Good Energy Practice Guide

Improve energy efficiency and increase profits in shop bakeries

- Cut energy costs by 20 per cent or more
- Implement practical solutions today
- Take action on greenhouse emissions

AUSTRALIA

INDUSTRY SCIENCE RESOURCES

Baking Industry Association (NSW)

energy efficiency best practice

Further information

The Energy Efficiency Best Practice (EEBP) program works with companies in industry sectors to achieve the financial, social and environmental benefits that smart energy practice can deliver. Assisting companies to reduce their energy consumption, EEBP introduces steps to measure, control and reduce energy use. The program also aims to use innovation and best practice to encourage companies to achieve big step gains in energy performance.

EEBP has undertaken studies in the bread-baking sector, covering five industry sub sectors:

1. major corporate groups;
2. in-store (supermarket) bakeries;
3. franchise bakeries;
4. large independent bakeries; and
5. small independent bakeries.

Five separate reports, one for each sub sector and each containing an implementation plan, were published as a result of these studies. Each report contains an overview of the study and strategies for achieving cost savings through energy efficiency. A summary report, entitled *Energy efficiency opportunities in the bread baking industry*, and individual executive summaries for each sub sector, are available from EEBP.

Further information about energy efficiency in the bread-baking sector is available from:

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The Department of Industry, Science and Resources (ISR) intends this work to be used as a guide, not a detailed reference.

February 2001

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1. Why you need the *Good Energy Practice Guide*

This *Good Energy Practice Guide* contains valuable and practical advice, providing shop bakeries in Australia with the opportunity to:

1. cut energy costs by 20 per cent or more by improving energy efficiency;
2. take action on greenhouse emissions; and
3. show leadership in the bread-baking and retail sectors, and to customers.

Cut energy costs by 20 per cent or more by improving energy efficiency

The guide offers practical advice on actions you can take to save money starting *immediately*, often through simple changes in bakery practices, which involve little or no capital investment.

Shop bakeries cannot afford to ignore the positive benefits of energy efficiency—bakeries spend between $5 000 and $50 000 per year on energy, with the average cost being about $10 000.

You can expect to save about 20 per cent in the short term by using energy in the most cost-effective and economical way possible, without adversely affecting the processing or quality of your final product. This could translate to savings of between $1 000 and $10 000 per year for each shop bakery in Australia.

Even a saving of $2 000 a year for an average bakery equals the profit on approximately 14 000 loaves of bread, or $30 000 worth of sales.

And it is important to remember that these savings can be even greater if you have the opportunity to implement longer-term improvements or solutions that require capital investment, such as buying more efficient equipment.

Handy hints

Simple actions such as switching off equipment or lights when not required can lead to real energy savings.

Take action on greenhouse emissions

As well as increasing your profits and improving efficiency, you can help the environment by reducing your energy consumption. The shop baking sector produces approximately 250 000 tonnes of greenhouse gasses per year, which is equivalent to the emissions from around 55 000 cars.

Reducing greenhouse gas emissions is important since scientists believe that increasing levels of greenhouse gas cause a rise in the earth's temperature. Some of the predicted effects of this global warming are:

- increasing severe storms, floods and droughts;
- rising sea levels;
- increasing spread of infectious diseases like malaria, carried by pests; and
- bleaching of coral.

You can reduce emissions by:

- decreasing energy use through good practice;
- installing energy efficiency equipment and appliances and improving production efficiency;
- replacing in-house energy sources with those that produce less greenhouse gas emissions; and
- sourcing a portion of energy from renewable energy sources (for example, installing a photovoltaic system or subscribing to a 'green power' scheme).

Show leadership

Exercising good energy efficiency practice also positions your bakery as a good corporate citizen and a leader in your industry, the retail industry and in the eyes of your customers.

Following the steps in the *Good Energy Practice Guide* will ensure your bakery works towards a sustainable future.

With more than 4 500 bakeries currently supplying the Australian market with bread products, this is important. The sector is the largest cereal foods-based manufacturing industry in Australia, with energy costs representing about three per cent of total costs, and six per cent of controllable costs. Energy costs for the sector are around $45 million per year, with shop bakeries accounting for about 65 per cent of this, even though they only produce about 50 per cent of the total product.

Smart bakeries can achieve a great deal through good energy practice.

Gain recognition for your bakery's commitment to energy efficiency by sharing your successes with us. Case studies of bakeries implementing energy efficiency initiatives will progressively be added to Appendix E of the *Good Energy Practice Guide*.

Contact EEBP if you would like to take advantage of this opportunity. Contact details are on page ii.

Handy hints

Reducing the running time of equipment saves on maintenance costs and will ensure your equipment lasts longer.

2. What's in the *Good Energy Practice Guide*?

This guide is designed as a workbook and contains comprehensive and easy-to-use checklists and recommended actions covering all aspects of bakery operations. Worksheets and methods of calculating energy performance, examples of how successful energy good practice can work, and handy hints are also included.

The *Good Energy Practice Guide* focuses on the equipment and services found in a shop bakery, including hot bread shops, franchise and in-store (supermarket) bakeries.

3. Developing an energy management program

Developing and implementing an overall energy management program will ensure you cover all bases and tap into all opportunities for improvement.

Effective energy management needs to be ongoing and supported by processes and systems. Your energy management program will vary depending on the size of your bakery and whether you are an independent operator or part of a larger group. It is best designed as an integral part of your existing management systems.

As part of developing an energy management program, it is recommended that shop bakeries:

- monitor energy consumption;
- set energy use reduction targets;
- highlight key areas where energy savings can be made;
- develop an action plan; and
- implement energy savings.

The success of your energy management program's implementation depends on:

- the motivation and full commitment of staff (see 3.1);
- the availability of adequate funds and staff resources;
- access to the right amount and type of information; and
- effective reporting and accountability systems.

3.1 Staff and management motivation and commitment

Staff motivation and commitment is critical to the success of a shop bakery's energy management program. Staff play an important role in helping save energy through good practice and so need to be well informed and motivated to 'do the right thing'.

