Energy-efficient Schools

A guide for trustees, principals, teachers, students, caretakers, and energy managers

- ☑ Use the energy mapping and action plan templates
- ☑ Model energy efficiency practices
- ☑ More funding for teaching resources through lower energy cost

EECA
Energy Efficiency and Conservation Authority
Te Tari Tiaki Pūngao

NERI
National Energy Research Institute

The Enviroschools Foundation
empowered students...sustainable communities

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An energy-efficiency checklist

"What is the point of having a nice school without a decent planet to put it on?"

Adapted from **Henry Thoreau**

What is my school doing around energy efficiency?		
We know what our total energy costs are	✓	×
We have the best supply contract in terms of price and carbon footprint	✓	×
We know how we compare to other schools	✓	×
We have conducted an energy audit recently	✓	×
We have an energy efficiency policy	✓	×
We monitor energy use	✓	×
We have an energy efficiency plan	✓	×
We model good energy-efficiency practices to students and parents	✓	×

Using this booklet

This booklet outlines why and how schools can reduce energy use and cost.

Why schools are considering energy efficiency is summarised in the introduction; how they are going about it is detailed in four case studies.

There are three planning templates and a schedule to assist schools. Those schools that have built energy efficiency into the curriculum have been especially successful in making change to their energy-use practices.

Cover photo: **Peter Smith. Lincoln High School students and staff gather information for an energy audit**

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Contents

> …controlling consumption is critical.

We live in a time of rapidly changing national and international energy contexts. World energy use depends heavily on non-renewable energy sources – fossil fuels. As well as being non-renewable, fossil fuels degrade the environment.

There are widespread efforts to move to renewable energy sources such as hydro, geothermal, nuclear, biofuels, wind, marine, and solar. Approximately 70% of New Zealand's electricity use comes from renewable sources. Non-electricity energy use, e.g. transport, some heating, is largely based on fossil fuel use.

The conclusion that many people are reaching is that, while meeting the challenges of renewable energy is important, controlling consumption is critical. This requires people to adopt energy-efficiency practices.

What is energy efficiency?

Energy refers to "power obtained from physical or chemical resources to provide light and heat or to work machines" (OED, 2006). It includes electricity and fuels for vehicles, boilers, and other machinery.

Energy efficiency "means a change to energy use that results in an increase in net benefits per unit of energy" (Energy Efficiency and Conservation Act 2000).

Why is energy efficiency important for schools?

> Parents, teachers, and students increasingly want their school to model sustainable practices.

The USA Department of Energy research estimates that USA schools waste one third of their energy consumption, and that the most energy-inefficient schools use four times the energy of the most energy-efficient schools.

In New Zealand, there are high incentives for schools to reduce their energy consumption. Parents, teachers, and students increasingly want their school to model sustainable practices. Energy-efficient practices are part of this modelling and many schools are building it into their curriculum. The new curriculum could make this easier to do with the inclusion of the theme of sustainability.

Currently, heat, light, and water funding is individually assessed for each school and covered by the Ministry of Education to address their reasonable needs but government policy may change. Monitoring energy use and developing action plans to improve schools' energy efficiency will have real benefits for schools if they are able to fund teaching resources through energy efficiency.

This guide in a nutshell

This guides aims to assist schools to:

- improve energy efficiency
- move towards sustainability, and
- model good energy-efficiency practice.

There are four main chapters plus a resource chapter. The chapters go through a simple action-learning process designed to assist people in schools learn about the school's energy situation and then take action.

Chapter	Content
1. Identify the current situation Where are we now?	Knowing where your school's energy comes from and how you use it is a crucial first step to understanding what changes can be made.
2. Explore alternatives What have others done?	Seeing what others have done can give you ideas about your own possible actions. Some case studies are provided, and there may also be local schools that can assist you.
3. Take action What changes can we make?	This involves changes to technology and changes to practice. The templates assist energy managers to map their school's energy use and then to plan change.
4. Monitoring and sharing results How are we doing?	Monitoring will provide information on how successful you have been and what to plan for next. If schools share results, benchmarking can assist schools understand how they're doing in a national context.

Making change to a school's energy-efficiency practices may be coordinated by the principal, property manager, caretaker, or a teacher. However, successful schools tend to involve the whole school and involve students throughout the process.

Change to energy-efficiency practices will affect more than your school – through modelling good practice, it will affect New Zealand's future.

Overview

Energy conservation is a critical issue affecting everyone, including schools. Government policy initiatives and evolving society awareness are changing energy-use patterns. This change is driven by supply, financial, and environmental factors.

Supply

Over the next 10 – 20 years New Zealand will transition to higher cost sources of energy than what we have become used to. Also, the government has announced a policy to charge for carbon emissions, and this will further increase the cost of generating electricity using fossil fuels, as we do (in part) now.

Financial

Higher energy pricing appears to be inevitable. Funding of schools' heat, light, and water is regularly reviewed, and a longer-term policy of rewarding efficient energy management will be consistent with society's trends.

Environmental

Conservation of non-renewable resources is increasingly important to New Zealanders, and reducing greenhouse gas emissions is increasingly important to everyone on the planet. Schools have the opportunity to address these issues by building energy conservation into their educational programmes.

Controlling consumption is critical

Like all countries, New Zealand has increasing energy consumption and increasing energy costs. New Zealand also has low energy efficiency. As a nation, we face energy challenges, because:

- we have almost maximised our large hydro sources
- our supplies of cheap natural gas are running out and we will have to spend more if we want to develop new sources of natural gas
- we are a net importer of energy fuel, and
- we need to adopt behaviours and technologies that are consistent with a low emissions energy future.

These factors are already leading to higher energy costs. The government's Emissions Trading Scheme will further increase energy costs.

The 2007 National Energy Strategy sets a target to increase New Zealand's renewable electricity generation to 90% by 2025 (from a 2007 level of approximately 70%). This sets a real challenge for everyone, including schools. For the full strategy, see: www.med.govt.nz/upload/52164/nzes.pdf

'New Zealand uses energy less efficiently than other countries, which gives us scope for significant improvement' (New Zealand Energy Strategy to 2050, p. 21).

How is energy used in your school?

New Zealanders have been privileged to have had cheap energy. As a result, we have typically taken energy for granted and developed poor energy-conservation practices. Often we have little knowledge of how much energy we use.

An energy audit

An energy audit is a step towards changing this. It may be an across-the-school audit or it may focus on selected areas, and it may be conducted by staff and students or it may involve a professional energy expert. See: www.energywise.org.nz/es/directory/SearchDirectory.aspx.

Energy audits have two distinct parts:

- The technology, eg fixtures, fittings, types of energy used.
- How people use the energy in the school – the day-to-day energy practice.

Both are important enough to be in someone's job description.

- The technology could be part of the Property Manager's role.
- The day-to-day energy practice could be part of a staff member's role (and it could be performed by students).

Managing efficient energy use is an ongoing job and requires time to be done well.

An audit process

Students should be involved in the audit process as it is a significant learning opportunity.

1 A starting point could be to monitor how much energy your school uses. Consider all energy sources, eg electricity, gas, coal, firewood, solar, wind, and wood pellets for a calendar year in terms of amount of each fuel used and supply costs.

2 The next step may be measuring the energy use of specific electrical items. This can be as simple as determining the draw (wattage) and hours of use of each item (see the **Energy audit** template on page 15), or it can be more clinical and use an instrument to measure the actual running cost, eg Power-Mate (see ww.esis.com.au/Loggers-small/Power-Mate.htm).

To conduct an energy audit, it is helpful to understand some common energy-efficiency issues for each main energy-use area.

Lighting

Lighting may account for 80% of a school's electricity use if electric heating is not used.

Inefficient technologies

- **Incandescent lamps** (tungsten filament bulbs) use only a small percentage of their energy to generate light, the rest being lost to heat.
- **Not replacing fluorescent tubes** because they haven't failed. As they age, they produce less and less light using the same amount of electricity.
- **Lighting all spaces to the same level.** Recommended lighting levels are generally 240 lux. (Lux is a measure of light intensity – see Standard AS1680.2.3:1994 – currently being revised). Multiplying the recommended level by 1.25 allows for the effects of dirt and decline in lamp output over the life of the lamp. This lifts the level

Check that you buy low-energy lamps (not 'long life' bulbs or 'low voltage' light fittings as they won't save energy).

