



Be Energy Efficient

UNIT OF WORK STAGE 3



Education
& Training
Northern Sydney



FIELD OF MARS
ENVIRONMENTAL EDUCATION CENTRE
EXPERIENCE ENGAGE ENABLE

Be Energy Efficient

UNIT OF WORK STAGE 3

Be Energy Efficient is a Stage 3 Science and Technology Design and Make unit of work on energy. The unit leads students to a sustainability action project to improve energy efficiencies at school.

This book contains detailed teaching and learning sequences, extension activities, background information, term overview, resource links, and student worksheets. Links are also listed on the Field of Mars EEC website.

ACKNOWLEDGEMENTS

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Cover images:

CFL light bulb - <http://www.publicdomainpictures.net/view-image.php?image=912&picture=cfl-bulb> >CFL Bulb by Petr Kratochvil

Solar panel - <http://www.sxc.hu/browse.phtml?f=download&id=990286>

Sydney Blue Gum - Steve Papp, Field of Mars EEC

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Be Energy Efficient

FOCUS

Be Energy Efficient is a 10 week Science and Technology unit of work for Stage 3 students. In this unit the students will develop understandings and knowledge about energy, how it is generated and used, why energy efficiency is important and how it can be conserved at home and at school. They apply this knowledge through the design of an energy efficient building and plan and take action that reduces energy consumption at their school. Through this process, the students will develop energy efficient attitudes and behaviours.

SUSTAINABILITY ACTION PROCESS

The sequence of learning experiences has been written using the Sustainability Action Process (SAP). Action projects which are embedded into the curriculum are more meaningful and enable authentic and transferrable student learning.

"When sustainability action is applied as a systematic process to issues and needs, it can be modelled, reapplied to new problems and learned by students with increasing levels of sophistication and complexity. The ultimate learning goal is for students to be able to implement sustainability action with such fluency that they can operate independently of the need for a scaffolded process." (Quote and image below: http://www.curriculumsupport.education.nsw.gov.au/env_ed/teaching/framework/index.htm)



BE ENERGY EFFICIENT & THE SUSTAINABILITY ACTION PROCESS FRAMEWORK

SUSTAINABILITY ACTION PROCESS	BE ENERGY EFFICIENT - SEQUENCE OF SCAFFOLDED QUESTIONS
Making the case for change	<p>Exploring energy What is energy? Where does energy come from? What uses energy in our home and school? What does sustainability and efficiency mean and how do they relate to energy? How do we use energy at home?</p>
	<p>Assessing the current situation through a school energy audit How do we use energy in our school? Where does the energy we use come from? What are our needs and wants in relation to school energy use?</p>
	<p>Investigating concepts and ideas relating to energy and its sustainable use What are the issues relating to the burning of fossil fuels? What are alternative energy sources? How can buildings be designed to minimise energy use? What good habits can we practise so that we are more energy-efficient?</p>
	<p>Stating the case for what needs to change in the school and why What is the preferred future in regard to our school energy use? What do we need to change in our school and home? Why do we need to bring about that change? How can we communicate our ideas?</p>
Defining the scope of the action	<p>Exploring options for making a change How will we know if the change we make has been successful? How have others made significant improvements in this area? What action can we take to bring about the change we want? Who are the people (stakeholders) at our school who use energy and what are their needs and concerns?</p>
	<p>Identifying available resources and constraints Who might be available to help us? What time is available for the project? What finances are available for the project? What might limit our actions?</p>
	<p>Developing the statement (brief) describing an agreed direction for action Have we clearly stated the type of action to be undertaken, the resources that are available and the criteria to be used to judge the success of change?</p>
Developing the proposal for action	<p>Generating and selecting ideas for action What are the different ways we could make improvements? How have others made improvements in this area? How can we come up with a great idea? What will we do?</p>
	<p>Preparing and communicating the proposal What will the changes cost? Who will take the actions? Who do we need to share our plans with? How will we use feedback to improve our proposal?</p>
	<p>Gaining agreement on the proposal What modifications have been made to the proposed change to gain endorsement from the Principal?</p>
Taking action	<p>Implementing the proposal Receive the Principal's support for implementing the proposal. Implement the proposal.</p>
Evaluating and reflecting	<p>Evaluating and reflecting Evaluate the sustainability action. Reflect on the processes used and our learning.</p>

Syllabus Links

FOUNDATION STATEMENTS

Science - Students independently plan, implement and manage the design process and evaluate the results using design criteria. They consider the implications of design and production in relation to environmental, aesthetic, cultural, ethical, safety and functional factors. Students select, safely use and evaluate equipment, computer-based technology and other resources to meet the requirements and constraints of design tasks.

They identify and describe various sources, forms, uses, transfers and changes in forms of energy. They recognise that the Earth is the source of most materials, and resources must be managed for sustainability.

HSIE - Students investigate human interactions with environments and recognise ecologically sustainable development. They sketch, label and use maps, applying appropriate conventions and terminology.

Source: *NSW Board of Studies* - <http://www.boardofstudies.nsw.edu.au/k-6/>

SCIENCE AND TECHNOLOGY

OUTCOMES	BIG IDEAS
<p><i>CONTENT OUTCOMES</i></p> <p>Built Environments</p> <p>BE S3.1 Creates and evaluates built environments demonstrating consideration of sustainability, aesthetic, cultural, safety and functional issues.</p> <p>Earth and its Surrounds</p> <p>ES S3.6 Recognises that the Earth is the source of most materials and resources, and describes phenomena and processes, both natural and human, that form and change the Earth over time.</p>	<p>ES3.1</p> <p>People influence the quality of life into the future through the products, systems and environments that they design, construct and use.</p> <p>ES3.6</p> <p>People and natural forces can change the surface features of the land, e.g. erosion, the greenhouse effect, and these changes can be monitored and patterns determined.</p> <p>Sometimes changes to the Earth can be harmful to the ecological balance but, in some cases, the damage can be rectified.</p> <p>Some resources are renewable and others are not.</p> <p>Experimenting and trialling can improve ideas for places and spaces.</p>

OUTCOMES	BIG IDEAS
<p><i>LEARNING PROCESS OUTCOMES</i></p> <p>Design and Make</p> <p>DM S3.8 Develops and resolves a design task by planning, implementing, managing and evaluating design processes</p> <p>Using Technology</p> <p>UT S3.9 Evaluates, selects and uses a range of equipment, computer-based technology, materials and other resources to meet the requirements and constraints of investigation and design tasks.</p>	<p>DM S3.8</p> <p>Produces annotated concept sketches and (freehand) drawings for use by other people.</p> <p>Selects tools, equipment and resources to meet the requirements of production and use.</p> <p>UT S3.9</p> <p>Works independently with equipment and materials, and applies established procedures for their safe use.</p> <p>Programs and adapts computing applications to suit the constraints and requirements of investigation and design tasks.</p> <p>Recognises that computer-based technology sometimes expands what can be done and sometimes limits what can be done.</p>

SCIENCE AND TECHNOLOGY VALUES AND ATTITUDES

- Demonstrates confidence in one's own ability and a willingness to make and implement decisions when investigating, designing, making and using technology
- Shows informed commitment to improving the quality of school and home environment
- Models positive behaviours that minimise consumption of resources
- Reduces, reuses and recycles resources
- Works co-operatively to minimise use of resources
- Develops skills to prepare for an ecological sustainable future.