Handy hints

Monitor energy consumption monthly to determine if your energy efficiency initiatives are working.

Appropriate measures for motivating staff and building commitment to energy efficiency and savings will vary from bakery to bakery. Common measures include:

- providing opportunities for staff to suggest what energy savings may exist and ways to implement efficiencies;
- developing and implementing an ongoing education and communications/publicity program, including:
  - training sessions;
  - providing information through letters or memos from management and program coordinators, videos or other audio visual material; and
  - promoting the value of conservation at work (including, for example, in brochures and/or on displays).
- developing a suite of information and instructional products, including information stickers and signs, placing them where they are most needed (for example, over switches and taps, and/or on equipment or machinery).
- developing a recognition and rewards program for staff, to celebrate achieving tangible results.

Management also plays a key role in the successful implementation of an effective energy management program. Ongoing support is required and management needs to take the time to:

- conduct a thoughtful analysis of the bakery's culture;
- assess the bakery's energy use;
- clearly identify where the greatest potential for energy reduction exists; and
- feedback results to all staff in the bakery (and across the group, if applicable).

4. Monitoring energy consumption and setting targets

Monitoring consumption, setting targets and comparing your performance over time, or with other bakeries, is one of the most effective ways you can manage energy costs. It enables you to stay on top of how your bakery is performing and can highlight changes in energy use that you should be aware of. Without monitoring, you will not know if you have succeeded in reducing energy use.

4.1 Calculating your energy intensity

You should monitor energy consumption monthly to determine if your energy efficiency initiatives are working.

When comparing the amount of energy you use each month, it is important to take into account your production levels. This is because the amount of energy you consume will generally increase as the amount of product you make increases.

Energy consumption adjusted for production is known as '*energy intensity*'.

Follow these four steps to help you successfully monitor your bakery's energy intensity:

1. Note the readings from your monthly bills.
2. Decide on the most appropriate way to measure your monthly production (for example, total weight of flour used, number of loaves baked, etc.).
3. Use the formulas in Appendix A to determine your energy intensity.
4. Compare your energy intensity from month-to-month remembering that if you are progressively implementing energy efficiency initiatives, your energy intensity should decrease over time. If you notice significant variations, look for reasons why this may have occurred.

Handy hints

Reducing the heat-up time for your oven will result in significant cost and energy savings.

An example of how a shop bakery can monitor energy intensity is provided at Appendix A. This appendix has an example of a completed monitoring sheet for a typical shop bakery, as well as a blank monitoring sheet for your own use.

4.2 Ways of comparing your energy intensity

Comparing your energy intensity to past performance

You should compare the current performance of your bakery against your past performance, to see how effective your energy efficiency initiatives are. This is the most effective and accurate way of measuring your performance over time and it will enable you to detect trends and variations.

Comparing your energy intensity to other bakeries

Another effective way to analyse your energy performance is to compare it to a network of other bakeries that produce a similar range of goods and employ similar processes. Regularly comparing energy use within a network like this may allow members to identify good energy practices and collectively identify opportunities to reduce energy consumption. Shop bakeries should join a network, if one is available, or take the initiative to organise one.

How does your energy intensity compare to a benchmark?

ISR's Energy Efficiency Best Practice (EEBP) program developed a benchmark for energy intensity in shop bakeries during a study into energy efficiency in the bread-baking sector. This benchmark is based on the finding that energy intensity is proportional to production. It is a reference point against which you can compare your own performance.

You can use the following equation to calculate a benchmark, which will allow you to compare your energy performance to other bakeries studied by EEBP.

Benchmark (kWh/kg) =
1.97 – 0.000139 x flour consumption (kg/month)

Comparing your bakery's energy intensity to the benchmark will give you an indication of how your bakery is performing.

If your bakery has an indicator that falls *below* the benchmark, you are amongst the top performing bakeries in Australia. This guide can help you perform even more strongly by assisting you to identify more opportunities for improvement and determine what additional efficiencies you can implement.

If your bakery has an indicator that is *above* the benchmark, you will find that this guide includes many recommendations on how you can improve your energy efficiency and, in doing so, reduce your energy costs.

This benchmark has been developed for small bakeries that primarily bake bread. So whilst comparisons to the benchmark provide a valuable indication of the energy performance of your bakery, it is important to remember that energy intensity is affected by factors such as the type of product baked, the age and type of equipment used, the local climate and the sale of additional goods by the bakery (such as beverages).

Handy hints

You can reduce standing losses by rescheduling work and ensuring you are filling your oven as much as possible when it is on.

5. Baking plant

The main baking plant, which includes ovens, provers and mixers, accounts for approximately 80 per cent of the energy used by the average bakery. Even if your bakery plant is well controlled, there are likely to be energy efficiency improvements you can still implement. Table 1 is a detailed checklist to help you reduce the amount of energy used in your baking plant. Some of the options available to you are described in more detail below.

Reduce standing losses

You may find that your ovens are currently switched on earlier than necessary. To become more energy efficient, without adversely affecting the quality of your product or baking schedule, you need to determine the minimum heat-up time required for your equipment.

There are two ways you can determine your minimum heat-up time:

1. Note the time, from start-up, that the thermostat on the oven switches the heat off. This will tell you what your minimum start-up time is.
2. Gradually delay your oven start-up by no more than 15 minutes at a time, over several days, until you find the shortest time needed to heat the oven to working temperature. Decreasing the start-up time by small amounts will ensure you achieve energy efficiencies without adversely affecting your product quality.

Reducing the heat-up time for your oven will result in worthwhile cost and energy savings. One bakery, for example, has reduced heat-up time by 20 to 25 minutes for racks and by 40 to 50 minutes for decks.

Rescheduling work

You can also reduce standing losses by rescheduling work and ensuring that you are filling your oven as much as possible when it is on. Overall, a bakery that uses its oven for eight full loads will use less energy than one that bakes the same quantity over 11 loads.

