviewing key DE&T departmental staff, we met with three schools that had successful energy efficiency programs: Mount Waverly Secondary College, Cobden Technical Secondary College, and Minor's Rest Primary School. Those schools were chosen because of their involvement in the Sustainable Energy Authority Victoria's Energy Smart Program. In addition, we met with a school in the process of beginning an energy efficiency program, Mitcham Primary School, to provide a basis for comparison. In each school, we used observation, through school tours, to form an impression of current energy efficiency practices. The tours provided us with an understanding of the structure of Victorian school buildings and the energy inefficiencies present. Our team interviewed the principal and energy manager to learn about implementing an energy efficiency program and their strategy for making it a permanent feature of school culture. We performed group and individual teacher interviews to gather information concerning current energy efficiency teaching materials in use. Furthermore, we studied what constitutes quality teaching materials. The purpose of these data gathering methods was to provide us with the information that aided in making a website designed specifically for Victorian schools.

We found that the analysis of the collected data could be divided into four topics: encouraging schools to implement energy efficiency programs, making energy efficiency

a permanent feature of school culture, examining energy audit practices, and evaluating energy efficiency teaching materials. We used the field data collected from Victorian schools in addition with information from the literature review to form the specifications of the webpage.

In order to encourage school to implement an energy efficiency program, we completed a cost-benefit analysis. By minimizing the costs and maximising the benefits, the schools would be more willing to participate in a program. Costs include money for building improvements and time to make the improvements. Benefits include environmental and building improvements, short payback periods, money savings from less energy usage, easy implementation of the program, and school reputation improvement.

To make energy efficiency a permanent feature of school culture, each school with an energy efficiency program had a unique approach. In the analysis, these approaches were examined and combined to form a list of four points including having a responsible leader in charge, signing an energy management policy, getting everyone involved, and advertising results.

For energy audits, the project team completed a chart that compares the energy efficiency practices of each of the four Victorian schools. Using this chart, we were able to examine current energy efficiency practices as well as choose the prominent inefficiencies found throughout all of these schools. This information was necessary in forming an simple audit checklist to be included in the webpage specifications.

The process of evaluating energy efficiency teaching materials was completed by analysing what the teachers in each school were looking for when designing their

curriculum and combining it into a matrix for rating energy efficiency materials. We were able to analyse information that would be useful in an energy efficiency resources webpage. For example, many teachers use the advice of other teachers when choosing a material to use. As a result, including a posting board would prove useful for teacher exchange.

To recommend the specifications of an energy efficiency and resources webpage, we developed a series of pages addressing the initial goals of the project.

- **To encourage schools to participate in an energy efficiency program.**

  In order to encourage school to participate in the energy efficiency program, we focus on emphasizing the benefits from such a program. We stress the environmental benefits by giving information on global warming and the greenhouse effect. We also offer organisation links, giving schools the ability to go to other sites to see the energy efficiency programs being used in Victoria and in other parts of the world. Furthermore, we highlight the easy implementation and short payback periods of energy efficiency programs.

- **To specify strategies to make energy efficiency a permanent feature of school culture.**

  We offer a page that describes five steps to making energy efficiency a permanent feature of school culture and gives a synopsis of each. The steps include:

  - Have a person in charge
  - Sign an energy policy agreement
  - Get everyone involved
  - Publicize and gain support
  - Do something new with the program

- **To provide details of a simple self-help audit checklist to encourage schools to locate energy inefficiencies.**

  The webpage has a very simple energy audit checklist. This checklist was designed so that even the smallest primary school would be able to identify their energy inefficiencies. There are more complex energy audit information and links provided on the website as well.

- **To provide a comprehensive list of quality teaching materials available to schools for the teaching of energy efficiency.**

  For teachers, there is an extensive list of quality energy efficiency teaching materials, which were rated using the matrix developed in the analysis. There is also a posting board for teachers to exchange ideas and information. For students, there are energy efficiency children links provided.

The energy efficiency strategy and supporting resources webpage is designed to give Victorian schools a place to find as many energy efficiency resources as possible including energy audits, teaching materials, and methods to making energy efficiency programs a permanent feature of school culture. The website is organised to be user-friendly, informative, and colourful. In addition to the content that we have developed, the websites provides multiple links to other sites where schools can get more information concerning energy efficiency.

AUTHORSHIP

The authorship of all sections of this report were accomplished equally by all of the team members: Rachel Ryznal, Anthony Montano, and Ryan Petti.

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Chapter I. INTRODUCTION

The increase of greenhouse gases, primarily carbon dioxide, methane and nitrous oxide, changes the chemical composition of the world's atmosphere. These gases retain heat, thus trapping some of the outgoing energy from the earth. This is referred to as the "greenhouse effect" (Abrahamson, 1989). Before the Industrial Revolution, the greenhouse effect kept the temperatures of the earth warm enough to support life. Since then, however, as human emissions of the greenhouse gases increase, the greenhouse effect has also magnified (http://www.epa.gov/globalwarming/emissions/index.html).

Much of the scientific community believes the greenhouse effect is the main cause for the rise in global mean temperature. According to the Environmental Protection Agency, the global mean temperature has increased 0.45-0.6 degrees Celsius and sea level has risen four to eight inches in just the last century. The global temperature will continue to rise 0.6-2.5 degrees Celsius in the next fifty years, and 1.4-5.8 degrees Celsius in the next hundred years. (http://www.eps.gov/globalwarming/climate /index/html). There are skeptics in the scientific community who deny that global warming is a result of increasing greenhouse gases. Patrick Michaels, a professor of environmental science at the University of Virginia, believes that the trend of increasing global temperature during the past decade is a result of the weather phenomenon called El Nino. He thinks that the observed global warming trend remains far below the amount predicted. Likewise, he believes that the carbon dioxide amount is increasing at a rate below that of most climate change scenarios because of growing vegetation (http://www.cato.org/pubs/pas/pa-329es.html). Kenneth Green, the Director of Environmental Studies and Sr. Policy Analyst, believes that since the earth's climate has

fluctuated for the past four billion years, human kind knows so little of past climate conditions. There is no standard of comparison scientists can use for global warming, thus it is inaccurate to determine greenhouse gas emissions as the leading cause (http://www.reason.org/climatefaqs.html). The opposition, however, believes that scientists do have enough evidence to make conclusions on global warming. Stephen Schneider, a Stanford University climatologist, states that it is 90 percent likely that the increase in global warming by 1 percent in the last century was not natural, occurring no more than once in a millennium during the earth's history (http://www.msnbc.com/news /106332.asp?cp1=1). From the evidence presented above, an increase of greenhouse gas emissions as the leading cause of the global warming trend is a controversial topic largely argued between scientists. In any case, countries have become more conscious of the amount of energy and greenhouse gas emissions it produces. Even though the cause of global warming is not yet known, many people believe it is their duty to do what they can for the environment and reduce their energy usage.

Australia is a very large, flat and arid continent with nutrient-poor soils. Its climate is highly influenced by the surrounding oceans, with tropical cyclones and monsoons in the north and strong storm systems in the south. Due to what may be the greenhouse effect, Australia's air temperature has risen 0.5-0.9 degrees Celsius in the past century. The ocean temperatures off shore have increased as well. In 1996, the Australian Commonwealth Scientific and Industrial Research Organization (CSIRO) scenarios predicted temperature increases of 0.3-1.4 degrees Celsius and a 10 percent increase in rainfall magnitude by the year 2030. With the rise in temperatures, there will be negative consequences in Australian ecosystems, hydrology and water resources, food

and fiber production, costal systems, and perhaps most importantly human health (http://www.grida.no/climate/ipcc/regional/061.htm). There will be increased risks of more volatile weather conditions, worse drought and flooding, and a shifting of normal residency areas of various insects that carry diseases (http://www.reason.org /climatefaqs.html).

In response to global warming and the increase of greenhouse gas emissions, the Australian government recognizes the importance of energy efficiency. Being one of the world's biggest exporters of coal, Australia is actively trying to find a balance between remaining economically strong while still promoting energy conservation to lower emissions (http://www.grida.no/climate/ipcc/regional/061.htm). The Victorian government proposed a program in 1999 to decrease energy consumption by 15 percent by the year 2005 in the public sector, measured in *quantity of energy used per unit of area per unit of time*. The Victorian Department of Education and Training (DE&T) is bringing this project to the school systems (http://www.deet.vic.gov.au/deet/).

As part of the Victorian government program, DE&T intends to make both students and administrators of primary and secondary schools more aware of energy efficiency and conservation methods that will contribute to the 15 percent reduction goal. Ideally, by increasing the knowledge of energy efficiency, less energy will be used by the public sector and greenhouse gas emissions will decrease. Furthermore, it is in the interest of the school to save money on energy bills by increasing their energy efficiency.

DE&T has proposed to create an "Energy Efficiency Strategy and Supporting Resources" web page as one way to provide Victorian schools with this information. The web page will serve a number of purposes. It will provide resources and materials

pertaining to effective energy efficiency programs, encourage the implementation of energy efficiency programs in schools, and provide lists of other resources available to schools to implement these programs. Specifically, the web page will provide valuable self-help audit process techniques and lists of quality materials available for the teaching of energy efficiency and conservation to students.

As the WPI project team working with DE&T, we researched and developed the necessary background information and data involved in building the specifications of the web page. This was done using a number of methods: initially we researched the literature related to energy efficiency and possible ways to promote it. We examined case studies to determine effective energy efficiency practices. In addition, we studied four Victorian government schools to determine the nature of energy efficiency already existent. We found existing energy audit processes, and developed a simple audit for any school to perform. We developed criteria for evaluating current energy teaching materials. Furthermore, we studied methods to making energy efficiency a permanent feature of school culture. All of this information provided DE&T with the necessary tools to build a web page to better the awareness of energy efficiency by primary and secondary schools.

Chapter II. LITERATURE REVIEW

The information contained in this chapter is intended to provide a background that supplies a rationale for proceeding with the project. First we will discuss the difference between the terms *energy efficiency* and *energy conservation*, a necessary distinction in order to understand other information presented here. Secondly, we present a definition, basic information and examples of energy audits, the first step to effective energy management. A discussion of curricula is presented next, explaining the need for energy efficiency curricula, giving an example of curricula assessment in the U.K. and also touching upon different types of learning styles among children. The fourth section is one that describes various organizations available to schools and compares their styles and impact. Lastly, we present ways and techniques to make all of these energy management and efficiency practices a permanent feature in school cultures. This background information will provide the necessary knowledge to fully understand the goal of the project and the methods to go about completing the project.

Energy Efficiency and Conservation

The terms *energy efficiency* and *energy conservation* are often used interchangeably, although there is a logical and needed difference between the two. Hollander and Schneiders (1995) provide their own differentiation between the two terms: energy conservation suggests sacrificing a common action or task in the name of saving energy while energy efficiency refers to doing a larger amount of common actions or tasks and at the same time using less energy. Even though the definitions of these two terms are different, both contribute to the reduction of energy use. Kreith and West

(1997) state two main approaches to energy reduction that parallel Hollander and Schneiders' views:

1. Improve the efficiency of the conversion process of a primary resource into a usable form of energy suitable for performing a given task.
2. Reduce the amount of energy needed to perform a specific task.

These descriptions directly coincide with the methods for energy reduction provided by the Sustainable Energy Authority Victoria, a Victorian Government agency that has published guidelines for the 15 percent energy reduction plan. Item one in the list above is termed *energy efficiency* and can be achieved by acquiring more efficient equipment or designing new energy efficient facilities (Sustainable Energy Authority Victoria [SEAV], 2001). Item two can be labelled *energy conservation*, which is accomplished through changes in practice and public awareness (Kreith & West, 1997; SEAV, 2001).

The most prominent reason evident in the literature for the necessity of energy efficiency awareness is the increase in energy consumption across the world. Every year, the Energy Information Administration, a division of the U.S. Department of Energy, publishes an Annual Energy Outlook report for use by Federal, State, and local governments in the United States. In the Annual Energy Outlook for 2000, total energy consumption between 1998 and 2020 was projected to increase from 94.9 to 120.9 quadrillion Btu in the U.S. alone (1999). The world energy consumption follows the same trend, according to the International Energy Agency (IEA). The IEA believes that the primary energy demand will increase from 8,000 to 13,000 million tons of oil

equivalent by 2020, closely following the U.S. Department of Energy's prediction of a 75 percent increase in 2020 over the 1995 values (*Australia Energy News*, 1998).

Many people may argue that energy consumption can be solved by renewable sources such as solar, wind and water power; however, these sources are being used and their effects on reducing energy consumption have shown to be insignificant (Miller & Miller, 1993; Annual Energy Outlook for 2000, 1999). Renewable power equipment such as solar panels and wind generators have also proven to be very expensive thus limiting the use of renewable resources. In light of these circumstances, there have been responses through energy efficiency. Despite these responses, the actions taken often fall short of what is technically possible (Hollander & Schneiders, 1995). Kreith and West (1995) support this idea, indicating that there is enormous opportunity for energy efficiency based on a 1990 review by national laboratories.

The Energy Audit

An energy audit is a process that identifies all places in a building where energy is used and recognizes possible energy conservation opportunities (Thumann, 1995). There are three benefits energy audits can provide when applied to schools: identification of energy wasteful buildings, instruction on efficient operation and maintenance for the building managers, and the recognition of retrofit, or soon to be available energy projects (1979). Identifying energy wasteful buildings along with the efficient operation of such buildings is essential: in the United States alone, buildings consume one third of the fuel resources and over 65 percent of the electricity (Sherman & Jump, 1997). Also, identifying possible energy efficiency programs that may not have existed when the school was built could be extremely beneficial. If the institution qualifies for funding,

these programs can be both cost-free and provide large energy benefits. Although energy audits alone may have little impact on energy efficiency, the payback associated with implementing audit recommendations encourages organizations to perform these audits. In addition, the monetary gain received from such paybacks eventually provides a start for effective energy saving programs (Schipper & Meyers, 1992).

As a result of the continuing advance of technology, the energy audit process has been enhanced using computer software. Energy Audit software can cover many aspects of the audit process: energy accounting, survey data reduction, cost estimation, computer assisted design and drafting, estimation of energy saving and building energy simulations. Thumann describes how audit software has made tasks possible that could not be accomplished before. Simulation programs can offer retrofit options and give accurate portrayals of future conditions. One can predict how effective programs can be and whether or not more improvements need to be made (1995).

There are many public domain programs in common use, the most popular of which are DOE-2 and the newest auditing software, EnergyPlus (DOE-2, 2001). Universities and laboratories developed the DOE-2 system with major backing from the U.S. Department of Energy. Given the necessary information, it predicts a building's hourly energy uses and costs and generates reports of resulting data. The system can be used for both energy conservation studies and building design studies. DOE-2 has been used to design and retrofit many public buildings such as the White House, the Sears Tower, and the New Parliament House in Australia. At the time of the release of EnergyPlus, building owners and designers had already used DOE-2 to save an estimated $20 billion (Monroe, 2002). EnergyPlus is a significant step beyond the DOE-2 system,

because it provides more opportunities for energy and cost saving. It also allows users to calculate the effects of different heating, cooling, and ventilation systems to maximize building energy efficiency and comfort (Monroe, 2002).

However wonderful these programs may sound, there are various drawbacks. Thumann (1995) describes the programs as powerful simulation tools, allowing detailed input that produce excellent results with detailed output reports. However, Thumann continues by saying that these programs require large amounts of labour and training, and are sometimes too costly for smaller buildings (1995). However, if the manpower and funding are available, these programs provide important information and assistance into designing for energy efficiency management of buildings and structures.

In Australia, the Australian/New Zealand Standard AS/NZS 3598: 2000 Energy Auditing sets minimum requirements for conducting energy audits (SEAV). This document is available for a fee from the Standards Australia International (SAI) at http://www.standards.com.au/catalogue/Script/Details.asp?DocN=AS613572284182. According to the SAI document, there are three levels of energy audits, each one providing a different degree of effort, information and accuracy (SAI, 2002; Energy Efficiency and Conservation Authority [EECA], 2001). A Level 1 energy audit can be performed with or without an auditor visit to the site; however observations done by a trained auditor can be useful. This type is not expensive but shows only that energy consumption is excessive. It does not suggest possible opportunities for savings. A Level 2 energy audit includes all aspects of Level 1 but includes an extensive site inspection and saving opportunities based on a single auditor visit. For this level, cost and savings are estimated to about 20 percent accuracy. A Level 2 audit should be

adequate for most purposes. If a more accurate and extensive data is required, a Level 3 energy audit should be performed. This level audit is a more extensive version of a Level 2 audit. Savings opportunities are looked at over a period of time instead just during the auditor's visit. Savings and costs are estimated to about 10 percent accuracy. Usually contractors will perform Level 3-quailty audits.

Curricula

Environmental awareness has increased in schools across the globe throughout the last decade. The introduction of environmental topics into these schools has proven to increase children's awareness of the environment in which they live (Reiva, 2001). The Henley Centre (1994) found that children in general believe that, unless something is done now, damage to the environment will have a direct impact on the society in which they live within the course of their own lifetimes.

A study conducted by the Henley Centre (1994) found that there was a high level of interest in the environment among young people aged eight to twelve. Overall, one-third of the children studied stated that they were "interested" in the environment, and half stated that they were "slightly interested" (The Henley Centre, 1994). A similar study conducted by Millard Brown in 2000, found that 38 percent of children claimed to be "very interested" in environmental issues, and 50 percent to be "slightly interested." For these children, environmental awareness is simply a common-sense reaction to rising environmental issues across the globe (Reiva, 2001). According to Strong (1998), the concern for the environment is particularly true for children under the age of ten, who are considered to be less able to focus on more than one issue at a time. Strong showed that when asked an unprompted question what their main concern was, 47 percent of children

stated an environmental issue was their main concern. He concluded that it is the responsibility of schools to incorporate the children's concerns about the environment into its lessons and projects.

As a result, curriculum material is available on the internet that allows teachers and schools to teach their students about energy availability, including the benefits and the monetary, environmental, and social costs associated with it. Many of these materials emphasize the importance of energy efficiency in school and at home (http://www.eren.doe.gov). While initial programs and materials focused primarily on ways to save electricity, recent material has broadened its scope with the hope of reducing school energy cost while educating its students in a range of subjects.

Multidisciplinary lesson plans have fast become the focus of many teachers and schools around the globe (http://www.eren.doe.gov). The United States Department of Energy (DOE) offers a list of available quality curricula through its website. Monitored by the DOE this material has proven itself in an educational setting in the United Kingdom. The curriculum materials available on the website are rated against criteria that have been successful in the U.K.

Environmental Education in the United Kingdom

The rise in international environmental awareness and education has helped shape the goals, objectives and planning of an environmental education curriculum within the schools in the United Kingdom (Palmer and Neal, 1994). With the help of the individual schools and teachers, the United Kingdom (U.K.) integrated environmental education into its national curriculum (Palmer and Neal, 1994). The United Kingdom believed that a good environmental education, like any good education, must convey a wider

understanding of the material and situation through a cross-curricular theme. This multidisciplinary approach to education allows environmental issues to be discussed in a number of other areas of the curriculum (Palmer and Neal, 1994). The objectives of the approach are:

1. to promote thinking and discussion on questions of values and beliefs,
2. to add to knowledge and understanding, and
3. to rely on practical, experimental learning and decision making.

The above objectives are based on those produced by the National Council for Curriculum and Assessment (NCCA, 1990). The NCCA's objective is to advise the Minister for Education and Science on matters related to the curriculum and assessment procedures for primary and second level education (http://www.ncca.ie/whoare.htm). The NCC set out the objectives of the environmental education as follows;

1. Education about the environment – teach basic knowledge and understanding of the environment.
2. Education for the environment – incorporate the values, attitudes and positive action for the environment.
3. Education in or through the environment – use the environment as a resource with emphasis on enquiry and investigation and pupil's first hand experience.

With respect to the above objectives, individual schools have the ability to incorporate these guidelines into their curriculum in any manner they see fit (NCC, 1990). As a result, environmental education has become a permanent part of education in the United Kingdom (Palmer and Neal, 1994).

Schools are quickly learning about the benefits that can be felt as a result of becoming energy efficient and aware. By incorporating energy efficiency into their curriculum, schools are finding it possible to reduce energy costs while at the same time educate its students. To aid in the search for quality curriculum materials there are many community and government sponsored organisations that provide assistance to schools that are trying to implement these energy efficiency programs (http://www.eren.doe.gov).

Learning Styles

One perceives and processes information in different ways according to their perceptual and sensory strengths (Taylor, 1997). Taylor believes that as a result of this combination of perceiving and processing one develops a unique learning style. A learning style is a way in which a learner begins to concentrate on, process, and retain new and difficult information (Dunn & Dunn, 1987). Dunn and Dunn further state that in order to identify one's learning style, it is important to examine the individual's characteristics. According to Sternberg (1994) a style is simply a preferred way of one using all of their abilities, not one specific ability. For teachers to be successful, Sternberg believes that teachers must vary teaching techniques and assessment methods in order to reach all students.

According to the recent findings by several leading psychologists, there are seven specific types of learning styles (Mantel, 2001). In order to maximize the learning advantages and ultimately retain the desired information for the greatest amount of time in any given student, an educator must create lessons that encompass the greatest number of learning styles. This is accomplished by creating the lesson plan to have multiple tasks associated with it in order to cater to each individuals learning style (Schroeder, 1993).

Schroeder warns that students cannot, and should not be categorized as solely one type of learner, since it is possible and very likely to have more than one style of learning. This is especially evident in older students who tend to have the ability to adapt in a particular situation as a result of life experiences (Mantel, 2001). The seven learning styles are summarised in Table 2-1 below.

Table 2-1. Seven Types of Learning Styles.

Learning Style:	Characteristics:	Learn best by:
Linguistic	Love to read, write and tell stories. Tend to memorize places, dates, names and trivia very easily.	Saying, hearing, and seeing words. Written words are usually fixed in their minds.
Logical	Very mathematically inclined. Enjoy stepping through problems in a sequential manner. Are very straightforward learners and ask many questions.	Categorizing, classifying, and working with patterns and relationships.
Spatial	Very artistic in nature and have the ability to visualise. Spend much time dreaming and separated from reality.	Encouragement to be creative in any way. Many times this is artistic in manner.
Musical	Likes humming a tune or studying with background music. Pays particular attention to detail. Able to turn the abstract into concrete objects.	Incorporating rhythm, melody, and music. Use songs to help memorization.
Bodily	Always on the move. Constantly walking, touching and using body language to convey feelings.	Incorporating interdisciplinary lessons that encourage active education. Keep lessons short and changing.
Interpersonal	Very social and have many friends. Many times emerge as an informal leader of a group. Patient, understanding and very empathetic.	Participating in group work, projects and collaboration.
Intrapersonal	Strong willed and work best alone. Have a deep understanding of themselves and are the "strong, silent type."	Self paced instruction, individual projects, and working alone.

Source: Mantel, 2001.

In addition to the seven aforementioned styles of learning there are broader styles that can be characterised in one of only three styles; visual learners, auditory learners, and tactual learners (Radovic, 1998). Many of the same characteristics that were evident in the seven different learning styles can be found in the three types of learners. Visual learners are those who must visualize or see an object before believing it. These learners can be characterised as having a strong sense of colour and artistic ability while they have difficulty with spoken words especially in a lecture setting. They will benefit from visual aids and diagrams incorporated into lessons. Auditory learners are those who rely on their sense of hearing to remember information. Characteristics of auditory listeners include difficulty following written directions and struggle with reading and writing. Incorporating videos, interviews and verbal summaries of notes and lectures can be very useful to this learner. Lastly, the tactual learner is one who must touch a physical object in order to remember it. These learners prefer hands-on activities such as assembly, physical activity and laboratory work although they may have problems sitting still. Using experiments that allow the student to work at his or her own pace and allow frequent breaks in study periods will maximize their learning capabilities (Radovic, 1998).

Mantel (2001) states that each individual has elements of each learning style, although one or two seem to be prominent. He emphasizes the importance of determine the style and type of learner that a student is so that the teacher can devise lessons and activities that incorporate as many styles as possible. This will ultimately allow the greatest number of students to comprehend and more importantly understand the presented information (Mantel, 2001).