Photo: Monique Zwaan, with permission

Natural lighting from the building design assists energy efficiency at Albany Junior High School

Photo: Pip Lynch

to 300 lux. Lighting should be higher than 300 lux in spaces such as workshops with detailed bench or machine work, laboratories and music, reading, and computer rooms, and lower than 300 lux in corridors and stairways, assembly halls, audio-visual rooms, and social areas. Overlighting may take the form of:

  - higher-wattage lamps than are required
  - twin fluorescent lamp systems when one is sufficient, or
  - wiring that doesn't enable staff and students to turn off banks of lights parallel to windows or in part of a room that is not being used.

- **Poor lighting** is not always due to low energy use. It may be due to:
  - opal diffusers which soften the intensity of light but discolour with age
  - dirty fixtures and lamps (light levels on working surfaces can drop by over 50% and research estimates that annual cleaning can reduce lighting costs by 15%)
  - dirty windows, or
  - vegetation or verandas shading windows.

Efficient technologies

- **Compact fluorescent lamps** (CFL) use approximately 20% of the wattage of traditional incandescent light bulbs for the same lighting level. They have a lifetime of 8,000–12,000 hours, whereas incandescent bulbs typically last less than 1,000 hours.
- **NG (New Generation) tri-phosphor light tubes** – 26 mm diameter tubes use 8–10% less energy than 38 mm diameter tubes.
- **Installing dimmer switches** provides flexibility and reduces the power draw, especially in rooms with good natural daylight. There are new compact fluorescent and standard fluorescent (electronic ballast) lamps that will allow dimming.
- **Installing occupancy movement sensors** which automatically turn lights off when no movement has been detected after a set time.
- **Wiring** rooms so that only areas being used are lit.

Heating

Typically, the two main heating concerns for schools are the boiler and the swimming pool. Many schools are heated with a coal boiler, which often requires considerable labour and a discharge permit. For many schools, heating the swimming pool may account for as much as 50% of the school's energy use.

Inefficient technologies

- **Incomplete combustion** in the boiler due to age and settings. High flue temperatures, visible smoke from the stack, problems firing the boiler, and variable classroom temperatures may indicate that a tune-up is necessary.
- **Coal and oil-fired boilers** are significant polluters. EECA offers a 'Sustainable heating' programme which provides funding for boiler conversion to sustainable bioenergy, eg wood pellets. For more information, see: www.eeca.govt.nz/renewable-energy/ bioenergy/school-heating.html
- **Pipes** from the boiler to each classroom aren't insulated well if the lagging is warm to touch. This may be another reason why classrooms aren't at the same temperature throughout the school.
- **Radiator heaters** in classrooms may be the wrong size for the room or their thermostats may be set incorrectly.
- **Poorly insulated rooms** require nearly twice the heating of well-insulated rooms. Almost half the heat loss from a room is through the ceiling. Insulation can deteriorate over time and, if it's possible to inspect classroom ceiling cavities, this is worth doing.
- **Electric heating of the swimming pool** is an expensive option.
- **Continuous pool filtering.** In many parts of New Zealand, filters run during winter to prevent frost damage. Sometimes they run 24 hours a day.

Replace fluorescent lamps (and their starters) as a group after 16,000–20,000 hours of running time. Use energy-efficient, tri-phosphor colour 84 lamps and buy 15% extra as replacements. To maximise the efficient use of energy, clean light fittings when you replace lamps.

Fluorescent lamps contain minute amounts of mercury. Recycle them to ensure that the mercury is collected safely. Some councils provide a hazardous waste collection – the HazMobile. There is also a company that offers a collection and recycling service for which there is a charge (for more information, see: www.interwaste.co.nz).

Switches controlling sets of lights within a classroom at Opoho School

Photo: Pip Lynch

Photo: Pip Lynch

The temperature control system on a school boiler should be adjusted to provide only the heating that is needed

Photo: EECA

Wood pellets igniting

Efficient technologies

- **Boilers will often run more efficiently** when the air dampers and fuel feed rates are adjusted. This requires expertise and a flue gas analyser. For advice, see:www.energywise.org.nz/es/directory/SearchDirectory.aspx
- **Converting boilers** to use renewable fuel such as wood pellets or wood chips.
- **Pre-moulded insulation** makes a significant difference, although it may be hard to insulate all piping and valves:
  - foam-rubber sleeves (after fitting the sleeve around the pipe, a better seal is achieved when the slit is glued together), and
  - snap-on, insulating valve covers.
- **Room insulation** measures include:
  - installing automatic door closures, particularly on exterior doors
  - reducing drafts by attaching weather seals around doors and windows, and brush strips on the bottom of doors
  - replacing louvre windows with standard sheet-glass windows (because louvre windows don't close tightly)
  - placing fibreglass batts, polystyrene, or wool insulation in the ceiling cavity
  - placing fibreglass batts, polystyrene or wool insulation in the walls when you renovate, and
  - placing foil or polystyrene insulation under the floor if it's accessible.
- **Solar heating** of pools is one option and the technology is increasingly cost-effective. See www.schoolgen.co.nz/awareness.aspx
- **Pool covers** minimise evaporation and reduce energy use by as much as 50–70%. Most school pools have covers and roller systems.
- **Consider installing a timer on the pool filter pump** to ensure that no more energy is used than is necessary.

Equipment

Equipment and appliances typically account for approximately 20% of a school's energy use. Much of this energy use occurs when the equipment is not in use (in standby mode). Standby loads look small but because they are running continuously they can amount to a large energy use. This can be measured by reviewing your power bills and checking off-peak energy use, and by using an electronic power usage tool, eg www.esis.com.au/Loggers-small/Power-Mate.htm. For typical energy use, see table below.

Photo: Opoho School

Energy Star

Appliances vary in their energy efficiency. **Energy Star** is the global mark of energy efficiency, eg it's claimed that Energy Star photocopiers can use 40% less energy than standard photocopiers.

ENERGY STAR

Equipment energy use

Item	Typical energy use (watts)	
	In use	**In standby mode**
Desktop computer (not counting the monitor)	40	3
Laptop	45	3
Server (no monitor)	80	Never sleeps
Monitor (CRT)	65	2–10
Monitor (LCD)	25	3
Printer	100	5
Fax	40	5
Fridge[1]	800	The motor turns on and off to maintain temperature
Microwave	600–1500	5
Water boilers and coffee machines[1]	750	100
Dishwasher	2,000	5
Photocopier[1]	400–1500	25
Projector	300–350	5
Hand dryers	400	0

[1] Size is a large variable.

Note: It's important to store water at sufficient temperature to destroy legionella bacteria.

Hot water

Inefficient technologies

- **Storing hot water** ready for possible use, even in weekends and holidays, is inefficient in some cases.
- **Poor insulation of old hot-water cylinders:** if the cylinder is warmer than the ambient temperature to touch, the insulation is inadequate.
- **High-flow showers** often use considerable water. EECA suggests that if you can fill a two-litre container in less than 10 seconds, then the flow rate is excessive.
- **Hot-water leaks,** eg dripping taps and shower heads. The wastage may not seem great but it adds up over 24 hours, seven days a week.

Efficient technologies

- **Instantaneous water heaters** which heat water only when required may be more efficient than a hot-water cylinder, although demand is a major factor. Depending on demand, it may also be more efficient to turn the heating off during the holidays.
- **Well-fitted insulation wraps** around hot-water cylinders work best when the joins are taped together and the pipes from the cylinder are lagged.
- **Water-conservation measures for showers** include using low-flow showerheads, fitting washers in existing heads, and installing timers.

Transport

Most transport involves non-renewable fuel and is a major source of carbon emissions. This includes transport during school hours and transport that students and staff use to commute to and from school. In Auckland, studies have revealed that 40% of all car traffic is school related.