Example 1 (Appendix B) shows that, depending on the relative costs of peak and off-peak energy in an area, a shop bakery altering its heat-up time and rescheduling work during the latter part of a working day can save $1 500 in a 300-day working year.

Buying energy efficiency ovens and other equipment

When buying a new oven or other equipment for your bakery, consider energy efficient models and remember that using a more efficient oven could offset a higher purchase price.

This is critical since:

- most ovens last more than 10 years, and over the life of an oven you will likely spend more on the energy required to run it than you will spend on initial purchase and installation;
- it is anticipated that energy costs will continue to increase substantially during the life span of your oven; and
- selecting the most energy efficient equipment can reduce the amount of heat lost into the bakery area, thereby reducing the air-conditioning load and improving the general working environment.

With this in mind, you should ask your supplier about the energy efficiency of their equipment. This will help you make the right choice from the range of energy efficient ovens and equipment available on the market today. When talking to your supplier, bear in mind that the following general factors can influence an oven's energy efficiency:

- whether the oven door windows are double glazed;
- whether each deck has an individual control; and
- the thickness of the oven's insulation.

Example 2 (Appendix B) looks at how valuable choosing an energy efficient oven and energy efficient equipment can be.

Handy hints

When replacing your hot water system consider a point-of-use system. These systems are very efficient because they heat water on demand.

Oven design

Recent breakthroughs in design can also help reduce energy costs and so should be considered when selecting an oven for your bakery. Examples are:

- *a new rack oven loading and unloading system.* This feature allows baked goods to move from proving racks to separate oven racks, avoiding the need to heat and cool the racks themselves. This also results in a faster and more consistent bake; and
- *stand-by-mode when the oven is empty.* This feature maintains the temperature of an oven, whilst reducing the speed of the recirculation fan and closing the exhaust. This reduces the amount of energy needed to reheat the oven as well as the standing losses. With most ovens today, the fan is switched off when the oven door is opened.

Proper maintenance

Since most equipment used in a bakery lasts for more than 10 years, you should ensure that you regularly maintain your equipment. This will ensure that it continues to operate efficiently and cost effectively.

An effective maintenance program is based on preventative action. Work with your equipment supplier and service contractors to develop the best maintenance program for your bakery.

Maintenance actions to help you use as little energy as possible and maximise the life of your equipment include:

- repairing damaged oven and prover seals;
- repairing damaged insulation on your oven and provers;
- cleaning electrical elements and radiant surfaces; and
- lubricating moving parts.

Table 1—checklist for maximising energy efficiency in your baking plant

Item	Yes	No	Action required
1. Are ovens and provers correctly maintained?			Contact oven contractor.
2. Is your equipment switched off when not in use?			Raise staff awareness and place signs near equipment.
3. Are oven and prover door seals in good condition?			Have oven contractor repair door seals.
4. Is insulation defective as a result of accidental damage?			Have oven contractor repair damaged insulation.
5. Have start-up times for ovens and provers been optimised to minimise standing losses?			Use Table 7 in Appendix B.
6. Are electrical elements cleaned and is resurfacing of worn radiant surfaces carried out?			Have oven contractor clean and repair radiant surfaces.
7. Are ovens and provers scheduled to operate at full capacity?			Use Table 7 in Appendix B.
8. Are all moving parts lubricated on a regular basis?			Have service contractor check and lubricate according to manufacturers' recommendations, or as required.
9. When purchasing equipment, do you consider energy costs? Have you thought about recovering heat from oven flue gasses to provide hot water, heat for proving or space heating?			Discuss with your supplier or an energy consultant.

Handy hints

Staff motivation and commitment is critical to the success of a shop bakery's energy management.

6. Refrigeration

For some bakeries, refrigeration can be a significant cost, especially when freezing and chilling of product is vital. There are many ways you can minimise energy use and save on the cost of refrigeration in your bakery. Table 2 is a checklist of quick steps you can take.

Some of the options to save through refrigeration are described below.

Correct servicing of equipment

In most cases, you can achieve savings through correct servicing of your equipment. Meet your local refrigeration service contractor and put in place a service and maintenance program, to ensure your equipment operates as efficiently as possible. You will also extend the life of your refrigeration equipment if you do this.

Using equipment properly

You can achieve additional savings by ensuring that bakery staff exercise good practice in the way they use refrigeration equipment. Often, simple actions that require little or no investment, can lead to significant savings. Examples include:

- switching off refrigeration equipment when not in use;
- implementing proper loading procedures;
- correctly setting temperatures; and
- keeping refrigerators and freezers fully loaded, without restricting airflow.

Educating staff about the importance of refrigeration will encourage good practice and lead to savings. Other communications techniques, such as placing information or instructional signs in appropriate areas to remind staff of good practice, may also be used.

Table 2—checklist for minimising refrigeration energy use

Item	Yes	No	Action required
1. Are deep freezers and retarders maintained at recommended temperatures (temperatures 1°C lower than necessary can increase costs by three per cent)?			Adjust to recommended temperature.
2. Are refrigeration units regularly serviced?			Service refrigeration equipment six-monthly, or as recommended.*
3. Are freezers/refrigerators defrosted when they need to be?			Implement regular defrost cycle—never allow more than 20 mm of ice to accumulate.
4. Are freezer/refrigerator condensing coils free of obstructions and dust to ensure clear airflow?			Have coils cleaned and checked as required.*
5. Where split-system refrigeration units are used, is the supply pipe-work properly insulated and dry? The effectiveness of insulation is reduced if wet.			Have service mechanic check and insulate pipe-work.*
6. Are freezers/refrigerators situated as far as practically possible from baking ovens and other heat sources?			Move freezers and refrigerators to coolest place practical.
7. Are batch freezers and retarders only switched on shortly before being loaded?			For batch freezing or retarding, switch on refrigeration equipment when required.
8. Are freezers/refrigerators fully loaded whenever possible? Is it possible to replace two partially used freezer/ refrigerator units with one fully loaded unit?			If multiple freezers, fully load freezer and switch off unused freezers.
9. If it is safe to do so, is the product allowed to cool naturally before being put in the freezer/refrigerator?			Cool product under ambient conditions before placing in freezer/refrigerator.