Organisations Promoting Energy Efficiency in Schools

Around the world there are organisations dedicated to preserving the quality of life through energy conservation. These organisations encompass coalitions of business, education, science, and government leaders that come together to create energy efficient programs and teaching resources for the benefit of school systems. Some of these organisations are listed in Appendix D. Four of the most flourishing organisations are the *Alliance to Save Energy* in Washington D.C., *A Campaign to Rebuild America* in conjunction with The Department of Energy in the United States, *The Centre for Research, Education, and Training in Energy* in the United Kingdom, and *Sustainable Energy Authority Victoria* in Australia. These are shown in Table 2-2 on the following page. Although the Department of Education and Training supports the program created by the Sustainable Energy Authority Victoria, three other prominent energy organisations were studied to gain a better understanding of the many different approaches to providing energy efficiency information. Each of these organisations offer unique resources, ideas, and programs to teach children about energy and make energy efficiency a permanent feature of school culture.

Table 2-2. Organisations Promoting Energy Efficiency in Schools.

	Alliance to Save Energy	Campaign to Rebuild America	CREATE	SEAV
History	Founded in 1977 by Senator Charles Percy and Senator Hubert Humphrey	Founded in 1994 by the United States Department of Energy.	Founded in 1988 by the United Kingdom.	Founded by the Victorian government.
Funding	Corporate donations and U.S government grants	U.S. Government Sponsored	Main U.K. government sponsoring and corporate partnerships.	Victorian government and corporate partnerships.
Mission	Promote national commitment to energy conservation	"To build partnerships among communities, states, and the private sector to improve building performance and connect people, resources, ideas and practices for energy solutions to community needs."	"Dedicated to sustainable development and to reducing the effects of climate change."	"Contribute to the reduction of greenhouse gases, and support and facilitate the development and use of sustainable energy options to achieve environmental and economic benefits for the Victorian community."
School Program	Green Schools	Energy*Smart* Program	School Energy Program	Energy Smart Schools
Reference	http://www.ase.org	http://www.rebuild .org	http://www.create .org.uk/	www.seav.vic.gov.au

Green Schools Program

The Alliance to Save Energy is the creator of the Green Schools Program, which is being adopted by schools in parts of the United States (Harrigan, 1999). The program is dedicated to informing administration, faculty, and students of energy efficiency and preserving the environment (Going Green, 2001). The energy education strategy includes incorporating energy education into grade school curriculum, locating the sources of energy consumption in school facilities, and releasing informative literature on conserving energy to magazines.

In order to integrate energy lesson plans into a wide range of subjects including math, science, and language arts, the Green Schools Program offers a wide range of teaching materials. The students use math to compute energy and pollution emissions, science to explore the environment, and language arts to study energy policies. The program is meant to teach children about the environment, as well as change behaviour and attitude to promote energy efficiency (Green School Power Patrols, 1999). It provides free teacher materials for elementary and middle schoolteachers offered online and in packets sent to the schools. Lessons on conserving energy in schools, reading a meter, keeping heat in or out for insulation, and window treatments for energy savings are available. The program is designed to combine lesson plans with other teacher materials, so that students get the maximum exposure to the issue of environment conservation (http://www.ase.org/greenschools/index.htm).

One problem many schools face is finding the sources of energy consumption in their facilities (Agron, 2000). The Green Schools program is intended to locate the sources, and make suggestions to improve energy efficiency. For example, the program may find certain windows or lighting fixtures waste more energy than others. It is assumed that the school's administration and staff use the suggestions to improve their facilities, and save money through the applied changes. Ten Californian schools that are involved with the program cumulatively saved $51,000 in just eight months. Students participate by having energy efficiency lessons and applying their energy education to their home. The faculty contributes by actively applying energy efficient changes to the school building (http://www.ase.org/media/newsrel/press.htm). Likewise, students from the East San Gabriel Valley Regional Occupations Technical Centre in California formed

a project to reduce energy usage by $12,000 a year (Jenkins, 2001). With the help of the Green Schools program, teachers and students are able to work together to locate and suppress the sources of energy consumption (Harrigan, 1999).

The Green Schools program releases instructive literature to educational magazines and journals. The articles are meant to promote energy efficiency and inform the public of the importance of environmental conservation (http://www.ase.org/media /newsrel/press.htm). In one cover story, the Green Schools program recommended several easy steps to reduce energy consumption in schools. The list instructed readers to simply remember that turning off the lights that are not being used will save energy. It continued with information for teachers to involve the entire school by publicizing energy costs and savings, giving students an incentive for participating, stopping leaks, turning off computers, and recycling (American School Board, 1999). The Green Schools program released another article that gave guidelines for conserving energy during the coldest months of the year (Winter Energy Tips, 2001). The guidelines included schools use a programmable thermostat, install a motion detector on exterior floodlights, and turn off any unused appliances (http://www.ase.org/media/newsrel /wintertips01.htm).

The main goal of the Green School's program is to bring energy efficiency to schools by increasing energy education in the curriculum, locating sources of energy consumption, and releasing informative literature. After participating in the program, students should be able to apply their energy efficiency education to both school and home (Harrigan 1999).

Energy*Smart* Schools

The Campaign to Rebuild America operates Energy*Smart* Schools, a program designed to reduce energy consumption in schools (Science Activities, 2001). Its goals are to reduce costs through energy efficiency, help schools reinvest their savings from improvements, and increase community awareness of their environment. The program attempts to provide school systems with teacher resources, building efficiency advice, and trends of school energy use. The following information was taken from the Energy*Smart* website (http://www.eren.doe.gov/energysmartschools/about.html). A printout of the website can be found in Appendix F.

The program provides teacher resources for incorporating energy efficiency into the curriculum. It discusses the importance of energy education, promotes student involvement, and includes several teacher material assessments. The "EnergySmart Schools In-Class Activities" is a teacher's guide to hands-on experiments that teach children about the environment. A link on the program's website, "Kids Page", allows students to visit an energy plant and an oil refinery, take an energy quiz, and learn facts on energy consumption (http://www.eia.doe.gov/kids/). Through this program, schools are able to get the teaching materials necessary for integrated energy education into current curriculum.

The building energy efficiency advice provided by the Energy*Smart* program is meant to inform schools on how to begin improving their energy usage. The advice is divided into six sections including getting community support, forming a team, considering options, using a development checklist, selecting an energy analyst, and assessing the situation. It gives tips on how to get everyone excited about participating in

the program. School systems are advised to begin by informing the teachers, students, and parents on the school's energy history. By showing the lack of energy efficiency, and by estimating how much money can be saved, a school may gain support of the program participants. Likewise, the program gives information about how to form a team of knowledgeable people to locate sources of energy consumption in the building. This information could be valuable to schools that are beginning to think about increasing their energy efficiency.

The Energy*Smart* program has very constructive teacher resources and advice on improving energy efficiency in schools. Once the school is officially participating, they will begin to receive program material in the mail. The program intends to help schools identify and improve the sources of energy consumption in their buildings. Through the curriculum provided, students could develop their understanding of energy and the environment (http://www.eren.doe.gov/energysmartschools/about.html).

School Energy Program

The Centre for Research, Education, and Training in Energy, or CREATE, developed the School Energy program (Bright Schools Save Energy, 2001). The program is focused to help schools in the United Kingdom conserve energy. The materials provided by the program are extensive, with information concerning energy advice, teaching resources, and case studies on participating schools. Schools located in Scotland, England, Northern Ireland, and Wales are targeted. The following information was obtained from the School Energy website (http://www.schoolenergy.org.uk/). A printout of the website can be found in Appendix F.

The program provides energy advice on heating, ventilation, light, and performing a series of audit checks. It is assumed that the checks are easily understood and executed, and the advice is easy to follow. Schools are advised to check the filters in fan convector heaters are cleaned regularly. Furthermore, it is recommended that schools report areas that consistently overheat. Advice on ventilation includes remembering to turn off extractor fans when they are no longer needed because they extract heat as well as air. A lighting tip is to keep skylights, windows, and light fittings clean to make use of daylight. The energy checks include a temperature check, the recording of the temperature in different areas of the school in order to detect overheating or loss of heat. A maintenance check is the making sure that lights are off in rooms not used, windows are clean, and thermostats are regulated. Although some teachers may not have time to execute these duties, janitors and students could perform the checks (http://www.schoolenergy.org.uk/se_england.asp). The above energy advice and checks are useful for schools to begin improving energy efficiency.

The School Energy program provides brochures, pamphlets and books of curriculum materials for teachers. The "School Energy pack" focuses on curriculum for primary and secondary schools. "Energy Zone" is a guide for teachers concerning energy topics in the National Curriculum for England and additional teaching resources. The book "Openings" is an index of energy education materials and support organizations. The School Energy program also provides free teaching materials for energy efficiency. (http://www.schoolenergy.org.uk/se_england.asp).

There are several case studies about the success of participating schools provided by the School Energy program. The program suggests using a rebate system to reward

schools with money that have shown a significant improvement in energy efficiency (Bright Schools Save Energy, 2001). The Dersingham Primary School in London earned the largest rebate available, three thousand pounds. Findings included the need to adjust heating and lighting controls and remove lighting where rooms were over lit. By investing six thousand pounds in heating improvements, at least 15 percent cost savings could be achieved. The results were concluded that the school would expect to save 1,400 pounds per annum and that the measures would pay for themselves in less than five years. Another case study was done on the Needham Market Middle School. This school took the program one step further by integrating the energy education with daily lesson plans. The school energy bills dropped 800 pounds one year following efficiency improvements (http://www.schoolenergy.org.uk/se_england.asp).

The School Energy program gives teachers a resource for energy advice, teaching materials, and case studies. Nearly 1,500 schools have lowered their energy bills with the help of this program (Bright Schools Save Energy, 2001). The program is extensive, and offers a wide variety of energy information for school administrators and teachers.

Energy Smart Schools

The Sustainable Energy Authority Victoria (SEAV) created the Energy Smart School program to teach Victorian children about energy as well as reduce the energy usage of schools buildings. The program is very dedicated to making students enthusiastic about saving energy. The Energy Smart program features the Low Energy Week Challenge, Energy-Smart Awards, and case studies on participating schools. (http://www.seav.vic.gov.au/schools/intro.html).

The Low Energy Week Challenge is a competition for participating schools to reduce their energy consumption. Schools that significantly increase their energy efficiency can earn a cash prize. The last challenge was held September seventh through September fourteenth, 2001. The challenge not only encourages the school administration and teaching staff to locate and minimize energy consumption, but also incorporates energy education into the curriculum of students. For example, one activity is to have children construct a newspaper about energy, including interviews, comics, and advertisements. The challenge is designed to get participating schools enthusiastic about saving energy (http://www.seav.vic.gov.au/schools/challenge/activities.html).

Energy Smart awards are given to acknowledge schools and individuals who have shown an exceptional commitment to the program. Awards are given out to outstanding leadership and the best school. Once a year, the program gives out the awards during a grand banquet to honour the winners (http://www.seav.vic.gov.au /awards/ESA/2001/index.html).

The Energy Smart program gives a case study to show the program in action at one of the participating schools. It is about a Melbourne secondary college built in the 1950s and 1960s. The school was heated by a boiler system, which was in need of replacement. The cost of replacement was A$14,750. The Energy Smart Program suggested three improvements. The first was a space heating system that would include an automatic time switch and room temperature sensor, eliminating the need for manual handling. The next was using return air, which includes the modification of air handling units so that the fan rooms take return air from corridors instead of outside. The final suggestion was using domestic hot water. This would require replacement of centralized

hot water systems with five separate hot water systems, because small systems only heat water for immediate use. The estimated savings are shown in Table 2-3 below.

Table 2-3. Savings for an Energy Smart School Case Study.

	Gas	Electricity	Total	Simple Payback
Space Heating System (A$900)	A$2400	A$100	A$2500	4.3 months
Return Air (A$8,500)	A$4100	0	A$4100	2.1 years
Domestic Hot Water ($11,000)	A$3730	A$100	A$3830	None

Findings from the case study show that a 39 percent reduction in gas consumption occurred in just one year following the improvements. It is hypothesized that the school improvements will reduce the total energy consumption by 16 percent, and save A$4300 a year (http://www.seav.vic.gov.au/schools/CS/cs01.html).

Making Energy Efficiency a Permanent Feature of School Culture

Instituting and maintaining energy efficiency programs can prove to be difficult for many schools. Success with an energy efficiency program is never straightforward because the actual implementation can be complex and frustrating. Three of the main reasons school energy programs dwindle and discontinue are a lack of interest in teachers, despair at not seeing immediate results, and early complacency. Schools struggle with the lack of encouragement of varied views within and across all constituents to find common ground with the program (Fullan, 2001). It is assumed that energy programs are taken seriously in school systems, and will have some impact on the

school culture. In the article "Understanding Change", the downfall of programs in schools is due to the teacher and student resistance to change, because it is new and unknown. Furthermore, when first implemented, change can be hard to adjust to, uncomfortable, and awkward (Byvelds, 1992). In conclusion, it is not easy for schools to execute a new energy program without the support of both students and teachers.

Despite the obstacles to establishing an energy program, there are strategies to making energy efficiency a permanent feature of school culture. There are organisational steps and methods required to accomplish this goal. Steps include creating a vision, involving all stakeholders, integrating energy efficiency into the curriculum, planning for ongoing monitoring and assessment, and preparing for the future (Successful K-10 Technology Planning, 2001). There are four methods to reducing the resistance to change, thus allowing for the program to become more permanent in the school culture. These are communication, participation, support, and negotiation. The use of newsletters, committees to review and access the program, and clarification of the purpose are essential to reducing resistance to change (Byvelds, 1992). It is assumed that by involving the entire school community, more people will be excited about the program and its benefits. The Manitoba School Improvement Program is successful because of motivation with a combination of pressure and support (Fullan, 2001). Parents, teachers, administrators, and students openly discussed their concerns and ideas for the project, so that an agreement could be reached. By doing this, the school was able to gain support from parents, thus motivation for students. The school uses the evolutionary approach, which is an ongoing assessment of how the program is doing, to promote a sense of pressure for continuing success (Fullan, 2001). In conclusion, by using certain steps and

methods, it is possible to overcome the boundaries of integrating a program in the culture of a school.

Chapter III. METHODOLOGY

In order to provide DE&T with an energy efficiency web page specification, we performed a comprehensive research method strategy to gather the data necessary for our project. This chapter describes the exact steps taken in gathering this data. Similarly to work done in the United States prior to implementation, we examined relevant literature and case studies in order to investigate the energy efficient programs in Victoria. We then conducted interviews with curricula and energy efficiency experts to create criteria for judging quality teaching materials. These interviews gave us a better understanding of school structures and the difficulty involved in creating and critiquing teaching materials.

A major portion of the project data collection involved on-site meetings at four Victorian schools and colleges: Mount Waverly Secondary College, Cobden Technical Secondary College, Mitcham Primary School, and Miners Rest Primary School. There was no formal sampling method in choosing these schools. Three of the schools were recommended by the Sustainable Energy Authority Victoria. The department chose the remaining school on the basis that the school had not implemented an energy management program. This was done in order to provide our project with a contrasting view of energy management. Because of this lack of a formal sampling method, the school visits were treated as mini-case studies instead of literal representations of all Victorian schools. The number of schools was limited to four for two reasons:

1. Vacation time for Victorian schools lay directly in the middle of our seven weeks in Victoria. This made it impossible to visit schools during and after this time, since time after was taken for data analysis.

2. The involved and time consuming approval process necessary for obtaining permission to meet with each school prevented us from meeting with more schools.

While at these schools, the project team used observation and both group and individual interviews with school teachers and energy managers to get a clear understanding of energy efficiency practices and techniques. All of these methods combined provided for an informatively rich mixture from which to gather data and evidence.

For each school meeting, there were three main parts: interviewing with school energy managers and principals, either group or individual interviewing with teachers, and walking around schools observing energy efficiency practices. The number of interviews conducted at each school is listed in Table 3-1 below.

Table 3-1. Number and Details of Interviews Conducted at Each School Meeting.

Schools	Principal	Energy Manager	Teachers	Notes
Mount Waverly	0	1	1	
Cobden	1	1	4	Group interview with teachers
Mitcham	1	1	3	Interview with principal and energy manager, Group interview with teachers
Miners Rest	1	1	1	
TOTALS	3	4	9	

By interviewing Victorian school principals and energy managers, we learned about the implementation of audit processes, the current energy efficiency strategies, and the conditions of school environments. We performed a semi-standardized interview with

the energy manager and principal in each school. Depending upon their availability and time constraints, we performed either a group interview with the energy manager and the principle, or performed separate interviews with each. Sampling at the school was not an issue because schools usually have only one energy manager and one principal. The main questions we asked are shown in Table 3-2.

In addition to school administrators, another group that was integral to the successful completion of our project was the teaching staff of Victorian schools. The information obtained from the teachers helped create and evaluate energy efficiency teaching materials, helped to identify conditions and environments in schools, and aided in developing a web page specification. Specifically the questions asked are shown in Table 3-3.

To obtain this information we used a combination of group interviews—or brainstorming sessions—and individual interviews. The brainstorming sessions were used whenever possible. In some cases, these sessions were not feasible because of teachers' schedules or the number of teachers available at each school. The objective of these sessions was to determine what teachers want or think should be included in quality curriculum materials. In total, two group interviews were conducted: one at Cobden Technical Secondary College and the other at Mitcham Primary School. The teachers were chosen from a school's teaching staff using purposive sampling. Given our time constraints and the strict approval process we faced, it was required that the teachers be chosen by the principals of the schools. We provided the principals with a description of the areas of knowledge the teachers should possess, and, based on this information, the

Table 3-2. Questions Asked by the Project Team at Interviews With Energy Managers and Principals.

Primary Question	**Related Secondary Questions**
What were your past audit processes including date, how performed, and results?	How much time and money was spent on becoming energy efficient?
What are your opinions about audit processes and their worth in determining energy usage?	
What kind of audit processes information would you like to see on a website?	• Would you prefer student performed or adult performed audit process information? • Would it be beneficial to include audit software information? • Would it be useful for the website to include audit checklists?
What kind of information on energy conservation / efficiency teaching materials would you like on a website?	• Would you prefer free teaching materials or materials for a fee? • What kind of resources would you like to see on a website? • Would you find a teacher Q+A section helpful when choosing teaching materials?
What strategies have you used in the past to reduce energy consumption?	• How successful were the strategies? • How did you make the program a permanent feature in your school culture? • What the barriers are to starting or continuing an energy program?

Table 3-3. Questions Asked at by the Project Team Interviews With School Teachers.

Primary Question	Related Secondary Questions
What energy efficiency/conservation curriculum materials have been used in the past?	• How did you get these materials? From a program, Internet, government, journals, etc.? • How often do you use them?
What are the features of quality energy efficiency/conservation teaching materials?	
How well has the school implemented energy efficiency/conservation practices?	• How successful was the program? • Has the program become a permanent feature of school culture?
How could energy efficiency/conservation practices be improved?	
What would you like to see on an energy efficiency/conservation website?	• Resources? • Website links for children? • Checklist for audits?

principal chose teachers from the teaching staff. One primary questioner led the sessions while another team member served as the primary note-taker and observer. Analysis of the data included comparing the results and decisions of each group to each other to determine any constant or intrinsic themes or ideas.

In cases where group interviews were not possible, namely Mount Waverly Secondary College and Miners Rest Primary School, we conducted semi-standardized, attitudinal and behavioral individual interviews instead. This type of interview was chosen because of the qualitative nature of information we were collecting. Further explanation of the theory behind these types of interviews can be found in Appendix B. At Mount Waverly Primary School, we performed two individual interviews: one with

the energy manager and another with a schoolteacher. At Miners Rest, the energy manager also serves as a teacher since the size of the school is extremely small. In this case, we interviewed the energy manager and one other schoolteacher about teaching material issues. The goal of these interviews was to gather further information on school conditions and environments with regard to energy efficiency and also to discover teachers' ideas relating to energy efficiency teaching materials. The sampling method for these interviews is identical to that of the group interviews. A primary questioner and a primary observer and note-taker also attended individual interviews. Analysis of these interviews was similar to that of the group interviews, looking for similarities in ideas.

As a result of these teacher interviews we developed a list of curriculum criteria. These criteria were used to evaluate the free energy efficiency teaching materials that were found on the internet. The list of criteria was created and used to assure the Department that the list of materials we provided on the website has met a minimum quality standard. It is in the best interest of the Department to ensure that all information it provides to its schools are of high quality.

The project team first created the list of criteria upon completion of our teacher interviews followed by a discussion with a curricula expert to assess the effectiveness of its criteria. The questions were then weighted according to their importance with respect to all of the criteria. The questions were given weights from one through three. A weight of one indicates that the criterion is of least importance. A weight of two specifies the criterion as important to the overall quality of the material. A weight of three indicates those criteria that are essential to the effectiveness of the material. Refer to Figure 3-4 on the following page to see the completed list of criteria and their associated weights.

Table 3-4. Curriculum Criteria Used to Assess Energy Efficiency Teaching Material.

CRITERIA	WEIGHT
General Content	
Are lessons centred around themes not facts?	3
Are the lessons multidisciplinary?	3
Are the lessons interesting?	2
Are the lessons connected to the students' lives and society?	2
Lessons can be related to Australia?	1
Presentation	
Are the lessons clear and easy for students to understand?	3
Is the overall layout interesting and appealing?	2
Is the vocabulary used appropriate for the grade level?	2
Are vocabulary words defined in context?	1
Is the amount of text appropriate for the grade level?	2
Is there proper use of illustration?	2
Is there proper use of colour?	1
Teacher Usability	
Are there clear and concise instructions for the teacher?	2
Are objectives and outcomes clearly stated?	2
Is background information provided?	2
Is the time required for the lesson clearly stated?	3
Units and language can be easily converted if developed in the U.S.?	2
Are the subjects/disciplines integrated into the lesson clearly stated?	2

Next, the criteria were used to assess fifty-three energy efficiency teaching materials. Each criterion was rated on a scale from one through five. A score followed by its description can be seen below.

- 1 – Criterion is minimally met within the material.
- 2 – Criterion is marginally met within the material.
- 3 – Criterion is met throughout the material.
- 4 – Criterion exceeds the minimum standard.
- 5 – Criterion is highlighted throughout the material.

A score of zero was given if the material did not address the criterion. The materials that received a total weighted score of at least 111 were included on the website as energy efficiency teaching materials that have met a minimum standard. This cut-off number was calculated by multiplying each criterions weight by a score of three and finally added. This ensures the materials have on average at least met the criterion throughout the entire material. Upon using the list of criteria to assess fifty-three free energy efficiency teaching materials, thirty-eight were found to meet this minimum standard. A list of the materials can be seen in Appendix E.

We also took guided tours around the schools, observing and asking questions about the schools' techniques and ideas regarding energy efficiency. The questions served as a follow-up probing interview to our initial interview with the energy manager or principal. Primarily, this tour was to serve as a basis for the project team in creating a self-help energy audit specification to be presented on the final web page. In preparation for tours around schools, we created a list of questions for our guide and listed possible energy conservation practices or techniques to find evidence of. This list was edited and augmented as we discovered more ideas and techniques used in schools.

Chapter IV. RESULTS

The information contained in this chapter serves as a summary of the data collected by the project team. The information presented in this chapter is largely qualitative in nature. The project team collected data from interviews with school principals, energy managers, and teachers. The qualitative nature of the data is a direct result of the answers and information provided by the respondents.

As stated in the methodology chapter, the project team visited four schools to conduct research. In this chapter, the data received at each of these schools is presented individually as mini-case studies. Each school's section presents data concerning the type of school, current energy efficiency programs within the school, results pertaining to energy audits, data on making energy efficiency a permanent feature of the school culture, and curricula information.

Mount Waverly Secondary College

The first school the project team studied was Mount Waverly Secondary College. Situated about thirty minutes east of Melbourne, Mount Waverly is a large metropolitan college consisting of nearly twelve hundred students. As a secondary college, Mount Waverly has students in grades ranging from seven to twelve.

According to Mount Waverly's energy manager, the process of implementing an energy efficiency program began with the Sustainable Energy Authority Victoria (SEAV). The school received a pamphlet in the mail and decided to attend a seminar to get more information. The school decided to participate in the Energy Smart Schools program in order to save money from energy improvements and help the environment.