Energy audit template

To become more energy efficient, it is important to know how energy is currently being used. This template assists schools to determine their energy use and type. It will provide the base information for improving both energy efficiency and energy sustainability. Ideally, students use the template as part of their learning.

Improving energy efficiency is a gradual process. Once you have identified what energy you use and where, making change may be best done by choosing two or three priority areas. Getting started is the key.

For further energy audit information, see: www.eecabusiness.govt.nz/emprove/emprove-library/implementation/conduct-an-audit/guide/energy-audit-manual-07.pdf

See also: www.contactenergy.co.nz/web/view?page=/contentiw/pages/shared/energychallengerintro&vert=fb

Energy use	Detail	How many	Load	Time on	Use	Energy source	Renewable energy
			Watts	Hours per day	kW per day	Fuel type	Y/N/Mixed
Lighting	Low-energy lamps High-energy lamps						
	Lighting organisation Good ☐ Could be improved ☐ Poor ☐						
Heating	Boiler / radiators Coal stoves Gas heaters Electric heaters Air conditioning Swimming pool						
Equipment	Computers Printers Photocopiers Projectors Whiteboards Faxes TVs Video recorders Speakers Lawn mowers Power tools Pool filter pump Fridges Dishwashers Microwaves						
Hot water	Storage cylinders Kitchen instant Kitchen jugs Coffee machines						
Transport	Vans Buses Staff who car pool, walk, bike, bus, or train Students who car pool, walk, bike, bus, or train						
Energy monitor:				**Date:**			

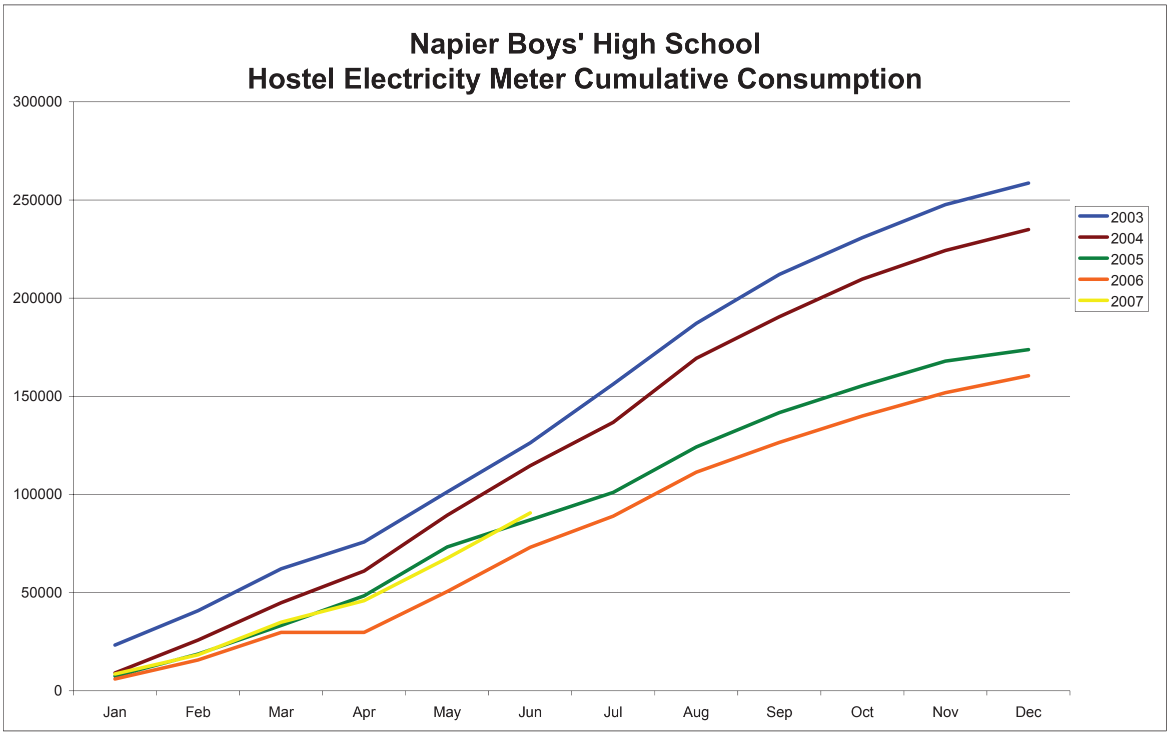
Napier Boys High School

> "…the school contracted an energy-consulting company to conduct an energy audit."

Photo: Napier Boys High School

Napier Boys has a hostel, making a systematic approach to energy efficiency all the more rewarding. The figures below relate to the school and hostel combined.

In 2003, the school contracted an energy-consulting company to conduct an energy audit. The company then guided their energy-efficiency programme. The school's 2003 total energy use was 66 kWh/m^2 or 546 kWh per student. By 2006, this was reduced to 37 kWh/m^2 or 330 kWh per student.



How did they do it?

Following the energy audit, Napier Boys' main initiatives were:

- Assigning formal responsibility for energy management to the Property Manager.
- Implementing an energy-efficiency policy and culture.
- Installing an energy automation system to control lighting and heating, which included optimising the boiler-heating load.
- Adding insulation to ceiling cavities in particular.
- Enabling standby mode where possible in electrical equipment, eg computer monitors.
- Logging all new electrical equipment that came on site.
- Standardising all lights (converting 270 incandescents to CFLs inside and six metal halide floods to 250W sodiums outside).
- Monitoring monthly energy invoices.

Northcote College

Auckland

Northcote College is a co-educational secondary school with a roll of 1300-1400. Most of the current buildings were constructed in the 1950s and 1960s. These include single-storey classroom blocks, Nelson style double-storey buildings, some prefabs, and new technology and science blocks. There are two gymnasiums, a 25 m swimming pool, and a hall. Community education programmes use the buildings out of school hours and swimming clubs make extensive use of the pool.

Heating is through a mix of a coal-fired boiler, electricity, heat pumps, and gas. Lighting is almost exclusively fluorescent. The school has installed 12 photovoltaic panels through the SchoolGen project.

Given the complexity of the facility – the range of building ages and materials, and the long history of modifications – becoming more energy efficient wasn't a simple task. Many people might justify postponing action, but not so at Northcote. The school has addressed a range of energy conservation and efficiency issues, originally spearheaded by the Property Manager, Fredrieke Cannan. More recently, the schools environmental group, Cocoon, has focussed on energy sustainability.

Northcote is an Enviroschool, with an active group of students and teachers working towards the school becoming more sustainable. The school has worked to become energy efficient in five ways.

“The school has installed 12 photovoltaic panels through the SchoolGen project.”

1. Bring in the 'professionals'

In 2003 the Board of Trustees agreed to enlist the support of professionals and undertake an energy audit. This was supported by the Energy Efficiency and Conservation Authority (EECA).

The auditors used data loggers, analysed accounts, and completed a thorough site survey. A reasonable target for secondary schools in 2003 was about 40 kWh for every building square metre. The school was above this at 52.34 kWh / m^2 but when the gas use was included (primarily pool heating) this increased to 102.6 kWh / m^2. Gas use in 2003 was over 800,000 kWh – more than half the total energy used in the school.

The key recommendations were as follows.

Install new pool covers

The pool covers were old, ineffective insulators, and often not used due to difficulties in rolling them out. Given that the pool is housed in a large marquee-type cover, it gains little insulation from the building, and heat retention is largely provided by the pool covers.

The process followed was to:

- Build a case using the data that had been gathered.
- Gain approval to spend the money.
- Consult with all pool users as to their needs and systems that they would use, that is, teachers, swimming clubs, and other pool users such as a kayak group. (A pool cover is only any good if it is used).
- Find the best product to suit the situation.

The pool covers were replaced in 2004, reducing gas use by 40% – a saving of about $20,000 (in 2007 dollars).

Upgrade fluorescent lighting

Lighting accounts for about 40% of the electricity used.