* These actions need to be carried out by a refrigeration service mechanic. If you do not already have a contractor servicing your refrigeration equipment, you can find one in your local yellow pages.

Handy hints

Regularly maintain your equipment to ensure it continues to operate efficiently and cost effectively.

Table 2—checklist for minimising refrigeration energy use (continued)

Item	Yes	No	Action required
10. Are staff trained to minimise the time refrigerators and freezers are left open? Do staff, for example, leave cool room doors slightly ajar?			Raise staff awareness and place information notices at entries. Fit a five-minute timer with a beeper to the door switch that operates the evaporator fan, to alert staff that door is ajar.
11. Are curtains fitted to walk-in units wherever possible, to minimise the loss of cold air?			Have service mechanic fit curtains.*
12. Are freezer fans switched off and lights switched on automatically when doors are opened?			Have service mechanic fit automatic switch.*
13. Can the heat from refrigerator condensing coils be used to warm storage, office or retail areas of the bakery?			Install ductwork if practical.

* These actions need to be carried out by a refrigeration service mechanic. If you do not already have a contractor servicing your refrigeration equipment, you can find one in your local yellow pages.

7. Hot water

Paying attention to how your bakery is supplied with hot water, and implementing good practice with hot water use, is another way you can save energy and costs.

Bakeries are supplied with hot water from several sources, including:

- a conventional gas hot water system;
- a point-of-use water heater;
- a tank which stores water heated by off-peak electricity; or
- a solar hot water system.

Table 3 is a checklist you can use to become more energy efficient with your hot water production and Appendix B, Example 3, provides further details about how water-heating costs can be cut. Some of the options available to you are described below.

Using cheaper rates

Most bakeries that use large electric systems to heat their water can cut costs by making full use of cheap off-peak rates. Contact your electricity supplier to take advantage of off-peak rates.

Replacing old equipment

There are several options available to you when considering a replacement for your old hot water system, which will enable you to save energy and costs. Some of these are listed below:

1. *'Point-of-use' hot water unit (instantaneous systems/units).* These are small hot water systems that heat water on demand and can eliminate standing losses.
2. *Solar hot water system.* Depending on climate and location in Australia, hot water from a solar hot water system may not be available all year round and you may need a backup system. Discuss your best option with your local solar hot water supplier.

Handy hints

You can achieve savings by ensuring that staff exercise good practice in the way they use refrigeration equipment.

3. *Standard gas or electric hot water system.* Depending on your situation, a standard gas or electric hot water system may be most appropriate. Compare the energy efficiency star-rating of the available brands.

Table 3—checklist for minimising hot water energy use

Item	Yes	No	Action required
1. Is hot water stored in a properly insulated storage tank, with a well-fitted 75 mm insulation jacket or sealed plastic foam?			Have hot water contractor repair or insulate tank.
2. Is water stored at proper temperatures? High temperatures will increase standing losses.			Adjust thermostat.
3. If water is heated using electricity, is full use made of off-peak heating?			Discuss options with your electricity supplier.
4. If off-peak water heating is already installed, is the tank large enough?			Install tank of appropriate size. Ensure tank has booster element.
5. Have point-of-use water heaters been considered as a more suitable alternative?			Install an efficient point-of-use water heater, where appropriate
6. Is hot water pipe work well insulated to prevent heat loss?			Have plumber insulate pipe work.
7. Have ‘dead legs’ (unused pipe runs) in the distribution system been eliminated wherever possible? This can cut heat loss by reducing the amount of hot water needed to refill the pipe work after use.			Have plumber eliminate ‘dead legs’.
8. Are hand basins and showers fitted with flow reduction nozzles to reduce waste by using hot water more effectively?			Install low-flow fittings where practical.
9. Are hot water taps running directly to drain or leaking?			Have plumber fix running taps and/or leaks.
10. Is water used for washing utensils at the correct temperature?			Minimise temperature of water used for cleaning utensils. Do not reduce the temperature below the requirements under health legislation.
11. If chilled water is used to achieve the right dough temperatures in summer, can ambient rather than hot water be used in the mixing process?			Use ambient and chilled water where practical for dough mixing. Do not use combination of hot and chilled water.

Handy hints

Savings on lighting can often be made with quick paybacks. A properly designed lighting system can also provide a safe and productive working environment.

8. Lighting

Many shop bakery lighting installations are used almost continuously during the working week. This means that if a bakery is working 18 hours per day and six days per week, lighting is on for around 5 500 hours per year. As a result, savings on lighting can often be made in the average shop bakery with quick paybacks.

Lighting levels also affect productivity and sales. A properly designed lighting system can have the added benefit of providing a safe and productive working environment for staff. It can also help you to effectively promote your products to customers.

Table 4 is a checklist you can use to ensure that your bakery lighting system is efficient. The checklist covers the following types of ways to improve lighting in your bakery:

1. increasing the efficiency of existing fittings;
2. making greater use of daylight;
3. substituting more efficient lamps or lighting controls; and
4. improving the layout of your bakery.

Each of these options for improvement are discussed below:

1. Turning off lights when not required is often the easiest way to save energy and represents the biggest cost reduction. With fluorescent lamps, if the light is to be left off for more than 10 minutes, then it is beneficial to turn it off.
2. You can save on lighting energy use and costs by taking full advantage of natural daylight. This will depend on the location and operating hours of your bakery, but is certainly worth exploring. South facing windows offer the best opportunity as they minimise direct sunlight, which can affect product quality.
3. You should assess the type and use of lamps and lighting controls you have in your bakery to ensure maximum efficiency. This does not necessarily involve big expense. For instance, if your bakery needs lighting all or most of the time, you should consider changing from tungsten filament to fluorescent lighting.

