Commercial
Heating, Cooling and Ventilation

work Energy Smart!

Heating, cooling and ventilation are very important for your business as they provide a pleasant and comfortable environment to work or shop.

It is estimated that heating, cooling and ventilation account for 70% of energy consumption and 63% of greenhouse gas emissions in commercial buildings in Australia. In a typical office they can account for about 40% to 50% of energy bills.

Reducing the need for heating and cooling

The amount of heating and cooling needed in a building is dependent upon the heat gain or loss from outside the building and the internal heat gain from within the building. Reducing these heat gains and losses will reduce heating and cooling needs.

Building energy use

Building occupants, lighting, refrigeration equipment, cooking and office equipment and even some parts of a cooling system can add to a buildings heat gain in summer.

Whilst heat gain from a building's energy use is not such an issue over winter, reducing energy use will lead to lower operating costs.

Building design

Building design is the most important factor in reducing external heat gain and loss. Sensible building design can allow the sun's free heat energy into the building in the cooler months (known as passive solar heating), while providing adequate window shading in the warmer months.

Tips to reduce external heat gains and losses

- Insulate the building, particularly the ceiling/roof. It may also be beneficial to insulate walls and floors depending on the climate, the type of building and the hours of use.
- Shade windows from direct sun when cooling is required. Double glazing, window tinting, reflective coatings and internal blinds and curtains can be used if external shading is not practical. Heavy curtains can also be used to reduce heat loss from windows in winter.
- Minimise the use of skylights and roof glass. Skylights can admit beneficial daylight into a building, but too much roof glazing can add to the amount of cooling needed.
- Reduce air leaks. Ceilings, poorly fitting windows and doors and permanently open vents all add to unwanted heat gain or loss.
- Keep doors closed. Door closers, electronically controlled automatic doors, plastic strip curtains and air curtains can minimise heat gains or losses, whilst still allowing easy entry.

Selecting appropriate heating and cooling systems will save you energy.

Types of cooling systems

Evaporative systems

Evaporative coolers are available in a large range of sizes, from small portable units that need to be manually filled with water up to very large ducted systems.

Evaporative systems:

- are relatively low in cost
- only work effectively in low humidity areas - in these climates evaporative cooling offers the most energy efficient cooling available
- are ideal for buildings that have poor air sealing or where doors are left open as part of business activity such as retail stores.

Refrigerative air conditioning systems

Refrigerative air conditioners work by transferring heat from inside the building to outside the building.

Wall and split system air conditioners

Wall (also known as room air conditioners or RAC's) and split system air conditioners are small sized refrigerative air conditioners which:

- are relatively low in cost
- use considerably more energy than evaporative systems
- are not as energy efficient as larger packaged or central cooling systems
- are suitable for small to medium sized areas such as small retail stores
- can be easily retrofitted to existing buildings
- can be used to create a simple zoning system via installation of multiple units
- can work as reverse cycle heaters and therefore provide both heating and cooling in one unit.

Split systems are usually quieter to operate, have slightly higher peak efficiency and are available in larger capacities. With both types of systems, look for the most energy efficient model using the energy rating label.

Packaged systems

Packaged systems are built from separate components that are 'packaged' together. They generally have a central refrigeration unit (some have multiple units) and provide cooled air to multiple outlets using air ducts and piped refrigerant. Packaged systems:

- are suitable for medium sized areas such as restaurants and fast food outlets
- are more efficient than wall and split systems in many applications
- can have a lower capital cost than chiller systems
- can be customised to the application
- can include energy saving features such as zoning, return and fresh air dampers, economy cycles and night time cooling
- can also work as reverse cycle heaters.

Chiller systems

Chiller systems are large refrigerator units that include one or more compressors, a condenser and an evaporator. The condenser may be air-cooled or water-cooled. Water-cooled systems are typically more efficient.

It is important to ensure that energy efficiency is considered when designing a centralised chiller system. Sizing, selection of individual components and the overall system design can have a large impact on energy efficiency. Chiller systems:

- are suitable for large areas such as hotels, hospitals and large office buildings
- are generally more efficient than other refrigerative systems
- can be customised to the application
- provide a range of energy efficiency options
- can be combined with a boiler system for heating.

Ventilation systems

Ventilation of areas that are not air conditioned is often required for removal of vapours (eg fumes), odours and/or heat. Ventilation can be achieved mechanically, using fans, or naturally.

The same energy efficiency principles apply to ventilation systems as air conditioning systems.