Fluorescent lighting is generally considered to be the most efficient, but it does require maintenance. A large number of rooms had old 38 mm fluorescent tubes. Their light output had dropped, and metering showed that light levels in a number of rooms were between 100 and 200 lux. Light output was further reduced by opal diffusers – the covers that soften the intensity of the light. Some were discoloured and others had dust and insects trapped inside.

Some classrooms had lights above the whiteboards, which had originally been in place for use with blackboards. Some light fittings had two 58 W lamps in each fitting when only one was needed.

A bulk replacement policy was recommended. Group replacement takes place every 13,000 hours of running time. This is measured by purchasing 15% more lamps than are required and using the additional lamps for replacements. When the additional lamps are used, it's time to replace the whole lot again. The starters are replaced at the same time.

What the school did

The school:

- Gained agreement to replace lamps in bulk.
- Removed the lights above the whiteboards.
- Removed lamps from some fittings.
- Replaced 100 W lamps in some fixtures with 75 W lamps.
- Worked with staff to ensure that natural lighting was maximised, including trimming plants by windows.

Lighting energy use has greatly reduced. It's difficult to quantify the reduction as metering doesn't isolate lights. However, the school's total electricity use between 2002 and 2006 didn't increase despite an increase in buildings and electrical appliances. There is no doubt that the re-lamping contributed to this. At the same time, classroom lighting improved.

Heating review

While the coal-fired boiler supplied much of the school, its effectiveness was variable. Rooms close to the boiler were well heated or over heated, while those far from the boiler tended to be under heated. The reliance on non-renewable fossil fuels, although cheap, was an issue.

As the roll has grown and buildings added, other heating options have been used: a small gas-fired boiler, relatively efficient radiant heaters, and a range of plug-in heaters. Some rooms were due for remodelling and efficient heating was recommended for these.

What the school did

The school:

- Checked pipe lagging and found it to be sufficient.
- Disconnected distant classrooms from the boiler and installed electric heat pumps in them. They also had their ceiling insulation improved, reducing the need for heat input in winter and helping to keep the rooms cool in summer.
- Installed heat pumps in rooms when building remodelling took place. Heat pumps have increased comfort in both winter and summer. Heating and cooling are available and they are regulated within limits. This has increased the electrical load, which is generated from both renewable and non-renewable sources, but decreased a small load from a non-renewable source.
- Discouraged the use of small plug-in type heaters.
- Started to explore other options to replace the boiler's use of coal – see Coal-fired boiler conversion (EECA trial) on page 22.

Metering review

Northcote found that it was worth addressing the metering. There are various aspects to consider:

- Are there meters for electricity, gas, or both?
- Who owns the meters? It may be the school or the energy supplier.
- How accurate are they? Typically old meters run slow as bearings wear. This is not an issue with new electronic meters.
- How many meters are there? There may be too many and, if each has a line charge, can you remove some? The school had six gas meters and only one had any significant use. Those not in use were disconnected.

Appliances review

The trend to use more electronic tools in schools continues, particularly with data projectors, smart boards, and increasing numbers of computers in classrooms. This shift in technology is likely to continue.

What the school did

A check was made of all plug-in heaters. The school banned their use where other heating is provided. Installing heat pumps to a number of rooms has alleviated the need to use less efficient forms of heating.

CRT computer monitors are being replaced with LCD monitors. The flat screen monitors use one third of the electricity that CRT monitors use, resulting in decreased electricity use despite there being more computers in the school.

Students examined how efficiently appliances were used as part of their audit process. They are aware of the opportunity for saving energy (see **Student audit** on page 20).

2. Ongoing building plan

Like many schools, Northcote has continued to upgrade its buildings. New science labs and a new technology block were opened in 2005. In the science block, gas underfloor heating was installed and external window filters were included to reduce glare but allow natural lighting.

There are plans to upgrade the hall and the gymnasium and these will include energy-efficiency elements. There are also plans to investigate the use of passive solar heating.

Despite the increase in the number of buildings, there has been no overall increase in the consumption of electricity.

3. Renewable power generation on site

Photo: Monique Zwaan

Roof-mounted photovoltaic panels

Northcote was keen to take part in the SchoolGen project as it offered the school the opportunity to generate some of its own electricity with photovoltaic panels, and for students to learn first hand about solar generation. The 12 panels generate 2 kW in full sun, enough to run about 20 computers with LCD screens.

This has led to greater student awareness of renewable energy and has helped motivate a group of students to examine energy use. Their aim was to determine how much the school could reduce its dependence on non-renewable energy sources.

4. Student audit

Student interest through the environment group Cocoon was raised with projects like the SchoolGen project. The opportunity for students to run a workshop at the Enviroschools Youth Jam for secondary schools was an added incentive for students to focus their work.

This led to an interest in carrying out further audits as they had observed that improvements could be made through behavioural change. Students realised that by using energy more efficiently within the school, they could save at least as much energy as that generated by the solar panels. Saving energy sometimes costs nothing, yet derives benefits that may be environmental as well as financial.

To plan for reduced usage, the students decided that they needed to find out first what current patterns of use were. The following approaches were used:

- Gauging trends of current use.
- Meeting with the Principal and the Property Manager to gain information.
- An ‘Open all doors’ walk through audit to determine areas of unnecessary waste.
- A student campaign.
- A staff survey.

This research has led to the development of an action plan which will be implemented across the school and is anticipated to save 15% of electrical load.

The student time taken in this work is estimated to be about 100 hours and has been undertaken by two students as a voluntary exercise. With the introduction of NCEA Level 2 standards in Education for Sustainability, students can carry out this work in future as part of the curriculum. This 24-credit course can be taken as a full-year course, or individual achievement standards can be introduced across curriculum areas.

Gauging trends of current use

About 30 students filled out a tally sheet during each class of the day for a week. They noted where energy was being used unnecessarily, eg lights on but daylight bright enough, projectors on and not used, and heating on and doors open.

The three areas identified for change were:

- Lights on in the afternoon. These were usually not needed.
- Heaters on and doors or windows open.
- Inefficient use of blinds (minimising natural lighting).

The students also identified that classrooms are led by busy teachers. While staff could delegate or share responsibility for reducing inefficient energy use, this needs to become part of a school direction. Students were unlikely to initiate change independently.

Meeting with the Principal and the Property Manager

Two students met with the Principal for permission to develop their energy audit. They invited the Property Manager to address Cocoon, their environmental group, to share her knowledge of the school's energy history.

This led to students undertaking a walk-through audit during the school holidays.

`Open all doors' walk-through audit

A walk-through audit serves the purpose of quantifying where the energy use is taking place. It can uncover 'hidden treasure'. For example, in another school a hot-water cylinder with a failed thermostat was near boiling point and locked in a cupboard unused for years. Not only was there no way of accessing the cylinder, it was a safety issue.

The students' goal was to identify:

- What items could be turned off as part of a holiday shut-down process.
- Where were these items?
- Were there some real 'energy crimes'?

Their audit revealed 289 items left on unnecessarily, eg a class of computer monitors, two empty fridges, and a number of photocopiers. While this number seems high, it amounts to only two or three items for each staff member and, when spread around the school, it doesn't attract attention.

What they learnt

- Most items left on were in 'teacher spaces' such as offices. Many staff come in during the holidays to work.
- Many items could easily be turned off.
- About a third couldn't easily be turned off, eg power switches for fridges were difficult to reach.

The next step

They realised that they needed to change their initial focus from students to staff. They had planned to raise awareness about energy use among their peers. However, their findings made them realise that they needed to engage the staff first.

The challenge was to tell staff that they were wasting energy and encourage them to change. The students arrived at the following solutions:

- Present initial findings to staff at a meeting without any judgment or suggestions.
- Canvass staff for their opinions through a survey.
- Invite staff to a follow-up meeting for detailed presentation to work with the willing and interested.

> "Their finding revealed 289 items left on unnecessarily"

> "…they needed to change their initial focus from students to staff."

> "The challenge was to tell staff that they were wasting energy and encourage them to change"

Staff survey

A detailed survey was given to all staff. The purpose was to find out how staff perceived environmental issues, what their priorities were, and how much they were prepared to implement change.