Fluorescent lighting uses less electricity and will double your savings. A standard 38 mm fluorescent tube gives about four times more light than a standard filament bulb, for example. New 26 mm diameter tubes are about five times more efficient. They also last longer.

Another option is the recently developed compact and efficient fluorescent lamps, which can be used in place of tungsten light bulbs without changing fittings.

You should also remember that a large portion of the energy used by standard tungsten filament light bulbs is wasted as heat. Only use these types of bulbs when occasional lighting (less than three hours), dimming or frequent switching is required.

Also, modern high efficiency reflectors fitted to fluorescent tubes can halve the number of tubes required to provide the same light output.

4. It is important to consider the layout of your lighting when installing new equipment or changing the layout of the bakery. Lights situated above or behind plant equipment contribute little to lighting levels in work areas. You can increase your profits by isolating or removing these light fittings.

Handy hints

Most bakeries that use large electric systems to heat their water can cut costs by making full use of cheap off-peak rates.

Table 4—checklist for minimising lighting use

Item	Yes	No	Action required
1. Are staff motivated to 'switch off' lights?			Raise staff awareness. Place signs near exits and light switches.
2. Are switches in the right place? If staff have to walk across the bakery to switch lights off, they are more likely to leave lights on.			Have electrician install switches in most appropriate position.
3. Are lamps over work areas controlled separately? This can stop large areas being lit when only a small area needs to be illuminated.			Have electrician install individual switches where required.
4. Does the switching system allow lights near windows to be switched off when daylight provides enough light to work in?			Have electrician install individual switches where required.
5. Have you considered automatic lighting? Systems activated by daylight sensors or other types of sensors can save money.			Have electrician install automatic switches.
6. Are lighting levels correct? Too much light wastes electricity, too little can affect efficiency and safety. Use a light meter to check and, if necessary, alter lighting locally.			Refer to lighting consultant.*
7. Have you considered individual desk or workstation lights? These can give the higher local level of lighting necessary for close work.			Refer to lighting consultant.*
8. Are you using the most efficient types of lamp or tube?			Use fluorescent globes where practical. Refer to lighting consultant.*
9. Are you using the most efficient types of lighting covers?			Refer to lighting consultant.*
10. Do you have a regular program for cleaning lamps, reflectors and glass panels in lighting systems to minimise light loss and improve lighting levels?			Put in place program to clean light fittings.

* These actions need to be carried out with a lighting consultant. You can find a list of lighting consultants in your local yellow pages.

9. Air-conditioning, ventilation and space heating

Climatic conditions in Australia vary drastically, and affect the space heating and air-conditioning requirements of shop bakeries. You can save energy and cut costs by examining your air-conditioning, ventilation and space heating systems. Table 5 is a checklist you can use to become more energy efficient. The options below highlight how you can make changes in your bakery.

1. Properly control your heating systems. Raising the temperature 1°C beyond what is needed can increase your heating bill by between five and 10 per cent. The same applies when setting the temperature too low for your air-conditioning system.

2. Make sure your air-conditioning and space heating systems are as efficient as possible by:
   - using time switches to ensure that heating and cooling is switched off during shutdown periods; and
   - using an optimum start controller to adjust your air-conditioning system's start times according to weather conditions. This ensures that areas that are heated and cooled are at the proper temperature by a set time. It also minimises the preheat and/or cooling period by relating the start time to the outside temperature. Often cooling will not be required in a bakery until the ovens have been operating for a number of hours, especially with early morning starts.

3. Consider using infra-red heaters to heat small areas instead of large quantities of air. This is particularly suitable for larger bakeries where work is concentrated in specific areas, and where work areas are subject to frequent air changes (for example, areas near a loading bay or freezer doors).

   Infra-red units are available either as gas-fired units or with electric elements. The best locations for, and methods of use, will vary from bakery to bakery, so you should talk to your suppliers and installers about the best approach.

4. Use natural ventilation wherever possible, but only where baking will not be affected by changes in temperature and humidity, and where birds, insects and other pests cannot get in.

Handy hints

Turning off lights when they are not required is often the easiest way to save energy. It also represents the biggest cost reduction in your lighting system.

Table 5—checklist for minimising energy use with air-conditioning, ventilation and space heating

Item	Yes	No	Action required*
1. Are heated and air-conditioned areas controlled using a thermostat set to an appropriate temperature?			Set thermostats to an appropriate temperature. Usually 21.5°C is the most comfortable temperature, but to conserve energy try 23°C in summer and 19°C in winter.
2. Is thermostat operation checked at least at the beginning of each season to see if it is working correctly?			Check that thermostat temperature and actual temperature are consistent.
3. Is the air-conditioning or heating switched off during shutdown periods?			Raise staff awareness. Place signs near exits and thermostats. Install timer.
4. Are optimum start controls fitted to allow for varying weather conditions?			Consult air-conditioning contractor.
5. Can slow-moving ceiling fans or a roof vent be used to remove or improve the efficiency of heat distribution in high-roofed areas?			Install fans and roof vents as required.
6. Have you thought about replacing a centralised heating system with local infra-red heaters?			Consult electrical contractor.
7. Can waste heat from ovens be used to provide ‘free’ heat in part of the bakery?			Install ducts to move hot air from the oven area to other areas.
8. Are ventilation fans switched off outside baking time?			Switch off ventilation fans when not required.
9. Is bakery ventilation balanced or do inlet and extractor fans work against each other?			Consult air-conditioning contractor to ensure proper fan sizing and placement.

* Many of these actions need to be carried out by an air-conditioning service mechanic. If you do not already have a contractor servicing your air-conditioning and heating equipment, you can find one in your local yellow pages.

10. Bakery layout

Bakery design and layout can have a major influence on the efficiency and convenience of producing baked goods. They can also influence the energy efficiency of your bakery plant, particularly in areas where products are heated or chilled.

The most effective bakery layout depends on many factors, including the type of product produced, volume of product produced, type of equipment in the bakery, the site of the bakery, method of product handling and the core business of the bakery (wholesale or retail). When designing the layout of a new bakery or optimising the layout of an existing bakery, consult a bakery engineer to determine how best to meet your requirements.

