

Commercial Refrigeration

work

Energy Smart.

Smart use of commercial refrigeration can provide significant savings for businesses.

There are a number of simple practices and energy efficient refrigeration systems that can help you save money.

By saving energy not only will the profitability of your business improve, you will also help protect the environment by reducing greenhouse gas emissions.

Strategies for reducing refrigeration energy use

Reduce the amount of cooling needed

- Load the product when cool.
- Set thermostat to avoid overcooling merchandise.
- Turn lighting off when not needed.
- Turn anti-sweat heaters off when not required.
- Defrost frozen goods in the refrigerator.

Keep heat out

- Use high insulation levels.
- Locate the refrigerator in a cool position.
- Avoid direct sunlight.
- Maintain the door seals.
- Keep the door(s) closed as much as possible.
- Avoid drafts on open display units.
- Cover display units after hours.
- Use PVC strip curtains on open display units.

Help the evaporator

- Keep defrosted.
- Allow enough air circulation.

Help the condenser

- Keep the condenser clean and free of dust.
- Locate in cool surroundings.
- Avoid direct sunlight.
- Ensure sufficient ventilation.

Facts and Figures

- Commercial refrigeration systems consume around 6,600 GWh per year in Australia. This is enough to power around 1.3 million homes.
- Greenhouse gas emissions from commercial refrigeration systems are around 6.6 million tonnes of carbon dioxide per year. This is equal to the annual greenhouse gas emissions from approximately 1.3 million cars.
- Technical improvements to modern refrigeration systems have the potential to reduce energy consumption by 15%-40%.
- Improving simple operational practices requires minimal capital investment and can often reduce energy costs by 15% or more.



Adding covers to display units after hours reduces heat gain.

Use less refrigeration space

One of the easiest ways to save energy is to simply use less refrigeration. It is quite common for businesses to have considerably more refrigeration space than is required. Carefully consider your refrigeration requirements and what refrigeration equipment is best suited for your business.

- Consider how much non-perishable product needs to be stored cold. Only stock enough merchandise in refrigerators to meet the demand.
- Consider putting refrigerated goods into a smaller number of refrigerators.
- If cooling requirements are seasonal, consider shutting some refrigeration equipment down during low-use periods.

Review thermostat settings

Setting thermostats to unnecessarily low temperatures simply wastes energy and provides little benefit. Set thermostats to the maximum suitable for the product type. Be sure to regularly check temperatures to make sure that correct temperatures are maintained.

Load products efficiently

A significant amount of energy can be used in cooling products down from the ambient temperature to the refrigerated temperature, especially high turnover products. Storing goods in a cool area before loading will reduce the time needed to cool and therefore reduce energy consumption.

- Load goods into refrigerators when they are cool - avoid storing goods in hot areas such as in direct sun on a loading bay.
- Transfer pre-cooled products as quickly as possible from one refrigerated environment to another.

Pay attention to location

Locating refrigeration equipment in cool positions will reduce energy use significantly. Hot locations, such as near cooking equipment or heated display units and in direct sunlight should be avoided.

For self-contained refrigeration equipment, it is also important to provide good ventilation around the condenser coils and fans.

Consolidating stock requires less refrigeration space.



Manage anti-sweat heaters

Anti-sweat heaters are commonly used to reduce condensation on some types of refrigeration equipment. The heaters use energy directly and also contribute to the cooling requirements of the system.

The need for anti-sweat heaters can be reduced or eliminated by using higher insulation levels and avoiding thermal connections between the internal and external surfaces. However, this may be difficult to achieve with some types of display equipment.

- Determine if anti-sweat heaters are really necessary. In some climates, condensation may not form at all or only during some parts of the year.
- Consider turning anti-sweat heaters off after hours. Timers may be useful to turn equipment on and off.

Reduce lighting needs

Lighting can be a major energy user in refrigeration systems. This is particularly the case for display units where products for sale must be attractively presented.

On average, lighting uses around 20% of the energy needed in display units, but may be as high as 40% for some types of equipment. Not only does the lighting consume energy, it also generates heat, which adds to the cooling requirements of the refrigeration system.