The findings were encouraging. Most staff were taking action and could be described as 'willing, but not yet fully active' participants for change. Fifteen came to the full presentation on the energy findings. This forms the basis for real change – where those who will be most affected can shape its process.

The students have now set a target to reduce energy use by 15% in the coming year. This can be measured by kWh / student data.

5. Coal-fired boiler conversion (EECA trial)

With greater knowledge about CO_2 emissions, climate change, and the effects of particulate matter on air pollution, the school questioned the wisdom of continuing to use coal-fired boilers, even when coal remains a cheaper source of fuel. However, if a school decides to replace their coal boiler, they have to decide what with.

Northcote is addressing this important question and has applied to be one of the schools in an EECA trial. The trial is exploring whether it's best to convert the boiler to use wood pellets or gas, or to change to another source altogether.

Summary

Northcote College has faced situations that many secondary schools face and was determined to address them.

The benefits to the school have been:

- A reduction in the consumption of gas by 30–40%.
- A steady state use of electricity consumption over the last five years despite:
  - introducing electrical heating to nine classrooms in the form of heat pumps
  - increasing the electrical load through acquiring more data projectors and computers
  - an overall improvement in the quality of lighting, and
  - constructing two moderate-size buildings.

The school has explored opportunities to teach students about renewable energy by participating in the SchoolGen project. It's keen to investigate passive solar heating. Through voluntary actions driven by students, the school is ready to implement a plan to reduce electricity consumption by 15%.

Forbury Primary School

Dunedin

Forbury is a primary school with a roll of approximately 100 students. The school hall was constructed in 1891, the swimming pool in 1929, and the main block in 1931. The main block and hall are wooden structures; the pool is housed in a concrete block building, which includes changing rooms.

The school is serviced by mains electricity (including the swimming pool) and, until recently, a coal-fired boiler. The school doesn't have a caretaker, so the cleaner shovelled the coal and cleaned out the ashes at night and the Principal oversaw the running of the boiler in general and cleared the ash each morning.

Students from the University of Otago conducted a Level One Energy Audit in accordance with AS/NZS 3598:2000 as part of an energy management course (EMAN 405).

Energy use

There were difficulties with a complex metering arrangement for electricity supply, irregular meter reading, and inadvertent overcharging by the electricity retailer. The school is locked into an electricity pricing schedule determined by the way the premises have been wired: pool heating is charged at a fixed cost of over $4/day throughout the year; the main block and hall are charged at lower rates. Changing the wiring has been considered but found too expensive. The figures below are estimates for the period November 2005–November 2006.

Electricity use

	Electricity use (kWh)	% of total electricity use
Pool	21,340	47
Main block	20,057	44
Hall	4,376	10
Total electricity use	**45,773**	

Coal use

The boiler consumed the equivalent of 161,352 kWh worth of coal, or 80% of total energy use. Because coal is cheaper than electricity, this was 33% of the school's total energy cost. However, the audit noted that "…the financial cost to the school for the coal does not include the cost of such externalities such as coal-smoke-related asthma attacks in students, damage to [staff] future health caused by exposure to coal-dust, and environmental pollution…." The audit recommended that a future energy audit should include the costs of externalities of the current heating system and alternatives such as wood-fired pellet boilers, heat pumps, and gas-fired heating systems.

Energy Performance Indicators (EPIs)

The energy audit used only heated spaces to calculate the EPI (that is, areas such as stairways and storage areas were excluded). The figures below are for the year November 2005–November 2006.

Energy use

	Electricity use kWh/m^2 per year	Fossil fuels kWh/m^2 per year
Pool	95	
Main block	34	254
Hall	17	

This data compares poorly with the comparable UK figures listed below.

UK BRECSU, 1996	Electricity use kWh/m^2 per year	Fossil fuels kWh/m^2 per year
Typical primary school	28	173
Good practice primary school	20	126

It seems reasonable to expect that greater efficiencies are possible for Forbury, and potentially many other New Zealand schools.

Large energy-users

“The pool is the single largest electricity consumer despite being turned on for only six weeks of the year.”

Swimming pool

The pool is the single largest electricity consumer despite being turned on for only six weeks of the year. It is used by one other school.

The energy audit recommended that a future energy audit should:

- Measure the performance of the current pool heating and circulation systems.
- Assess the option of alternative systems, including a heat pump and solar heating.
- Assess the level of insulation in the pool building.

Boiler

Two electric pumps move water from the boiler to radiators throughout the school.

The boiler was repaired in 2007. Before the repairs, rooms at the far end of the radiator loop were colder and required supplementary electrical heating: a heat pump was installed in the junior's room. (The boiler continued to be faulty and in Term 3 2007 new leaks directly into the firebox sealed its fate. It has now been decommissioned).

The audit recommended that a future audit should conduct a flue gas analysis and evaluate the existing radiator network to estimate the required heating load.

Lighting

Most lighting is natural. There are fluorescent tubes in most classrooms, but some were very old.

Summary

Otago University's energy audit of Forbury School recommended that:

- Schools need on-going expert advice on energy-management issues.
- Forbury School should commission a study to look at:
  - alternative heating sources to the coal boiler and investigate possible funding from the Ministry of Education and EECA
  - the level and state of insulation in the school buildings.
- The school should seek funding for a cheaper pool-heating system.
- The school should ask their electricity retailer to address the issue of irregular meter readings and, if the outcome is unsatisfactory, switch to another retailer.
- A follow-up energy audit should be conducted in two years' time.

Since the audit, the school's Board of Trustees took advice from a consulting engineer and as a consequence decided to replace the coal-fired boiler with a gas boiler. Two of the factors taken into account in this decision were the Ministry of Education's funding of the cost of the gas and the fact that a gas line runs right past the school.

Wallacetown Primary School

Invercargill

Wallacetown Primary is a small rural school 12 kms from Invercargill with a roll of 42. The school was built in 1963 and by 1976 consisted of classrooms, a library, an administration and staff room, a covered swimming pool, and a waste water treatment plant for sewage treatment. The school buildings are wooden and are heated with a coal-fired boiler system. Pool heating was introduced in 2000–2001.

In 1999/2000 Peter Anderson, a school parent, undertook an energy audit as part of a Diploma in Energy Management course. This gave the school a snapshot of its energy use, which is outlined below. This case study also outlines what decisions have been made since and how energy is being used more efficiently within the school.

Energy use

Energy	1998/1999 (12 month period)	2006 (12 month period)
Electricity	41,184 kWh	35,745 kWh
Pool heat pump	No heating	5,232 kWh
Lines fixed and metering	50 kVA	30 kVA
Coal	9 tonnes	Approximately 3.5 tonnes

The overall energy use in the school has dropped over this time despite a steady roll and the introduction of a pool heat pump. Metering indicated that half the electrical load in the school was from operating the waste-water treatment plant. (A three-phase 4.0 kW compressor aerates the sewage before it's processed through a UV stabiliser running on a 0.5 kW single phase pump with a 50 W UV light).

> "We would use no more power if we had 100 students"

The school runs four classrooms for 42 students, plus a library and administration area. The Principal, Trevor Witt, commented: "We would use no more power if we had 100 students."

Steps taken to achieve this

1. Tariff analysis

A review of the tariff structure can identify whether or not the school is being charged the best price for its energy, whether the supply to the school is appropriate, and whether the size of supply is the best fit.

What the school found

The audit revealed that the overall cost of the electricity to the school could be reduced by 36% through tariff changes. These no-cost changes included:

- Being correctly billed.
- Changing the metering to 'time-of-use' metering.
- Meeting off-peak rating requirements by using low-tariff energy (night rates) where possible.
- Implementing direct debit payments.
- Reducing the kVA rating from 50 kVA to 30 kVA following a careful analysis of the current load profile and future anticipated load.
- Ensuring that controlled energy wasn't being charged at uncontrolled energy rates.

Note: Time-of-use meter is only financially beneficial if your electricity supplier offers a multi-rate tariff (where electricity price varies depending on time of day).