You can use the checklist found in Table 6 to help ensure you have the most suitable bakery layout for efficient energy use.

The following tips can also help you enhance energy efficiency through the layout of your bakery.

1. Avoid locating a freezer close to an oven or prover exhaust area since this will work against your efforts to reduce energy efficiency. Reasons for this include the:
   - large temperature variations that occur when freezer doors are open; and
   - the additional loading on freezer condenser coils which results from high local ambient air temperatures.
2. Product that is transferred from a blast freezer to a storage freezer may, in some cases, be left in high temperature areas while freezer doors are opened and closed. Unless this product can be held in a curtained-off lobby area, some reheating will take place.
3. Conversely, products taken from a prover may be subjected to unnecessary cooling from draughts before they are loaded into ovens for the baking process.

Handy hints

Assess the type and use of lamps and lighting controls you have in your bakery to ensure maximum efficiency.

Table 6—checklist for ensuring an energy efficient layout of your bakery

Item	Yes	No	Action
1. Has a logical layout been adopted for mixing, preparing, proving, baking and cooling? This will make processing easier, and use energy more efficiently.			Improve layout where possible.*
2. Is there enough room to allow ovens to be loaded quickly?			Improve layout where possible.*
3. Has full use been made of ambient cooling before further processing or freezing the product?			Use ambient cooling (within health guidelines).
4. Are refrigeration condenser coils located in the coolest part of bakery (or outside in a shaded cabinet)?			Improve layout where possible.*
5. Have you considered a curtained-off lobby area for freezers, to prevent unnecessary warming?			Install curtained-off area if appropriate.
6. Can frozen or chilled goods be loaded directly into isolation or refrigerated transport, without passing through a hot baking area?			Reduce exposure of goods to heated area.
7. Can waste heat from baking areas be used in place of independent space heaters in thawing/conditioning rooms?			Consult air-conditioning contractor.
8. Are cream preparation and finishing areas located well away from oven areas?			Improve layout where possible.*
9. Are offices and other staff accommodation located away from sources of heat, or draughts?			Improve layout where possible.*

* These actions may need to be carried out in consultation with a bakery engineer.

Appendix A
Monitoring energy intensity

Monitoring energy intensity is important for shop bakeries.

An example of a completed monitoring sheet, for a typical shop bakery, is found below. Also included in this appendix is a blank monitoring sheet, which you can use to monitor energy intensity in your own bakery.

Monitoring sheet of energy intensity for a typical shop bakery

	Gas m^3	Gas kWh	Electricity kWh	Total energy use kWh	Total flour kg	Energy intensity kWh/kg	Benchmark kWh/kg
	A	A x 10.81 = B	C	B + C = D	E	D/E = F	G = 1.97– 0.000139xE
Jan	274.67	2 970	5 349	8 319	5 100	1.63	1.26
Feb	363.20	3 928	5 219	9 147	5 400	1.69	1.22
Mar	248.53	2 688	5 439	8 126	5 700	1.43	1.18
Apr	178.13	1 926	5 181	7 107	6 100	1.17	1.12
May	170.67	1 846	5 024	6 870	6 000	1.14	1.14
June	248.53	2 688	4 363	7 051	5 100	1.38	1.26
July	177.60	1 921	4 487	6 408	4 600	1.39	1.31
Aug	199.47	2 157	3 878	6 035	3 500	1.72	1.48
Sep	271.47	2 936	4 638	7 574	5 100	1.49	1.26
Oct	203.20	2 197	5 057	7 255	5 400	1.34	1.22
Nov	229.33	2 480	5 302	7 782	5 800	1.34	1.16
Dec	251.20	2 717	4 808	7 525	6 400	1.18	1.08
Total	**2 816.00**	**30 454**	**58 745**	**89 199**	**64 200**	**1.41**	**1.22**

Handy hints

Use time switches to ensure that heating and cooling is switched off during shutdown periods.

Filling in your energy intensity monitoring sheet

Follow these steps to fill out the bakery monitoring energy intensity work sheet, using January as a working example:

1. Note the readings from your monthly bills and then follow steps A and B.
   A. Use the conversion table provided in Appendix D to convert each type of energy into a common unit (such as kWh).
   B. Add the gas (kWh) and electricity figures together for each month of the year to calculate the total energy consumption for the year.

      Example:

      The total electricity use for January is 5 349 kWh for electricity. Record this figure in column C.

      The total natural gas consumption for January is 274.67 cubic meters. Record this figure in column A. The conversion factor for natural gas is 10.81.

      To convert cubic meters to kWh:

      Gas (kWh) = column A x 10.81
      = 274.67 x 10.81
      = 2 970 kWh

2. Record the gas consumption (2 970 kWh) in column B.
3. Calculate your total energy consumption by adding columns B and C and record this figure in column D.
4. Decide on the best way to measure your monthly production. This might be the total weight of flour used, in kg or any other measure you consider appropriate (such as the number of loaves, weight of product, boxes of biscuits, turnover etc.).

   Example:

   Flour consumption for January is 5 100 kg. Record this figure in column E.

Note: The equation used to calculate energy intensity in step 5 is based on kWh/kg of flour. If you use another measure of production or energy, this example and the benchmark that follows cannot be used for direct comparison. The benchmark can only be used in bakeries where the main product produced is bread.

5. Use the values obtained to calculate your energy intensity.

   Example:

   $$\text{Energy intensity} \quad \frac{8\ 319\ \text{kWh}}{5\ 100\ \text{kg}} \quad = 1.63\ \text{kWh/kg}$$

   Record the energy intensity in column F.

6. Monitor energy intensity on a monthly basis. This will help you realise that energy costs can be controlled, and reveal variations in energy use which could be increasing your costs. Variations in energy intensity could result from an oven controller that is poorly adjusted, a refrigeration plant that needs defrosting, hot water that is running to waste, or other energy wastage.