- Reduce excessive light levels. Use lower wattage globes or fewer fluorescent tubes.
- Use energy efficient lighting. Fluorescent lighting is best where lighting will be on for long periods.

- Turn lighting off when not required. It may be necessary to install separate switching for lighting. Consider using timers for display units and occupancy sensors for cool rooms.
- Regularly check that door operated switches function properly.

Use tariffs intelligently

Make the most of off-peak tariffs. Many businesses can operate equipment in off-peak periods where the cost of electricity is cheaper. For example, timers may be used to utilise overnight off-peak rates to cool non-perishable products loaded the previous evening.

For businesses with demand based tariffs it may be possible to turn refrigeration for non-perishable products off during peak use periods so as to reduce the overall peak demand.

Optimise location of compressors and condensers

Self-contained refrigeration systems add heat to the building. In most cases this heat must be removed by the air conditioning system. This increases cooling costs and may also necessitate a larger capacity cooling system.

Locating the compressor and condenser in cool and well ventilated areas outside the building will remove this heating effect and improve efficiency. In addition, the remaining refrigeration equipment will provide a cooling effect, which will reduce air conditioning requirements further.

Understanding refrigeration

Refrigeration equipment works by transferring heat. The heat is absorbed by the evaporator inside the cooled space and is transferred to the condenser outside the cooled space by a compressor. The compressor is the main user of energy in refrigeration systems.

Refrigeration system components:

- **Refrigerant** - a gas that is circulated around the system.
- **Evaporator** - absorbs heat in the refrigerator and transfers it to the refrigerant.
- **Compressor** - 'pumps' the refrigerant around its circuit.
- **Condenser** - rejects heat from the refrigerant to the surrounding space.
- **Control device** - controls the flow of refrigerant to the evaporator.
- **Insulated enclosure** - holds the cool product and stops outside heat entering.

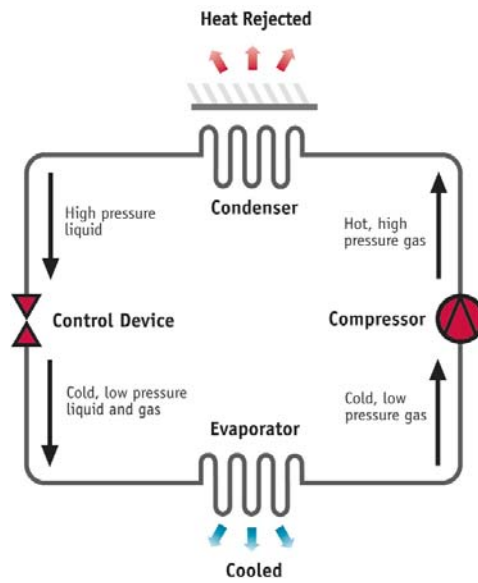
Other components found in many refrigeration systems include:

- **Fans** - circulate air around the condenser and evaporator.
- **Lighting** - for product visibility and signage.
- **Anti-sweat heaters** - prevent condensation.

Do basic maintenance

Paying attention to basic maintenance can reduce energy use.

- Regularly check and maintain door seals.
- Defrost evaporators regularly (if not auto-defrost).
- Defrost freezers when ice build-up reaches 5mm thick.
- Keep condenser coils clean.
- Check that equipment is running smoothly and quietly.
- Check that the compressor is cycling on and off regularly.



How refrigeration systems work.

General purpose refrigerators and freezers

General purpose refrigerators and freezers are often used for storing food and beverages. They can be upright, chest type or under counter and are available in sizes from 100 litres to 2,000 litres.

Standard domestic refrigerators and freezers are commonly used. These can be low cost and very energy efficient.

For large and high use applications, specialised commercial-quality equipment should be used. Commercial types are more durable and are available in a wide range of sizes, including custom built models designed to hold particular types and sizes of products.

Energy management tips

- Provide enough ventilation. Units that are 'built-in' or are installed under counters may have restricted ventilation unless this is specifically provided.
- Don't leave door(s) open.