- Natural ventilation should be used where possible.
- Ventilators can be operated automatically to provide 'controlled ventilation'.
- Fans should be sized correctly and only operated when required.
- Avoid ventilating areas that are air conditioned.

Insulation will reduce heating and cooling requirements.

Types of heating systems

Heaters can be categorised into two main types - convection heaters and radiators.

Convection heaters heat the air, which is then circulated through the space, either naturally or by fans.

Radiators direct heat towards the object/persons to be heated and usually use a high temperature 'red' heat source.

Select the appropiate heater for the task.

Electric resistance heaters

Electric resistance heaters use electricity to directly produce heat in heating elements. Heat may be distributed by radiation (such as bar radiators) or convection (such as fan heaters). These heaters:

- are suitable for heating very small areas, open and breezy areas (using radiators) and where heating is only used occasionally
- are often relatively low in capital costs
- usually have high operating (energy) costs.

Reverse cycle air conditioners/ heat pumps

Reverse cycle air conditioners - work on the same principle as refrigerative air conditioners, but in reverse mode when heating. They transfer heat from outside the building to inside the building. These systems:

- are suitable for small areas
- are much more efficient than electric resistance heating and gas heating, typically providing two to four times the amount of heat for the same energy consumption.

Many window/wall and split air conditioners are reverse cycle and thus provide both heating and cooling. Look for the most energy efficient model using the energy rating label.

Heat pumps - are also suitable for large areas. They may be air sourced (extract heat from outside the building) or they may source heat from other sources, including the ground, ground water or surface water. It is best to consult a specialist if considering this option.

Gas heating

There are many types of gas heaters available. A large number are designed for heating houses, but they can be used in many businesses. Most types are available in both natural gas and liquefied petroleum gas (LPG) models.

Unflued heaters - vent the combustion exhaust gases directly into the building and therefore for health and safety reasons, minimum outside air ventilation levels are required to ensure adequate air quality. When choosing a heater look for the energy rating label and select a heater with features to suit the heating requirements. Unflued heaters:

- are generally suited to heat small areas
- are normally the cheapest type of gas heater to buy.

Flued heaters - vent the combustion exhaust gases outside the building. Their efficiency can vary considerably so it is important to look for the energy rating label when choosing a new heater. Flued heaters are:

- available in larger capacities
- generally more expensive to buy than unflued heaters.

Ducted systems

Ducted systems supply heated air to multiple outlets via ducts from a central heating source. Air is returned to the heating unit for reheating and may be mixed with incoming fresh air. Another common form uses decentralised electric elements, located in the duct system, to heat the air.

It is important to consider the overall system design as the energy rating label only rates the performance of the furnace. These systems:

- are suitable for medium to large open areas and floors of office buildings
- can have considerable variation in the efficiency of heating furnaces. For example, a 2 star rated furnace will use over 50% more gas than a 5 star rated furnace.

Boiler systems

Boiler systems operate by producing hot water or steam that is then used to heat the air. These types of systems are more complex and it is important to consider energy efficiency at the design stage. These systems:

- are suitable for large areas such as hotels, hospitals and large office buildings
- are generally more efficient than other heating systems
- can be customised to the application
- provide a wide range of energy efficiency options
- can be used in conjunction with a chiller system (which provides cooling).

Active solar heating

Active solar heating uses solar heating panels, usually located on the roof, to heat air or water that is then distributed to the building via fans or pumps. These systems:

- can have very low or zero greenhouse gas emissions
- are suitable for supplementary heating to other heating systems or may be completely separate
- are generally costly in terms of up-front capital
- normally have very low running costs.

Purchasing new equipment

The best time to reduce energy costs from cooling and heating is at the design stage. Considering your needs carefully and then selecting and installing equipment to match those needs can not only provide the lowest operating costs but may also reduce initial costs.

Assess requirements carefully - ask yourself these questions

- What areas need to be cooled/heated and what conditions (temperature, humidity) are required?
- Is 'zoning' required to allow for different thermal loads and/or operating hours in different areas?
- Can reducing the external and internal heat gains and losses reduce your heating/cooling requirements?
- Can outside air be used to achieve energy savings?
- What controls are needed and where should they be located?
- Are there areas that need special attention - such as computer rooms, kitchens and areas used after normal operating times?

Step one - Choose the most appropriate system

The most appropriate air conditioning system will depend upon your needs. A combination of types may be the best option.