RELATED HSIE OUTCOME

ENS3.5 Demonstrates an understanding of the interconnectedness between Australia and global environments and how individuals and groups can act in an ecologically responsible manner.

ENVIRONMENTAL EDUCATION OBJECTIVES

Students will develop...

Knowledge and understanding that:

- resources may or may not be renewable
- people can improve or degrade present and future environments
- living things depend on each other to survive

Skills in...

- organising, classifying, analysing, evaluating information
- transferring knowledge gained to affect one's own actions
- co-operatively developing a positive environmental plan at home.

Suggested Term Plan

WK	SUSTAINABILITY ACTION PROCESS (SAP)	TOPICS	TEACHING AND LEARNING SEQUENCE
1	Making the case for change	Topic 1 - Exploring Energy	Introduction – <i>Field of Mars EEC visit to your school</i> Household appliances survey Energy-saving appliances in my home
2		Topic 2 - School Energy Snapshot	School energy snapshot (audit)
3			Where does our energy come from?
4		Topic 3 - Energy Efficiencies	Energy Efficiency Blitz – <i>Field of Mars EEC visit to your school</i> Fossil fuels and the future Design an energy efficient building – get started
5		Topic 4 - Design & Make an Energy Efficient House	Design and make task - design an energy efficient building
6			Design and make task continued
7		Topic 5 - What Needs to Change?	Presentation of sustainable house designs What is the preferred future? Do we need change at school? Saving energy in the home
8	Defining the scope for the action	Topic 6 - Options for Change	Success stories Making a change Stakeholder interviews Review and discuss – <i>optional VC with Field of Mars EEC</i>
9	Developing the proposal for action	Topic 7 - Action Project Planning	Timeline Meetings What do we want to happen? Plan action project Present action plan Approval and support
10	Taking action Evaluating and reflecting	Topic 8 - Project Implementation Topic 9 - Evaluation & Reflection	Implement the actions Reflection Action project evaluation

Topic 1 - Exploring Energy

Field of Mars EEC will conduct the introductory session at your school

FOCUS - EXPLORING ENERGY

What is energy?

Where does energy come from?

What uses energy in our home and school?

What do 'sustainability' and 'efficiency' mean and how do they relate to energy?

How do they relate to energy?

BACKGROUND INFORMATION

WHAT IS ENERGY?

In the broadest sense, energy makes things move. Food and drink gives us the energy needed to live our lives; the sun, a form of energy, makes plants grow, and energy such as electricity makes machines work.

A definition of energy is "the power from something such as electricity or oil, which can do work, such as providing light and heat" (http://dictionary.cambridge.org/dictionary/british/energy_2)

WHERE DOES ENERGY COME FROM?

Renewable energy

Renewable energy sources can be used over and over again. These include solar energy (from the sun), hydro-electricity (from moving water), wind power (from the wind), geothermal power (from underground steam) and biomass energy (from plant and animal materials).

Non-renewable energy

Non-renewable energy sources can be used only once. These include fossil fuels such as oil, natural gas and coal. Fossil fuels were formed from plants and animals that died and were buried under layers of rock and soil over time. Over millions of years, the heat and pressure from the Earth turned these rotting remains into fossil fuels. Most of the electricity we use today is produced in power stations that burn coal.

Uranium is another non-renewable energy source and is used to create nuclear energy. When a nuclear atom is split, heat energy is released which is used to produce electricity.

WHAT DO 'SUSTAINABILITY' AND 'EFFICIENCY' MEAN AND HOW DO THEY RELATE TO ENERGY?

The definition of 'sustainability' is a goal "in which society meets the needs of the present without compromising the ability of future generations to meet their own needs". (World Commission on Environment and Development (1987) *Our Common Future*. United Nations, p. 54.)

'Environmental sustainability' is the ability to live and work in a way that maintains the physical environment into the future so that natural resources are not damaged or diminished over time. Using energy efficiently contributes to sustainability as it helps conserve natural resources and reduce carbon emissions.

'Efficiency' is defined as "when someone or something uses time and energy well, without wasting any" (<http://dictionary.cambridge.org/dictionary/british/efficiency>).

'Energy efficiency' is using energy economically and with minimal waste. This may include behaviours such as switching off lights and power points, the installation of devices that use energy efficiently, eg energy efficient lightbulbs, or fittings that reduce the need for energy use, eg, awnings to provide shade.

LESSONS

Field of Mars EEC will conduct the introductory session at your school



Energy efficient house model (before energy efficiencies have been applied), Field of Mars EEC

INTRODUCTION TO 'BE ENERGY EFFICIENT'

Soundscape - To introduce the unit of work and the concept of energy, the students will be shown an animated soundscape of a morning in a typical house as the family prepares for the day. The students will be asked to listen for and identify the energy-using appliances that they hear in the soundscape. This will be used as a springboard for a discussion on energy.

Video - The students will be shown the video, *You've Got the Power* from the Movie Room on *Energy Quest* - <http://www.energyquest.ca.gov/index.html>. This provides an explanation of energy, resources to make energy, renewable sources of energy and ways to save energy.

Energy efficient house model - The concepts of 'sustainability' and 'efficiency' will be introduced then the students will 'retro-fit' the energy efficient house model with energy and water efficient installations and appliances.

The following activities should be conducted by the class teacher

HOUSEHOLD APPLIANCES SURVEY

To raise awareness of our reliance on energy for day-to-day living, students use the *List of Household Appliances* chart (Worksheet 1), to list the appliances in their bedroom, kitchen, laundry and lounge/family/TV room as a homework task.