> "…the overall cost of the electricity to the school could be reduced by 36% through tariff changes."

2. Lighting

The lighting systems installed throughout the facility were mainly incandescent lamps, with most classrooms having four 200 W lamps. There were some fluorescent tubes and security lighting. Lighting accounted for about 20% of the total electricity use or 40% if waste-water treatment was excluded.

What the school did

The school initially replaced the incandescent lights with T5 technology fluorescent lighting throughout the classes and some office areas. However, despite lighting calculations indicating that this was the best solution, staff and students found that there was insufficient light at desk height. The school subsequently changed the light fitting to fluorescent tubes in classrooms. The overall lighting has now improved while using less electricity.

3. Hot water system

The school had seven hot water cylinders heated on controlled load. Three cylinders were found to be on although only one was needed.

What the school did

They turned off the two cylinders not in use and switched the main cylinder in use to ripple time use. Initially this did not provide sufficient hot water at times required, so the temperature was increased slightly and the cylinder insulated with a cylinder wrap.

4. Swimming pool

The 4 m x 20 m swimming pool is housed in a purpose-built building. However, the distribution board was installed in the same room as the chemical treatment and was corroded. It wasn't clear whether or not the circulation pump needed to operate continuously. There was no pool heating, limiting use of the pool season.

What the school did

Repairs to the switchboard were undertaken with all terminations being remade and corroded terminals cleaned up.

The school had decided to install heating, and chose an electrical heat pump which required the circulation pump to operate at night. Adding a heat pump could have affected the decision to change the overall supply from 50 kVA to 30 kVA, but load profiling indicated that this wouldn't be an issue. This has been confirmed to be the case and the pool season has been extended.

5. Waste-water treatment

The school operates a waste-water treatment plant to process its sewage.

What the school did

The school maintains a detailed operating document for the operation of waste-water treatment equipment. Detailed analysis of possible opportunities revealed that no opportunities existed to reduce energy through options like reducing hours of use.

Testing shows that the quality of water leaving the treatment plant is high.

6. Heating

A single coal-fired boiler supplied radiators in almost every room. This had a timer but no thermostatic control. This meant that the boiler had to be manually shut down when a classroom became too hot. There were possible opportunities to reduce demand or install efficient technology.

What the school did

A temperature controller was installed and coal use has halved.

7. Raise energy awareness

How people behave can have a significant effect on how electricity is used.

What the school did

Staff and students were reasonably aware of the need to reduce drafts and keep doors closed. All external doors had automatic closers fitted. The audit raised awareness about the energy supply to the facility and its use.

The school has the resource kit 'Energy Action' prepared by Negawatt Resources and available to staff following professional development. It's used every second year as part of the senior students' energy studies.

Overview

Energy efficiency is a broad issue that needs to be tackled on many fronts. It's not a task that you can tick off and put aside. It requires a change of attitude, planning small steps, and taking action.

EECA recommends six steps that schools may be able to adapt for their situations:

1 Build the team.
2 Know what staff think.
3 Planning.
4 Implementation.
5 Review.
6 Maintenance.

For more information on these steps, see www.eecabusiness.govt.nz/emprove/implementation/staff-awareness-and-motivation-kit/index.htm

Action involves changing the technologies that the school is using and changing peoples' practices and behaviours.

Regarding the technical aspects, the following order is recommended:

1 Avoid wasting energy.
2 Use energy more efficiently.
3 Use energy from renewable sources.

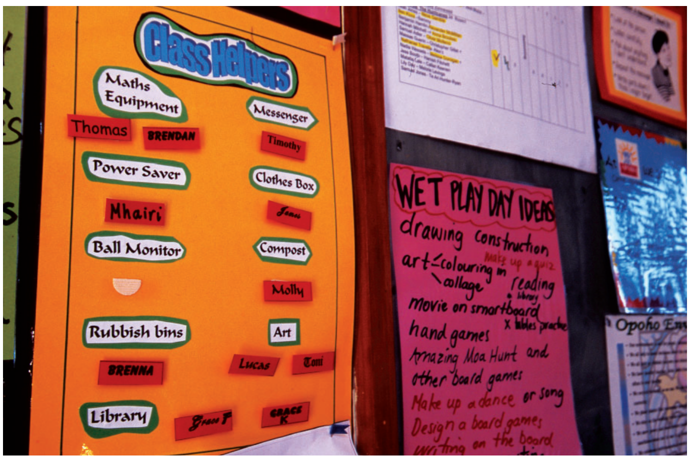
1. Avoid wasting energy

Energy efficiency begins with simple 'housekeeping' measures' such as:

- **Not lighting and heating unused spaces.** Leaving lights on to save money is myth. Even fluorescent lights should be turned off when they are not required for 10 minutes or more. Research suggests that this can save 8–20% of lighting costs. For more information, see www.facilitiesnet.com/MS/Aug03/aug03lighting.shtml
- **Clear labelling of switches** to make it easy to light a specific area of a room.
- **Closing doors and windows** to retain heat. However, it's important to provide adequate ventilation to limit CO_2 levels in classrooms.
- **Developing a school culture of energy efficiency** is important, but a backup is to appoint energy monitors who carry out set tasks on a daily basis and report back on everyone's performance.
- **Daily use of a pool cover** is probably the single greatest energy-management technique for pools. Pool covers may be left off when the pool is not in use, including by outside groups using the pool. Energy-efficiency gains may be made by reviewing the school's policy on using the cover, eg:
  - Is the pool covered after each session, at the end of the last session, or at the end of the day?

In this classroom one student has responsibility for monitoring power use

Photo: Pip Lynch



- What is the policy when the pool is used out of school hours and is this policy being implemented?
- **Turning equipment off when it isn't in use,** eg the computer monitor typically uses 67% of the total energy used by the computer system. Reviewing your power bills to see how much off-peak energy you use will give some indication of the standby usage. Check that everyone is aware that screen savers don't save energy. Equipment may be turned off during the summer break, eg fridges may be emptied and switched off.

Photo: Paul Cottam, Christchurch City Council

A walking school bus in Christchurch

Walking to school

If it's possible, walking to school has considerable benefits.

Many schools have walking school buses. They are under the care of a 'driver', usually a parent, and are both an energy saver and a way to get children to and from school safely.

Five to eight-year-olds are most likely to use a school walking bus. By walking regularly on the bus, children learn the road safety skills that they need to be able to walk independently.

Older students may be encouraged to use the bus by giving them responsibilities, eg watching out for cars entering or leaving driveways or looking after younger children. Some schools support older children to do this by rewarding them with house points, certificates, or stickers.

Walking school buses may be set up by a parent, teacher, principal, school board trustee, the local road safety coordinator, or students. This person or persons is key to coordinating the programme and gaining community support.

Land Transport New Zealand promotes a range of walking-to-school programmes. For further information, see www.landtransport.govt.nz/travel/school/walk-to-school/index.html

What caregivers say

'Socially, it's great. My children have formed some good friendships because of the walking school bus. The adults get to know each other better too.'

'The more families involved the better. If you have five-plus families in your group, there's more flexibility with the roster.'

From: www.landtransport.govt.nz/

Switch off at the wall
Most modern appliances have a standby load. This is the energy consumed to keep electrical items ready, even when the switch on the item is switched off.

To eliminate a standby load, an appliance must be switched off or unplugged at the wall.

Car pooling

Car pooling by parents can make significant energy savings. It may be initiated by the school and operated by parents. A start is to share with one other family and halve your trips.

Similarly, staff car pooling can have significant positive environmental benefit.

Many of the measures in the Simple-fixes template aim to avoid energy wastage (**see page 32**).

2. Use energy more efficiently

Once the energy wasters have been tackled, it may be worth considering investing in:

- Timers and occupancy sensors that automatically turn off lights. Timers are best used in areas that have predictable occupancy times, eg offices, libraries, auditoriums, certain classrooms, and exteriors. For installation diagrams and guidance for lighting control in schools, see www.wattstopper.com/pdf/SchoolK12guide.pdf
- Master switches that make it easy to turn off all electricity in a room.
- Heaters with thermostat and timer controls.
- Insulation that retains a high proportion of the heating.