- One larger system can have lower maintenance costs than several smaller systems.
- A number of smaller systems may be more suitable and efficient when areas are not used for long periods.
- Packaged systems and chilled water systems tend to be more efficient than room or split air conditioners.
- Evaporative air conditioners are cheaper to run than refrigerative systems, but the performance of these systems deteriorates as the humidity increases.
- Fans provide cooling and help circulate warm air. They also cost very little to run.
- Radiators are generally more effective when heating large areas or outdoors.

Step two - Size the equipment properly

Undersized systems won't deliver the required cooling or heating. Oversized systems cost more to buy and may cause undesirable temperature fluctuations. Consult a specialist for expert advice on sizing your system properly.

Duct and pipe sizes can also have an impact on energy consumption. More energy is used to deliver air or water through small ducts/pipes than larger ones.

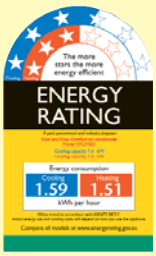
Step three - Look for the most efficient system

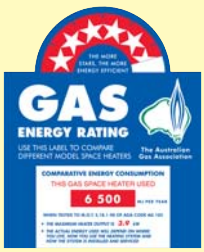
There is a lot of variability in the efficiency of air conditioning systems. Buying a high efficiency system may cost a little more initially but you should save money in reduced operating costs. The Coefficient of Performance (COP) is the ratio of heating/cooling produced for energy used. The higher the COP, the more efficient the system.

The efficiency of larger systems can also vary markedly. Ask your designer/installer for the most energy efficient system.

Step four - Make sure the system is installed and operated correctly

- Compressors and condensers should be located outside the building and out of direct sunlight.
- Ensure that the system is located correctly to heat or cool the area efficiently.
- Ductwork and pipework should be insulated wherever possible.
- Controls should be set and operating times, temperature setpoints and economy cycle setpoints, etc adjusted to suit the design requirements.
- Multiple outlet systems should be balanced for effective distribution of air.
- Staff should be trained to operate the system and manuals provided.





Energy rating label

Purchasing an energy efficient model may cost little or no more than a less efficient model. Look for the energy rating label on wall and split system air conditioners and on unflued, flued and ducted gas heating systems. This label provides a star rating that relates directly to the efficiency of the system and also displays an estimated annual energy consumption (under standard test conditions).

The more stars (six is the best) the less electricity/gas is used and the lower the operating costs. For example, a 4 star split system air conditioner will use about 25% less energy than a 2 star system. This also means reduced greenhouse gas emissions.

For more information on window/wall, split system and reverse cycle air conditioners visit the Energy Rating website and for information on gas heating systems visit the Australian Gas Association website.

How to save energy

There are many strategies to reduce heating and cooling costs. Some need little money or cost nothing at all.

Make the most of 'free' cooling and heating

Well-designed buildings can reduce external heat gain or loss by at least 50%.

In the south west of WA the climate can provide 'free' cooling for most of the year. By making the most of 'free' cooling you can save money.

In hot and humid conditions, it is important to reduce the amount of heat entering the building and to make the most use of recycled air.

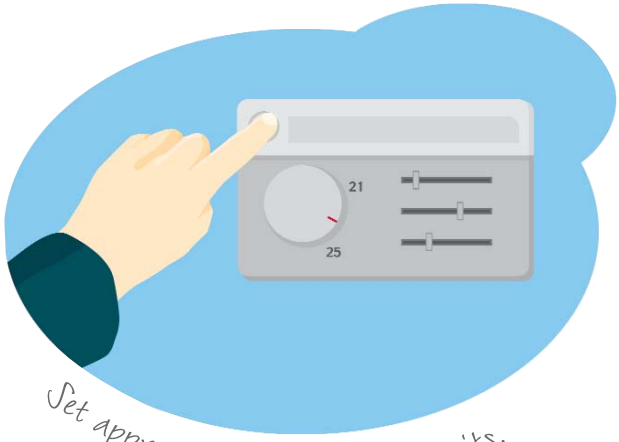
On cold days and nights it is important to reduce the amount of cold air entering the building.

Most of WA also has consistent and relatively high levels of solar radiation for a good part of the year. This can provide 'free' heating in many applications.

Manage fresh air intake

Making the most of fresh air will reduce energy consumption. Depending on your business and the type of system, you could:

- open doors and windows to allow cool breezes in, when conditions are suitable
- in systems where the air intakes are fixed, (i.e. fixed quantity of outside and recycled air) make sure that too much outside air is not being introduced. AS 1668 sets the minimum outside air requirements
- install motorised 'economy cycle' dampers. These can be combined with automatic controls to select the best air stream for energy efficiency
- install 'low leakage dampers' to prevent infiltration of outside air when not wanted
- use CO_2 sensors in large systems to monitor air quality and adjust fresh air intake to the minimum level required.