ENERGY-SAVING APPLIANCES

At school, show the students images of energy and water ratings labels <http://www.energyrating.gov.au/con3.html> and <http://www.waterrating.gov.au/about/index.html> and briefly explain the ratings system. Ask the students if they noticed energy and/or water ratings labels on any of their household appliances. Also ask the students if there are any energy or water saving devices installed in their home, eg, timers, energy saving lights.

The students complete the first box, 'Energy-saving appliances or devices in my home', of the worksheet *Saving Energy in the Home* (Worksheet 2).

EXTENSION ACTIVITY

WHAT'S A WATT?

Students research the units used to measure electricity and gas on a meter and on an appliance. Students also research the amount of energy produced per cubic metre of gas and per kWh of electricity. The students explain this information to the class or create a chart for display.

ADDITIONAL RESOURCE

About Energy - <http://www.energyaustralia.com.au/Common/Education/About-energy.aspx>

Topic 2 - School Energy Snapshot

FOCUS - ASSESSING THE CURRENT SITUATION THROUGH A SCHOOL ENERGY AUDIT

How do we use energy in our school?

Where does the energy we use come from?

What are our needs and wants in relation to school energy use?

BACKGROUND INFORMATION

WHERE DOES THE ENERGY WE USE COME FROM?

Most of the electricity we use today is produced in power stations that burn fossil fuels, mainly coal.

1. Inside the power station, coal, oil or gas is burned to heat water to create steam.
2. The steam drives turbines (like fans with many blades).
3. The turbines are connected to a generator which is a coil of copper wire surrounded by large magnets. The turbines turn the magnets causing electrons to flow quickly from atom to atom to create an electric current.
4. The electric current (electricity) is sent through a transformer to increase the voltage so that it can travel long distances.
5. A network of high-voltage transmission lines carry the electricity to the cities and suburbs. These high-voltage lines are strung between tall power stanchions.
6. The electricity passes through sub-stations where the voltage is lowered to safe levels.
7. The electricity then travels through smaller power lines into homes and businesses, passing through an electricity meter that measures usage.
8. The electricity goes through a switchboard which divides it into the various sections and uses of a building.

Resource: Generating electricity - http://www.energex.com.au/switched_on/electric_energy/electric_generating_electricity.html



School energy audit, Loftus PS

LESSONS

SCHOOL ENERGY SNAPSHOT

It is suggested that the students work in teams and complete one snapshot activity per team then report back to the class.

1. School energy bills - analyse the school's energy bills. For each form of energy, find the total cost over 12 months, the total consumption and total greenhouse gas emissions. Plot usage and emissions monthly over a year using a graphing tool such as Excel and look for spikes and lows.

Use the *Energy Use Calculator* at <http://www.sustainableschools.nsw.edu.au/Default.aspx?tabid=235> to find use, emissions and cost per student.

2. Energy habits survey - pairs of students visit classrooms at pre-arranged times to ask about energy use. Firstly, formulate a set of questions. Include a question about what equipment is left on stand-by mode. A sample school survey is available at <http://www.rumbalara.eec.education.nsw.gov.au/sempr/Energy%20Audit%20June%202010.pdf> (pp. 8-9).

3. Temperature control measures - on a map of the school students look for passive cooling installations that may help control the temperature in rooms, eg, blinds, awnings, open verandas, COLAs, whirly-gigs, tree plantings. The students use a key to label them on the map and take photos of the installations. The students should also note the aspect of the rooms, ie, windows facing west, etc. They should also try to find out if any rooms have ceiling or wall insulation and mark these on the map. (It is suggested that students work in pairs within the team and be allocated different sections of the school.)

4. School appliance survey – a survey of the energy using equipment in the school can reveal where most energy is being used. The process and Excel spreadsheets are on the *Sustainable Schools NSW* website - <http://www.sustainableschools.nsw.edu.au/Default.aspx?tabid=178>. A copy of the *School Appliances* recording sheet is attached - Worksheet 3.

5. **Energy ratings** - for the main appliances in the school, students use the *Energy Rating* website to search the ratings for several of the major appliances <http://www.energyrating.gov.au/>. Students record the appliances and ratings on the *School Appliance Rating Sheet* (Worksheet 4). This activity could be repeated for appliances in the students' homes (optional).

WHERE DOES OUR ENERGY COME FROM?

List the main sources of energy used at home and at school: electricity, natural gas, LPG. The students should be encouraged to look at their household energy bills to understand household energy use.

Students use the *Energy Chains: Power Up!* interactive learning object (Code X02JC on Tale4Students) to find out about energy sources and converters. (<http://www.tale.edu.au/tale/components/includes/trap.html?uid=aHR0cDovL3RsZi5kbHluZGV0Lm5zdy5lZHUuYXUvbGVhcm5pbmdvYmplY3RzL0NvbnRlbnQvTDIzNTYvaW1zbWFuaWZlc3QueG1sLmh0bWxAVGFMRV8yMDA1X1RMRI9WMg==>)

EXTENSION AND OPTIONAL ACTIVITIES

RATE YOUR HOME

Students use the *NABERS Home Rating Calculator* to find out how their home's water and energy use compares to other homes - <http://www.nabers.com.au/home.aspx>. (Note: This is quite a time-consuming process.)

ELECTRICITY FLOWCHART

The students construct a flowchart or diagram showing electricity production and distribution, eg, coal is mined → transported to power station → burned to boil water → changes to steam → steam through turbines → generates electricity → through transformer → travels along power lines → into homes.

ADDITIONAL RESOURCE

Energy: Ollie Saves the Planet - <http://www.olliesworld.com/planet/aus/info/issue/energy.htm>



School electricity bill analysis, Epping North PS

Topic 3 - Energy Efficiencies

Field of Mars EEC will conduct the first part of this topic at your school

FOCUS - INVESTIGATING CONCEPTS AND IDEAS RELATING TO ENERGY AND ITS SUSTAINABLE USE

What are the issues relating to the burning of fossil fuels?

What are alternative energy sources?

BACKGROUND INFORMATION

WHAT ARE THE ISSUES RELATING TO THE BURNING OF FOSSIL FUELS?

Carbon emissions - burning coal releases large amounts of carbon dioxide and sulphur dioxide into the atmosphere. The emissions contribute to the greenhouse effect: the warming of the planet due to gasses in the atmosphere trapping the sun's energy.

Air pollution - cars, buses, trucks and trains use petrol or diesel for power. The exhaust from the burning of these fossil fuels in these vehicles creates air pollution.

Mining damage - extracting fossil fuels, through mining and drilling causes massive environmental damage.