7. Use the total flour usage (kg) to determine the benchmark. The equation for the benchmark is given by:

   Benchmark (kWh/kg) = –0.000139 x flour consumption (kg/mth) + 1.97

   Example:

   For the month of January the benchmark will be:

   Benchmark (kWh/kg) = –0.000139 x 5 100 + 1.97

   Benchmark (kWh/kg) = 1.26 kWh/kg

   Record this figure in column G.

Results

If your bakery has an indicator that falls *below* the benchmark, you are amongst the top performing bakeries in Australia. This guide can help you perform even more strongly by assisting you to identify more opportunities for improvement and determine what additional efficiencies you can implement.

If your bakery has an indicator that is *above* the benchmark, you will find that this guide includes many recommendations on how you can improve your energy efficiency and, in doing so, reduce your energy costs.

Handy hints

Use an optimum start controller to adjust your air-conditioning system's start times according to weather conditions.

Regular monitoring

Regular monitoring will show you the effectiveness of your energy efficiency measures.

The performance of the typical shop bakery used in this example is shown in Figure 1. The energy intensity indicator in August is high because of the low production rate during that month. This is also reflected in a higher benchmark (the benchmark depends on flour usage). Although August had the lowest energy consumption of the year, the plant could have operated more efficiently if oven loading and waiting time had been improved.

In May the lowest energy intensity was achieved. This was because the mix of products allowed for improved plant scheduling.

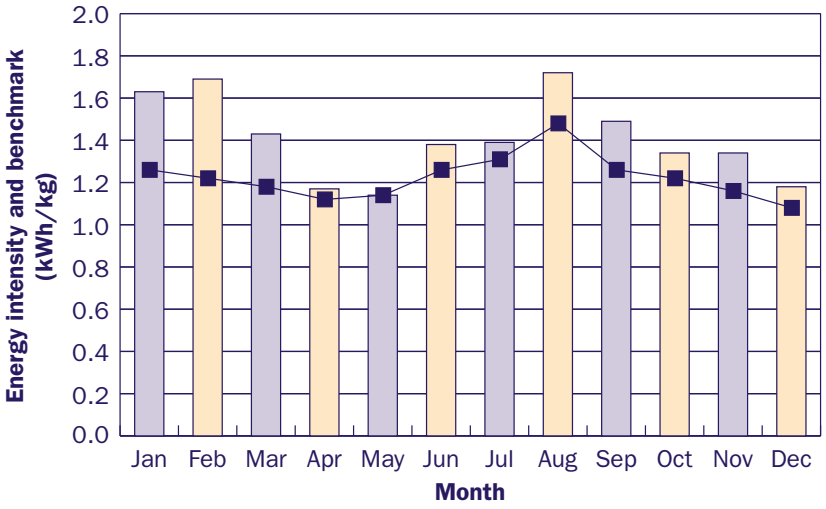
The average energy intensity for the 12 months in Figure 1 was 1.41 kWh/kg. If the bakery was to achieve the benchmark of 1.22 kWh/kg, the resulting savings would be around $1 000 or 13.5 per cent (based on an average energy price of 8c/kWh).

A spreadsheet is available for you to use when calculating the benchmark and the energy intensity for your bakery. This spreadsheet is online through the Department of Industry, Science and Resource's web site at www.isr.gov.au/energybestpractice

You will need your own licensed copy of Microsoft Excel to use the spreadsheet.

Alternatively you can photocopy the blank table provided in this appendix and manually enter and calculate information.

Figure 1—graph of monthly energy performance for a typical shop bakery



Blank monitoring sheet

	Gas m^3	Gas kWh	Electricity kWh	Total energy use kWh	Total flour kg	Energy intensity kWh/kg	Benchmark kWh/kg
	A	A x 10.81 = B	C	B + C = D	E	D/E = F	G = 1.97– 0.000139xE
Jan							
Feb							
Mar							
Apr							
May							
June							
July							
Aug							
Sep							
Oct							
Nov							
Dec							
Total							

Handy hints

Avoid locating a freezer close to an oven or prover exhaust area since this will work against your efforts to reduce energy efficiency.

Appendix B Examples of energy efficiency best practice

Example 1—scheduling times for oven operation and production

A shop bakery discovers that its oven operating costs, after the initial heat-up period, average $2.50 per hour.

The bakery also discovers that its heat-up time is longer than required and can be reduced by 30 minutes without affecting product quality or disrupting the 04:00 production start time.

Since more savings are achieved by carefully scheduling work during the last four hours of the working day, the bakery increases its oven loading and reduces its operating time by one hour. The oven is also shut down more quickly than before.

The original and revised schedules are shown in Table 7.

Under the original schedule, the oven is used from 02:30 until 14:30, for a total of 12 hours.

Under the revised schedule the oven is used from 03:00 until 13:00, for a total of 10 hours.

This change in work practice leads to an energy saving of $5 per day or $1 500 for a 300-day working year. The total amount saved is even greater when the costs relating to the significant reduction in labour, resulting from this good practice, are factored in. In addition, since the oven is on for less time, less heat is lost from the oven to the bakery, and the air-conditioning load is reduced. This results in further energy and costs savings.

Table 7—schedules for shop bakery in Example 1

Time	Original schedule		Revised schedule	
	Action	Oven loading	Action	Oven loading
02:00	02:30 switch on			
03:00			switch on	
04:00	baking starts	100%	baking starts	100%
05:00		100%		100%
06:00		100%		100%
07:00		100%		100%
08:00		100%		100%
09:00		60%		80%
10:00		60%		80%
11:00		40%		40%
12:00		40%	12:50 baking stops	
13:00	13:50 baking stops		13:00 shut down	
14:00	14:30 shut down			
15:00				

Handy hints

Bakery design and layout can have a major influence on the efficiency and convenience of producing baked goods.

Example 2—choosing energy efficient baking equipment

A new deck oven costs around $50 000 and uses $10 000 worth of electricity a year.