Features to look for

- For domestic fridges and freezers, use the energy rating labels.
- For commercial units, ask the supplier about energy efficiency features and energy consumption. Good suppliers should be able to provide this information.
- Avoid features that waste energy and may provide little benefit (such as glass doors).

Energy Rating Labels



All new domestic refrigerators and freezers carry energy rating labels, which use star ratings to help you compare the energy efficiency of different models.

The more stars (six is best) the less electricity is used and the lower the operating costs. This also means reduced greenhouse gas emissions. A one star improvement can save around 20% on running costs for the most common types of fridges and freezers. Rating labels will also tell you the expected annual energy consumption in kilowatt-hours per year (kWh/Year).

For more information, contact SEDO's Energy Smart Line on 1300 658 158 or you can visit www.energyrating.gov.au

Display and vending units

There are a wide range of products falling into this category, including glass door food and beverage merchandisers, open multi-deck display units, open chest type units, food and beverage vending units, chilled water dispensers and glass counter displays. In many businesses these units can be the major energy user.

Display and vending units need to have excellent product visibility and easy product access for customers. These requirements usually result in increased energy consumption compared to general-purpose storage systems. For example, the glass doors used to provide product visibility have lower insulation levels than equivalent solid doors. Similarly, the open nature of multi-deck display units provides excellent access for customers, but these units generally have higher energy consumption.

Smaller units are usually self-contained and are available in standard 'off-the-shelf' and custom built designs. Larger units, such as those used in large supermarkets, are usually custom designed and built for the application. Compressors and condensers placed in a cool location outside can provide significant energy savings.

Free Fridges?

Product suppliers provide display and vending units to retailers to promote a particular brand of product. These "free" fridges and freezers are installed in retail outlets across Australia and many stores have several of these units.

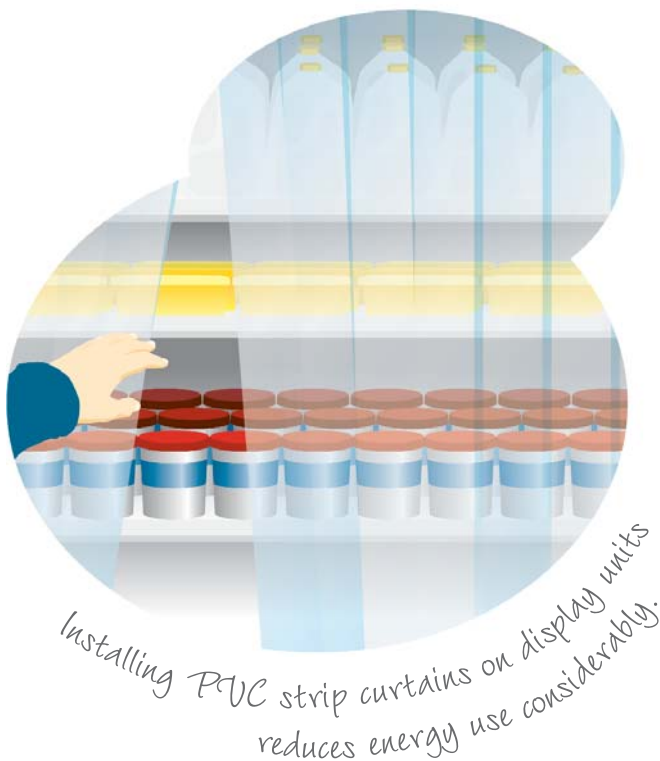
Unfortunately, there is little incentive for the equipment owners to provide more efficient types as they are not responsible for energy costs, which are borne by the stores. In addition, it is usually a requirement that the supplied equipment is only stocked with the supplier's products. This often means that more refrigeration equipment is used than is necessary.

It is worth considering what benefit is obtained from the refrigeration equipment provided by suppliers. In some cases it may be worthwhile using fewer units than the supplier is willing to provide. It may also be practical to buy your own energy efficient equipment so that different brands can be stocked more efficiently in the one unit. This can significantly reduce your ongoing energy costs.