3. Use energy from renewable sources

Renewable energy resources can provide long-term security of supply. They also have less effect on climate change, although they vary in their overall environmental impact.

Moving to renewable energy sources requires planning. Schools may review the feasibility of:

- **Converting coal, oil, or gas boilers to wood pellets or wood chips.** Older heating systems, and coal boilers especially, are cheap and do the job but they also take their toll on the climate with carbon dioxide and sulphur dioxide emissions and ash that ends up in landfill. Renewable energy, such as wind, solar, hydro and wood fuels is self-restoring and therefore easier on the environment. Of these forms of renewable energy, wood fuels are the most reliable fuel for heating in schools. Wood pellets and chips are made from wood waste. Comparatively, burning wood fuels has almost zero net greenhouse effect as the carbon dioxide released is absorbed by growth of replacement forest. For more information on wood pellets and funding options, see page 37.

The coal-fired boiler at Opoho School. Many schools use coal as an energy source for heating

Photo: Pip Lynch

- **Using solar heating in buildings and the swimming pool.** There is a capital cost to installing solar heating. However, the technology has improved in recent years while the cost has reduced. When calculating the payback period, allow for anticipated energy price increases. For more information, see: www.eeca.govt.nz/eeca-library/renewable-energy/solar/report/operation-of-swimming-pool-solar-heating-at-blackmount-school-02.pdf

Involving the whole school in changing practices

The greatest challenges to energy-efficiency gains aren't technical. Active and continuing support by staff is key to the success of energy-efficiency programmes. Providing staff training, frequent reminders, environmental care codes, checklists and schedules, and possibly incentives are elements of this support.

An energy-efficiency programme makes the most sense when it's built into staff and students' school life. This requires a participative approach that could include:

- developing a school-wide energy-efficiency policy that sets a clear, whole-school direction, and
- engaging students through curriculum programmes to explore energy issues and make changes to their own behaviours in the school.

“The greatest challenges to energy-efficiency gains aren't technical.”

Templates for change

A school can immediately improve its energy conservation through simple fixes. Then, by using energy-audit information, staff and students can make informed decisions on how to manage the school's energy use.

The templates below are planning tools to help schools become more energy efficient.

Photo: **Monique Zwaan – SchoolGen workshop**

Staff awareness building

There is much more to energy efficiency than measuring usage and setting policies. Staff support is essential. For maximum impact, involve staff from the outset, provide them with information, and seek their ideas.

Energy saving is primarily about behaviour change. Discuss this with staff and encourage them to support each other to change the culture of energy use.

Successful organisations increase staff morale by achieving results as a team. Discuss progress regularly with staff to encourage them to support the programme.

Simple-fix template

Good housekeeping practices have been shown in UK schools to reduce energy costs by at least 10%. Because students take home much of what they learn in school, the downstream effect on students and their families' energy practices is significant.

Energy use	Check	Yes / No	Priority High/Medium/Low
Is the school receiving the best electricity rate possible?			
Is there a designated school energy manager?			
Are there energy monitors?			
Are the cleaners clear on what you expect?			

Energy use	Check	Yes / No	Priority High/Medium/Low
Lighting	• Is there overlighting in any rooms? • Are low-energy bulbs used throughout? • Are lights turned off when not in use?		
Heating	• Do all opening windows close tightly, especially louvers? • Are exterior doors closed during winter, eg are they fitted with spring-loaded closures? • Are there draughts around and under doors? • Are there draughts around windows? • Do heaters have timers or thermostats? • Are the timers' clocks set accurately? • Is the heating 19°C or lower?		
Equipment	• Is equipment turned off at the wall overnight? • Are computer monitors turned off when not in use? • Is the back of the fridge well ventilated and clear of dust? • Are the fridge temperatures set in the range 2–5°C? • Are the fridges defrosted? • Is the dishwasher used on the economy cycle and only when full?		
Hot water	• Do old hot-water cylinders have cylinder wraps? • Do showers have low-flow heads (less than 10 litres / minute)? • Is hot water in the range 50–55°C at the tap? • Do any hot-water taps drip? • Are all hot-water pipes lagged? • Is the swimming pool covered when not in use?		
Transport	• Is there a student-transport scheme, eg walking school bus or car pool? • Is there a staff car pool scheme?		
Other			

Longer-term planning template

After the 'simple fixes', many major inefficiencies that may take up to 10 years to change are likely to remain. They may include both energy inefficiency and the use of energy sources that severely damage the environment. Because the savings aren't immediate, it's more difficult to gain support for these changes. Support may be more forthcoming if you provide payback times, especially if payback times factor in anticipated energy-price increases.

The Ministry of Education is piloting a Green Star rating tool for new buildings. It's proposed that the actual performance of a new building will attract additional funding, and that the tool will enable sustainable development targets to be set for new schools.

Energy efficiencies	Scheduled	Comment
Control systems • Can heating be centrally controlled? • Are switches easily accessible? • Does switching enable specific areas only to be lit?		
Lighting • Are the fittings appropriate? • Is light saving technology in place: timers, dimmers, or occupancy detectors? • Do interior paint colours minimise lighting requirements?		
Insulation Are the following insulated: • Ceilings? • Windows – double glazing? • Underfloor? • Walls?		
Solar water heating • Is the swimming pool heated by solar power?		
Boiler • Does the boiler use renewable energy? • Does the boiler have a timer and is it working properly? • Has the boiler been tuned in the last year (does it smoke, run hot, or run erratically)?		
Does all equipment have a: • High energy-efficiency rating? • Manual switch-on / automatic switch-off system?		
School transport energy • Are school vehicles efficient energy users? • Is there a transport plan?		

Energy-efficiency schedule

Month	Check	✓	Comments
January	• Swimming pool filter pump is only running when needed • Insulation in the ceiling, and around the hot water cylinder and pipes is in place and dry • Water at hot water taps is in the range 50–55° C		
February	• Heating system is set to provide room temperatures in the range 16–19°C • Swimming pool filter pump is only running when needed • Turn on hot-water cylinders		
March	• Swimming pool filter pump is only running when needed • Window and door seals are in good condition • Boiler and radiators are operating properly; flue pipe and stack aren't corroded		
April	• Swimming pool filter pump is only running when needed • Turn hot-water cylinders off for the holidays		
May	• Boiler is operating only when needed • Other heating is operating only when needed • Room temperatures are maintained		
June	• Boiler is operating only when needed • Other heating is operating only when needed		
July	• Boiler is operating only when needed • Other heating is operating only when needed		
August	• Boiler is operating only when needed • Other heating is operating only when needed		
September	• Boiler is operating only when needed • Other heating is operating only when needed • Turn hot-water cylinders off for the holidays		
October	• Boiler is operating only when needed • Other heating is operating only when needed		
November	• Shut down heating system • Swimming pool cover is in good condition • All pool users, including after-hours users, cover the pool after use • Swimming pool filter pump is only running when needed		
December	• Swimming pool filter pump is only running when needed • Turn hot-water cylinders off for the holidays • Total school year energy usage is compared to the previous year		

Comparing use

Energy prices seem likely to increase in future. This can't be ignored, particularly if operation funding changes to place responsibility for energy costs on schools. However, schools should measure energy efficiency in terms of use as well as cost.

To measure use, a school needs to aggregate all its energy types. This may indicate a tension between financial efficiencies (eg a high proportion of fossil fuel) and environmental efficiencies (a high proportion of renewable energy).

Annual comparisons

The table below suggests a possible approach.

Schools can set internal benchmarks by comparing their energy performance to cluster school norms, or by comparing to past years.

Monthly comparisons

Another simple method is to graph cost and consumption on a monthly basis with three years shown on the graph. This simple exercise allows the energy manager look at the results and ask informed questions.

Monthly readings will allow simple trends to be seen and highlight what needs attention. More complex energy use reporting using 'degree day' data will assist in comparing one year to the next.