The program had two key selling points: easy to implement school energy improvements and a short payback period. In addition, the school community was eager to participate in the program because of the monetary and environmental benefits. Although the school did not have an official strategy to make the energy efficiency program a permanent feature of school culture, the energy manager emphasised keeping the school community involved. The school advertised the energy improvements and savings to the school administrators and to parents through a newsletter.

The energy manager at Mount Waverly also conveyed to the project team that the school's focus was mainly on the structural and physical management aspects of making the school energy efficient and less on integrating energy efficiency into the school culture and curriculum. In our interviews and the tour through the school site, we noted a number of energy efficiency and conservation practices already in place, as well as some energy inefficiencies present.

The typical building design at Mount Waverly consisted of a room with a slanted roof, with the larger wall on the south side. Windows ran along the north and south side of the room with smaller windows near the ceiling where the roof is slanted up. The energy manager stated that this design helped to keep the room cool, allowing the breeze to come through the open windows while the heat rises and flows out of the windows near the ceiling. By this same method, these windows provided light without heat. Another heat-reducing method the energy manager exhibited was the use of trees in front of windows in direct sunlight. The trees blocked the sunlight from entering the room, and thus prevented extra heat from entering. Throughout the campus, the school used many such devices: awnings to provide shade and a wooden structure over a window to

block the sun. Further heat reducing techniques were shown in the use of covered walkways, or breezeways. Doors were left open at the ends of these breezeways to allow the wind to travel through the school, cooling the hallways. A large majority of the rooms also used ceiling fans for cooling.

Mount Waverly has also concerned itself with lighting issues. The energy manager communicated to the project team that all of the bulbs in use are low-energy triphosphorus tubes that provide more light while needing less electricity. He also stated that, when first replaced, the lighting fixtures that normally contain three tubes produced too much light. As a solution, fixtures now only have two lighting tubes each. Some fixtures kept all three tubes where needed, for example in metal and wood shops. Lights were more often than not turned off in empty rooms. The school's exterior lights were only powered at night and run on timers and sensors.

Some inefficiencies were apparent upon viewing the Mount Waverly campus. The hot water system ran constantly throughout the day instead of just when needed. Also the relocatable buildings— temporary structures the government provides to schools lacking adequate space for a growing student population—proved to be the most inefficient on campus. The relocatable buildings were the hottest buildings during the summer and in poor condition in general. Lastly, the school's library was kept very warm in comparison to the other rooms. The energy manager stated that this was because the books needed to be kept at a certain temperature. These and other practices and inefficiencies of Mount Waverly can be viewed in Table 4-1. Dashes in the table indicate instances where the project team did not come across any examples in the study to answer the corresponding question.

Table 4-1. Mount Waverly Observation Results.

Category	Issue	Yes/No
Lighting	Less than full lighting fixtures?	Yes
	Efficient use of natural light?	Yes
	Reminder stickers?	No
	Off in empty rooms?	No
	Timers and sensors for exterior lights?	Yes
Heating and Cooling	Timer for thermostats?	No
	Natural gas?	Yes
	Overhead fans?	Yes
	Use of trees or shade structures to reduce heat?	Yes
Building Structure and Layout	Buildings run east to west?	Yes
	Slanted roofs?	Yes
	High ceilings?	Yes
	Portables or relocatables?	Yes
Windows and Doors	Are windows north facing?	Yes
	Are windows tinted?	No
	Venetian Blinds for windows?	-
	Are doors kept closed between heated/air-conditioned rooms?	-
	Are doors used to allow breeze in summer?	Yes
	Reminder stickers to keep doors closed?	No
Obvious Inefficiencies	Lights on in empty rooms?	Yes
	Air-conditioning units used?	Yes
	Computers always on?	-
	Use of lights where natural light would suffice?	No

The energy manager at Mount Waverly was also a teacher. Due to uncontrollable factors by the project team, individual or group interviews with teachers were not conducted during the visit. As a result, information concerning energy efficiency teaching material was gathered during the energy manager interview.

Mount Waverly has focused on building improvements and energy audits within the past twelve months rather than on incorporating energy efficiency teaching material

into its curriculum. The respondent believed that teachers find it hard to incorporate new material into an already "crowded curriculum." To his knowledge, energy efficiency topics have not yet been the focal point of many lessons within the school. This is not to say that other teachers within the school have not incorporated energy efficiency into their lessons.

As a result of the lack of incorporation, the respondent believed that an energy efficiency resources website would benefit schools such as Mount Waverley in instituting such materials into the curriculum. He believed that offering practical and educational material that can be connected and used in conjunction with the Curriculum Standards Framework (CSF) would be most beneficial to the school and its teachers. With respect to specific teaching material, the respondent suggested offering a posting page where teachers and administrators could share ideas concerning programs and materials that are currently being implemented or have proved successful in the past.

This method of gathering teaching material that has been used in the past by others has become the preferred means as a result of proving its effectiveness in the classroom. The respondent believed that when gathering energy efficiency material the approach would remain the same. Currently Mount Waverley receives curriculum information from the SEAV in its Energy Smart Schools pamphlet that is sent to schools across Victoria. In addition, there are seminars conducted by the SEAV across the state that provide helpful energy efficiency information and materials. Mount Waverley has attended these seminars in the past and has used the information to establish its energy saving techniques.

Cobden Technical Secondary College

The project team also studied Cobden Technical Secondary College. Like Mount Waverly, Cobden has students in school grades seven through twelve. Cobden, a rural school of about 330 students, is located approximately two and a half hours west of Melbourne. It is renowned for having one of the best energy efficiency programs in all of Victoria according to the SEAV.

The process of implementing an energy efficiency program began with the drive from an enthusiastic teacher. It was her goal to raise the environmental awareness of the school community. She became interested in making Cobden a sustainable school, and she decided to participate in the Energy Smart Schools program and the Waste-Wise program. She used energy efficiency materials in her classroom and began an extensive recycling program. She also designed a unique program that involved students making bricks from recycled paper, which can be burned for heat. In addition, she organized a staff weekend to discuss school energy improvements. The project group asked the teachers in the group interview what would happen if this teacher were to leave the school. They stated that the program would change but not disappear, because the program became a permanent feature of school culture.

To make energy efficiency a permanent feature of school culture, the school, led by the enthusiastic teacher, took several steps:

- The school signed an energy efficiency agreement at the beginning of the program that was proposed to and approved by the school council. Through this agreement, the school community was dedicating itself to participating in the energy efficiency program.

- The school was involved in competitions for being energy efficient. The Energy Smart Schools program had an Energy Challenge Week where schools across Victoria compete to see who can reduce the most energy. The first year Cobden competed in 2000, they won the energy efficiency award. They were highly commended in year 2001. Through competing for these awards, the students became highly involved in the energy conservation process. They even made their teachers more aware of their energy usage.
- The school publicised the results of energy savings to the students and teachers through posters and the school newspaper. Newsletters posting the results and giving energy saving tips were also sent out to parents.
- The school utilized classes to teach students about energy efficiency.

Cobden used a formal and structured approach to setting up an energy efficiency program and developing it to become a permanent feature of school culture. They used this series of steps to ensure a successful program. Through the enthusiastic teacher who began the programs, interest proved contagious among the entire school community.

The structural and physical management techniques used at Cobden concerning buildings, lighting and heating and cooling systems, parallel the extensiveness of the ideas used to implement energy efficiency knowledge in the community. Cobden's building structure was poorly designed in terms of energy efficiency. All of the school's roofs are flat with some actually indenting down where long corridors are present. In addition, there are many portable and relocatable buildings on the campus. However, despite these problems, Cobden has implemented many strategies and techniques with lighting and cooling to counter act the negative effects of the building design.

Cobden has also addressed lighting issues in a number of effective and creative ways. The school uses natural light instead of electricity whenever possible. While studying the school, we discovered an ongoing project in which electric lights were being replaced with a natural light system within the schools corridors. Often where electric lights are installed in classrooms, they are not used because of the adequacy of the natural light from skylights or windows. In each classroom there are reminder stickers to turn the lights off. Cobden has also replaced light tubes with the more efficient tri-phosphorous model. Our guide also stated that cleaning their lighting fixtures has given them large improvements. Exterior lights are on both timers and sensors.

Cobden has also considered their heating system. The school converted to natural gas heating in 1997. Thermostats are timed: heating is turned on at 6 AM so the building is warm when students and teachers arrive at school; the heating is then turned off at noon so the heat lasts for the remainder of the day and is not wasted after students and teachers leave. In addition, the school uses overhead fans in place of air conditioners wherever possible. Air conditioners are only used in the relocatable buildings. A summary of Cobden's energy management practices and advantages is shown in Table 4-2.

In addition to a strong reputation for being energy efficient, Cobden prides itself on being a technical college and providing its students with an education in a wide range of subjects as well as numerous trades. As a result, the overall willingness to incorporate subjects such as energy efficiency and conservation into its curriculum is a result of the overall nature and culture of the school.

Table 4-2. Cobden Observation Results.

Category	Issue	Yes/No
Lighting	Less than full lighting fixtures?	Yes
	Efficient use of natural light?	Yes
	Reminder stickers?	Yes
	Off in empty rooms?	Yes
	Timers and sensors for exterior lights?	Yes
Heating and Cooling	Timer for thermostats?	Yes
	Natural gas?	Yes
	Overhead fans?	Yes
	Use of trees or shade structures to reduce heat?	No
Building Structure and Layout	Buildings run east to west?	Yes
	Slanted roofs?	No
	High ceilings?	No
	Portables or relocatables?	Yes
Windows and Doors	Are windows north facing?	Yes
	Are windows tinted?	Yes
	Venetian Blinds for windows?	No
	Are doors kept closed between heated/air-conditioned rooms?	Yes
	Are doors used to allow breeze in summer?	Yes
	Reminder stickers to keep doors closed?	Yes
Obvious Inefficiencies	Lights on in empty rooms?	No
	Air-conditioning units used?	Yes
	Computers always on?	-
	Use of lights where natural light would suffice?	No

A group interview with four math and science teachers was conducted during the school visit to gather information concerning the incorporation of energy efficiency teaching material. Currently the school is incorporating lessons and activities that directly relate to energy improvements that are being made to the school building. This approach is believed to give the students a hands-on learning approach to the subject of energy efficiency. For example, when the school decided to change to energy saving tri-

phosphate lamps, the teachers included a science lessons that focused on the differences between traditional and energy saving bulbs. Light measuring devices were then used to measure the strength of light emitted by each bulb. The students were amazed to find that half the amount of tri-phosphate bulbs illuminated the rooms better than twice as many traditional lamps. As a result of such experiments, students have created signs and fluorescent cards to be placed at each light switch and other energy using devices to remind students and teachers to shut them off after use. Teachers believed that the school's involvement in competitions increases the awareness and interest of energy efficiency throughout the school, which in turn encourages teachers to incorporate the topic into its lessons.

The teachers have found their students enthusiasm a driving force in incorporating these activities into the school curriculum. When asked what teachers thought about the "crowded curriculum," each admitted to the issue but continued by stating that they use the Curriculum Standards Framework (CSF) as only a guide when choosing material and activities rather than a basis. This allows teachers to incorporate material that the students enjoy and find interesting. For example, the school's most requested class is forensic science, which admittedly has no direct ties to the CSF. Students and teachers alike enjoy the subject, which is why it is still offered.

Enthusiasm concerning energy efficiency and conservation was evident throughout the entire group interview. Discussion of an energy efficiency resources website stimulated conversation concerning the contents of the page. First and foremost the teachers would like to observe a commitment to an overall website that would both encourage energy efficiency in addition to providing the resource necessary in doing so.

The teachers would like the opportunity to contact schools that have successfully implemented programs to gather information concerning instituting a programs of their own. Information concerning energy efficiency and its societal impact as it relates to Australia and the globe proved invaluable to teachers. The teachers believe that becoming energy efficient and aware is much more than a monetary savings opportunity. They believe teaching energy efficiency is an opportunity to make the world a better place for generations to come.

When discussing the specifics of energy efficiency material, certain qualities were discussed. All agreed that it is hard to establish criteria because gathering material is a technique that is learned over time by instituting lessons in one's classroom. There were qualities discussed that all teachers agreed would characterise quality teaching material. The teachers use material that is cross-curricular in order to incorporate lessons into as many subjects as possible. Within this same context, the material is present in an interesting and enjoyable manner as to motivate both the teachers and the students. The material must also be appropriate for the grade level and build on or incorporate what students already know. Proper illustrations and presentation are very important when gathering materials for primary school students. These illustrations again should be appropriate and incorporated into the context of the lesson. Finally, the teaching material must show that it has potential to work in a classroom environment. Any teaching material that has been used successfully in the past would encourage most teachers to use the specific material.

Mitcham Primary School

A third school studied was Mitcham Primary School. As a primary school, it teaches students of school grades ranging from preschool to six. Mitcham, a small metropolitan primary school of about 300 students, lies about one hour east of Melbourne.

Mitcham still has major barriers to cross in order to begin implementing an energy efficiency program. Through the principal interview, the project group was able to gain insight into a school that was trying to get an energy efficiency program started and the issues that they must overcome to do so. The issues that the school had to address were a budget problem and lack of parental support. The school was in the beginning stages of setting up an independent program with three other primary schools in the area called the Sponsorship Proposal for Mission Energy. In order for this program to be commenced, the school needs to receive A$300,000 from government grants and sponsorship. If the school were to receive the money, the principle would begin a construction program to make the school buildings more energy efficient. If the school were not to receive the grant, the idea of an energy efficiency program would be abandoned. The principal stated that the parents who were not on the school council did not show an interest in teaching their children about energy efficiency.

To make energy efficiency a permanent feature of school culture, the principal emphasized involving people in the decision making process. The principal was highly dedicated to promoting the quality of life through energy efficiency. He emphasized that the school was forward thinking and the teachers were dedicated. For Mitcham, the focus was not on having an energy leader but on having committees that share the

responsibility. The main focus for the energy efficiency program was not to save money but to preserve the quality of life. Mitcham's principal was developing a concept to split the savings between the students and the school. This concept would give the students an incentive to become really involved and excited about participating. Furthermore, the principal wanted the students to take an active role in learning and take their energy education home.

The oldest buildings on the Mitcham Primary School campus were built in 1929. As a result, these buildings have the distinct high ceiling and brick layering characteristics of buildings of the early twentieth century. The main hallway of the front building, however, was recently renovated. The principal informed the project group that they had considered energy management issues during the renovation but actually implemented little because of budget issues. Other buildings on the Mitcham campus had the same structure as the Mount Waverly buildings: slanted roofs with windows on the high wall to allow heat to escape. However, contrary to what was previously discussed, the principal at Mitcham stated that these buildings were not a very good energy efficient design. The principal continued in saying that the design may be more efficient in theory but may not actually be more efficient when used. The principal also believed that the design was used only because it was more economical.

With an adequate program lacking, lighting issues were often not addressed at Mitcham. In rooms where natural light from windows or skylights would suffice, all electrical lights remained on. Also, all lighting fixtures contained the full amount of lighting tubes possible. When asked about efficient lighting tubes, the principal stated

that the tubes would be replaced with more efficient models in the future. Exterior security lights are run on timers only.

Most classrooms at Mitcham use reverse cycle air conditioners to counteract the summer heat. In a certain area of the school, the entire ceiling was made up of a large skylight that caused the heating of the hallway. This skylight also provided the only source of light in the hallway. The principal explained that in this area the heat in the summer was unbearable, resulting in the installation of air conditioners. Some rooms have both ceiling fans and air conditions. Air conditioning was also used in the school's relocatable buildings. The principal stated that while these air conditioners were a poor use of energy, they were only actually used six weeks out of the year.

There are many inefficiencies in addition to the ones presented above that could be addressed at Mitcham. One such inefficiency is in the use of computers. In one computer room, computers were all on and clumped together on one table; some had their screens on, some off, some had screensavers, and some did not. The room also had no ventilation, causing it to be several degrees warmer then any rooms in the rest of the school. These and other energy efficiency practices and inefficiencies at Mitcham are shown in Table 4-3.

Also during the Mitcham Primary School visit, a group interview with three teachers was performed. Again the same topics and issues were discussed to establish potential trends amongst all schools and respondents. The teachers admitted to only minor additions of energy efficiency and conservation materials currently being incorporated into the schools curriculum. None of the three teachers had instituted formal lessons concerning the issue. Regardless of this fact, the teachers were the most

Table 4-3. Mitcham Observation Results.

Category	Issue	Yes/No
Lighting	Less than full lighting fixtures?	No
	Efficient use of natural light?	No
	Reminder stickers?	No
	Off in empty rooms?	No
	Timers and sensors for exterior lights?	No
Heating and Cooling	Timer for thermostats?	No
	Natural gas?	Yes
	Overhead fans?	Yes
	Use of trees or shade structures to reduce heat?	Yes
Building Structure and Layout	Buildings run east to west?	Yes
	Slanted roofs?	Yes
	High ceilings?	Yes
	Portables or relocatables?	Yes
Windows and Doors	Are windows north facing?	Yes
	Are windows tinted?	No
	Venetian Blinds for windows?	-
	Are doors kept closed between heated/air-conditioned rooms?	Yes
	Are doors used to allow breeze in summer?	No
	Reminder stickers to keep doors closed?	Yes
Obvious Inefficiencies	Lights on in empty rooms?	Yes
	Air-conditioning units used?	Yes
	Computers always on?	Yes
	Use of lights where natural light would suffice?	Yes

enthusiastic of all those interviewed. They appeared to be excited and innovative in offering suggestions for an energy efficiency resources webpage. This attitude was present throughout group interview.

The teachers' main concern regarding incorporating energy efficiency materials into the curriculum was the "crowded curriculum." Being a primary school, the teachers believe that they must follow the Curriculum Standards Framework (CSF) more closely

than secondary schools. The foundation of numeracy and English is established during the primary schools years; therefore the teachers felt as though the goals set forth in the CSF are the prime responsibility of the school's curriculum. The teachers believe that with the correct materials, energy efficiency can be moulded into the existing curriculum.

The teachers communicated to the project team suggestions to consider in the development of the webpage. All of the information provided concerning what they would like to encounter on a website would give them good reason to return to the site in the future. The site must be easy to navigate, not only for teachers in administrators but for primary students as well. This includes pictures and links for students concerning energy efficiency and conservation that they can visit independently. User friendliness is an important factor when deciding if the teachers will return to the site in the future. Specific to teaching materials, the respondents would encourage a teacher network where teachers and administrators can communicate about useful materials and or strategies that have been successfully implemented.

In addition to recommended material, the teachers would be willing to visit a site with a list of resources that includes quality teaching materials. The respondents stated the importance of monitoring and updating the contents of the website to provide the most recent information and resources. When researching teaching material the following list of features are used to establish the value of the material.

1. Material must be motivating to both the teacher and the students as to stimulate and increase enthusiasm for the subject.
2. Primary school material must be fun and involve different activities.
3. Material must be multidisciplinary as to incorporate as many subjects as possible.
4. Material should incorporate a teacher's guide for all lessons.

5. Material must be grade and level appropriate as to the subjects that are pertinent to that grade.
6. Use of colour and graphics appropriate to grade level.
7. The time for the lesson should be given within the lesson plan.
8. Lesson plans should be well thought out as to allow for easy implementation.
9. Material should be sequential and build from prior lessons.
10. Lessons must be easy to read and understand.
11. Material must use the correct language for the grade level.
12. Units and language should be converted easily if developed in the United States.

In addition, the teachers stated that they are much more likely to gather free teaching material from a website. Materials that incur a cost must provide an example, contact information, and relevant costs.

Miners Rest Primary School

Miners Rest Primary School was the fourth school the project group studied. Miners Rest, like Mitcham, is a primary school thus teaching preschool through grade seven. Miners Rest is an hour and a half west of Melbourne in a rural area near Ballarat. Of the four schools, Miners Rest is by far the smallest with about 130 students and only six classrooms.

Due to the small size of Miner's Rest, the implementation of an energy efficiency program was kept simple and easy. The energy manager saw an advertisement in a science related journal for the Energy Smart Schools program and decided it might be a good way to save the school additional money. He attended the seminar and made a spreadsheet of the school's past three years energy usage. He also drafted the Energy Management Policy for the school to commit to. The entire process of implementation took only three weeks.

According to the energy manager, the school looked to the students to help make the energy efficiency program a part of the schools culture. The theory was that if students were interested in saving energy then their teachers and parents would be as well. To involve the students, the school set up an energy competition between classrooms, where the older students acted as monitors. During recess these monitors checked to see if lights were left on, heaters were left on, or if the door was left open. The competition went on for a few weeks and the classroom winner got a certificate prize. This competition was meant to raise awareness and get all age groups involved in saving energy. Another strategy to getting students involved was to post energy saving tips in every classroom. These tips give students ideas on what they could do to save energy.

Miners Rest is unique in that there is one building, which is approximately 150 years old. It is used for administration. There are six other relocatable buildings used as classrooms. The older building used a triple layer of brick for insulation. The layout of all of these buildings forms a crescent shape around a central courtyard area. Trees block the open end of the formation. According to the principal, this design was done purposefully. Miners rest is an abnormally windy area and the formation of these buildings reduces that wind. In addition, the trees against the courtyard complement the building layout, reducing the wind but also providing shade and shelter in the summer while allowing light in the winter.

Lighting issues at Miners Rest vary in terms of how well they are considered and solved. Although lights are often turned off when rooms are left empty, the school's use of natural light is somewhat lacking. Some rooms use natural light through skylights very effectively while most of the classrooms cover the Venetian blinds with children's

artwork and various classroom posters. The principal stated that more efficient lighting tubes would be installed over time. Also, exterior lights run on sensors and, according to the principal, are actually on a minimal amount of time.

The relocatables at Miners Rest seemed to be the most difficult part of the school to keep cooled and heated properly. These relocatables are given to schools by the government and do not address energy efficiency issues well. As a result, Miners Rest has made active efforts to overcome these inefficient buildings. The school replaced the rather inefficient furnaces in the older model relocatables with a better heating device. The older model buildings were also lacking air conditioners and ceiling fans; the school installed both in each classroom. Newer models of the same buildings contained both air conditioners and ceiling fans. These buildings also had large windows running the length of the wall. These windows tended to raise the temperature of the room significantly if they were not covered. In response, the school has installed Venetian blinds in each classroom to counter act the sun's heat while still providing light. These energy efficiency practices and techniques used at Miners Rest can be seen in Table 4-4. After the observational school tour, we conducted an individual interview with one of the schools six teachers in order to gather more information on energy efficiency teaching materials. Incorporating lessons concerning energy efficiency is subsequent to current competitions or programs that the school is involved. These competitions have become the focal point of teaching the students about energy efficiency. During "energy

Table 4-4. Miners Rest Observation Results.

Category	Issue	Yes/No
Lighting	Less than full lighting fixtures?	No
	Efficient use of natural light?	Yes
	Reminder stickers?	Yes
	Off in empty rooms?	Yes
	Timers and sensors for exterior lights?	No
Heating and Cooling	Timer for thermostats?	No
	Natural gas?	Yes
	Overhead fans?	Yes
	Use of trees or shade structures to reduce heat?	Yes
Building Structure and Layout	Buildings run east to west?	Yes/No
	Slanted roofs?	No
	High ceilings?	Yes
	Portables or relocatables?	Yes
Windows and Doors	Are windows north facing?	Yes/No
	Are windows tinted?	No
	Venetian Blinds for windows?	Yes
	Are doors kept closed between heated/air-conditioned rooms?	Yes
	Are doors used to allow breeze in summer?	No
	Reminder stickers to keep doors closed?	Yes
Obvious Inefficiencies	Lights on in empty rooms?	No
	Air-conditioning units used?	Yes
	Computers always on?	Yes
	Use of lights where natural light would suffice?	No

efficiency week" individual year five and six students perform checks of each room during recess, lunch and the end of the day to see if lights and or computers are left on, whether windows and doors are closed etc. The school holds assemblies for the students during this time to discuss energy saving techniques and the positive effect that they can have on the environment. Students are encouraged to walk to school with an adult to reduce pollution and then discuss the purpose and effect on the globe. The school is

introducing its students to the large environmental issues that are the underlying factors in why schools should become energy efficient.