Non-renewable - the reserves of fossil fuels will eventually run out - they are a non-renewable resource.

WHAT ARE ALTERNATIVE ENERGY SOURCES?

Solar energy - light energy from the sun is trapped in panels of photovoltaic cells. Tiny panels are commonly used to power calculators, small panels are used to power street signs, such as School Zone warning signs, and larger panels are used on rooftops of homes, schools and businesses.

The sun's energy can also be used to heat water in solar hot water heaters which can be installed on roof-tops.

Hydro-electricity - moving water is used to generate electricity. Large dams are built on rivers to trap the water. Water flowing out of the dam is controlled and used to power turbines to generate

electricity. Australia's Snowy Mountains Hydro-electric Scheme is one of the most complex hydro-electric power schemes in the world.

Whilst hydro-electricity is a renewable energy source, the building of dams has major impacts on valleys and river systems.

Wind energy - wind turbines use the energy of the wind to generate electricity. The wind turns the propeller-like blades which turn the attached generator. Often several are built in a windy area and this is known as a wind farm. The electricity generated can be fed into the grid or used to power individual homes.

Wind is a renewable energy source and is known as a form of 'clean energy'. Some people are concerned about the visual impact of wind turbines.

Nuclear energy - nuclear power plants are used to produce electricity, particularly in North America and Europe. When a nuclear atom is split, heat energy is released. This heat is used to boil water to create steam which is then used to drive turbines to generate electricity.

Nuclear energy does not release harmful gases into the atmosphere, however, radioactive waste is generated which is very dangerous if released accidentally. Uranium is a non-renewable resource and mining it causes massive damage to the environment.

Wave and tidal energy - this is a form of hydro-electricity which uses the movement of the ocean's waves and tides to power turbines to generate electricity. The construction of tidal power stations causes damage to coastal environments.



Wind farm - source: <http://www.sxc.hu>



Testing the effect of insulation in the Energy Efficiency Blitz

Geothermal energy - geothermal means heat (thermal) from the earth (geo). In some areas, particularly volcanic areas, there are hot rocks and lava relatively close to the earth's surface. In these areas, drilling captures steam and hot water which is used to power turbines to generate electricity. In New Zealand, Rotorua's geothermal springs are used to produce electricity.

Biomass energy - is energy derived from recent plant and animal materials. An example of a biomass energy source in Australia is sugar cane waste called bagasse. This is processed then burnt to boil water that creates steam which is used to generate electricity. Another example is methane gas (or biogas), which is naturally produced by rotting plant and animal matter (eg, animal manure). This gas can be collected and used as fuel. Biomass can also be converted into a liquid or gas, such as ethanol from sugar cane and other crops. Biomass energy effectively uses waste materials and is a renewable resource.

LESSONS

Field of Mars EEC will conduct the Energy Efficiency Blitz session at your school

ENERGY EFFICIENCY BLITZ

Field of Mars staff will use a slide show to explain the origin of fossil fuels, the concepts of greenhouse gas and carbon emissions, and will introduce renewable energies. (Resource: *Black Balloons Energy Saving Campaign* video http://www.youtube.com/watch?v=6Eg_SEAnE-M)

Field of Mars staff will then run a hands on workshop in which the students can explore items which use renewable energy (solar and kinetic), test various energy efficient installations such as insulation and shading, and use meters to measure electricity use of various appliances and heat and light levels in the classroom.

The students will work in teams of four and will undertake four of the eight explorations. For each workstation, each students completes the *Predict, Observe, Explain* recording sheet (Worksheet 6).

Examples of workstations:

- How much power does an appliance use?
- How much power do pilot lights and stand-by modes use?
- Does insulation really work?
- What is solar power
- Does shading make a difference?
- What are our classroom light levels?
- Can we reduce heat in a room?

The following activities should be conducted by the class teacher

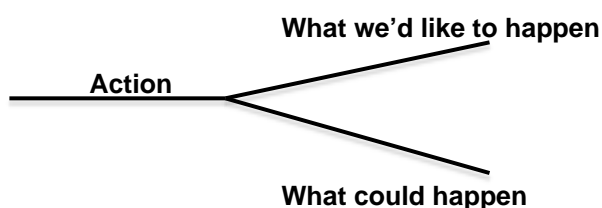
FOSSIL FUELS AND THE FUTURE

Discuss the issues relating to the burning of fossil fuels. Use 'what if' questions to generate discussion. As a class complete the *Burning Fossil Fuels Issues Map* (Worksheet 6) to explore the breadth of issues relating to the burning of fossil fuels.

EXTENSION AND OPTIONAL ACTIVITIES

FUTURES CHART

The students create a Futures Chart showing the possible futures relating to the burning of fossil fuels.



RENEWABLE ENERGY

Create a list of renewable energies, eg, solar energy, wind farms, hydro power, carbon sequestration, biomass, wave and tidal power. Allocate a group of students to each form of energy to research. They present the main points to the class. This could be done in a dramatic way to demonstrate how the energy is created.

Alternatively, students research each form of energy and present the information in table form: energy source, how it is used to generate electricity, advantages, disadvantages. The student evaluate the different sources and present their point of view on the most sustainable in a speech or newspaper article (exposition).

ADDITIONAL RESOURCES

Country Energy - <http://www.countryenergy.com.au/content/renewable-energy>

Energy – Ollie Saves the Planet - <http://www.olliesworld.com/planet/aus/info/issue/energy.htm>

How coal is formed - http://www.classzone.com/books/earth_science/terc/content/visualizations/es0701/es0701page01.cfm?chapter_no=visualization

Topic 4 - Design & Make an Energy Efficient Building

FOCUS - DESIGNING AND MAKING AN ENERGY EFFICIENT BUILDING

How can buildings be designed to minimise energy use?

What good habits can we practise so that we are more energy-efficient?

BACKGROUND INFORMATION

HOW CAN BUILDINGS BE DESIGNED TO MINIMISE ENERGY USE?

Factors to consider when designing an energy efficient building include the orientation of the building, design features which provide for passive cooling and sun control, landscaping for sun control and water use, access to the sun for solar panels and installation of energy efficient devices.

WHAT GOOD HABITS CAN WE PRACTISE SO THAT WE ARE MORE ENERGY-EFFICIENT?

There are many ways individuals, families, schools and workplaces can conserve energy. Refer to the links to energy saving tips in the resources section below.