In all cases ask the supplier for the most energy efficient refrigeration equipment available and for operating instructions so that you can operate the equipment efficiently and reduce your energy costs.

Energy management tips

- Consider if all the display and vending equipment is really necessary. For example, use sales to determine how much of each product really needs to be displayed. Also, consider putting products from several display units into one display unit.
- Display products effectively so that they are well laid out and that glass doors are free of condensation and signage that will reduce visibility. By doing this, customers will not need to search for merchandise and allow cold air to escape.
- Use energy efficient cool rooms for product storage and have a smaller area for display refrigeration.
- Locate open display units away from draughty areas, which can drive out cold air and bring in warm air.
- Locate open and glass door display and vending units away from direct sunlight or cooking equipment.
- Add covers or extra insulation to display units after hours to reduce energy consumption. This is particularly important for open types such as multi-deck displays and open topped chest freezers. You can also put covers on the glass doors of drink merchandisers. Many specially designed products are available from suppliers. It is also possible to construct simple covers out of materials such as polystyrene foam, reflective foils and air-cell insulation materials.
- Install PVC strip curtains on open multi-deck display units.



Features to look for

- It is important to choose the most efficient type of display unit for the job. For example, while open multi-deck units may be appropriate for high turnover products, glass door merchandisers will generally use less energy and may be more suited to products with a lower turnover.
- Look for energy efficient features, including:
 - glass doors with triple glazing, low-e coatings and thermal breaks in the doorframe
 - separate switching for lights and anti-sweat heaters
 - sliding doors, etc on counter displays
 - integrated pull down covers for open display units.
- External compressors and condensers on large display systems.

Cool rooms and freezers

Cool rooms are commonly used for bulk product storage in a wide range of applications in retail, food and agricultural industries. They range in size from a few cubic metres up to warehouse sized cool rooms.

Many cool rooms are custom built for the size and purpose required, however they are also pre-built in a variety of sizes. Most are built from prefabricated insulated panels. The refrigeration equipment is either packaged integrated units or custom designed.

Energy management tips

- Don't leave doors open when entering and leaving cool rooms. Self-closing doors are useful, but may not be suitable for all applications. Plastic strip curtains or swinging doors are good options for frequently accessed cool rooms. Automatic doors and those operated by remote control may also be suitable.
- Avoid frequently entering cool rooms for small quantities of product. Consider keeping high-turnover products in a separate, smaller refrigerator.
- Utilise cool room space effectively. If you have more than one room investigate the potential for reducing their use by consolidating product.



- Turn lighting off when not required. Automatic timers and occupancy sensors may be helpful.
- Regularly check for damaged insulation, poorly fitting doors and damaged seals. Cool rooms are often subject to relatively harsh treatment and may sustain damage that reduces performance.
- Locate cool rooms in the coolest place possible, preferably out of direct sunlight.
- Locate compressors and condensers in cool, well-ventilated areas.

Features to look for

- Carefully assess your requirements before choosing a cool room. Factors such as product cool down needs, turnover levels, humidity controls and access requirements will have a significant effect on design and energy use. For example, a cool room designed to cool product rapidly will require a higher refrigeration capacity compared to one where this is not required - even if the physical size of the cool room is the same.
- Insulation has a big impact on energy consumption. The most cost effective insulation will depend on many factors including the cool room temperature, the expected external temperature range, exposure to sunlight and energy costs. In many cases it may be cost effective to specify higher levels of insulation - particularly in hot climates and where energy costs are higher (such as off-grid areas).

- The components used in the refrigeration system will influence energy consumption. Specify compressors, evaporators and condensers that are the right size for the load requirements. Consider using multiple compressors in large systems or where load requirements are highly variable.

Purchasing new systems

Specify the right type and size

A good understanding of refrigeration requirements is an essential first step when buying new equipment. A system that is not right for the job will either be expensive to buy and run or will be inadequate for the job. Answering the following questions and using the information in this publication will help in finding the most suitable system.