Although formal lessons have not been incorporated into the curriculum, teachers receive material and ideas from the SEAV on a regular basis. In addition to the SEAV, Miners Rest uses the Internet to gather additional information concerning energy efficiency and believe it is a valuable resource for this issue. Although the school has not used lessons in the classroom the teacher believes that only free material would be used as a result of budget issues within the school. If costly materials were warranted an example of the material must be given with an extensive explanation of the materials effectiveness in the past. When gathering materials for any subject the respondent searches for the following qualities.

1. The material must be interesting to the students.
2. Materials should be user friendly with regards to ease of implementation for the teacher.
3. The material must be appropriate for the age and level of the students.
4. Material points to additional resources and activities.
5. Lessons should be cross-curricular.

The respondent believed that incorporating energy efficiency into the curriculum will take time and effort on the part of the teachers as to establish how to best incorporate material into an already "crowded curriculum." The government concerning specific subjects and the amount of hours they must be taught mandates Twenty-five hours of class-time per week. Mathematics must be taught for five hours while English for ten. This leaves ten hours per week to incorporate all other goals within each of the subjects in the CSF. It is within these ten hours teachers would have the opportunity to incorporate energy efficiency unless it could be taught during mathematics and English.

Chapter V. ANALYSIS

The information contained in this chapter serves as an analysis of the data collected by the project team. The data collected in each school was divided into four sections: energy audits, curricula, encouraging schools to implement energy efficiency programs, and making energy efficiency a permanent feature of school culture.

Energy Audits

The two main objectives of the DE&T energy efficiency web page specification concerning energy audits are:

1. To provide energy audit resources,
2. To provide an example of an energy audit.

This analysis of information gathered pertaining to the energy audit aspect of the web page is divided according to these two objectives. First, resources that surfaced in the interviewing and school meetings process will be described. We used this as well as additional information to provide schools with a list of energy audit resources on the web page. Next, common energy efficiency techniques and practices found to be instituted in the schools studied will be discussed. These techniques will help to specify the introductory sample energy audit to be provided on the web page.

The first main objective of the web page is to provide energy audit resources. As a result of interviews with energy managers and principals of the four schools involved in our study, we found that the main energy audit resource for all four schools, both primary and secondary, was the Sustainable Energy Authority Victoria (SEAV). The project team

discovered that the SEAV offers free auditing services to schools. Schools simply need to contact the SEAV, express interest in an energy audit and an auditor will come on-site to perform an energy audit at no charge. After the audit is performed, a report is given to the school detailing areas where energy efficiency can be improved and recommendations for money-saving possibilities. Representatives of two schools, Mount Waverly Secondary College and Cobden Technical Secondary College, presented these reports to their school council to receive additional funding for energy efficiency projects. In studying the SEAV further, we found that the organization provides schools with elaborate checklists and spreadsheets for determining their energy use.

Other potential sources for energy audit material were discussed and analysed in the Literature Review. Those resources include the DOE-2 and EnergyPlus software packages. Although the project team discovered that schools prefer free materials, any school that wishes to deepen the level of detail and complexity of their audit process can use these packages. These software packages may be more suitable for larger schools or perhaps schools just being built.

The second and more important main audit objective of the energy efficiency web page was to provide a sample energy audit. The goal of this checklist is for schools to recognize simple tasks, encouraging schools to employ energy audits and ultimately to realize energy efficiency programs. The audit was designed to serve as enough information for a school administrator to feel as though energy efficiency is worth the effort involved but at the same time the audit would not discourage small schools wanting to start energy efficiency programs.

Many of the areas of energy efficiency covered in energy audits were discovered through our tours of school property. There are five main areas the project team addressed when observing school campuses:

- Lighting,
- Heating and cooling,
- Building structure and layout,
- Doors and windows, and
- Any obvious inefficiencies the project team may have discovered.

Tables 4-1 through 4-4 are combined in Table 5-1 in order to compare the five areas of each school. Each of these five areas will now be discussed individually, including and comparing all the information gathered from each school. In addition, the information included in the example audit from each these areas will be discussed. It is important to remind the reader that three of the schools studied already had active energy efficiency and conservation programs in place. These schools are Mount Waverly Secondary College, Cobden Technical Secondary College, and Miners Rest Primary School. Mitcham Primary School did not have a program in place, although, at the time of our visit, plans were being made for one.

Lighting

Of the four schools visited, the three with programs in place had actively addressed energy efficiency issues specific to lighting. The one school that did not was also the one without a formal energy plan instituted. Also we discovered that, in schools that implemented reminder stickers on their light switches, the lights were almost always off in empty rooms. This suggests that if minor efforts are taken to encourage practices like shutting off lights in empty rooms, the results are worth the initial effort.

Table 5-1. Comparison of Energy Efficiency Practices Among Schools Studied

Shaded areas represent responses that promote energy inefficiency.	Victorian schools involved in study			
	Mount Waverly	**Cobden**	**Mitcham**	**Miners Rest**
Lighting				
Less than full lighting fixtures?	Yes	Yes	No	No
Efficient use of natural light?	Yes	Yes	No	Yes
Reminder stickers?	No	Yes	No	Yes
Off in empty rooms?	No	Yes	No	Yes
Timers and sensors for exterior lights?	Yes	Yes	No	No
Heating and cooling				
Timer for thermostats?	No	Yes	No	No
Natural gas?	Yes	Yes	Yes	Yes
Overhead fans?	Yes	Yes	Yes	Yes
Use of trees or shade structures to reduce heat?	Yes	No	Yes	Yes
Building structure and layout				
Buildings run east to west?	Yes	Yes	Yes	Yes/No
Slanted roofs?	Yes	No	Yes	No
High ceilings?	Yes	No	Yes	Yes
Portables or relocatables?	Yes	Yes	Yes	Yes
Doors				
Kept closed between heated/air conditioned rooms?	-	Yes	Yes	Yes
Used to allow breeze in summer?	Yes	Yes	No	No
Reminder stickers?	No	Yes	Yes	Yes
Windows				
North facing?	Yes	Yes	Yes	Yes/No
Tinted?	No	Yes	No	No
Venetian Blinds	-	No	-	Yes
Obvious inefficiencies				
Lights on in empty rooms?	Yes	No	Yes	No
Air-conditioning units?	Yes	Yes	Yes	Yes
Computers always on?	-	-	Yes	Yes
Use of lights where natural light would suffice?	No	No	Yes	No

For this reason checking for reminder stickers and lights off in empty rooms are included on the example checklist.

The use of natural light was another major difference among the schools with programs and the one without. The three energy schools all used natural light effectively in place of electricity through both windows and skylights. We found at Mitcham that, even when natural light was enough to light a room, most electric lights were on as well. In the other schools, some ways that natural light was used effectively included windows with adequate shading, roofs made of translucent material and windows located near high ceilings. By these examples studied at the other three schools, natural light could be used in simple ways; an elaborate skylighting system as being currently installed in Cobden is not necessary. Therefore, checking for efficient use of natural light is also included in the example audit.

Mount Waverly and Cobden also removed lighting tubes from each fixture after bulbs were replaced with more efficient lights. Both schools cited two reasons for such action:

1. Taking out a tube directly resulted in reducing their lighting costs
2. The newer efficient tubes provided too much light.

The two schools that did not implement this idea were the two primary schools, Mitcham and Miners Rest. Mitcham did not have an energy program in place as of yet and Miners Rest, as a result of its small size, possibly did not have the manpower available to perform such tasks, although both principals stated lighting tubes would eventually be replaced. The process of replacing lights can vary in complexity depending on the size of

the school and is usually not an easy process to complete. Consequently, we did not include replacing bulbs in the example audit for fear of discouraging schools with this complex task.

Heating and Cooling

The goal of Victorian schools with regards to heating and cooling is primarily to keep hot air out of the buildings while keeping cool air in. In the process of studying these four schools, the project team witnessed many practices, both passive and mechanical, that reduce heat in school buildings. The next three sections discuss these practices through the use of thermostats and air conditioners, building structure and layout, and windows and doors.

Some examples of passive heat reducing techniques seen at the schools studied include the use of trees as a shading device. Both at Mount Waverly and Miners Rest, trees were used to block the sun from warming areas of the school. Additionally, during the winter months these trees will allow desired light and heat to enter. Although efficient and natural, such use of trees to reduce heat is a long term and involved project. In addition to trees, some schools used other devices to reduce the sunlight and the heat. At Mount Waverly, a large awning was placed over an area where students congregate. The classrooms at Mitcham had extended eves on the roofs that reduced the amount of sun that shone inside the room, thus reducing heat. These techniques, however, are somewhat permanent and subsequently were not included in our sample auditss.

There were also a number of mechanical methods to cool or heat buildings in the schools studied, the most prominent of those being the use of ceiling fans. We found fans, which have a high initial cost but extremely inexpensive operating costs, to be

present in each of the four schools. Although ceiling fans are an efficient way of reducing energy, all of the schools also had air conditioners installed to combat high summer temperatures. Most air conditioners in use were reverse cycle air conditioners. These units are more efficient than normal refrigerated models and can be used as heaters in the winter. While the more efficient reverse cycle models of air conditioners are in general use, they remain a large consumer of electricity. Also, often times air conditioners remain on even when the room is comfortably cool enough. Unnecessary cooling of a room can cause further energy inefficiency. Therefore it is recommended in our sample audit that air conditioners be operated until a certain room temperature is reached to avoid unnecessary energy consumption.

One method included in our audit to reduce heating costs was to place timers on all of the thermostats. The principal at Cobden stated that their heating system was run from a specific schedule of timers, reducing their heating costs by a large amount. The sample audit also addresses possible problems with timers not being set correctly. These issues were included on the sample audit mainly to make administrators aware of their importance.

Building Structure and Layout

The energy reducing strategies presented in this section are the most permanent since they are directly related to building design and location. Because of the complexity involved in improving building architecture for energy efficiency, this section was omitted from the sample energy audit we created. However, findings at the four schools relating to this topic are discussed.

Both Mount Waverly and Mitcham used the heat reducing classroom architecture discussed in detail in the Results chapter: a slanted roof with windows near the ceiling. When this style of building was mentioned to the Cobden principal, he agreed that it would have been a better design compared to the flat roofs that occupy the Cobden campus. Miners Rest did not present a need for such architecture only having seven buildings, six of which are relocatables.

The most common aspect in all four schools related to building structure was the use of these portable and relocatable buildings. As discussed in the Results, these buildings are temporary classroom buildings the government provides to schools and were used to save money and keep up with a growing student population. During every school tour, our guide expressed the difficulty in keeping these buildings cool. The project team found while at Miners Rest that older models of these buildings did not have ceiling fans and air conditioners included; they had to be installed individually at the schools expense. Another problem involved with these buildings is the long windows that stretched the length of the wall. The room is heated when the sun enters through these windows resulting in a large increase in temperature. However, Cobden, with its reputable energy efficiency program, proved that despite the limitations presented by some building architectures, measures could be taken to improve energy efficiency in other areas to compensate for inefficient building designs.

Doors and Windows

Because both doors and windows both directly related to passive energy efficiency techniques to reduce heating and cooling costs, they are both presented here in

one section. During the tours, the project team found that passive techniques could be addressed with simple practices involving windows and doors.

Almost every school involved in the study used doors and doorways effectively in trapping conditioned air as well as cooling entire areas of buildings. An obvious solution to reducing costs is to keep doors closed between rooms that are being heated or cooled. However, depending on the type of equipment being used, doors may need to be kept open. If air conditioners are using evaporative technology, doors need to be kept open to allow for air circulation. Three of the four schools implemented reminder stickers to shut doors between rooms that were being heated or cooled. Mount Waverly, the one school that did not have these stickers, often left doorways open to allow the breeze to enter through structures called breezeways, which were discussed in the Results. Cobden used a similar practice, leaving doors open at the end of long corridors to cool the area. The project team found these practices simple to execute and are included in our sample audit accordingly.

Windows can also be an effective tool of reducing energy consumption. Principals at Cobden and Miners Rest stated that windows, especially those installed in relocatable buildings, cause most of the unwanted heating of rooms. Unfortunately, on all of the tours conducted, the project team noticed that windows of this style—large windows that run the length of the wall—are not just present in relocatable buildings, but also most other school buildings. Cobden's attempt at solving this problem was to tint the windows, reducing the amount of sunlight that can enter. Miners Rest made a simpler attempt by installing Venetian blinds on affected windows. These blinds not only block sun, but also provide an option on how much sunlight and thus heat is allowed in the

room. Having proper sun shading devices was a large concern for the schools; therefore this issue was included in our audit.

Obvious Inefficiencies

Some obvious inefficiencies found throughout the four schools have been discussed previously: lights left on in empty rooms and the use of air conditioners. These issues are addressed in our example audit in other sections. However, another common inefficiency was found in both Mitcham and Mount Waverly: the energy efficient use of computers.

In both Mount Waverly and Mitcham, computers and monitors were left on when unused. The principals conveyed to us that the computers were used fairly often; however, both tours occurred during recess and thus the computers were not being used. In addition, monitors, which consume about half of a computers power, were also left on. Reminders stickers to shut off unused equipment, like those implemented for lights and doors, could be a possible solution to this problem. Additionally, administrators could make sure some kind of power save mode is in use on the computers. Because these very simple techniques can greatly reduce the amount of energy consumed by computers, they were included as questions in the project group's sample energy audit.

Curricula

The information provided in this section analyses all of the information concerning teaching energy efficiency in the classroom. Information from all respondents concerning curricula is included in this analysis. The information can be categorised into five topics or themes. The topics include:

1. incorporating energy efficiency teaching materials into school curricula,

2. current commitment to teaching energy efficiency in the classroom,
3. methods used in gathering teaching materials,
4. information that would be useful on an energy efficiency resources web page, and
5. what teachers look for when choosing teaching material.

Each of these topics will be addressed and qualified with additional information that was gathered during the interviews.

To gather information concerning what teaching materials were already being used in the school curriculum teachers were asked if and how such materials were currently incorporated into the curriculum. It was found that three of the four schools felt that they are restricted in the material that they can teach by the Curriculum Standard Framework (CSF). This framework sets forth the goals and objectives of a school's curriculum, but does not provide a specific path to achieving these goals. This task is ultimately left up to the discretion of the individual teacher. Four out of ten teachers indicated that they are currently incorporating energy efficiency materials into their classrooms, although this material is largely related to actions the school may be doing to become more energy efficient. For example, Cobden Technical Secondary College has made major strides and improvements to the building structure and has used these changes to incorporate the students into their implementation. It should be noted that three of the four aforementioned teachers are Cobden teachers. These teachers see the CSF as only a guide and are not afraid to step outside the boundaries of the goals in the CSF. Cobden's most popular class has been forensic science for the past five years although it has no direct tie to the CSF. The administration and teachers believe that it is

their duty to provide the students with classes that they enjoy. It must be emphasised that energy efficiency can be incorporated into the existing curriculum and will not detract from other subjects but rather compliment them.

Miners Rest Primary School has incorporated activities for the entire school that focus around school-wide energy days. Unfortunately when these energy days or weeks are concluded, the topic is not continued. Mitcham Primary School has not incorporated energy efficiency into its curriculum although its teachers are very enthusiastic about bringing the topic into the classroom. Therefore, schools should be encouraged to participate in competitions to increase enthusiasm and awareness about energy efficiency.

This enthusiasm was evident at each of the schools we visited. The enthusiasm and desire to incorporate energy efficiency materials into the curriculum is often outweighed by the need to teach the specific subjects and goals presented in the Curriculum Standards Framework (CSF). The term "crowded curriculum" was used in all of the interviews concerning curriculum and incorporating energy efficiency teaching material. All of the teachers believe that it is hard to incorporate material that is not directly set forth in the CSF while still attaining the framework's goals. They believe that there is already too much information to teach the students in an insufficient amount of time. There are twenty-five hours of class-time each week in a Victorian school, five of these hours are dedicated to math and ten to English which leaves only five additional hours to teach additional material. These figures are mandated by the government and restrict the school in how it uses its class time. As a result, teachers stated that in order to better incorporate energy efficiency material into the curriculum it must be

multidisciplinary in nature. This will allow the teachers to incorporate and include a number of subjects and use the material in attaining the goals in the CSF.

It is evident that there is an interest in incorporating these materials into the curriculum by teachers and principals although current practices are minimal and not consistent throughout the visited schools or within the individual schools themselves. The current commitment to incorporating energy efficiency into its lessons is widely left in the hands of the individual teacher, and are generally activities related to improvements the schools is taking to improve energy efficiency. It was stated by a majority of the teachers that this approach allows the students to see what they are discussing in their own environment. This stimulates and motivates the students into wanting to learn about the subject further.

Unfortunately outside of these activities only minor strides are being made in including energy efficiency into the overall curriculum. Much of this is a result of the amount of emphasis the school puts on following the CSF. Because Cobden does not place a large emphasis on the CSF, they are able to incorporate more activities than the remaining three schools. This may be a result of the nature of the school being a technical college, of which there are very few left across Victoria, which may help the school in incorporating such teaching materials. All of the schools have found that it is very helpful and easy to teach energy efficiency when the school enters energy contests or competitions. These events bring the entire school together and increase the overall awareness of the issue. At Cobden the students have become more aware of turning off lights and practicing simple energy reduction techniques as a result of these competitions.

Each school has stated that these competitions have increased energy efficiency practices and teaching in some way.

When dealing with teaching a specific topic in the classroom there are various ways in which teachers gather the materials needed to conduct a lesson. When asked what method teachers would use to gather energy efficiency material it was found that all of the teachers would in some way use the Internet as a resource. In that respect this qualifies the need to incorporate an energy efficiency teaching materials section in the energy efficiency and supporting resources website. The Internet allows for simple and prompt gathering of information. It was found that when a teacher encounters a website that is informative and useful, the teacher will return to this site many times for additional information. At each of the four schools the SEAV website was mentioned as a primary source on energy efficiency programs and teaching materials. Teachers do not have the time to search the Internet endlessly and as a result use the resources that they believe are most informative many times. With regards to not only energy efficiency material all teachers stated that they would most likely choose free material over material that had a cost associated with it. This may be due to budget constraints or the time associated with allocating money and receiving the material. In any case, material that has been recommended by another teacher is the preferred method of gathering teaching materials. This allows for discussion and brainstorming of ideas between teachers related to the quality and effectiveness of the material in a classroom environment.

Knowing that the teachers use the Internet as a valuable tool to gather information and material it is important to determine the qualities, features and information these teachers would like to see on a website. This information will be used to formulate

characteristics of the website and determine what additional information will be included. First and foremost teachers would like a site that is comprehensive, that is a section dedicated to all levels of administration and students. The SEAV website was mentioned in all interviews as a quality site in terms of the page organisation. The teachers emphasised the need to incorporate a student section that would include links for students to websites that have on-line activities for them. These activities would complement classroom activities and raise student interest and awareness. The teachers would also like background information regarding energy efficiency as to become educated about the subject which will in turn allow them to better understand and incorporate energy efficiency activities and materials into their lessons. One cannot assume that when simply provided with the information a teacher has the ability to incorporate the material into their classroom. Informing the teachers about energy efficiency will raise their interest and in turn allow for greater discussion if incorporated into lessons.

When teachers search for quality materials, it was discovered that there are underlying criteria they search. This criteria is non-specific with regard to subject, rather these criteria are used as a guideline to establish the overall quality of the material. The following list of criteria was created from the qualities presented in the previous chapter. Table 5-2 describes the criterion that was used in accessing whether or not individual teaching materials met a minimum standard. Those materials that met this standard were recommended to the Department and are included on our proposed website. For a discussion concerning the development, weighting and scoring please refer to the Methodology.

Table 5-2. Curriculum Criteria.

CRITERIA	WEIGHT
General Content	
Are lessons centred around themes not facts?	3
Are the lessons multidisciplinary?	3
Are the lessons interesting?	2
Are the lessons connected to the students' lives and society?	2
Lessons can be related to Australia?	1
Presentation	
Are the lessons clear and easy for students to understand?	3
Is the overall layout interesting and appealing?	2
Is the vocabulary used appropriate for the grade level?	2
Are vocabulary words defined in context?	1
Is the amount of text appropriate for the grade level?	2
Is there proper use of illustration?	2
Is there proper use of colour?	1
Teacher Usability	
Are there clear and concise instructions for the teacher?	2
Are objectives and outcomes clearly stated?	2
Is background information provided?	2
Is the time required for the lesson clearly stated?	3
Units and language can be easily converted if developed in the U.S.?	2
Are the subjects/disciplines integrated into the lesson clearly stated?	2

Implementing an Energy Efficiency Program

Three of the four schools were involved in the Energy Smart Schools Program, in which they had specific guidelines for implementing an energy efficiency program. Mitcham primary school, the only school just beginning an energy efficiency program, also had a similar technique. The points that they all had in common were:

- Person became interested in saving energy and began researching energy efficiency.
- The school received information from the Sustainable Energy Authority Victoria (SEAV) through mail, brochures, seminars, etc.
- The school performed an energy audit with the help of SEAV's professionals to determine building inefficiencies.
- The school signed an energy management policy to commit itself to the energy efficiency program and set guidelines for the school community to follow. The school council approved the policy.
- The school recorded past energy information, and kept track of energy savings.

Three out of four of the school had strategies to make energy efficiency a permanent feature of their school culture. In addition to these points, it is important to have a responsible enthusiastic person in charge as well as set goals for the school to achieve in energy efficiency. A person in charge serves as a motivator of the program. Likewise, having goals will allow the school to work towards achieving a desired state of energy efficiency.

Encouraging Schools to Implement Energy Efficiency Programs

In order to persuade a school to participate in any program, it is essential to probe into the background of the school and understand its history. In Victorian schools, a cost-benefit analysis was completed to compare the barriers and rewards of implementing an energy efficiency program. It is necessary to minimize the costs and maximize the benefits, in order to convince a school to become involved in the programs. Table 5-3 displays the costs and benefits involved in implementing an energy efficiency program.

Table 5-3. Costs Versus Benefits of Implementing Energy Efficiency Programs.

Costs	**Benefits**
Money for improvements	Environment and building improvement
Time for implementation	Short payback period
Over-crowding the curriculum	Money savings from less energy usage
Change	Fun and informative
	Improve school reputation
	Easy implementation

There were several barriers that Victorian schools face when implementing an energy efficiency program. One of the barriers was the money involved in making building improvements, as well as the money associated with energy efficiency teaching materials. Mitcham primary school, the only school that did not yet have an energy program in place, focused highly on the money for implementing an energy program and receiving grants from the government. The time required for the implementation of a program was also an issue for schools to overcome when deciding to participate. The time included registering for the program, doing an energy audit and spreadsheet, making energy efficiency improvements, searching for energy teaching materials, and attending

seminars. In all four schools, over-crowded curriculum was an important factor that influenced initial hesitation on the program, because it was believed there was no room for energy efficiency lessons. Furthermore, the teachers and students had a natural resistance to change that may hinder a new program. For example, the energy manager at Cobden Technical Secondary College said that when the energy efficiency and waste management program was first initiated in the school, the students complained at first but it eventually became commonplace for them.

Although these costs were substantial issues for each school to face when deciding whether or not to participate in a program, the benefits were the deciding factor. The principal, energy managers, and teachers in three of the four schools that we visited focused more on the benefits so that concern for the costs was minimized. Perhaps the biggest selling point of the energy program was the short payback period of the building improvements and the continuous energy savings. The program was not only easy to implement, but the time was minimal. At Miner's Rest, the implementation of their energy efficiency program took only three weeks. Many principals also stated that a main motivation was improving the environment as well as teaching the students a valuable lesson about energy usage. Often resistance to change was overcome by making the program fun and informative. Several of the schools performed competitions to get the students excited about participating. Lastly, the energy efficiency program can be a tool to improve a school's reputation.

The information gathered at the four schools emphasized that the way to encourage schools to implement an energy efficiency program was to approach it as a beneficial situation. Not only was the program a way to save money, but it also helped

the environment. The costs were veiled behind a much larger and extensive list of benefits.

Energy Efficiency As A Permanent Feature of School Culture

How do schools make an energy efficiency program a permanent feature of school culture? This is a question many schools face after the initial implementation of an energy program. The schools we visited had similar approaches to solve this problem. They had four main points in common, which are intended not only to make the program successful but also to make it long lasting and integral to the school.