Set appropriate temperature limits.

Heat or cool only the areas required

Heating and cooling unutilised areas or allowing cooled/heated air to escape wastes energy and money as well as adding to your cooling or heating needs.

Dividing up a building into different 'zones' will reduce your energy needs. The number of zones required in a building will depend upon the orientation, shape, layout and what the building is used for.

Maintain equipment properly

It is worthwhile making sure your heating and cooling systems are running efficiently. A well-maintained system will save you money and operate more effectively. If you need any help in maintaining the equipment, you should talk to a technician or consultant.

- Keep condensers, evaporators, cooling coils and heater elements clean, as dust and dirt will reduce the ability to transfer heat.
- Regularly check and adjust controls such as timers and thermostats.
- Ensure dampers, valves, etc are opening and closing fully.
- Regularly check and repair any leaks in ducts and pipes.
- Keep insulation in good condition.

Reduce internal heat gain

- Use energy efficient lighting.
- Purchase energy efficient appliances and equipment. Use the energy rating label to purchase efficient appliances such as refrigerators and purchase ENERGY STAR compliant office equipment.
- Switch off equipment such as lighting and hot water units when not needed.
- Consider providing a separate ambient air supply and extraction system in those areas where a lot of heat is generated, such as in commercial kitchens.
- Locate refrigeration compressors and condensers that give off heat outside the building.

Control air conditioned areas

- If an area is unoccupied turn the air conditioning off.
- Don't over heat or cool. Set appropriate temperature limits in the range of 21°C to 25°C.
- Locate equipment and controls so that air conditioning can be turned off when not required. If a particular area such as a computer room needs to be continuously cooled, provide it with a separate air conditioning system.
- Use motion sensors or switches to turn off air conditioning if not needed.
- Use a separate system in areas that have exhaust fans such as kitchens.
- Install timers to automate air conditioning.
- Adjust times to suit seasons and your businesses needs.
- Install 'after hours' buttons, which will run air conditioning for a set time.
- Put temperature sensors in suitable locations and not in positions where they will experience abnormal temperatures (such as in direct sunlight).
- Install a Building Management System (BMS) to monitor and manage the operation of larger buildings.

Outdoor and open area heating

Heating large open spaces such as outdoor eating areas and industrial buildings and warehouses is quite inefficient. Gas radiator heaters (either natural gas or LPG) are typically used for heating outdoor and open areas. Electric radiators can also be suitable, but are more costly to operate. When heating outdoor areas keep the following points in mind:

- use windbreaks to reduce wind and make the most of free heating from the sun
- use radiative, not convective heat. Radiative heat will heat the occupants directly and provide warmth whatever the air temperature. It is also important to direct radiators at occupants
- turn off heaters when not required. Heat is lost almost immediately from open spaces so there is nothing to be gained from heating unoccupied areas.

Environmental issues

Greenhouse gas emissions

When fossil fuels such as coal or natural gas are burnt at power stations to generate electricity, they create greenhouse gases, which contribute to global warming. By reducing your energy use, you not only cut your costs but also reduce greenhouse gas emissions.

Ozone / CFC and HCFC issues

Refrigerants in older refrigerative air conditioning systems and chillers may use CFC or HCFC refrigerant (eg R11 or R12). 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 more 'ozone friendly' refrigerant. These newer systems are also generally more efficient. For more information contact Environment Australia.

Legionella

Legionella bacteria are naturally occurring inhabitants of moist environments and are the source of legionnaire's disease, a potentially fatal infection. Infection occurs by the inhalation of water aerosols containing the bacteria. Air conditioning systems, particularly those with cooling towers or evaporative systems need to be properly designed and regularly maintained to ensure safe operation. For further information contact your local health authority.

Visual and noise issues

Air conditioning systems can be noisy and unsightly, particularly equipment located outside such as condensers, cooling towers, compressors and fans. Consideration of the location and type of system should be made when installing any new equipment. In many cases local regulations will apply.

More Information
If you would like more information regarding heating and cooling you can contact a consultant or engineer or the Australian Institute of Refrigeration, Air-Conditioning and Heating.

Information on choosing domestic-sized heaters and air conditioners and other 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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