- How much product needs to be stored?
- What product cool-down rate is required?
- How much product turnover is there?
- How accessible does the product need to be?
- How visible does the product need to be?
- What are the temperature and humidity requirements?
- What space restrictions are there?
- What ambient temperature conditions will the equipment be operating in?

Look for efficient components

Reliable and easily comparable energy consumption information is generally not available for commercial refrigeration systems at present. This makes comparing various options difficult.

Environmental and health considerations

Refrigeration and the environment

Older refrigeration systems may use CFC or HCFC refrigerants (eg CFC R502). These potent substances deplete the ozone layer and have been banned from sale in Australia. If your system utilises CFC or HCFC refrigerant you should consider changing to a newer system, which uses a more 'ozone friendly' refrigerant. These newer systems are also generally more efficient. For more information on refrigerants contact Environment Australia.

Greenhouse gas emissions, mainly carbon dioxide, result from burning fossil fuels for electricity. So reducing the amount of

electricity used for refrigeration will help in reducing greenhouse gas emissions.

Refrigeration systems can also cause noise and visual concerns, particularly systems located near residential areas. Careful design and location can reduce the impact of noise and visual pollution significantly.

Safety

Refrigeration is used for three main reasons:

- to keep potentially hazardous products safe to eat (eg dairy and meat products)
- to extend product life (eg fruit and vegetables)
- to enhance products for consumption (eg refrigerated drinks and confectionary).

For potentially hazardous products, it is usually required that products are stored below 5°C or above 60°C. Other specific health and safety requirements may also apply.

Poor temperature control of food is a major cause of food poisoning. It is therefore important that, when considering energy efficiency initiatives, your business has a good understanding of the food safety requirements for the types of food that the business deals with. For more information regarding food safety contact your Local Government Environmental Health Officer.

However, it is possible to develop a reasonable understanding of how efficient a system is by looking at the different components and features. Ask suppliers about how efficient the various components are and how the overall design reduces energy consumption. Specifying efficient components will generally add to the cost of systems, but it should be more than offset by savings in energy.

- **Compressors** - vary in efficiency and many manufacturers make both standard and high efficiency compressors. Ask for the most energy efficient available. Three phase drive motors are more efficient than single phase and variable speed compressors can provide extra energy savings.
- **Evaporators and condensers** - need to be the right size and well located in order to extract/reject heat.
- **Cabinet design and insulation** - look for well insulated cabinets. Check both the thickness and type of insulation. Try to avoid cabinet designs that have 'weak spots' in the insulation, such as thermal connections between the internal and external surfaces and areas of single glazing.

- **Controls** - many different control systems are available ranging in complexity from very simple thermostat controls to more sophisticated programmable digital controls. The type of control will depend on the application. In general, digital controllers will provide better temperature control and many have more sophisticated defrost controls that can further reduce energy consumption.
- **Extras** - look for energy efficient lighting and anti-sweat heaters that can be controlled easily and independently.

Use a consultant

For large applications it may be worthwhile to use a professional refrigeration engineer to ensure that all aspects of the system provide the most cost effective and efficient solution. Consultants can also supervise installation and commissioning to ensure that the system is installed and operating correctly.

Minimum Energy Performance Standards

At present Minimum Energy Performance Standards (MEPS) are in place for domestic refrigerators and freezers. MEPS prevent low efficiency models from being sold, providing some protection to purchasers. Even with MEPS there is still considerable variation in the efficiency levels of equipment and therefore it is important to purchase efficient products.

MEPS for commercial refrigeration systems are expected to be introduced in early 2004 and result in greenhouse gas emissions savings of over 1 million tonnes of carbon dioxide per year by 2015.

The introduction of MEPS will also result in more information on energy consumption being available from refrigeration system manufacturers and suppliers.

For more information on MEPS, contact the Australian Greenhouse Office.

More Information

If you would like more information regarding refrigeration you should contact a refrigeration engineer or visit the Australian Institute of Refrigeration, Air-Conditioning and Heating.

Further energy saving advice for business is also available from SEDO's **Energy Smart Line**. Simply call **1300 658 158** or alternatively visit SEDO's website at www.sedo.energy.wa.gov.au

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