The first point that was crucial to the initial success of the energy efficiency programs was to have a person in charge. This person got the program started, nurtured it, and eventually let it go on its own. Their duties included signing up for the program, doing an energy audit and spreadsheet of energy usage, promoting and implementing energy improvements in buildings and in curriculum, and influencing the school community to become interested and involved. Once their duties were completed, the school began to run the program. Without the person in charge, the program would not have gained enough momentum to become a permanent feature in the school culture.

The second point is that to integrate a program into the actual school community, it was necessary to write an energy policy for the school to sign. This involved getting permission and support from the school council to implement the energy efficiency program. Once this policy was signed, the school was committed to the program. This formality was essential because it drew attention and support for the program. It also set

guidelines for teachers and administrators to adhere to. The schools being committed to the program is a step to incorporating energy efficiency into the school community.

The third point was that after the program was initialised, the key to success was to get as many people involved as possible. Each school had a unique method to get the students involved. The differences in the primary and secondary schools were shown through. At Cobden, the students were given hands on activities to implement energy efficient practices. This included doing basic audit procedures such as changing lights, recording temperatures, and locating sources of inefficiency. Furthermore the students were given energy efficiency lessons in math and science. In contrast, Miner's Rest Primary used reminder signs by the doors and light fixtures reminding children to turn off the lights and shut the door. The hands-on activities were limited. One factor that they had in common was that both schools use competition to get the students excited to participate. Cobden participates in the annual Energy Challenge Week run by the Sustainable Energy Authority Victoria. Miners Rest has a classroom contest, run by the older students. The teachers were also involved in teaching the energy efficiency materials, as well as running the competitions.

The last point that was important to making energy efficiency a permanent feature of these school cultures was to publicize energy savings and gain support from the school community. By making the energy savings known, the schools gained support from the school council and parents, as well as teachers and students. In Mount Waverly and Cobden, newsletters were sent out to the parents describing energy tips and how the school was performing in energy usage.

Making an energy efficiency program a permanent part of school cultures is not easy. The schools that we visited used these four points to accomplish this problem. Hopefully, when the children leave these schools, they will bring the energy efficiency knowledge with them throughout their lives.

Chapter VI. CONCLUSIONS

This chapter provides the specifications of an energy efficiency and supporting resources web page for Victorian schools. The specifications address the energy audit checklist and resources, the implementation of an energy efficiency program, encouraging schools to participate in an energy efficiency program, and steps to making energy efficiency a permanent feature of school culture. The conclusions provide the content of the web page. The actual web page format is shown in Appendix H.

Sample Energy Audit and Audit Resources

This section describes the information to be included on the web page specification concerning energy audits. Following from the original objective of the energy efficiency web page, the audit information page will feature a sample energy audit as well as display other auditing resources available. The sample audit, which can be seen on the next page in Figure 6-1, was designed to encourage schools to start a formal energy efficiency program. At same time, caution was taken as to not make the audit and its ideas too complicated, which may cause someone to be become unenthusiastic and not try to start an energy efficiency program. Figure 6-1 displays the layout of the audit and all supplementary information. The information contained in the paragraph below the bold statement is based on a study conducted by the Sustainable Energy Authority Victoria. On the web page, the sample audit is in Microsoft Excel format.

Figure 6-1. Sample Energy Audit Included in Web Page as an Excel Spreadsheet.

Sample Energy Audit

Department of Education and Training

Lighting	Room 1	Room 2	Room 3	Room 4	Room 5
Are light switches left on in empty rooms?	0	0	0	0	0
Are light switches on when natural light from windows or skylights would suffice?	0	0	0	0	0
Are any light switches lacking "energy saver" reminder stickers?	0	0	0	0	0
Heating and cooling					
Are thermostats lacking timers or have timers that are set incorrectly?	0	0	0	0	0
Are air conditioners left on even when the room temperature drops below 24°C?	0	0	0	0	0
Doors and Windows					
Are any doors left open in air conditioned or heated rooms?	0	0	0	0	0
Are any doors lacking "close me" reminder stickers?	0	0	0	0	0
Are there any rooms with windows that lack tinting,Venetian blinds or some other sun-shading device?	0	0	0	0	0
Computers					
Are any computers left on when not in use?	0	0	0	0	0
Are any monitors left on when not in use?	0	0	0	0	0
Are rooms lacking reminders to turn off computers and monitors?	0	0	0	0	0
Do any computers not use power saving mode?	0	0	0	0	0
Room Totals	0	0	0	0	0

Sum all "Room Totals" for the entire and divide by the number of rooms to compute the average room total.

If you have an average room total at or above 3, you may have an energy management problem.

Studies show that most schools can save up to 10-15% on energy usage and costs by implementing simple energy efficiency practices like the ones given in this sample audit. Furthermore, investing in energy efficiency technology can help schools save upwards of 40%.

Simple instructions will first be provided at the top of the spreadsheet. As discussed in the Analysis, the audit is divided into four sections: lighting, heating and cooling, doors and windows, and computers. Each section proposes a group of questions addressing certain specific areas related to each section title. The questions were specifically worded negatively, prompting only yes or no answers. In other words, questions are phrased so that a "Yes" answer would indicate an energy inefficient aspect in place at the school.

The columns on the audit represent different rooms in the school with the different issues and their questions running down the left side. Users are instructed to place a "1" in the grid for every yes answer to these questions, and a "0" for no. The spreadsheet then sums all yes answers for each room. If a school needs more spreadsheets for more rooms, they can use multiple spreadsheets together. Room totals can then be used to see how energy efficient an individual room is.

As a final step, after all rooms in a school have been checked, the user is instructed to take the average score of all the rooms. This average room total is the decisive factor in determining whether or not a school may have an energy management problem. After analysis done by the project team, an average room total of three was decided upon to be the cut off point. This means that if schools have an average room total of three or more, the school does not implement at least 25 percent of the twelve simple practices included on the sample audit. This fact was considered to be a logical basis for the claim that the school may have en energy management problem. The statements at the bottom of the audit are included to further encourage schools to implementing energy efficiency programs by inform schools of possible financial savings they can make.

Also included in the energy audit section will be audit resources, both free and priced. These resources are presented as places where schools can go to get more in depth and involved energy audits. Free resources include the Sustainable Energy Authority Victoria, EnergyPlus, and the Energetics web site. Priced resources include the Energetics One-to-Five software as well as various audit tools listed on the US Department of Energy site. Administrators will be encouraged to use these free and priced resources further expand their knowledge and practice of energy efficiency.

Curricula Conclusions

A list of the free energy efficiency teaching materials can be seen in Appendix E. Fifty-three links were assessed, thirty-eight of which are included in the web page and appendix. These materials have been assessed with the list of curriculum criteria and have met the minimum standard as described by the project team. The project team believes that these materials meet the criteria that were discussed during teacher interviews. The materials described in the appendix will be included on the website with direct links to the download page of the material. This direct link insures DE&T that they are supporting only the energy efficiency teaching material provided on the website and not the organisation that has provided the teaching materials free for download. The individual organisations' websites were not assessed for their quality.

In addition to quality teaching materials, the web page also includes a model of an energy efficiency teaching material posting board. Teachers at a number of interviews suggested the idea as a place where teachers can discuss and critique energy efficiency teaching material. Also, teachers expressed to us that the opinions of other teachers who have used materials in their classroom were valued most when determining if that

material should be used at all. This posting board will serve just that purpose, giving teachers the opportunity to critique their teaching materials, give them a specific score and post the results for other teachers to view and comment on. Criteria that teachers can judge materials on are based on the same criteria used by the project team in determining what energy efficiency teaching material sites to include on the web page. Currently the web page does not have a functional posting board, but a model can be seen as part of Appendix H. The inclusion of this posting board gives a unique insight into energy efficiency teaching materials undiscovered anywhere else in our research.

Implementing an Energy Efficiency Program

There are six logical steps to beginning an energy efficiency program to be included on the website. These are listed below:

1. **Identify a responsible enthusiastic leader for the energy efficiency program**

   To begin a successful energy efficiency program, it is important to have an enthusiastic person in charge. Their duties would include: performing an energy audit, writing an energy management policy, recording energy usage, and getting the school community involved. This person may identify committees to manage the program. This is also the first step to making energy efficiency a permanent feature of school culture.

2. **Strategic goals for the school to achieve in energy management**

It is crucial for school communities to set energy efficiency goals for themselves. Consider three and five year plans to achieve these set goals. Goals could be as simple as reducing energy by a definite percentage, or saving a certain amount of money from energy efficiency improvements.

3. **Commit to an energy management policy**

Schools should sign an energy management policy to establish boundaries, objectives, and criteria for an energy efficiency program. This policy should have the permission and support of the school council.

4. **Keep track of energy savings**

Before the program is instituted, make a spreadsheet of your school's past two years energy usage. After implementing the initial building improvements, it is important to keep track of energy and money savings. They serve as a comparison for achieving your energy efficiency goals.

5. **Perform an energy audit**

Energy audits are designed to locate areas of energy inefficiency in school buildings. There are several resources for the undertaking an energy audit. On the proposed website, there is a simple audit checklist for any school to perform without assistance. There are software links available as well. The Sustainable Energy Authority Victoria also performs free audits for Victorian schools.

6. **Design a strategy to make the energy efficiency program a permanent feature of your school culture.**

In order to have a successful energy efficiency program, it is important to design a strategy to make energy efficiency a permanent feature of your school culture. To get more information, look at the section entitled "Making Energy Efficiency a Permanent Feature of School Culture".

Encouraging Schools to Participate in an Energy Efficiency Program

The key to promoting an energy efficiency program on a web page is to emphasize the benefits to participating. Benefits of the program include:

- Improvement to the environment
- Easy implementation
- Short payback period
- Money savings from less energy usage
- Informational and fun

The first and perhaps most important benefit to participating in an energy efficiency program is improvement to the environment. In order to emphasize this benefit on a website, a section was included that outlines the global warming trend and how it affects Victoria. The page will outline the issues behind the greenhouse effect and reveals the necessity of the government proposed fifteen percent reduction in energy usage. Figure 6-2 is an example of the global warming and government program information that could be included on the website.

Figure 6-2. Global Warming and Government Program Information on the Web Page.

Global Warming

The increase of greenhouse gases, primarily carbon dioxide, methane and nitrous oxide, changes the chemical composition of the world's atmosphere. These gases retain heat, thus trapping some of the outgoing energy from the earth. This is referred to as the greenhouse effect.

Before the Industrial Revolution, the greenhouse effect kept the temperatures of the earth warm enough to support life. Since then, however, as human emissions of the greenhouse gases increase, the greenhouse effect has also magnified. Scientists identify greenhouse gas emissions as the main cause of the global warming trend.

Impacts for Australia

With the rise in global temperatures, there will be increasingly negative consequences in Australian ecosystems, hydrology and water resources, food and fibre production, costal systems, and even human health. There will be increased risks of more volatile weather conditions, worse drought and flooding, and a shifting of normal residency areas of various insects that carry diseases.

How You Can Help

By reducing the amount of greenhouse gases you release into the atmosphere, you can help reduce the greenhouse effect! Implementing an energy efficiency program can be very easy! You can start by:

- Turning off the lights when you leave the room.
- Turning off the heating and cooling systems when they are not necessary.
- Keeping the doors and windows shut to keep the heat or air conditioning inside.

Get More Information (links)

EPA Global Warming Site, The Woods Hole Research Centre, Global Warming Information

Help Australia

In response to global warming and the increase of greenhouse gas emissions, the Australian government recognizes the importance of energy efficiency. Being one of the world's biggest exporters of coal, Australia is actively trying to find a balance between remaining economically strong while still promoting energy conservation to lower emissions.

The Victorian government proposed a program in 1999 to decrease energy consumption by 15% by the year 2005 in the public sector. With this web page along with other methods, the Victorian Department of Education and Training (DE&T) is bringing this project to the school systems. We hope the information provided on this site will prove useful in lowering your energy consumtion and helping your fellow Australians.

Not only was helping the environment emphasized on this page, but the easy implementation of an energy efficiency program was emphasized as well. The small section entitled "How you can help" shows that the implementation of an energy efficiency program can be as simple as turning off lights and shutting doors. In addition to this page, as stated earlier in this chapter, a developed audit checklist was designed to encourage even the smallest primary school to examine their inefficiencies. This checklist shows schools that saving energy can be uncomplicated.

The benefits of having a short payback period and energy savings were also addressed on the web page. Schools can save a substantial amount of money by improving their energy efficiency. Likewise, the money that schools put into energy efficiency improvements is usually paid back within a short time period. Figure 6-3 is an example for highlighting the benefit of saving money on a web page:

Figure 6-3. Web Page Information on Conserving Energy and Saving Money..

Conserve Energy and Save Money!

Conserve energy and save money for your school! Energy efficiency programs are designed to reduce the amount of energy your school uses on electricity, ventilation, heating, and cooling. Since the school's energy consumption is decreasing, energy bills will also decrease! Furthermore, the energy efficiency improvement in the school building will pay for itself within a short time period. To view case studies of Victorian schools and examine their money savings, visit this site:

Sustainable Energy Authority Victoria
www.seav.vic.gov.au/schools/intro.html

To make energy efficiency programs appear informative and fun, the web page offers numerous links for administrators, teachers, and students. In addition, it is important to make the web page colourful and illustrative. For teachers, there are multiple links for curricula materials for energy efficiency. For students, there are links to websites devoted to teaching energy efficiency to children. They are bright, colourful, and offer resources for students interested in saving energy. These websites are listed in Table 6-1 below.

Table 6-1. Links to Student Energy Websites.

EIA Kids Page	http://www.eia.doe.gov/kids
Cool Science	http://www.fetc.doe.gov/coolscience/index.html
Energy Matters	http://hyperion.advanced.org/20331
Energy Net	http://energynet.net/
Planet Energy	http://www.dti.gov.uk/renewable/ed_pack
Kids For Earth	http://bcn.boulder.co.us/environment/ed96/edkids.html
Earth Dog	http://www.earthdog.com/
Energy Quest	http://www.energy.ca.gov/education/index.html
Australia Advances	http://www.csiro.au/promos/ozadvances/
EREN Kids	http://www.eren.doe.gov/kids/
Energy Chest	http://www.energychest.net/
Schoolsenergywise	http://www.schoolsenergywise.com/

For administrators, the web page offers numerous links to organisations promoting energy efficiency in schools. This section is dedicated to informing administrators of energy efficiency practices that are being used by other schools in Australia and around the world. The websites are shown on Table 6-2.

Table 6-2. Links to Energy Efficiency Organisations.

Sustainable Energy Authority Victoria www.seav.vic.gov.au	Australia – Victorian secondary and primary schools. Energy Smart Program
Australian Cooperative Research Centre for Renewable Energy http://www.acre.murdoch.edu.au/acre.htm	Australia Overview of several research programs for energy efficiency.
NetEnergy http://www.isr.gov.au/resources/netenergy/	Guide to Australian government energy policy and issues
CREATE www.create.org.uk	United Kingdom Audit checklists, teacher resources, and student links.
Alliance to Save Energy http://www.asc.org	United States Teaching materials, including lesson plans and activities
Campaign to Rebuild America http://www.rebuild.org	United States Teacher and student resources
World Energy Efficiency Association www.weea.org/	Presents information on organizations throughout the world promoting energy efficiency.
National Energy Education Department http://www.need.org	United States Teacher and student resources
Northeast Sustainable Energy Association http://www.nesea.org	United States Energy efficiency program and resources
Education for a Sustainable Future http://csf.concord.org/esf/	United States Information on how to become a sustainable school
KEEP K-12 Energy Education Program http://www.uwsp.edu/cnr/wcee/keep	United States Dedicated to teaching students about energy efficiency
The Foundation for water and energy education http://www.fwee.org	United States Water and Energy materials
Citipower http://www.citipower.com.au/	Australia Energy efficiency in the home, office and school
Environmental Protection Agency http://www.epa.gov/	United States Offers resources on the environment and energy
Office of Energy Efficiency and Renewable Energy http://www.eren.doe.gov/ee.html	United States Offers energy resources

In addition to providing energy efficiency links, the web page will also provide an informative section on what is energy efficiency. This section describes what it means to be energy efficient and differentiates it from energy conservation. This section is meant to excite the reader's interest in energy efficiency, thus encourage them to get more information on an energy efficiency program. Figure 6-4 is an example of the energy information to be included on the website:

Figure 6-4. Energy Efficiency vs. Energy Conservation.

Energy Efficiency vs. Energy Conservation

The most prominent reason for the necessity of energy efficiency awareness is the increase in energy consumption across the world.

Energy Efficiency: Doing a larger amount of common actions or tasks and at the same time using less energy. Acquiring more efficient equipment or designing new energy efficient facilities can achieve energy efficiency.

Energy Conservation: Sacrificing a common action or task in the name of saving energy. This can be achieved through changes in practice and public awareness.

Even though these definitions are different, they both contribute to the reduction of energy usage. Energy consumption could be solved by renewable sources such as solar, wind power, and waterpower; however, these sources are still being developed. Thus is it important to look for other sources to reduce energy usage, such as a reduction in fossil fuel use.

Making Energy Efficiency a Permanent Feature of School Culture

To help schools make energy efficiency a permanent feature in their culture, the website should display the information in a list of six components. These are followed by a short paragraph explaining their relevance to making a program successful.

- **Denote a responsible adult to be in charge of the energy efficiency program**

  A responsible leader is necessary for the initial implementation of your energy efficiency program. His or her duties would include:

  - Recording energy usage.
  - Performing an energy audit.
  - Drafting an energy management policy for the school to sign.
  - Getting the school community as excited and involved in the program as possible.

- **Have your school sign an energy management policy**

  An energy management policy is essential to making an energy efficiency program an integral part of your school culture. By signing the policy, your school is dedicating itself to improving energy efficiency and making building improvements. Furthermore, by having an official policy, the school has an obligation to gain the support of the school council.

- **Involve the entire school in the energy efficiency program**

  Involving as many people as possible is a great way for expanding the energy efficiency program. Send newsletters to parents to show them the energy savings and give them tips to improving energy usage at home. Involve teachers by giving them current energy efficiency teaching materials that they could incorporate into their curriculum. Give them tips to improve energy efficiency in their classroom. Involve the students by giving them energy efficiency lessons. Have them make reminder stickers to shut of lights, shut off the monitors on computers, and close the doors when heat or air conditioning is being used.

- **Incorporate Energy Efficiency into the curriculum**

  Incorporating energy efficiency into the curriculum will help students and teachers learn about energy and the need to be energy efficient. Energy education is crucial to ensure good energy habits for students to carry into the future. The purpose of teaching energy efficiency is to raise awareness for energy and the environment.

- **Publicize your energy saving results**

  By publicizing the energy saving results, you are keeping the school community informed and interested. These results should be something that students, parents, and teachers are looking forward to hearing. The entire school community will be able to compare the energy saving results from month to month.

- **Be innovative.**

  Any subject, including energy efficiency, can seem a little overdone after a while. This is why it is especially important to introduce new teaching materials and lesson plans every month. Approach the subject of energy efficiency in different ways, such as using art for making posters or using math to compute energy usage.

Chapter VII. RECOMMENDATIONS

The Worcester Polytechnic Institute project team recommends the specifications of an energy efficiency and supporting resources website for Victorian schools to the Department of Education and Training (DE&T) as presented in the previous chapter and as illustrated in Appendix H. The website provides the following services:

- Encourages schools to implement energy efficiency programs.
- Details the processes to be followed to implement an energy efficiency program in schools.
- Identifies strategies to make energy efficiency a permanent feature of school culture.
- Incorporates details of a simple self-help audit checklist to encourage schools to locate energy inefficiencies.
- Provides a comprehensive list of quality teacher materials available to schools for the teaching of energy efficiency.

The specifications of the website fully address each of the criteria through extensive research and content development. We recommend the specifications of the website as a valuable tool for promoting energy efficiency in Victorian schools. Due to time constraints, the methodology of the project consisted of visiting only four schools. We recommend that DE&T visit additional schools, to provide a more extensive review of current energy efficiency practices across Victoria and to verify that our findings can be generalized to all Victorian schools.

Future Research

Upon the completion and implementation of the web page, the project team recommends the following:

- Publicize: To promote the web page in Victorian schools, it would be beneficial to publicize it in educational magazines and brochures. Perhaps with the cooperation of the Sustainable Energy Authority Victoria, it may be possible to post an advertisement in the monthly newsletter they send to schools. Furthermore, it may be helpful to email Victorian teachers and faculty members with information concerning the website address and contents.
- Update: The proposed web page will need to be updated on a regular basis. New teaching materials and audits concerning energy efficiency may be offered on the Internet, and it is important to keep the website as current as possible. Teachers and students want new information available, or they may stop visiting the web page. By continuously studying the energy efficiency programs in Victorian schools, there may be more information concerning making energy efficiency a permanent feature of school culture.
- Monitor: A website monitor may be necessary to supervise the website, particularly the teacher posting board for potentially destructive comments. A monitor could also update the website, providing additional links and resource materials. If necessary, the department may consider making this posting board secure, requiring that teachers register and log in to access it.
- Evaluate: Studies should be performed regularly to evaluate the effectiveness of the web page and whether or not Victorian schools are using the site.

Chapter VIII. APPENDICES

Appendix A. Department of Education and Training

Education became the right of all Victorian children aged six to fifteen when the Education Act 1872 was passed. This Act provided free and secular education. As a result of this Act many organizations have been created to provide the children of Victoria with that right. Today that responsibility lies with the Victorian Department of Education and Training.

The Victorian Department of Education, Employment and Training (DEET) was created after the 1999 Victoria state elections. As a result of the 1999 election, the Department of Education, the Department of Human Services, and the respective areas responsible for Employment and Youth Affairs within the Department of State Development, were formed into one unified organisation. DEET was created in response to the belief that education and training are vital to the delivery of the Government's vision for Victoria's social and economic development.

The key role of DEET is to provide government with the proper policies and planning advice for the delivery of education and training programs in Victoria and to coordinate its implementation. As a result, the Department's mission statement is to ensure that all Victorians have the knowledge and skills to participate as responsible, informed and productive citizens of society. The principal responsibilities of the Department are to:

- provide access to high-quality primary and secondary government education for all Victorian children. This includes providing support for non-government schools.

- Ensure that all Victorians have access to the high-quality training and further education services necessary for the social and economic development of the State.
- Create additional employment opportunities, particularly for disadvantaged people and communities.
- Link training and further education to employment, especially in high skill areas and areas of skill shortage.
- Ensure that Government policies and service delivery reflect and meet the needs of all young Victorians (http://www.deet.vic.gov.au/deet).

In addition the department provides support and advisory services to the Minister of Education, the Minister for Post Compulsory Education, Training and Employment, and the Minister for Youth Affairs, and is responsible for the management and administration of their portfolios. In addition to the aforementioned bodies the department provides support to organisations that aid in their cause. These responsibilities are categorised within three major output groups for the department: school education, tertiary education, training and employment, and policy, strategy and information services. The Worcester Polytechnic Institute project team provided information that can be categorized within the school education output group. For this reason the most emphasis has been placed on this output group's information relative to the project.

To measure the Department's success in achieving the above goals, the Department has set the following goals and deadlines as targets to ultimately be attained.