Some facts about saving energy (quoted from <http://www.livinggreener.gov.au/energy>):

- Standby power can account for more than 10 per cent of your household electricity use.
- Heat gain through an unshaded window in summer can be 100 times greater than through the same area of insulated wall.
- An uninsulated ceiling could waste 35 per cent of your winter heating and uninsulated walls another 10 to 20 per cent.
- Water heating accounts for almost a quarter of household energy use.
- Drying a load of washing in an electric dryer generates more than 3 kilograms of greenhouse gas.

DESIGN AND MAKE PROCESS

1. Explore and identify needs, wants and opportunities
2. Define the design task
3. Explore ideas
4. Develop ideas
5. Select solutions

6. Use resources to produce an outcome
7. Evaluate the outcome.

Resource: NSW DET Designing and Producing K-12 - http://www.curriculumsupport.education.nsw.gov.au/designproduce/tech_process.htm

LESSONS

DESIGN AND MAKE TASK - DESIGN AN ENERGY EFFICIENT BUILDING

1. Explore and identify needs, wants and opportunities

Show the students the *Sustainable Architecture PowerPoint* - <http://www.teachsustainability.com.au/resources/resource.2006-05-19.1681271382/sustainable-architecture-powerpoint/>, focussing on the final slides of sustainable designs.

2. Define a design task

Ask the students to imagine that they are architects and have been contracted to design a sustainable house, room, classroom block or classroom (with an unlimited budget!).

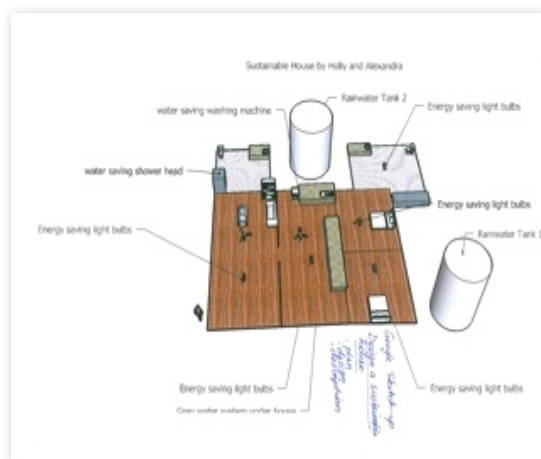
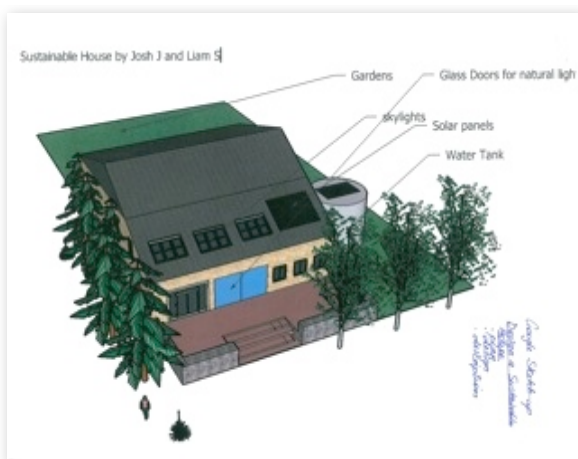
3. Explore ideas

Interactive Energy Efficient House - students use the Field of Mars EEC's *Virtual Energy Efficient House* to explore energy efficiencies. (This is a digital version of the house model and its components used in the introductory session. It has been developed into an interactive learning object using *Notebook software*.)

Additional or alternative resource: Energy Efficient House learning object - <http://tlf.dlr.det.nsw.edu.au/learningobjects/Content/L895/object/>

4. Develop ideas

In pairs or groups the students list the main energy efficiencies and sustainable features they would like to include in their building. Students could use the *Energy Efficient Building Design - Planning Sheet* (Worksheet 7).



Digital Designs using Google Sketchup by Stage 3 students, Lane Cove West PS



3D Model using cardboard, skewers, paper and other materials by Stage 3 student, Epping North PS

5. Select solutions

In pairs, the students draw a rough sketch of what their sustainable building may look like, labelling the sustainable features and energy and water efficiencies.

6. Use resources to produce an outcome

The students either create a digital or 3D model of their building or room.

Google Sketch-up can be used to create a digital model of their building, labelling key energy efficiency features. They could design the exterior or interior of the building.

Alternatively, a 3D model of a sustainable building can be made using construction materials such as corrugated cardboard, straws, foil, bamboo skewers, etc.

Another alternative is for pairs of students to construct a 3D model of an energy efficient room in a house or school. *Google Sketch-up* could be used for the 2D design. The 3D model could be constructed in a shoebox.

7. Evaluate the outcome

The students present their sustainable building or room design/model to the class, pointing out the sustainable features and their justification for them. The students could video their presentation or create a slide show for viewing by the teacher and students.

Alternatively, the students could write a newspaper or magazine article about their sustainable building. It should be written as if the building is real and will be open for inspection. The article should describe the sustainability features that the building showcases.

The presentation and article are good assessment opportunities.

ENERGY EFFICIENT BEHAVIOURS

Students refer to the energy saving tips available on the Internet (see Additional Resources below), and their understandings so far, to create a class mind map of 'best practice' behaviours and actions that the students and their families can do to minimise energy use at home, ie, the good habits.

In groups, the students repeat the mind mapping exercise, this time brainstorming good habits students and staff can do to be energy efficient at school.

EXTENSION ACTIVITY

For 3D models, students could incorporate solar powered lighting and/or cooling to the building. This can be designed and installed using a small solar panel kit as the basis. Consideration will need to be given to the location of the solar panels to maximise sunlight, and the integration of cooling methods into the energy-efficient design.

ADDITIONAL RESOURCES

Save Energy (Living Greener) - <http://www.livinggreener.gov.au/energy>

Tips to Help You Save - <http://www.savepower.nsw.gov.au/community/power-saving-tips.aspx>

Energy Saving Tips - <http://www.shellharbour.nsw.gov.au/FileData/pdf/EverydayEnergySavingTips.pdf>

Conserving Energy - <http://www.energyaustralia.com.au/Common/Education/About-energy/Conserving-energy.aspx>

Energy Saving Tips (Energy Star) - <http://www.energystar.gov.au/tips/index.html>

Which activities did you enjoy most? Why?

I enjoyed using Google Sketchup to design a house. I enjoy creating and learning how to create things better for the environment. That is why I enjoyed this activity.

Do you think it is important to study this topic at school? Explain your answer.

People say that children are the future. If this is so, we need to learn how to take care of our environment. This way we can almost guarantee that in the future climate change will slow down and we can live happily.

Topic 5 - What Needs to Change?