A bakery has a choice of two suitable ovens, with one offering a 20 per cent saving in energy use through improved insulation, better door seals and more accurate temperature controls. The economics of the two types of oven are compared in Table 8.

Table 8—a comparison of costs for two ovens

	Standard oven	High efficiency oven
Initial cost of the oven	$50 000	$56 000
Estimated energy use (standard work cycle)	400 kWh per day	320 kWh per day
Average energy cost	8c per kWh	8c per kWh
Total operating cost per working day	$32 per day	$25.60 per day
Working days per year	300	300
Total energy cost per year	$9 600 per year	$7 680 per year
Net energy cost saving per year		$1 920 per year

The simple payback for the extra investment of $6 000 is:

$$\frac{\text{Extra cost}}{\text{annual savings}} = \frac{\$6\,000}{\$1\,920} = 37.5 \text{ months } (3.1 \text{ years})$$

The high efficiency oven therefore appears to be a sound investment.

Note: this case study does not relate to ovens from particular manufacturers. It is simply used to demonstrate the type of balance that can be achieved between operating costs and capital costs. The potential for savings for specific makes and types of ovens should be checked with suppliers and, if possible, with a referee who has used the equipment previously.

Example 3—reducing the use of hot water in a bakery

The hot water supply to a basin used for manual tin washing is normally left running while the operator collects new batches of tins to wash. After five minutes, the basin is full. For approximately one minute, hot water runs out of the overflow. The operator then returns, turns off the tap and starts to wash the tins.

This wastes 3 762 kWh and costs the bakery $376 a year, as detailed below:

Water flow rate	=	20 litre/minute
Water temperature	=	55°C
Volume of washing basin	=	100 litres
Cost of water	=	50c per kilolitre
Cost of effluent disposal	=	40c per kilolitre

If you assume that the bakery handles 15 washes per day, times 240 working days per year, the following statistics emerge:

Number of washes/year	=	3 600
Hot water wasted/year	=	3 600 x 20 = 72 000 litres
Cost of wasted water/year	=	72 x 90c = $64.80
Energy wasted/year	=	72 000 x 4.18 x (55–10) = 13 543 200 kJ

This is equivalent to 3 762 kWh/year.

The next step is to factor in how the water was heated. If it is electrically heated, mostly at peak rate, at an average cost of 10c/kWh, the following statistics emerge.

Cost of wasted energy/year	=	3 762 x 10c = $376.20

If a bakery faced with this type of scenario changed its work practices and eliminated hot water wastage, it could achieve the following annual savings:

Water cost savings	=	$64.80
Energy cost savings	=	$376.20
Total annual cost savings	=	$441

The current costs of providing 100 litres of water for every wash cycle in this case are:

Water costs	=	$324
Energy costs	=	$1 128
Total annual cost	=	$1 452

It may also be possible to further lower costs, depending on whether a 100-litre basin is required and whether the number of wash cycles can be reduced.

Handy hints

Recent breakthroughs in oven design can help reduce energy costs.

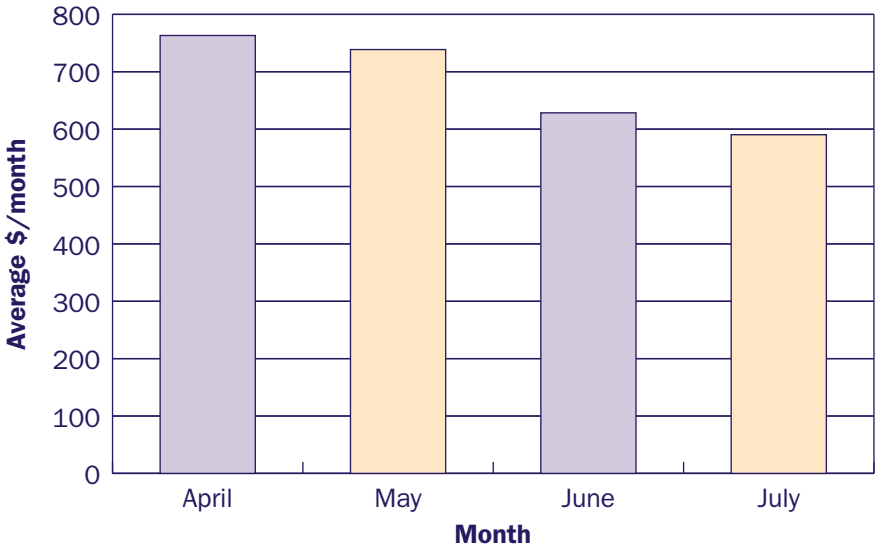
Appendix C
Example of good energy efficiency practice

A number of sites were visited during the bread-baking sector study. One site reported a reduction in electricity consumption by 20 per cent over the previous four months, through the introduction of energy efficiency initiatives. These reductions were achieved with little or no change in the quality or volume of production, or additional expense. Dedication from the bakery owners, managers and staff, however, was essential in implementing the following initiatives:

1. switching off unused decks on the oven with the thermostat;
2. switching off oven and prover when finished;
3. not using air-conditioning on cool days;
4. considering production scheduling to ensure that equipment run time is optimised; and
5. loading mixers to maximum capacity.

Figure 2 illustrates the energy efficiency benefits achieved during the four-month period.

Figure 2—monthly energy costs



Appendix D
Conversion table

Fuel type	Measured units	Multiply by to get kWh
Electricity	kWh	1.0
Natural gas	cubic metres	10.81
	MJ	kWh 0.28
LPG	litres	7.0

Appendix E
Energy efficiency case studies

This appendix is provided for you to add case studies of energy efficiency in shop bakeries to your guide. Stay tuned for new case studies, which will be available through Energy Efficiency Best Practice on an ongoing basis.

If you would like to showcase your bakery's successes and lessons learned please contact Energy Efficiency Best Practice—see contact details on page ii.

Handy hints

When buying a new oven or other equipment, consider energy efficient models. Using a more efficient oven could offset a higher purchase price.