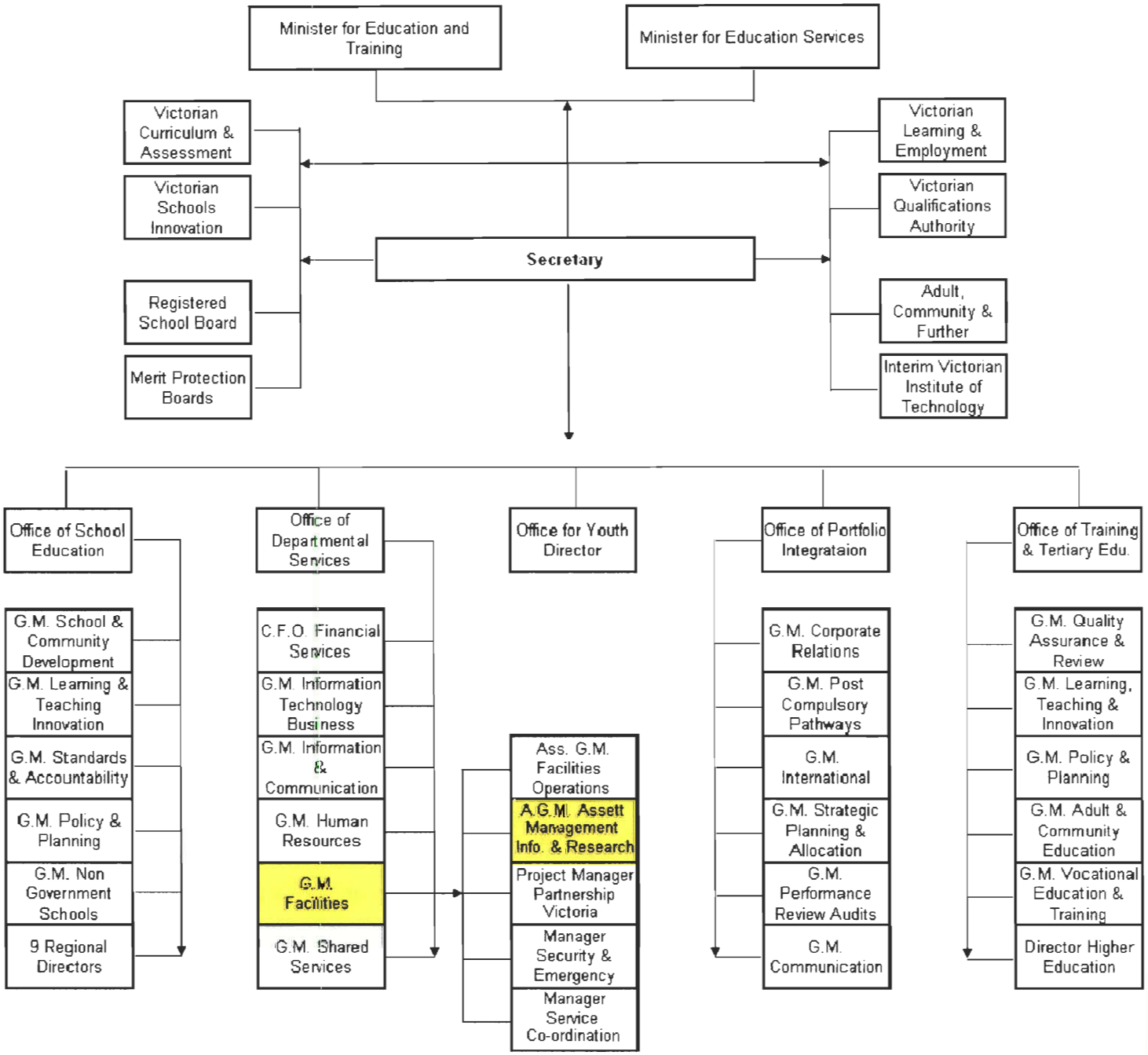
- Victoria will be at or above the national average benchmark for reading, writing and numeracy, as they apply to primary students by 2005.
- Ninety percent of young people in Victoria will complete year twelve, or its equivalent by 2010.
- The percentage of young people aged 15-19 engaged in education and training in rural regional Victoria will rise by 6 percent by 2005 (http://www.deet.vic.gov.au/deet).

The budget figures for 2000-2001 reveal the Department's goal of achieving these targets through the use of education. Below is a summary of the Department's budget corresponding to its previously discussed output group structure.

- School education – A$4609.3 million (82 percent)
- Tertiary education, employment and training – A$982.6 million (17.5 percent)
- Youth – A$6.5 million (0.1 percent)
- Policy, strategy and information services – A$20.0 million (0.4 percent) (http://www.deet.vic.gov.au/deet)

On February 11, 2002, the Department of Education, Employment and Training was divided into two separate entities, the Department of Education and Training (DE&T) and the Department of Education Services and Youth Affairs. This cabinet reshuffle took place in response to the growing number of responsibilities within the Department. This split is intended to further strengthen the Government's focus on the key areas of health, education, and jobs. This restructuring has had no affect on the project in any form. See Figure A-1 on the following page for an updated organisational chart.

Figure A-1. DE&T Organisational Chart.



The project team worked as part of the Facilities Division within the Department. In addition to the aforementioned goals of the entire Department, the facilities division has a mission and specific goals of its own. The core goal of the Facilities Division is to ensure that schools are supported in their attempt to offer Victoria's students the best education possible. It is the hope of the entire Department that upon completion of year 12, students will leave school literate, numerate, socially competent, and encouraged to continue their education or seek employment. The goals of the Facilities Division are linked to the belief that increasing a student's well being through the physical environment will ultimately increase the student's learning experience.

Within the Facilities Division there are three branches; Facilities Division Management, Facilities Branch, and Asset Management, Information and Research Brach. The project team worked specifically under Megan Broome, Assistant General Manager Asset Management, Information and Research Branch for liaison Todd Lucas, Senior Project officer. The scope of the project lies within the Division's responsibility to introduce an energy reduction strategy for Victorian primary and secondary schools.

The Victorian Department of Education and Training is committed to helping the Victorian Government with the proper support needed for the overall social and economic development of Victoria. As a result, in response to legislation passed by the Victorian Government to reduce energy consumption by fifteen percent in the public sector, DE&T believes it is their duty to convey this Government mandate by leading the way in Victorian primary and secondary schools (http://www.deet.vic.gov.au/deet).

Appendix B. Methods Definitions

We specifically selected methods such as interviewing and focus groups because of the personal nature of each. With these methods, we were able to interact with the people that our project affected most. It is essential to know these people in the best way possible in order to solve problems for them. Methods such as surveying and questionnaires, aside from taking too long to implement, would not have provided this degree of personalisation we needed to develop a successful project.

Interviews

There are three types of interviews:

Standardized Interview: Uses a predetermined, formal structure of questions. The participants are expected to answer every question. This method is easy to analyse because the participants are answering the same exact questions. However, the researcher is not allowed to add probe questions that were not in the original list.

Unstandardized Interview: Do not use a schedule of questions. Researchers must adapt, develop, and generate questions during the course of an interview. This method is not possible to analyse.

Semistandardized Interview: Uses a list of predetermined questions, however the researcher is allowed the probe into certain answers. It is slightly harder to analyse than the standardized interview.

We chose to perform semistandardized interviews because although we wanted to use a list of predetermined interview questions, we also wanted the ability to explore certain answers.

The first step to our interviewing was schedule development, where we determined the objectives and goals to our investigation. By choosing the two groupings of administrators and teachers, we were able to develop an outline of questions for each

section. Based on the outline that was developed, we were able to add or delete questions accordingly.

There were four types of questions that we included in our interviews: essential, extra, throw-away, and probing.

- Essential questions focus on the objective of the interview.
- Extra questions are essential questions worded slightly differently. They are asked to check the reliability of the responses and to see the effect different wording may have.
- Throw-away questions are general questions used to make the respondent relax, or change the focus of the interview.
- Probing questions draw out more information from the respondent.

There are two types of strategies to the research process; quantitative and qualitative. A quantitative strategy is used to accumulate data using numbers, figures, and names. By using quantitative sampling, the researcher is trying to define an entire population by sampling a small portion of that population. A qualitative strategy is an in-depth method that focuses on the feelings and opinions of people. Qualitative sampling focuses on determining information about an individual, instead of determining information about the entire population. We used a qualitative strategy for gathering information because we wanted to know how Victorian administrators and teachers felt about energy efficiency programs and curricula. There are three types of sampling techniques that were used in conjunction with the qualitative strategy.

- Reference Sampling is the method of snowballing; having the first respondent reference two people for the researcher to interview next. This method is heavily

biased towards the self-selected individuals. However, these biases can be minimized using triangulation, choosing many different people to do initial interviews.

- Purposive Sampling occurs when the researcher has specific attributes in mind for the interviewees. Based on these attributes, the researcher chooses the people to match. This can also be biased, however the researcher can minimize this by choosing people with different backgrounds.
- Convenience Sampling occurs when a researcher will interview anyone willing to talk. This can be very biased, and is very hard to analyze.

We chose to perform purposive sampling interviews because we were looking for specific qualities in the administrators and teachers that we choose. We were looking for people with different circumstances; including power status, influence, and lifestyles.

Focus Groups

A group interview or brainstorming session would normally be called a focus group. In our case, however, these interviews are not called focus groups because of the fact that it is very likely that teachers in these schools know each other (S. V. Gerstenfeld, personal communication, February 18, 2002). Aside from this fact, group interviews have the same advantages and disadvantages of a focus group. Often the discussion is moderated by a trained researcher to keep everyone focused on a specific topic or idea. The researcher must be careful not to offer opinions, only to provide direction to the group. The researcher may have an assistant to observe people's actions

or take notes (Vernon-Gerstenfeld, 2000; Jamison, personal communication, February 2002).

Group interviews had many advantages. They gave teachers the opportunity to discuss openly with each other what a quality energy curriculum should include. A group interview was beneficial considering our time constraints. We only had seven weeks in Australia with our time for personal interaction limited again by Australian school vacations. Group interviews provided a large amount of data in a short amount of time when compared to interviews. Lastly, group interviews provided a way to observe personal interaction among group members. Often non verbal interactions provided information just as well as verbal communication.

There are a number of disadvantages to group interviews, but none that cannot be address or solved. If one person disagrees with the rest of the group, it is possible that she will suppress their dissension so as to not be attacked by the group. This usually only occurs in groups where members know each other so steps must be taken to randomize the sample to avoid such situations when possible. Also, observing interaction among group members can make this dissention apparent; individual interviews can be set up to explore this dissention. Another disadvantage is that focus groups can be difficult to control. If the researchers practice effective group discussion techniques, this problem can be averted. Lastly, another potential problem is confidentiality. While respondents are guaranteed confidentiality with the researchers, it is not guaranteed with other respondents. This dilemma can be averted by providing contracts to all respondents ensuring they keep some degree of specified confidentiality. For our project, teachers

were merely discussing energy efficiency strategies and curriculum elements, so confidentiality was not an issue.

Our group interviews were constructed using purposive sampling, or choosing individuals based on certain characteristics or knowledge, since group interviews were designed for a specific purpose (Krueger, 1988). This environment provided the information we needed: elements of quality energy efficiency curricula materials. Ideally, the selection process would have had some degree of randomization, but this was left to the discretion of our liaison.

Appendix C. Fulfilment of the Interactive Qualifying Project (IQP)

As stated in the Worcester Polytechnic Institute Undergraduate (WPI) Catalogue 2001-2002, the purpose and goal of the Interactive Qualifying Project is;

> To provide an understanding of the priorities of other sectors of society, develop the ability to communicate effectively with disparate groups, organize and derive solutions to complex problems, and gain an awareness of the interrelationships between technology and people.

Collaboration between the Victorian Department of Education and Training (DE&T) and the WPI project team meets each of the aims and goals of the IQP. Performing the project off-site in Melbourne Australia requires that the team learn and become familiar with the priorities and different aspects of Australian culture. To successfully perform the project the team must learn to adapt and communicate with those not only in the project group but those involved in the project while in Australia. The project topic, energy efficiency, is technological in nature although it directly affects society and the environment. Informing the public about the topic now will allow society to minimize the effect that the topic will have on generations to come.

Appendix D. List of Organisations

There are hundreds of government-sponsored organisations dedicated to increasing energy efficiency. Here is a listing of several key organizations that can be reached online:

Australian Cooperative Research Centre for Renewable Energy
http://www.acre.murdoch.edu.au/acre.htm
Overview of several research programs for energy efficiency.

NetEnergy
http://www.isr.gov.au/resources/netenergy/
Guide to Australian government energy policy and issues

World Energy Efficiency Association
www.weea.org/
Presents information on organizations throughout the world promoting energy efficiency.

National Energy Education Department
http://www.need.org
Teacher and student resources

Northeast Sustainable Energy Association
http://www.nesea.org
Energy efficiency program and resources

Education for a Sustainable Future
http://csf.concord.org/esf/
Information on how to become a sustainable school

KEEP K-12 Energy Education Program
http://www.uwsp.edu/cnr/wcee/keep
Dedicated to teaching students about energy efficiency

The Foundation for water and energy education
http://www.fwee.org
Water and Energy materials

Citipower
http://www.citipower.com.au/
Energy efficiency in the home, office and school

Environmental Protection Agency
http://www.epa.gov/
Offers resources on the environment and energy

Office of Energy Efficiency and Renewable Energy
http://www.eren.doe.gov/ee.html
Offers resources about energy

Appendix E. List of Curricula

Education for a Sustainable Future
URL: http://csf.concord.org/esf/CurrViewByTopic.cfm
Title: Designing Sustainable Communities
Years: P-12

Infinite Power
URL: http://www.infinitepower.org/lessonplans.htm
Title: Renewable Energy
Years: P-12

Alliance to Save Energy
URL: http://www.ase.org/educators/download.htm
Title: Alliance to Save Energy
Years: P-12

National Renewable Energy Laboratories
URL: http://www.nrel.gov/education/energized.html
Title: Getting Energized
Years: 3-6

National Energy Education Development
URL: http://www.need.org/guides.htm
Title: NEED Energy Info books
Years: P-12

Charles Edison Fund
URL: http://www.charlesedisonfund.org/Experiments/experiments-list.html
Title: Charles Edison Fund
Years: 3-12

Watt Watchers
URL: http://wattwatchers.utep.edu/pages/Projects.htm
Title: Watt Watchers of Texas
Years: P-12

University of Wisconsin
URL: http://cf.uwex.edu/ces/erc/eypaw/listall.cfm?summaries=no
Title: Educating Young People About Water
Years: P-12

Georgia Pacific
URL: http://www.gp.com/EducationalinNature/teachers/
Title: Educational In Nature
Years: 4-5

City of Chula Vista
URL: http://eelink.net/cgi-bin/ee link/click.cgi?oid=552407&location
Title: Public Education Campaign on Global Warming
Years: 6

Mid-continent Research for Education and Learning
URL: http://www.mcrel.org/resources/plus/science/solar.asp
Title: Solar Energy
Years: P-12

National Renewable Energy Laboratory
URL: http://www.nrel.gov/education/lessons.html
Title: National Renewable Energy Laboratory Education Resources
Years: P-12

Northeast Sustainable Energy Association
URL: http://www.nesea.org/education/edmaterials/
Title: Northeast Sustainable Energy Association Educational Materials
Years: P-12

Bonneville Power Administration
URL: http://www.bpa.gov/Corporate/KR/ed/page6.htm
Title: Bonneville Power Administration
Years: P-12

Wisconsin K-12 Energy Education Program
URL: http://www.uwsp.edu/cnr/wcee/keep/publications/
Title: Wisconsin K-12 Energy Education Program
Years: P-12

Co-nect
URL: http://www.co-nect.com/Schools/Energy/
Title: Watts-up? A Co-nect Energy Project
Years: 3-12

Houston Museum of Natural Science
URL:http://www.hmns.org/hmnscontent/education/detail.asp?catid=9&scatid=42&p=104&o=2
Title: Fossil Fuels to Future Fuels
Years: 4-12

Florida Solar Energy Center
URL: http://www.fsec.ucf.edu/ed/sm/index.htm
Title: A Solar Energy Science Unit
Years: 4-8

University of Northern Iowa Earth Science Department
URL: http://www.earth.uni.edu/EECP/
Title: Energy Education Curriculum Project (EECP)
Years: 5-8

United States Department of Energy
URL: http://www.eren.doe.gov/energysmartschools/cd_movie.html
Title: Energy Efficiency and Renewable Energy Network
Years: 5-8

Timeforkids.com
URL: http://www.timeforkids.com/TFK/media/teachers/pdfs/energyteacherguide.pdf
Title: Energy Is Everywhere
Years: 5-8

Fusion Energy Education
URL: http://fusioned.gat.com/Teachers/Curriculum/Activities.html
Title: Fusion Energy Education
Years: 9-12

National 4-H Council
URL: http://www.4hgpmc.com/
Title: National 4-H Council
Years: 9-12

Global Systems Science
URL: http://www.lhs.berkeley.edu/GSS/gss.html
Title: Global Systems Science
Years: P-12

Florida Solar Energy Center
URL: http://www.fsec.ucf.edu/ed/sw/Tofc.htm
Title: Florida Solar Energy Center
Years: P-12

Green & Growing
URL: http://www.gatewest.net/~green/its/index.html
Title: Green & Growing
Years: 9-12

United States Environmental Protection Agency
URL: http://www.epa.gov/epaoswer/general/educate/svclearn.pdf
Title: Service Learning
Years: P-12

National Science Teachers Association
URL: http://www.nsta.org/Energy/find/lessons/
Title: Integrated Energy Lessons
Years: 9-12

Florida Solar Energy Center
URL: http://alpha.fsec.ucf.edu/ed/AFM/Activities.htm
Title: Alternative Fuel Matters
Years: P-5

National Energy Renewable Laboratory
URL: http://www.nrel.gov/education/resource.html
Title: National Energy Renewable Laboratory
Years: P-12

Sustainable Energy Authority Victoria (SEAV)
URL: http://www.seav.vic.gov.au/schools/project/index.html
Title: Sustainable Energy Authority Victoria
Years: P-12

Australian Greenhouse Office
URL: http://www.greenhouse.gov.au/education/resources.html
Title: Understanding the Greenhouse Effect
Years: 3-8

Citipower Australia
URL: http://www.citipower.com.au
Title: Greenhouse Activities
Years: P-12

Project Learning Tree
URL: http://www.plt.org/html/curriculum/curriculum_index.html
Title: Environmental Education Activity
Years: P-12

Learnaboutenergy.org
URL: http://www.learnaboutenergy.org/resources/plans.htm
Title: learnaboutenergy.org
Years: P-12

United States Environmental Protection Agency
URL: http://www.epa.gov/epaoswer/osw/kids/quest/index.htm
Title: The Quest for Less
Years: P-12

CREATE
URL: http://www.create.org.uk/resources/index.htm
Title: CREATE
Years: P-12

Appendix F. Organisation websites

Alliance to Save Energy – Green Schools Program

http://www.ase.org/greenschools/index.htm

Green Schools

Using Energy Efficiency to Strengthen Schools

The Green Schools program helps schools use energy efficiently through building retrofits, changes in operational and maintenance routines, and changes in the behavior of building users. Students, teachers, custodians, administrators, and community partners all work together toward a common goal--saving energy and money.

Everyone Benefits from Green Schools!

- **Students** benefit from hands-on lessons in energy conservation and efficiency that will pay off now and in the future.
- **Schools** benefit from considerable cost savings, curriculum support, cross-functional team building, and community involvement.
- **Communities** benefit from the partnerships established among key stakeholders.
- **The environment** benefits from the more efficient use of polluting fossil fuels.

How Green Schools Works
The Green Schools Program is a comprehensive educational initiative that encourages physical and behavioral changes within the school as a whole. It combines energy efficiency management and building retrofit intervention with student involvement in planning and implementing school wide behavior changes.
The Alliance to Save Energy's experience with 18 schools in five school districts around the country can help your school district set up and maintain a successful Green Schools Program.
The Green Schools Program...

- Combines conservation and education in a way that strengthens both
- Involves students in making a real difference in the way people use energy at school
- Encourages teamwork, energy awareness, and a healthy planet for future generations
- Fosters community involvement.

Energy efficiency concepts fit in easily with many academic subjects and grade levels. Students learn how to assess energy-use behavior, monitor the effects of behavior change, and track resulting energy and cost savings benefits.
Students learn to see the "big picture" of energy efficiency. Students identify and explore energy's links to the environment, the community, and the economy. The program is a "real-world" experience that reinforces curriculum content with lifelong energy-saving practices.

Money saved on energy resources is money that can be spent on educational resources.
Green Schools saves energy costs in two ways: through behavior change and building retrofits. Schools save energy by making simple changes in building operations and maintenance, and by teaching building users ways to use energy more efficiently. They also save water and reduce waste. In addition, inefficient equipment and technologies that waste scarce dollars and pollute the environment can be upgraded--an investment that typically pays for itself within a few years.

Potential Savings

While savings will vary based on local energy costs and an individual school's consumption patterns, the potential savings can be significant. Schools can dramatically reduce energy costs even *before* building retrofits are installed. Simple changes in energy use behavior and building operations--such as taking advantage of daylight where available, adjusting thermostats, and minimizing equipment run times--can result in energy savings of up to 20 percent.

As an added incentive, school districts participating in the Green Schools program agree to return a portion of the savings from the no-cost behavior and operations changes back to the schools that earned them.

Cost-effective retrofits can be financed by school district capital funds, by state assistance if available, or by energy service companies (ESCOs), and often pay for themselves in a few years. Utility and state partners can often provide technical assistance in determining appropriate measures to install, and in negotiating the financing arrangements.

Green Schools Are Saving Money!

- In their first year, three Green Schools in Seattle, Washington averaged more than $6,000 each in energy and water cost savings from behavioural and operational changes alone. These savings were realized in an area where electricity rates are the lowest in the country.
- Seattle also expects to save $260,000 each year after retrofitting its three Green Schools and 12 others.
- Four Green Schools in the Iroquois School District near Buffalo, New York saved 12 to 21 percent on electricity within the first eight months of implementing the program, with an average savings of $2,500 per school.

Getting Started...

It's easy to start and maintain a Green School in your community.

Need More Information?

Read about the Green Schools Programs successes in a press release issued in April 1999. The Alliance to Save Energy is happy to share our experience and resources for school wide energy efficiency.

Learn more about how you can measure the energy and environmental performance of your school building with the new ENERGY STAR benchmarking tool for schools.

Learn More About Green Schools

What's New
The latest news about Green Schools as well as alerts about new additions to the web site.

About Green Schools
An in-depth description of the program.

Start a Green Schools Program
Like what you see? Get the scoop on what it takes to get Green Schools going in your school.

Newsletters
Keep track of recent developments in the Green Schools program with the latest newsletter.

Teachers
Lesson plans, a bibliography of resources, comments from teachers currently using the Green Schools curriculum, and an online forum are some of the features specially created for teachers.

Students
In the School Spirit section you can learn about what students from other Green Schools are accomplishing. There is also an online discussion forum and links to other sites of interests to students.

Green Schools in Action
See more about successful Green Schools, from Seattle, Washington to Philadelphia, Pennsylvania (and many points in between).

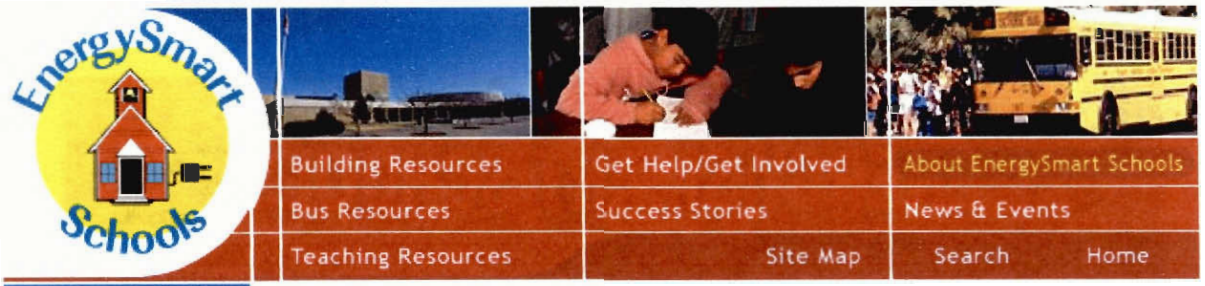
Green Schools International
The Green Schools program has been established in India and Ghana.

High Performance School Buildings
Although Green Schools doesn't deal directly with new school construction, we have added a page with links to new construction resources in response to the frequent questions we receive about this topic.

Did you know that schools spend more on energy than on computers and textbooks combined? These and nine other surprising and interesting energy facts produced with light animation and music come alive on the Alliance to Save Energy's website via Real Video clips.

Back to top

Rebuild America - Energy*Smart* Schools
http://www.eren.doe.gov/energysmartschools/about.html



Focus on Schools
How the Campaign Helps Schools
Myths About Energy In Schools
Interesting Statistics
Trends in School Energy Use
Frequently Asked Questions

Home > About EnergySmart Schools

About EnergySmart Schools

America's schools spend more than $6 billion each year on energy. The DOE estimates they could save 25 percent of that money—1.5 billion nationally—through better building design, widely available energy-efficient and renewable energy technologies, and improvements to operations and maintenance.