"...energy prices seem likely to increase in future"

	2005		2006		2007		
	Usage kWh	Cost $	Usage kWh	Cost $	Usage kWh	Cost $	Cents per kWh
Electricity							
Gas							
Coal							
Wood							
Total energy							

Photo: **Pip Lynch**

Setting internal benchmarks

New Zealand doesn't have national benchmarks for school energy use. Even if we did, increasing energy costs, combined with increasing awareness of the effect of energy use on the environment, will drive such benchmarks down in the near future.

By calculating your school's energy use and comparing to past years and similar schools, it will be possible to make an energy management plan.

Establishing cluster school norms

Good practice

> "Sharing good energy-efficiency practices is important."

Schools commonly share good teaching and learning practices. Similarly, sharing good energy-efficiency practices is important, including ways of building energy conservation into the school's curriculum.

Good practice involves both energy use (the total energy used per student) and the energy type (the percentage of renewable energy used).

Energy-use data

Schools vary considerably in their capacity for energy efficiency, eg building age, climate zone, building type and insulation, and whether or not they have a swimming pool. However, schools may get an idea of their energy performance by comparing their energy use data with similar schools.

The Enviroschools Foundation is currently developing a tool to help schools measure the outcomes of their sustainability practices - including energy efficiency. The tool will enable schools to collect annual energy data and compare it with their data from previous years as well as see how they are doing against schools nationally. See www.enviroschools.org.nz

Grants and loans

Purpose	Agency	Contact	Notes
Solar water heating programme	EECA	Grants Advisor solarfinance@eeca.govt.nz 0800 358 676 www.solarsmarter.org.nz	• Feasibility Study Grants and Installation Grants for public buildings (including schools) • Grants of up to 50% of the cost of commercial sized systems are available.
Crown energy-efficiency loan scheme	EECA	Emprove Account Manager www.emprove.org.nz 0800 367 768	• To assist government agencies reduce their energy expenditure. Public and integrated schools are eligible. • Up to 100% of the total cost of the project. This includes the cost of equipment, installation, design, project management fees, and energy audit fees.
Renewable heating for schools initiative	EECA	FIDA Project Manager fida@eeca.govt.nz 0800 358 676 www.eeca.govt.nz/renewable-energy/bioenergy/school-heating.html	• Capital funding of $10,000–$50,000. • State-funded schools in Auckland, Rotorua, Canterbury, and Otago / Southland are eligible. • Schools are selected on the age of their boiler, size of the school, and whether they are in the EnviroSchools Programme.
Compact Fluorescent Lightbulbs (CFLs)	Electricity Commission		• Subsidised lamps
Schoolgen Programme	Genesis Energy	www.schoolgen.co.nz/awareness.aspx info@schoolgen.co.nz	• Solar energy installations • Brochure and teaching resources on the website
Minister for the Environment's Sustainable Management Fund	Ministry for the Environment	www.mfe.govt.nz/withyou/funding/smf/index.html funds@mfe.govt.nz	Proposals must directly support one or more of the Ministry's priorities, eg: • Supporting sustainable business practices • Meeting the challenges of climate change.

Further information

Organisations

Organisation	Contact	Programmes	Notes
Enviroschools	The Enviroschools Foundation 07 959 7321	The Enviroschools Programme – a whole school process of environmental learning and action.	www.enviroschools.org.nz The programme includes school facilitation, annual awards, annual Scrapbook, professional development and a nationwide support network
Education for Sustainability Advisers School Support Services	School Support Services are based with universities	Working with schools and teachers on education for sustainability	www.esf.co.nz Support Enviroschools and other schools to become sustainable
Energy Efficiency and Conservation Authority (EECA)	0800 358 676	Energy efficiency	For various types of energy- efficiency information, see the website references below
Ministry of Education	04 463 8000	Green Star Standard rating tool for new buildings	If schools meet certain design criteria, they can apply for additional funding
Department of Building and Housing	04 494 0260	Energy efficiency	Energy-efficient buildings
Negawatts	04 939 0313	Energy Action – school energy programme	Also provides products, services and advice on the whole building envelope, both domestic and commercial.
Ministry for the Environment		Govt^3	A programme for public service agencies that focuses on recycling / waste, buildings, transport, and office consumables and equipment. MoE is a member of the Govt^3 programme.
Land Transport New Zealand	04 890 4773	Walking School Bus	www.landtransport.govt.nz/travel/school/walk-to-school/index.html Resources are available online or in hard copy
National Energy Research Institute	Office: 03 479 4273	Energy research and energy education	www.neri.org.nz

Energy consultants

See: www.energywise.org.nz/es/directory/SearchDirectory.aspx

Energy-efficiency websites

www.mfe.govt.nz/publications/sus-dev/workplace-sustainable-howto-mar07/workplace-sustainable-howto-mar07.html
A how to guide: Make you and your workplace more environmentally sustainable. Ministry for the Environment.

www.eeca.govt.nz
Energy Efficiency and Conservation Authority.

Strategy

www.eeca.govt.nz/eeca-library/eeca-reports/neecs/report/nzeecs-07.pdf
pages 48-49 may be of particular interest (transport)

www.eecabusiness.govt.nz/emprove/implementation/staff-awareness-and-motivation-kit/index.htm
Staff Awareness and Motivation Kit.

Lighting

www.eeca.govt.nz | Search on 'lighting' | Click on Improving Industrial Lighting | Scroll down to Table 2.

Tips

http://sme.eecabusiness.govt.nz/
www.energywise.org.nz/

Monitoring

www.eecabusiness.govt.nz/emprove/emprove-library/implementation/monitor-and-report/guide/monitoring-and-targetting-guide-02.pdf

www.eecabusiness.govt.nz/emprove/emprove-library/case-study/software-to-measure-and-manage-energy-04.pdf
Software for monitoring and managing energy use.

Audits

www.eecabusiness.govt.nz/emprove/emprove-library/implementation/conduct-an-audit/guide/energy-audit-manual-07.pdf
Although this manual focuses on energy auditing, it contains considerable background information, eg on lighting.

www.contactenergy.co.nz/web/view?page=/contentiw/pages/shared/energychallengerintro&vert=fb
Energy Challenger is a tool for analysing energy that medium and large schools could use.

www.landtransport.govt.nz/travel/school/walking-school-buses/index.html
A walking school bus resource kit containing guidelines, brochures, posters, stickers, bus tickets, certificates, and a Walking Bus Coordinators' Guide.

www.esis.com.au/Loggers-small/Power-Mate.htm
A power usage measurement tool.

http://217.10.129.104/energy_benchmarking/schools/ECG73.pdf
A UK best practice guide for energy managers in schools.

www.ase.org/uploaded_files/greenschools/School%20Energy%20Guidebook_9-04.pdf
This sizable booklet was written for US school districts rather than individual schools. There's a lot to read but it's strong on planning an inclusive approach to energy efficiency (see the case studies).

Education websites

www.energy-toolbox.vic.gov.au/summer_push/powermate information.html
Comprehensive teacher and student resource for energy efficiency in schools. There are primary and secondary kits.

www.generationisland.co.nz
Generation Island is a Meridian Energy resource. It's about electricity generation and conservation for Year 7 and 8 students and their teachers. There are lesson plans with curriculum links as well as student friendly games.

www.electrocity.co.nz
ElectroCity is a Genesis Energy resource. It's an online computer game that lets players manage their own virtual towns and cities and learn about energy, sustainability, and environmental management in New Zealand. There are also teacher resources.

www.schoolgen.co.nz
Schoolgen is a Genesis Energy website to support the Schoolgen project with activities and real-time data showing the electricity generated at Schoolgen sites.

www.wa$ted.co.nz
Activities based on the Wa$ted series.

www.esf.co.nz
An interactive site with resources, news, and events for New Zealand schools and teachers involved in all aspects of sustainability education.

www.doe.gov/foreducators.htm
A US Department of Energy's website which has extensive material for teachers and students.

www.energyhog.org
A US website that includes classroom activities for primary school students.