FOCUS - STATING THE CASE FOR WHAT NEEDS TO CHANGE IN THE SCHOOL AND WHY

What is the preferred future in regard to our school energy use?

What do we need to change in our school and home?

Why do we need to bring about that change?

How can we communicate our ideas?

BACKGROUND INFORMATION

The activities for the remainder of the unit draw on the understandings the students have gained. Students apply these understandings in determining how to be more energy efficient at their school. Identifying where changes can be made, options for change and developing and implementing an action project provide an authentic learning task in which understandings, attitudes and values can be consolidated and further developed.

LESSONS

WHAT IS THE PREFERRED FUTURE IN REGARD TO OUR SCHOOL ENERGY USE?

In groups, students agree on a target percentage to reduce energy consumption in the school, eg 15% reduction in the first year, 20% in the second year. List the desired targets on the board from each group. If there is a large discrepancy, ask for a representative from the groups to state their case. As a class, agree on a percentage reduction target.

DO WE NEED TO CHANGE AT SCHOOL?

Reflecting on the information and understandings gained through the unit, ask the students to identify the practices, devices and installations currently in the school that are energy efficient, eg, good habits such as switching off fans and lights when not in room. Identify bad habits observed.

Discuss what and where improvements could be made at school to be more energy efficient. List ideas for energy efficiency improvements at school, these could include physical changes and/or behaviours. (*School Energy Improvements - Worksheet 8*)

18. What can you do in your own home to be more energy-efficient?

To be more energy-efficient I can turn lights off when I leave the room, turn the T.V off at the point, don't leave the computer on.

19. What is renewable energy and what are some examples of renewable energy?

Renewable energy is energy that won't run out. Some examples of this is wind power, hydropower, solar power and

20. Whose responsibility is it to protect our planet's water and energy resources? Explain your answer.

It is everybody's responsibility! If only one person in the whole world was trying to save water on their own they would not succeed. If everybody did it would slowly but surely work.

Stage 3 student, Lane Cove West PS

SAVING ENERGY IN THE HOME

Drawing on the understandings gained so far, the students complete the rest of the worksheet *Saving Energy in the Home* (Worksheet 2), ie, 'Additional energy-saving appliances or devices that could be installed' and 'Responsible actions I can in my home to save energy'. (The first box of this worksheet was completed earlier in the unit in Topic 2.)

MAKING THE CASE FOR CHANGE	DEFINING THE SCOPE FOR ACTION	DEVELOPING THE PROPOSAL FOR ACTION	IMPLEMENTING THE PROPOSAL	EVALUATING AND REFLECTING
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Topic 6 - Options for Change

FOCUS - EXPLORING OPTIONS FOR MAKING A CHANGE

How will we know if the change we make has been successful?

How have others made significant improvements in this area?

What action can we take to bring about the change we want?

Who are the people (stakeholders) at our school who use energy and what are their needs and concerns?

BACKGROUND INFORMATION

For change to be successful in the long-term, a collaborative approach is recommended. If people feel that they have been consulted and their opinions heard, they are more likely to support changes made through the action project.

LESSONS

SUCCESS STORIES

Students work in groups to explore ways in which other schools have become more energy efficient.

There are several case studies listed on the *Sustainable Schools* website <http://www.sustainableschools.nsw.edu.au/Default.aspx?tabid=266>.

Additional resource: DET's Asset Management Energy Fact Sheets - <http://www.rumbalara.eec.education.nsw.gov.au/resources/assets%20fact%20sheets.htm>

MAKING A CHANGE

In groups then as a class, prioritise the list of potential energy efficiency improvements (Worksheet 8 - *School Energy Improvements*).

As a class, discuss criteria or indicators, in addition to the energy reduction target, that would show that change has been successful in reducing energy consumption, eg, lights and fans not on when rooms are empty, equipment (that can be) is not left on stand-by.

STAKEHOLDER INTERVIEWS

Identify the people (stakeholders) each potential idea might affect, eg, office staff, canteen staff, teachers.



Installing a timer on the staffroom hot water powerpoint, Epping North PS

Pairs or groups of students interview the main stakeholders to ascertain their attitudes to the potential changes that could be made and ask if they have any other ideas.

REVIEW AND DISCUSS

Optional video conference with Field of Mars EEC staff

A video conference can be held with Field of Mars staff for the students to discuss their potential list of energy improvements. The list of ideas can be shared on the interactive whiteboard via Bridgit and can be reviewed, amended or added to.

ADDITIONAL RESOURCES

Resource Management Links - <http://www.sustainableschools.nsw.edu.au/Default.aspx?tabid=69>

Enterprise Learning - <http://www.enterpriselearning.nsw.edu.au/whatis.php?pg=curriculum>

Topic 7 - Action Project Planning

FOCUS

1. IDENTIFYING AVAILABLE RESOURCES AND CONSTRAINTS

Who might be available to help us?

What time is available for the project?

What finances are available for the project?

What might limit our actions?

2. DEVELOPING THE STATEMENT (BRIEF) DESCRIBING AN AGREED DIRECTION FOR ACTION

Have we clearly stated the type of action to be undertaken, the resources that are available and the criteria to be used to judge the success of change?

3. GENERATING AND SELECTING IDEAS FOR ACTION

What are the different ways we could make improvements?

How have others made improvements in this area?

How can we come up with a great idea?

What will we do?

4. PREPARING AND COMMUNICATING THE PROPOSAL

What will the changes cost?

Who will take the actions?

Who do we need to share our plans with?

How will we use feedback to improve our proposal?

5. GAINING AGREEMENT ON THE PROPOSAL

What modifications have been made to the proposed change to gain endorsement from the Principal?

BACKGROUND INFORMATION

This project planning stage teaches students valuable skills in project planning in addition to clearly articulating what they collectively as a class want to achieve.

LESSONS

TIMELINE

As a class, create a desired timeline to reduce energy consumption at school.

MEETING

Elect or nominate students to meet with the Principal to discuss the 'wish list' of changes and potential funding sources, including available grants and community partners. Determine what is realistic and feasible.

WHAT DO WE WANT TO HAPPEN?

Create a class statement on what the students would like see happen in their school to be more energy efficient. This could be written as an aim or list of aims, eg,

"To reduce our school electricity consumption by 10% in the next 12 months by turning off electrical equipment and appliances when not in use and leaving nothing on stand-by."

and/or

"To reduce our school electricity consumption by installing thermometers in all rooms and establishing a minimum temperature policy for air conditioner operation."

and/or

"To improve the thermal comfort in classrooms by installing retractable awnings over all windows facing west."