Saving money, however, is just one aim of the EnergySmart Schools effort. We're focused on meeting four primary goals:

- Reducing energy consumption and costs, and increasing use of clean energy technologies in K-12 schools nationwide;
- Helping schools reinvest their savings from energy improvements;
- Improving the learning environment of schools through daylighting, better temperature control, better air quality and other elements related to buildings and bus fleets; and
- Increasing student, teacher, and community awareness of energy and related issues including financial management, air quality, climate change, and new technologies.

Part of Rebuild America

EnergySmart Schools was founded in 1998 by the U.S. Department of Energy. It is managed by DOE's Office of Building Technology, State and Community Programs, and operated through the program, Rebuild America.

Rebuild America helps schools and other building operators create local partnerships to plan and implement cost-saving building improvements using energy efficiency and renewable energy. More than 240 such community partnerships have already been formed, involving 2,000 schools. The program also has national partners—businesses and other organizations who support school energy improvements nationwide.

Both Rebuild America and its EnergySmart Schools effort share information and resources with other DOE programs affecting schools: Clean Cities, which focuses on alternatively fueled buses; the President's Million Solar Roofs Initiative, aimed at increasing use of solar technologies; the State Energy Program, a DOE grant program administered through state energy offices; and ENERGY STAR®, a joint DOE/EPA program focused on building energy performance improvements.

For more information about EnergySmart Schools, Rebuild America, and other programs, look on this Web site, on the linked sites shown here, or call DOE's hotline at 1-800-DOE-3732.

Sustainable Energy Authority Victoria – Energy-Smart Schools
http://www.energyvic.vic.gov.au/schools/about/intro.html

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BE ENERGY SMART. THE FUTURE IS IN OUR HANDS.

- About energy smart schools
- The benefits
- What schools receive
- Participating is easy
- Further information
- How to participate
- Energy Smart Schools

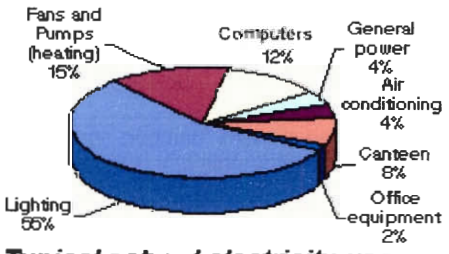
Quick Links

ABOUT ENERGY SMART SCHOOLS

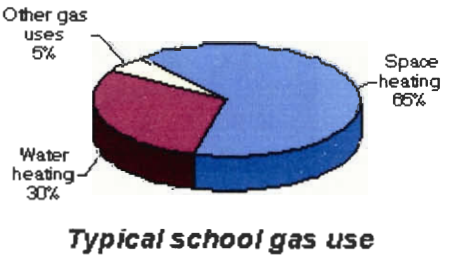
Sustainable Energy Authority is offering primary and secondary schools the opportunity to get smart about energy consumption. Our Energy Smart Schools program provides information and support to enable all schools to reduce utility costs through energy efficiency.

Energy use in schools

Energy Smart Schools is a management resource and support service for those responsible for school facilities. Our research indicates that energy in schools is mostly used for lighting and heating.



Typical school electricity use



Typical school gas use

Helping Victorian schools save energy and money

The Energy Smart Schools program is a voluntary program in which participating schools implement an energy and water management program that monitors and reduces consumption, saves money and helps the environment. It is intended for principals, administrators and school councils looking for immediate ways to reduce costs. Energy Smart Schools is management resource and support service for those responsible for school facilities. It is offered free to all Victorian schools.

To participate complete and return the Intention to participate form.

CREATE – School Energy Program
http://www.create.org.uk/home.htm

About the Scheme

About the Scheme | Cash Incentives | To Qualify

About the Scheme

Do you think your school energy bill is too HIGH?

Is your school putting off installing energy efficiency measures, because budgets are tight?

This is your opportunity to start the work NOW!

UK schools account for 25% of public sector energy costs, spending around £350 million per year. They release 8 million tonnes of carbon dioxide annually, one of the major 'greenhouse gases'.

Act now to:

Cut fuel bills

Help to reduce the threat of global warming

Qualify for a cash rebate for energy efficiency measure

Latest news

To see these news articles in full, click on the EnergyNews button.

Participating schools have already saved an annual of 15% on their energy bills.

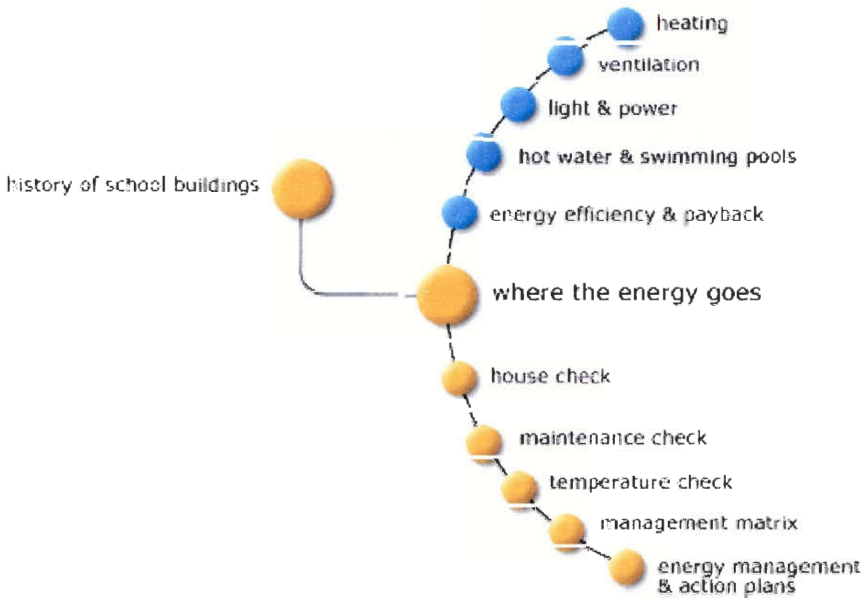
Apply on-line NOW

The School*Energy* programme is an Energy Saving Trust initiative, funded by government and industry.

SCHOOLENERGY

PROMOTING THE WHOLE SCHOOL APPROACH TO SAVING ENERGY

Information


heating
ventilation
light & power
hot water & swimming pools
energy efficiency & payback
history of school buildings
where the energy goes
house check
maintenance check
temperature check
management matrix
energy management
& action plans

Appendix G. Interview Notes

Notes from Interview with Paul White
Date: March 19, 2002
Time: 1:00pm-2:05pm

Basic Defining of Terms:

1. Curriculum: steps of learning that leads to a specific outcome
    - Derives a set of objectives to achieve goals
    - Tries to get a certain behaviour or value, effectiveness may be seen through long term (3+ years) observation
    - Doesn't tell the teachers how or what to teach exactly, it just gives a set of desired outcomes.
2. Curriculum Materials: Help to learn curriculum.

Policy Statement:

Each school has a three year statement, that gives a concentration for the school (either artsy, academic, balanced, life-capacities (in poorer communities))

- Some schools are very competition driven, competing with each other and with the "norm".
- Others are anti-competitive, even as far as having no grading system

**Control rests with the school council

- Each school has certain materials that it likes to use according to their policy statement.

Generalizations on How Teachers Choose Materials:

1. Policy of school council
2. Must move towards school objectives
3. Must fit in with the philosophy of the school
4. Must overtly show what the material intend to do, in other words must be clear and concise (not complex!)
5. Must give good results (without being too expensive)

How The Teachers Get Their Materials:

- Book Sellers (giving actually hard documents).
    - Not as popular because of the Internet and being too expensive
    - Pretty much died out
- Victoria, intranet
    - Softweb
- Subject Association (science, English, etc) monthly releases
- Word of Mouth
- Industrial union journals
- Education department – materials free for schools

Free Vs. Expensive Materials:

Not very important in most cases as long as teachers choose what is better for their class, than what is being provided free.

- Energy efficiency is NOT a separate subject, it is integrated into the curriculum of the other 8 (ideally) subjects.

Minimum Standards to Materials:

- Readability: normal, go towards the reading age of the kids
- Concept Load:
  - Early: trial and error
  - Middle: using their senses (touch, measuring, observing)
  - Late: Definitions
    - Example: Density
- Interest of Document
- Appropriateness of what it teaches relative to what the kids already know [cognitive structure and mental maps]
- Illustrations and presentation
- Easily Available
- Effectiveness. Does it work?

- Program from SEAV (white folder) that has very good teaching materials
- Skill of picking out bad teaching materials is not too hard to learn
- These are documented (curriculum theory/ pedagogics)
- AVOID unintended learning/outcomes especially in this subject matter
  - Find out what they are and how to get rid of them
  - Example: Sex Education (models were too beautiful)

Things to Understand:

- Sometimes photos are not the best idea
- Kids are different, will respond to different stimuli
- State does not have control over moral education, HOWEVER most schools have a half hour of religion per week. Non-governmental schools have religion too. 2/3 are catholic. This issue is not as important anymore because ethics are being integrated into subject matter such as science and social studies.

Programs and Energy Efficiency:

Ultimately, the school's council is in charge of all programs that come into the school. Without someone in charge, however, the program will NOT last because of overcrowded curriculum!

To become a permanent feature in school, the program has to be integrated into one or more (8 ideally) of the school subjects, and become part of the charter.

School Structure:

1. Principle: Executive officer of council
2. Associate Principles
3. Senior Staff Members: Key (8) subject learning coordinators

4. Pastoral towards kids: Focuses on kids, schools within schools etc.
5. Classroom Teachers

** 3 and 4 are on the same power level. This level makes the operational decisions of the school. They basically run the school.

Mt. Waverly Secondary School

Energy Managers (n=2) Interview

Conducted By: Tony Montano

Recorded By: Rachel Ryznal and Ryan Petti

They are part of the Energy Smart Schools, as of a few years ago. Really started implementing energy efficient practices 12 months ago.

- They focus more on the building (audit) processes than the curriculum because the curriculum is full. Energy efficiency could never be its own subject (unless students showed a direct interest in it).
- Energy Smart Schools give a grant for 50% rebate and do audits (walk around) to show the school the areas that they can save energy and money.
- They report the audit to the school council and the buildings and grounds committee to get support for more funding.

How do they get energy efficiency teaching materials?

- Online
- Energy Smart School pamphlet and handouts
- Seminars
    - Go to another secondary school for this
    - Are given materials for energy efficiency
- Word of mouth

What would you like to see on a website?

- Practical and educational materials
- Maybe connect CSF regulations to the teaching materials
- Maybe Q+A section
- Teacher posting

How do you get an energy efficiency program started?

- Get information from the Energy Efficiency School Program
- Seminars
- People want to do it

- Its not too hard to implement
- It pays for itself in a short amount of time, so school is willing to pay initial costs

How do we publicize a website so teachers know its out there?

- Pamphlet sent out to school
- Support from ESS (newsletter, maybe being referred by them)
- Advertise in Publications

Things that don't work

- Hot water timers (teachers play around with them, and they don't work properly)
- Monitors shutting down (people end up accidentally turning off computer completely)

Observation Transcription Notes

Building Structure

- Typical room has slanted ceilings
- Extended roof blocks direct sun
- Breeze drawn through the room: hot air rises and exits thru high windows
- Single level wings
- Relocatables
    - Heat enters easily – large problem.
    - Almost all have A/C
    - Gas furnace for each
    - Generally poor condition
    - Permanent portables in corner of campus have better insulation
- Breezeways
    - Covered walkways connecting corridors
    - Air out corridors, extend breeze through buildings
    - Doors open in summer

Lighting

- Some empty rooms on, some off
- Half full lighting fixtures, left in where needed (shops)
- Tri-phosphorus bulbs suggested by Energy Smart Schools
    - Told Mount Waverly about savings
    - Better lighting (too much light)
- External lights run on timers, sensors

Heating and Cooling

- Use trees to block direct sun
- Corridor doors left open to allow breeze
- Special shading devices:
    - Awning
    - Wooden shade
- Inefficient hot water management (continually runs through school istead of when needed)
- Heaters off until winter
- Insulated pipes

Room examples

- Gym
    - Lights all on
    - Doors open
    - Two large vents run to boiler (heat)
    - No A/C
    - Triple brick insulation
- Student Center
    - Recently built
    - A/C in every room
    - Awning
- Library
    - VERY warm (energy manager says to keep books in good condition)
    - 30 computers, all on
    - Open back door to let air in

Cobden Technical Secondary College

<u>Interview with Energy Manager</u>

Conducted by: Tony
Recorded by: Rachel, Ryan

Background

- Also a science and math teacher
- Sources
    - SEAV seminar
    - Waste-wise schools
    - Put two together
    - Both offered time off to write up plans/spreadsheets, analyze them and send them back
- Competitions
    - Has a focus and a point
    - Gets whole school involved

    - Measure power meters one week, conduct energy efficiency strategies, measure again another week, compare
    - Cobden saved 12% -- big savings, small number is deceiving
- Kids have become more aware than staff
- Publicize through newsletters, newspapers, posters
- Utilizing classes and getting kids involved is key
    - Information tech classes – posters
    - Ecology classes- envir. issues
    - Kids disturbing classes gets other kids curious – very visible

Is curriculum hard to incorporate into classes concerning the CSF?

- Use CSF as a guide, not a basis
- Have more room because of it
- Example: Forensic Science
    - Didn't really fit in with CSF
    - Kids were interested
    - Kept it, must think of what kids want to do
- Other schools make very loose ties with CSF (can make anything fit)
- Other ways:
    - Contests
    - Presentations by people in industry (see what they're doing is important)
    - Field Trips (wind farm)
- Grants (good for keeping goals and targets)
- Stay involved with committees that make decisions and write up statement
- No add ons, incorporate it into current curricula

How community is involved

- Parents send in brochures (feedback)
- Speak at parent groups
- Service club tours
- Convince community to recycle

Audits

- Need administrative support
- SEAV conducted, free service
    - Things that are good, bad, or can be changed
    - Write up report
    - Present for grant

Strategies

- Turn lights off/shut door
- Hold parent/teacher conferences in one wing of building
    - Less heating
    - Parents don't walk all over building

- Initially, kids complained but got used to it (recycling)
- Charge for printing costs (reduce waste)
- Web page on recycling (IT classes)
- Become an Energy Smart School
    - Requires commitment
    - Benefits will come back to you
- Sun Smart for primary schools
- Get it into the classroom
- Computers
    - Turn screens off
    - No screensavers (upset network)
    - Reminders come on screen to shut off
- Some savings last forever (changing lighting)

Where do you get the materials?

- Internet
- SEAV
- Textbooks

What to include on web page?

- Checklist
- Survey
- Photos – show examples and effects
- Show advantages
- Info/links on specific aspects (lighting: Where? How much? Differences?)
- Lists of things to do
- Free teaching materials
    - If not free, show examples

Other ideas

- Solar panels on during summer, store energy for school year
- Wind power?
    - Very expensive
    - Need really strong winds or else not worth it

<u>Group Interview With 4 Teachers</u>

Conducted By: Anthony Montano

Recorded By: Ryan Petti and Rachel Ryznal

1. **What energy efficiency / conservation teaching materials have been used in the past?**

(A) Environmental Ecosystems Class: Year 9+10
(B) Fluorescent cards were made with energy reminders: turn off lights, close door, turn off monitor, etc.
(C) Physics Group
- Made a room plan for all the rooms, determined the light usage
- Made recommendations on the best energy efficient lighting (tri-phosphate instead of 40 watt)

(D) Brick Making
- Reduces paper waste
- Gets kids involved

(E) Teaching and the curriculum:
- Curriculum is not set in stone, it can be somewhat modified to fit in energy efficiency

Example: junior science, teach about renewable energy and brought them to a wind farm.

- Recycling

Teach about it

Recycle computer parts, wine corks

Bins of materials

Graphics Bag

2. **How well has the school implemented energy efficiency / conservation practices?** Permanent feature of school culture

(A) Sue
- She pushed everyone to be excited and got the school involved with SEAV
- She teaches classes where she implements energy efficiency materials
- Started the recycling program and other school improvements
- Staff Weekend (changing lights)

(B) Interest is contagious

What would happen if Sue left?
- The program would not disappear, but it would take on a different format
- The school has adapted a statement that was accepted by the school council. The school is committed to this program
- Others are involved now (brick making etc)
- Everyone is very positive about saving energy

(C) The school does not participate to save money. They are doing this to raise awareness for this environmental issue.
(D) The awards have helped a lot in getting the school involved and excited about participating.

(E) Made teachers more aware. It's not just about students. Now teachers often don't even turn on the lights because they find that they have enough natural light from skylights etc.
(F) Improvements were made: reminder stickers, bricks, skylights, a/c (turn it on till 22 degrees then shut off), recycling, printer paper box, changing lights, and teaching about energy, etc.

3. How could energy efficiency / conservation practices be improved?

(A) They get drafts through the doors and windows
(B) Plastics / Vacuum not very efficient
(C) Making sure recycling labels are clear

4. What would you like to see in an energy efficiency website?

(A) 2 levels:
- Philosophical Commitment, how they get things going. There has to be a person in charge (Sue) but it is equally important to get everyone involved so that it becomes a school program.
- Out of Class. Involve the whole school (minimize rubbish, recycle, brick making, etc) "Rubbish Free Day".
  Graphics Class – separating trash
  Math Class – doing a survey
  Physics – fixing lights

(B) Info on recycling, paper bricks
(C) Kids taking pride in what they do
(D) Step- by- step brick process
(E) Fun Activates for a hands on approach
(F) What did other schools do?
- In class, out of class
- Whole school, cross-curricula
- List of activities

<u>Observation Transcription Notes</u>

General Information
- Small school, 320 students
- Too many kids, not enough rooms = more energy
- Very unique environment

    - Community involved with process (parent groups)
    - Kids are enthusiastic
- Plant property subcommittee (of school council)
- SEAV contest
    - Winner 2000
    - Highly Commended 2001

Building Structure

- Badly designed flat roofs with inlet in the middle
- No typical slanted heat-reducing roofs
- Lots of portables/relocatables

Lighting

- Natural light system for corridors being installed
- Stickers
- Replaced old bulbs with tri-phosphor (more light, less bulbs)
- Fixtures have just one tube
- Often not on at all, use natural light
- Big effect from
    - Cleaning fixtures
    - Changing bulbs
- Exteriors on timers, sensors

Windows

- Most energy loss in winter is through windows
- Slit windows
- Tinted
- No cheap plastic reinforcement

Heating/Cooling

- Thermostats are on a timer
    - On at 6 am (warm when students get there)
    - Off at 12 pm (lasts rest of day)
    - Hard to make comfortable since day temperatures fluctuate (esp. spring, autumn)
- Converted to natural gas in '97

Unique ideas

- Make bricks from recycled paper, burn for heat
    - One brick burns for 45 minutes
- Make plant holders from recycled paper
- Sell cardboard as recycled doghouses

Room examples

- Gym

    - No lights on when not in use
    - No heating
    - High ceiling to provide light (skylights)
- Portables
    - Some buildings taken from old primary schools
    - Skylights
    - Newer heaters (old system hard to control)
    - Ceiling fans
    - No drafts (just shut door)
    - Gets stuffy in winter
    - Relocatables equipped with A/C

Mitcham Primary School

Principle / Energy Manager Interview

Conducted By: Ryan Petti
Recorded By: Rachel Ryznal and Anthony Montano

Background information:

- They are in the primary stages of setting up an independent program (in correlation with 3 other primary schools in the area "SOLA") called "Sponsorship Proposal for Mission Energy".
- Besides for reconstruction work, the biggest areas of improvement need to happen with lights and air conditioners.
- Katrina is more concentrated on waste management rather than energy.
- They have four main saving areas:
    - AC being off
    - Reduce light usage
    - Turn off overhead fans
    - Don't turn on heater or AC until absolutely necessary (he will have a master switch)
- They need $300,000 from sponsors etc. for the program to go through (major barrier)
- The school is forward thinking, staff is dedicated, kids are easier (when young) to change their mannerisms.
- Kids at the Mitcham school don't understand environmental issues. Parents that are not on the school council (majority) don't show an interest in these issues. Somewhat low-income area.

History of past audit processes:

With the help of SEAV, they conducted an audit process last year. Results:

- Very inefficient use of oil.
- Some shading would help

- No wide involvement of staff

(He printed out the audit for our reference)

Opinions about audit processes:
SEAV was good in determining the areas of inefficiency, however the school does not have the budget to make most of the suggestions a reality.

Opinions about current energy conservation / efficiency materials:

- They do teach about environmental issues, but not concentrated on energy efficiency.
- They get resources from all over

What kind of information on energy efficiency / conservation would they like to see on a website?

- They would rather have free resources than pay for them.
  - Check out "Black Line Masters"
- They would rather have materials based on critical thinking and working through problems. They like open-ended activities.
- They would like worksheets that can be photocopied.
- Primary kids need lots of pictures and links
- Interesting, always improving, engaging practical.
- Activities for kids
- Interactive for upper levels
- Linking teaching materials to existing curriculum
- Universally applicable
- Interested teachers to communicate with each other
- ENTERTAIN!
- Rewards systems for the kids
- List of organisations

Is the program trying to get the school to be sustainable?
Principle: No. He does not believe that a school can really achieve sustainability

What strategies have they used in the past (or future in this case) to reduce energy consumption?

- Involve people in the decision making process.
  Its not good to have one person, get committees
- If there is a $ benefit, great. But the main focus is getting the quality of life.
  [Renew, reuse, recycle – level 3]
- Concept: ½ the savings go to the school, ½ the money goes to the students
- They want children to take an active role in learning and take the knowledge home.

Driving force for advertisement?

- Seminar
- Professional Development Session – provides a pack of resources
- Follow up workshop

3 Teachers Group Interview

Conducted By: Rachel Ryznal
Recorded By: Ryan Petti and Anthony Montano

1. **What energy efficiency / conservation teaching materials have been used in the past?**

   (A) Minor integrating of energy efficiency and conservation related topics into set curriculum
   (B) Find it hard to incorporate material with an already "overcrowded curriculum" as laid out in the curriculum standards framework (CSF)

2. **What are the features of quality energy efficiency / conservation teaching materials?**

   (A) Motivating to 1. the teachers and 2. the students. Otherwise the lessons will be dull and uninteresting
   (B) Fun with content
   (C) Broad in scope
   (D) Material that incorporates making a hypothesis and or evaluation
   (E) Target a certain age/grade
   (F) FREE!
   (G) Provide background information for the teacher concerning the lesson
   (H) The use of colour and graphics to that age level
   (I) Time, it must be simple and easy to follow and implement
   (J) Incorporates hands-on activities
   (K) Time frame given as to how long the lesson will take to administer
   (L) Sequential lessons that build off each other
   (M) Multidisciplinary, as to touch upon the most subjects in the CSF
   (N) Easy for the teacher to read and understand
   (O) Allow teachers to share comments and ideas concerning materials they have used
   (P) Uses correct language for level and country
   (Q) Units should be metric or easily converted

3. **How well has the school implemented energy efficiency / conservation practices?**

   (A) They have implemented some practices, but not well enough
   (B) Teaching habits of some teachers are to incorporate energy efficiency into science curriculum but no formal lessons
   (C) SEAV has contacted Mitcham and 3 other area schools to develop energy efficiency/conservation related curricula
   (D) The school has not been very involved in the past but has increased its awareness and is trying to incorporate energy efficiency into ongoing renovations

4. **How could energy efficiency / conservation practices be improved?**

   (A) Get everyone involved, teachers, students and parents
   (B) Make staff enthusiastic and aware of the issue

5. **What would you like to see in an energy efficiency website?**

   (A) Must be easy to navigate
   (B) Include links for kids
   (C) Must be user friendly for both teachers and students
   (D) Provide contact information with other schools who have implemented successful programs
   (E) Idea bank
   (F) Teaching materials that have been used in the past

6. **Additional ideas**

   (A) Encourage schools to take part in energy efficiency days
   (B) This is a complicated topic, inform and educate the teachers with background information, don't assume that the teachers know
   (C) Competitions, challenges within the schools or local area of schools
   (D) Teachers don't have time to research endlessly
   (E) Page must be monitored and updated

Observation Transcription Notes

General Information

- Built in 1929
- High ceilings provide for heat to rise
- Triple-brick layering resistant to temperature changes

- Main hallway recently renovated
    - Considered energy issues, not really implemented
    - Newer construction will include more

Building Structure

- Much like Mt Waverly
    - Slanted roofs
    - North side windows
    - In theory a better design, may not work in practice
    - Tilted most economical
- Eves on north side larger than south, cuts out heat

Lighting

- Inefficient use of natural light
    - All lights on when sun is adequate
    - Will try to mend problem once program is instituted
- Light fixtures have full amount of tubes
- Tubes will be replaced with more efficient bulbs
- Security lights
    - On each corner of buildings
    - Run on timers, not sensors

Heating/cooling

- Gas furnaces
- A/C in relocatables
    - Poor energy use
    - Used for only 6 weeks
    - Unbearable heat in summer
- Does not use evaporative a/c
    - Waste of water
    - Maintenance
- Take out a window, temp stays he same
- Old Boiler
    - Reinforced ceiling, walls
    - Expensive - $6000 upkeep
        - inspect twice a year
        - used once a year

Room examples

- Relocatable preschool wing
    - Wide corridor space, usable
    - Use boxes against walls to correct heating error
    - Hall is considerably warmer from skylight
    - Installed A/C to solve heat problem – necessary
    - All lights on w/ adequate natural light

    - Overhead fans in each room
    - "Shut door" signs for A/C rooms
- Old art room
    - To be demolished
    - Kiln – high energy use
    - Asbestos walls
- Library
    - 1960s/70s
    - Furnace vents on either side
    - Lighting iffy
    - Encapsulated asbestos ceiling
- Computer room
    - All on and running
    - HOT
    - No ventilation or A/C
    - Some screens on, off, screen saver
- Separate, unused building
    - Much like relocatable
    - Had to double energy efficiency techniques (costly)

Plans

- More use of natural light
    - Skylights in corridors – put off because of budget problems
- Major solar panel project

Miner's Rest Primary School

Energy Manager Interview

Conducted By: Ryan Petti
Recorded By: Rachel Ryznal and Anthony Montano

How did the program get started?

1. The energy manager saw in a science related journal an advertisement for SEAV.
2. He contacted SEAV, and they sent someone to the school for an audit with recommendations.
3. SEAV gave the school an "energy tracker" spreadsheet for gas, electricity, and water bills.
4. ½ day seminar
5. Report back to the school community how they are doing in trying to save energy.
6. Write up and submit an application to SEAV after being approved by the school council.

7. Draft a written policy "Energy Management Policy"
8. Time Frame? Short, Began in the beginning of 2001, and was intact a few weeks later.

What has the school done in terms of energy efficiency?

- The energy manager looks at the bills and keeps track of energy usage.
- They got rid of gas heaters
- Make sure doors and windows are kept closed when necessary (door signs).
- Energy Saving Tips in every classroom (designed by energy manager).
- Energy Competition for students.
    - Older students act as monitors. During recess, they check the rooms to see if lights were left on, heaters or a/c was left on, and the door was open.
    - It gets all age groups involved in saving energy, and raises awareness.
    - The classroom winner gets a certificate prize.

How effective are audits?
They are good for the comparison of bills, and see what money you could save in energy. They are useful as a starting point, to see high areas of usage. From there, you can start to make improvements.

Are there energy efficiency materials in the classroom?
Not yet. There were initial activities and discussion with the students when they first started implementing the program. They concentrated more on raising energy awareness with the challenge, monitors, and energy saving tips.

What are the quality features of teaching materials?

- Activities that are active
- Activities that are hands on and physical.
- Gives the kids leadership roles or management roles

Anything you would like to see in a website?
Simplicity
Easily presented
Driven by students

Teacher Interview

Conducted by: Rachel Ryznal
Recorded by: Ryan Petti

1. **What energy efficiency / conservation teaching materials have been used in the past?**

(A) Talk about preserving the globe
(B) Walking and riding bikes instead of driving
(C) "Walking Schoolbus" program
    i. Government initiative
    ii. Walk a set route to school with parents
    iii. Talked about with kids

1a. Where do you get materials?
(A) Internet
(B) SEAV (thru energy manager)

1b. Free vs. costly materials?
(A) Free preferred
(B) Have an example for costly

2. **What are the features of quality energy efficiency / conservation teaching materials?**
(A) User friendly
(B) Not too complicated
(C) Appropriate for students' level
(D) Points to other resources
(E) Capture kids attention (interesting)

3. **How well has the school implemented energy efficiency / conservation practices? (permanent feature)**
(A) Kids are more aware
(B) Do fairly basic things (shut lights off, etc.)
(C) Kids talk to parents

4. **How could energy efficiency / conservation practices be improved?**
(A) Computers stay on all day (have sleep mode)
(B) Getting kids to do things better (sometimes have to remind them)
(C) Heating and cooling
    i. Running warms kids up (good for winter, must cool down in summer)

5. **What would you like to see on an energy efficiency / conservation website?**
(A) Work modules, worksheets
    i. Develop awareness in kids
    ii. Sunsmart
(B) Encourage idea that kids can change the environment

Observation Transcription Notes

Building Structure & Layout

- One 150 year old building, the rest are relocatables
- Relocatables have large windows

    - Heat up room
    - Solved with installing Venetian blinds
- Crescent building layout
    - Reduces wind
    - East-west buildings get much hotter than north-south buildings

Lighting

- When room is empty, they are shut off
- Will be replaced with more efficient tubes over time
- Variable use of natural light
    - Some rooms use it
    - Classrooms cover Venetian blinds, allow no sunlight
- Exterior
    - Run on sensors
    - Minimal amount

Room examples

- Old building
    - 18 inch thick brick walls
    - Skylights face south – original design
    - Covered vents – let hot air thru
    - High ceiling, cool
    - Large window covered with shade
- Older classroom relocatables
    - Replaced "gas-guzzling" furnace with better model (vents in wrong place)
    - Fans and A/C installed themselves (reverse cycle)
- Newer classroom relocatables
    - More fans and an A/C come standard (reverse cycle)

Other techniques

- "Energy Saving Tips" in each classroom
- "Shut door" signs
- Planted new trees in courtyard
    - Reduce wind
    - Summer – provide shade and shelter
    - Winter – allow light
    - Long term solution
- Computers
    - Turn off screens automatically
    - On in morning and all day
    - In fairly constant use
    - 30 PCs run all day

Plans

Political - As town grows in population, school will request more funds

Appendix H. Webpage Specifications

The following pages contain print outs of the "Energy Efficiency and Your School" web page developed during this project. When printing, some sites on the web page were too large to fit on one page. In these cases, a page with all of the information will is shown not including the actual web page layout.

Department of Education & Training

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Energy Efficiency and your School

Getting Started

-- What is energy efficiency?

-- Why be energy efficien

School Resources

Teacher Resources

Energy Efficiency and Your School

Welcome to Energy Efficiency and Your School.

Use the menu at the left to navigate through the site. Click on the links below to read more about each section of this site:

Getting Started

School Resources

Teacher Resources

Go to the top

What is energy efficiency?

Energy Efficiency vs. Energy Conservation

The most prominent reason for the necessity of energy efficiency awareness is the increase in energy consumption across the world.

Energy Efficiency: Doing a larger amount of common actions or tasks and at the same time using less energy. This can be achieved through acquiring more efficient equipment or designing new energy efficient facilities.

Energy Conservation: Sacrificing a common action or task in the name of saving energy. This can be achieved through changes in practice and public awareness.

Even though these definitions are different, they both contribute to the reduction of energy usage. Energy consumption could be solved by renewable sources such as solar, wind power, and waterpower; however, these sources are still being developed. Thus is it important to look for other sources to reduce energy usage, such as a reduction in fossil fuel use.

Go to the top

Why be energy efficient?

- **Save Money**
- **Help the environment**
- **Help Australia**

Save money...

Conserve energy and save money for your school! Energy efficiency programs are designed to reduce the amount of energy your school uses on electricity, ventilation, heating, and cooling. Since the school's energy consumption is decreasing, energy bills will also decrease! Furthermore, the energy efficiency improvement in the school building will pay for itself within a short time period. To view case studies of Victorian schools and examine their money savings, visit the Sustainable Energy Authority Victoria website.

Help the environment...

Global Warming and the Greenhouse Effect | Impacts for Australia | How You Can Help

Global Warming and the Greenhouse Effect

The increase of greenhouse gases, primarily carbon dioxide, methane and nitrous oxide, changes the chemical composition of the world's atmosphere. These gases retain heat, thus trapping some of the outgoing energy from the earth. This is referred to as the greenhouse effect.

Before the Industrial Revolution, the greenhouse effect kept the temperatures of the earth warm enough to support life. Since then however, as human emissions of the greenhouse gases increase, the greenhouse effect has also magnified. Scientists identify greenhouse gas emissions as the main cause of the global warming trend.

Impacts for Australia

With the rise in global temperatures, there will be negative consequences

in Australian ecosystems, hydrology and water resources, food and fibre production, costal systems, and even human health. There will be increased risks of more volatile weather conditions, worse drought and flooding, and a shifting of normal residency areas of various insects that carry diseases.

How Can You Help

By reducing the amount of greenhouse gases you release into the atmosphere, you can help reduce the greenhouse effect! Conserving energy can be as easy as:

- Turning off the lights when you leave the room.
- Turning off the heating and cooling systems when they are not necessary.
- Keeping the doors and windows shut to keep the heat or air conditioning inside.

For more information on Global Warming, click on the following links:

- EPA Global Warming Site
- The Woods Hole Research Centre
- The Global Warming Information Page

Help Australia..

In response to global warming and the increase of greenhouse gas emissions, the Australian government recognizes the importance of energy efficiency. Being one of the world's biggest exporters of coal, Australia is actively trying to find a balance between remaining economically strong while still promoting energy conservation to lower emissions.

The Victorian government proposed a program in 1999 to decrease energy consumption by 15% by the year 2005 in the public sector. With this web page along with other methods, the Victorian Department of Education and Training (DE&T) is bringing this project to the school systems. We hope the information provided on this site will prove useful in lowering your energy consumtion and helping your fellow Australians.

Go to the top

Steps to becoming energy efficient

Follow these six easy steps to get a great start to your energy management program. You can click on each step to find more information.

1. Identify a responsible enthusiastic leader for the energy efficiency program.
2. Set strategic goals for the school to achieve in energy management.
3. Commit to an energy management policy.
5. Keep track of energy savings.
4. Perform an energy audit.
6. Design a strategy to make the energy efficiency program a permanent feature of your school culture.

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1. Identify a responsible enthusiastic leader for the energy efficiency program.

To begin a successful energy efficiency program, it is important to have a person in charge. Their duties would include: performing an energy audit, writing an energy management policy, recording energy usage, and getting the school community involved. This person may identify committees to manage the program. This is also the first step to making energy efficiency a permanent feature of school culture.

Go to the top

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2. Set strategic goals for the school to achieve in energy management.

It is crucial for school communities to set energy efficiency goals for themselves. Consider three and five year plans to achieve these set goals. Goals could be as simple as reducing energy by a definite percentage, or saving a certain amount of money from energy efficiency improvements.

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3. Commit to an energy management policy.

Schools should sign an energy management policy to establish boundaries, objectives, and criteria for an energy efficiency program. This policy should have the permission and support of the school council.

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4. Keep track of energy savings

Before the program is instituted, make a spreadsheet of your school's past two years energy usage. After implementing the initial building improvements, it is important to keep track of energy and money savings. They serve as a comparison for achieving your energy efficiency goals.

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5. Perform an energy audit.

Energy audits are designed to locate areas of energy inefficiency in school buildings. There are several resources for the undertaking of an energy audit. This website offers a simple audit checklist for any school to perform without assistance. There are software links available as well. In addition, The Sustainable Energy Authority Victoria performs free audits for Victorian schools. See these resources and more on the Audit Information page.

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6. Design a strategy to make the energy efficiency program a permanent feature of your school culture.

In order to have a successful energy efficiency program, it is important to design a strategy to make energy efficiency a permanent feature of your school culture. To get more information, see the School culture Integration page.

Go to the top

School Culture Integration

Schools can receive large benefits from simply making students and staff aware of energy issues. These six actions can help make energy efficiency a permanent part of your school's culture:

1. Denote a responsible leader to be in charge of the energy efficiency program.
2. Have your school sign an energy management policy.
3. Involve the entire school in the energy efficiency program.
4. Incorporate Energy Efficiency into the curriculum.
5. Publicize your energy saving results.
6. Be innovative.

---

1. Denote a responsible leader to be in charge of the energy efficiency program.

A leader is necessary for the initial implementation of your energy efficiency program. Their duties would include:

- Recording energy usage.
- Performing an energy audit.
- Drafting an energy management policy for the school to sign.

Get the school community as excited and involved in the program as possible!

Go to the top

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2. Have your school sign an energy management policy.

An energy management policy is essential to making an energy efficiency program an integral part of your school culture. By signing the policy, your school is dedicating itself to improving energy efficiency and making building improvements. Furthermore, by having an official policy, the school has an obligation to gain the support of the school council.

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3. Involve the entire school in the energy efficiency program.

Involving as many people as possible is a great way for expanding the energy efficiency program. Send newsletters to parents to show them the energy savings and give them tips to improving energy usage at home. Involve teachers by giving them current energy efficiency teaching materials that they could incorporate into their curriculum. Give them tips to improve energy efficiency in their classroom. Involve the students by giving them energy efficiency lessons. Have them make reminder stickers to shut of lights, shut off the monitors on computers, and close the doors when heat or air conditioning is being used.

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4. Incorporate Energy Efficiency into the curriculum.

Incorporating energy efficiency into the curriculum will help students and teachers learn about energy and the need to be energy efficient. Energy education is crucial to ensure good energy habits for students to carry into the future. The purpose of teaching energy efficiency is to raise awareness for energy and the environment.

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5. Publicize your energy saving results.

By publicizing the energy saving results, you are keeping the school community informed and interested. These results should be something that students, parents, and teachers are looking forward to hearing. The entire school community will be able to compare the energy saving results from month to month.

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6. Be innovative.

Any subject, including energy efficiency, can seem a little overdone after a while. This is why it is especially important to introduce new teaching materials and lesson plans every month. Approach the subject of energy efficiency in different ways, such as using art for making posters or using math to compute energy usage.

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Organizations that Help

There are hundreds of organizations around the world that promote energy efficiency in schools. A selection of these sites is given below with their base location and a summary of the information on the site.

Sustainable Energy Authority Victoria
Location: Australia
Summary: Victorian secondary and primary schools. Energy Smart Program

Australian Cooperative Research Centre for Renewable Energy
Summary: Overview of several research programs for energy efficiency.

NetEnergy
Summary: Guide to Australian government energy policy and issues

CREATE
Location: United Kingdom
Summary: Audit checklists, teacher resources, and student links.

Alliance to Save Energy
Location: United States
Summary: Teaching materials, including lesson plans and activities

Campaign to Rebuild America
Location: United States
Summary: Teacher and student resources

World Energy Efficiency Association
Summary: Presents information on organizations throughout the world promoting energy efficiency.

National Energy Education Department
Location: United States
Summary: Teacher and student resources

Northeast Sustainable Energy Association
Location: United States
Summary: Energy efficiency program and resources

Education for a Sustainable Future
Location: United States

Summary: Information on how to become a sustainable school

KEEP K-12 Energy Education Program
Location: United States
Summary: Dedicated to teaching students about energy efficiency

The Foundation for water and energy education
Location: United States
Summary: Water and Energy materials

Citipower
Location: Australia
Summary: Energy efficiency in the home, office and school

Environmental Protection Agency
Location: United States
Summary: Offers resources on the environment and energy

Office of Energy Efficiency and Renewable Energy
Location: United States
Summary: Offers resources about energy

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Energy Audit Information

Use this sample energy audit to see how your school can get started on an energy management program:

- Microsoft Excel Spreadsheet

For further information on more extensive audits and auditing software, follow these links:

Free:

- Sustainable Energy Authority Victoria
- Energetics
- EnergyPlus software package (free End-user License)

Priced:

- Energetics One-to-Five software package (PDF brochure)
- United States Department of Energy Software Tools

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Energy Efficiency and your School

Getting Started

School Resources

Teacher Resources

-- Free teaching materials

-- Student links

-- Post your comments

Free teaching materials

The following links offer free downloadable lesson plans in the exciting area of energy efficiency. The lesson plans available these sites have been assessed for quality. Those available h have achieved a minimum standard for use in Australian scho

Education for a Sustainable Future
URL: http://csf.concord.org/esf/CurrViewByTopic.cfm
Title: Designing Sustainable Communities
Years: P-12

Infinite Power
URL: http://www.infinitepower.org/lessonplans.htm
Title: Renewable Energy
Years: P-12

Alliance to Save Energy
URL: http://www.ase.org/educators/download.htm
Title: Alliance to Save Energy
Years: P-12

National Renewable Energy Laboratories
URL: http://www.nrel.gov/education/energized.html
Title: Getting Energized
Years: 3-6

National Energy Education Development
URL: http://www.need.org/guides.htm
Title: NEED Energy Info books
Years: P-12

Charles Edison Fund
URL: http://www.charlesedisonfund.org/Experiments /experiments-list.html
Title: Charles Edison Fund
Years: 3-12

Watt Watchers
URL: http://wattwatchers.utep.edu/pages/Projects.htm
Title: Watt Watchers of Texas
Years: P-12

University of Wisconsin
URL: http://cf.uwex.edu/ces/erc/eypaw/listall.cfm?summarie
Title: Educating Young People About Water
Years: P-12

Georgia Pacific
URL: http://www.gp.com/EducationalinNature/teachers/
Title: Educational In Nature
Years: 4-5

City of Chula Vista

Department of Education & Training

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Energy Efficiency and your School

Getting Started

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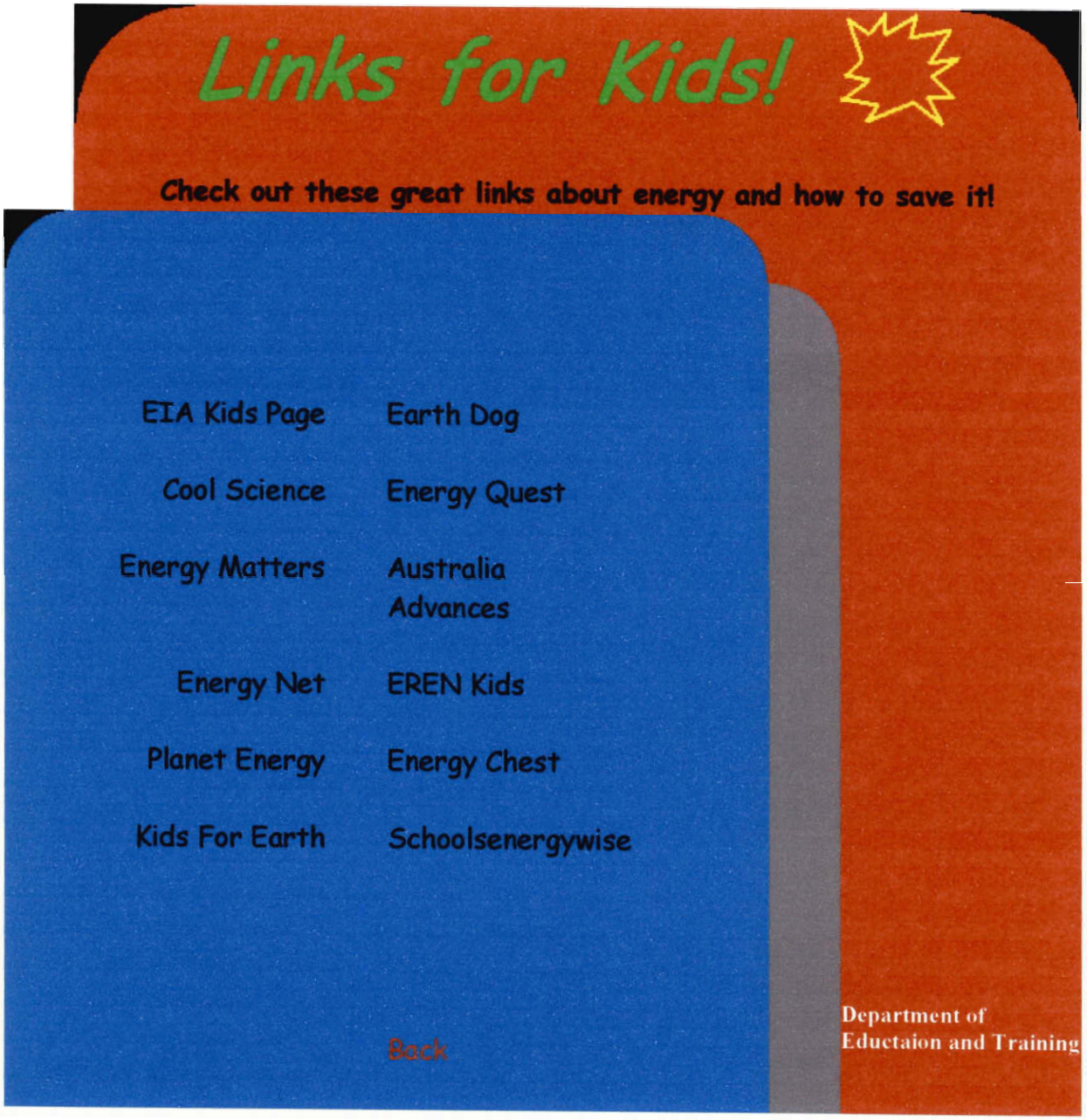
-- Post your comments

Student Links

These sites are specifically designed as fun and interesti energy efficiency web pages for kids.

EIA Kids Page
Cool Science
Energy Matters
Energy Net
Planet Energy
Kids For Earth
Earth Dog
Energy Quest
Australia Advances
EREN Kids
Energy Chest
Schoolsenergywise


Links for Kids!
Check out these great links about energy and how to save it!
EIA Kids Page
Earth Dog
Cool Science
Energy Quest
Energy Matters
Australia Advances
Energy Net
EREN Kids
Planet Energy
Energy Chest
Kids For Earth
Schoolsenergywise
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Energy Efficiency and your School

Getting Started

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-- Free teaching materials

-- Student links

-- Post your comments

Posting Board

Use this posting board to discuss energy efficiency teaching materials with other teachers. Each piece of teaching material below is rated directly by teachers who have used these materials in their own classrooms. To post your own comment about teaching material, click on Add Subject.

Add subject...

Subject	Date	Author	Written Responses
Subject 1	dd/mm	Teacher 1	8
Subject 2	dd/mm	Teacher 2	0
Subject 3	dd/mm	Teacher 3	3
Subject 4	dd/mm	Teacher 4	5
Subject 5	dd/mm	Teacher 5	1

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Posting Board

New subject Form

Please fill out the information below about the teaching material you wish to critique.

General Information

Where to get material:		Name of site/material:	
Reviewd by:		Author/publisher:	
Reviewer's email:		Date Reviewed:	

Brief Description

Possible topics to include are: organization, grade level,

Type of material:

- ☐ Lesson Plan
- ☐ Activity
- ☐ Experiment
- ☐ Resource

Characteristics

Please judge the material on a scale of 1 to 5 of how well the material follows these criteria. The scores should be assigned according to the description below:

- 1 – Criterion is minimally met within the material.
- 2 – Criterion is marginally met within the material.
- 3 – Criterion is met throughout the material.
- 4 – Criterion exceeds the minimum standard.
- 5 – Criterion is highlighted throughout the material

	1	2	3	4	5
General Content					
Are lessons centered around themes, not facts?	○	○	○	○	○

Are lessons multidisciplinary?	○	○	○	○	○
Are lessons interesting?	○	○	○	○	○

Presentation

Are the lessons clear and easy for students to understand?	○	○	○	○	○
Is the overall layout interesting and appealing?	○	○	○	○	○
Is the vocabulary used appropriate for the grade level?	○	○	○	○	○
Are vocabulary words defined in context?	○	○	○	○	○
Is the amount of text appropriate for the grade level?	○	○	○	○	○
Is there proper use of illustration?	○	○	○	○	○
Is there proper use of color?	○	○	○	○	○

Teacher Usability

Are there clear and concise instructions for the teacher?	○	○	○	○	○
Are objectives and outcomes clearly stated?	○	○	○	○	○
Is background information provided?	○	○	○	○	○
Is the time required for the lesson clearly stated?	○	○	○	○	○
Units and language can easily be converted if from overseas?	○	○	○	○	○
Are the subjects/disciplines integrated into the lesson clearly stated?	○	○	○	○	◉

Score

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