PLAN THE ACTION PROJECT

Use a scaffold such as PMI (Plus, Minus, Interesting) to evaluate the class list of school energy efficiency ideas. Reach consensus to establish an agreed and achievable action project.

If several components to the action project, students work in teams to prepare plans for their action component, breaking it into steps and identifying the resources needed (*Worksheet 9 - Action Project Planner*).

The students could use *Studio E* to plan the project. This is an interactive, web-based learning tool that assists students to explore a project task and define the project brief.

Resource: Studio E - http://www.enterpriselearning.nsw.edu.au/studio_e.php

PRESENT THE ACTION PLAN

In their project teams, the students identify the relevant stakeholders and prepare a short presentation outlining their action project. The students should outline their action, provide background information and 'sell' their ideas specific to their audience. (Support from key stakeholders will need to be gained for behaviour change otherwise it will not happen.)

This task is a good assessment opportunity.

APPROVAL AND SUPPORT

Present the action plans to the Principal and obtain the Principal's agreement and support.

Topic 8 - Project Implementation

FOCUS - IMPLEMENTING THE PROPOSAL

Implement the proposal

BACKGROUND INFORMATION

Becoming more energy efficient across the school will not only be more sustainable, it will save the school money.

LESSONS

IMPLEMENT THE ACTIONS

Implement the action project – do what was planned.

TELL OTHERS

Students write articles and take photos of the action projects for the school newsletter, school website and local newspaper. Celebrate and promote early successes.



Turning power points off at the end of the day saves energy, Boria Park PS

Topic 9 - Evaluation & Reflection

FOCUS - EVALUATING AND REFLECTING

Evaluating the sustainability action

Reflecting on the processes used and our learning

BACKGROUND INFORMATION

Once the action project has been implemented, consideration should be given into continuing energy efficiencies for the long-term. Good energy habits may take a while to become second nature but we all know how quickly we can slip into bad habits. A program of reminders, reinforcements and ongoing stewardship should help maintain school energy efficiencies into the future.

LESSONS

REFLECTION

Reflect on and discuss the learning, activities, sustainable building design and make task and presentations completed throughout the unit of work. The students could write a reflection statement or complete the *Be Energy Efficient Reflections* sheet (Worksheet 11).

Knowledge and understandings in the unit could be assessed using the *Be Energy Efficient Quiz* (Worksheet 10) and/or the *Make it Go: Energy Change*: assessment interactive learning object (Code X0368 on Tale4Students) [http://www.tale.edu.au/tale/components/includes/trap.html?](http://www.tale.edu.au/tale/components/includes/trap.html?uid=aHR0cDovL3RsZi5kbHluZGV0Lm5zdy5lZHUuYXUvbGVhcm5pbmdvYmplY3RzL0Nvb3RlbnQvTDk4NDMvaW1zbWFuaWZlc3QueG1sLmh0bWxAVGFMRV8yMDA1X1RMRl9WMg==)

[uid=aHR0cDovL3RsZi5kbHluZGV0Lm5zdy5lZHUuYXUvbGVhcm5pbmdvYmplY3RzL0Nvb3RlbnQvTDk4NDMvaW1zbWFuaWZlc3QueG1sLmh0bWxAVGFMRV8yMDA1X1RMRl9WMg==](http://www.tale.edu.au/tale/components/includes/trap.html?uid=aHR0cDovL3RsZi5kbHluZGV0Lm5zdy5lZHUuYXUvbGVhcm5pbmdvYmplY3RzL0Nvb3RlbnQvTDk4NDMvaW1zbWFuaWZlc3QueG1sLmh0bWxAVGFMRV8yMDA1X1RMRl9WMg==)

ACTION PROJECT EVALUATION

At regular intervals after implementation of the action project, collect data to evaluate the success of the project based on the criteria and indicators listed on the action plan. Monitor school electricity bills, adding to a graph of school energy use in the classroom or school foyer.

At regular intervals, measure and monitor energy use and make comparisons to the original data collected in the energy snapshot. Report and celebrate results at school assemblies, in the school newsletter, on the school website and in the local media.

Additional Resources

All About Energy - <http://www.planete-energies.com/content/energy.html>

Asset Management Fact sheets - <http://www.rumbalara.eec.education.nsw.gov.au/resources/assets%20fact%20sheets.htm>

Carbon Kids in Action – unit - <http://www.csiro.au/files/files/pqnt.pdf>

Climate Clever Energy Savers Program - http://www.curriculumsupport.education.nsw.gov.au/env_ed/programs/savers/index.htm

Energy Australia Education - <http://www.energyaustralia.com.au/Common/Education.aspx>

Energy – Ollie Saves the Planet - <http://www.olliesworld.com/planet/aus/info/issue/energy.htm>

Energy – teaching strategies and student investigations http://www.curriculumsupport.education.nsw.gov.au/env_ed/teaching/focus/energy.htm

Energy Management (Asset Management on DET Intranet) - <https://detwww.det.nsw.edu.au/assetmanagement/envisust/energyman.htm>

Kids Saving Energy - <http://www.eere.energy.gov/kids/>

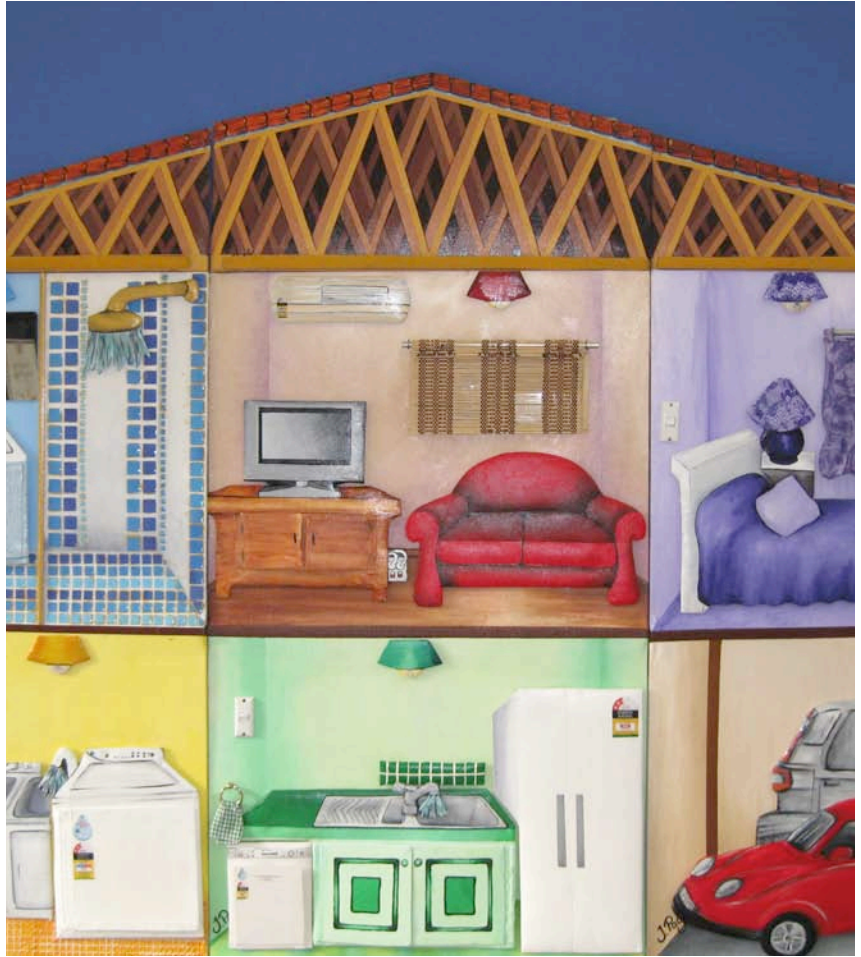
Power for a Sustainable Future - <http://www.sustainableenergy.eq.edu.au/html/what.html>

Schools Energy Efficiency Program - <http://www.savepower.nsw.gov.au/community/community-programs/schools-energy-efficiency-program.aspx>

SEMP – Energy (Rumbalara EEC) - <http://www.rumbalara.eec.education.nsw.gov.au/sempp/Energy%20Audit%20June%202010.pdf>

Sustainable Schools NSW - <http://www.sustainable.schools.nsw.edu.au/>

Switched On - http://www.energex.com.au/switched_on/index.asp



Be Energy Efficient

STUDENT WORKSHEETS

Name

Class

List of Household Appliances

List all the appliances in your bedroom, kitchen, laundry and family room (or TV room). Don't include lights. Indicate whether the appliance uses water (W), gas (G), electricity (E) or a combination.

KITCHEN		LAUNDRY	
Appliance	Uses	Appliance	Uses
<i>Fridge Toaster</i>	<i>E E</i>	<i>Washing machine</i>	<i>E, W</i>
FAMILY ROOM OR TV ROOM		MY BEDROOM	
Appliance	Uses	Appliance	Uses

Saving Energy in the Home

Complete the first box at the beginning of the unit in Topic 2. Complete the other boxes later in the unit in Topic 5 - What Needs to Change?

Energy-saving appliances or devices in my home

Additional energy-saving appliances or devices that could be installed

Additional energy-saving appliances or devices that could be installed in my home

Responsible actions I can take in my home to save energy

Additional energy-saving appliances or devices that could be installed in my home

School Appliances

Record how energy is used in your school. This data can be put into the Excel spreadsheet for computation available at <http://www.sustainableschools.nsw.edu.au/Default.aspx?tabid=178>

APPLIANCE	NO. OF APPLI- ANCES (TALLY)	AVERAGE WATTAGE	HOURS USED PER DAY	NO. OF DAYS USED IN YEAR
Computer		300		
Office light fitting		65		
Small air conditioner		2000		
Large air conditioner		6500		
Ceiling fan		100		
PC		300		
Laser printer		850		
Stove		6000		
Photocopier		250		
Fax machine		700		
Commercial fridge		500		
Domestic fridge		320		
Boiling water		2400		
Hot water		3600		
Kiln		15000		

Predict.. Observe.. Explain

ENERGY EFFICIENCY BLITZ

At each workstation, follow the instructions on the task card.

Before you start, predict what you think will happen and write it down. **After** the exploration, write what you observed and explain why it happened.

WORKSTATION TITLE -
PREDICT - What do you think will happen?
OBSERVE - What was the result?
EXPLAIN - Why do you think that happened?

WORKSTATION TITLE -
PREDICT - What do you think will happen?
OBSERVE - What was the result?
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Predict.. Observe.. Explain

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EXPLAIN - Why do you think that happened?

WORKSTATION TITLE -

PREDICT - What do you think will happen?

OBSERVE - What was the result?

EXPLAIN - Why do you think that happened?

Energy Efficient Building Design

PLANNING SHEET

1. DEVELOPING IDEAS - List the main energy efficiencies and sustainable features you would like to include in your sustainable building (minimum of 5)

2. SELECTING SOLUTIONS - What are you designing? Is it the interior or exterior or both? Draw a rough sketch of what your sustainable building may look like. Label the energy and water efficiencies.

Additional energy-saving appliances or devices that could be installed in my home

3. USING RESOURCES TO PRODUCE AN OUTCOME - Digital model or 3D model? If a digital model, list the resources/internet sites you need to use, eg, Google Sketchup. If constructing a 3D model, list the materials and equipment you need, eg, corrugated cardboard, skewers, paper, foil, glue gun, etc

Additional energy-saving appliances or devices that could be installed in my home

School Energy Improvements

Priority	What behaviours could be changed to improve energy efficiency?	Stakeholders	Indicators of success
Priority	What could be installed or physically changed to improve energy efficiency?	Stakeholders	Indicators of success

Action Project Planner

WHO is your target group? *Students Teachers Admin staff External users Others*

WHAT are you going to do? Briefly describe your action project.

WHEN will you do this? List key dates.

WHERE will you do it?

WHO will you do it with? Who are your project partners?

FUNDING - do you need it? How will you get it?

INDICATORS OF SUCCESS - what percentage energy savings are you aiming for? How else will you know your action project was successful?

Be Energy Efficient Quiz

1. Name 10 appliances in the home that use energy. _____

2. On energy rating labels, what colour are the energy rating stars? _____

3. Why do appliances have energy ratings? _____

4. What is currently the main form of energy used for electricity generation in NSW? _____

5. List any environmental issues that can be caused by using this form of energy. _____

6. Why do we need to reduce energy consumption? _____

7. List 3 things you personally do in your home to be more energy efficient. _____

8. What is renewable energy? _____

9. Name 3 examples of renewable energy. _____

10. Whose responsibility is it to protect our planet's water and energy resources? Explain your answer.

Be Energy Efficient - Reflections

What have learned from this unit of work?

What more would you like to learn?

Which activities did you enjoy most? Why?

Do you think it is important to study this topic at school? Explain your answer.

