Heating & Cooling

Air conditioners

Building a new home is a great opportunity to be able to design your home so as that you can limit the amount of energy you need to use on air conditioning. By following solar passive design principles, installing insulation and by shading your home you can make your home more energy efficient and can then minimise the size of the air conditioner needed. The Australian Institute of Refrigeration Air Conditioning and Heating has a good calculator that allows you to estimate the required size of an air conditioner.
http://www.fairair.com.au/
The most energy-efficient domestic air conditioners on the market today are evaporative air conditioners. They are ideally suited to the Victorian climate as the run efficiently in dry climates.

When purchasing an air conditioner check its star rating. The Energy Rating scheme rates the energy efficiency of electrical products and appliances to help you with your purchasing choices. The star ratings of all labelled products and appliances are also available on the energy rating website. When comparing different appliances or equipment it is important to look at comparative energy consumption, which is shown in kilowatt-hours, rather than just the number of stars.

Solar airconditioners

Solar air conditioners models in development now mostly use evacuated solar thermal tubes, like the ones used in many solar hot water systems. Instead of drawing on mains power on the hottest days, pushing power grid peak loads into the red, these systems would just hum along on solar energy. And the hotter it is, the better they work. Consensus is that solar aircon for homes could be only a couple of years away. Currently there are several types of system in development.

One of the most promising systems uses evaporation. The system uses a desiccant to remove humidity from the air, which is then re-humidified using wet pads so the air delivered to the building is both cool and not too humid. The desiccant is then solar-heated to remove the moisture it has collected, so it's ready to work again. These systems are very far down the track in terms of technical development and will probably be among the first to be commercialised for domestic use. They're efficient, robust and easy to maintain. A slight downside with desiccant-evaporative systems, however, is that they use a fair amount of water: CSIRO has estimated 30-50 litres on a hot day for a residential system (that's about as much as a four-minute shower with a low-flow showerhead).

Though not as far along as evaporative systems, uses ejector jet pumps, which rely on heat energy to circulate a fluid through a cycle of condensation and evaporation. The principle has been known for around 100 years, and Dr Mike Dennis, who heads the Australian National University's (ANU) solar ejector jet program, believes it has the potential to be more reliable, cheaper and smaller than comparable systems. The ANU is working with commercial partners to develop a prototype.

Naturally, the new technology will sell for a premium at first. But as with all new technologies, the cost will reduce over time. Just as solar hot water is now economically viable for ordinary households, solar climate control will be as well.

More info

Australian National University - http://solar-thermal.anu.edu.au/low-temperature/solar-air-conditioning/

Energy Rating - www.energyrating.gov.au

resourceSmart - http://www.resourcesmart.vic.gov.au/documents/SRI_cooling.pdf

Your Home - http://www.yourhome.gov.au/technical/fs62.html#cooling

SUPPLIERS

Smartroof - www.smartroof.com.au

Solamate - www.sola-mate.com

Soletcair - www.solectair.com

Ceiling fans

Mechanical cooling isn't a substitute for good passive design, but when you've exhausted your design pallet a cooling fan can make the difference between loving summers and loathing them. Ceiling fans should be the first choice over evaporative coolers and air conditioners, for reasons of energy efficiency and cost savings.

The basic principle behind ceiling fans is that they push air around. In summer, a "chill factor" is created as air moves past our skin and evaporates the perspiration on its surface. According to the Your Home Technical Manual, air movement is the most important element of passive cooling.

Consumers keen to conserve energy need to weigh the airflow, measured in revolutions-per-minute (RPM) against the wattage generated to keep those blades circulating. The material that blades are made from – typically timber, moulded plastic or a metal such as stainless steel – affects both airflow and energy consumption, as does the angle and design of the blade. A good rule of thumb is to remember that ornate and overly decorative blades move less air and generally will be less efficient.

Decisions about which blade material to choose will depend on where you plan to put the fan. Powder-coated steel in a coastal location will corrode, whether indoors or outdoors – use timber, ABS plastic, marine grade stainless steel or aluminium instead.

In general, metal blades produce a higher airflow than timber blades, because they have a steep 22 degree pitch (compared to timber blades which usually have a 12 degree pitch). But metal fans use more power than timber, because the steeper the pitch, the more energy it takes to move air. They can also make an audible "whirring" sound, though this is unlikely in quality models.

Metal blades are slim (approx 1mm thick, compared to a 4 to 5mm timber blade) which means they can cut skin if it comes into contact with a moving fan, so you may want to avoid putting them into children's rooms. There are now a range of moulded plastic blades with that same 22 degree pitch.

Ceiling fans can also be used in winter, especially in large rooms with high ceilings. By switching them into reverse mode the fans draws air from the middle of the room and circulates it back down the walls and across the floor, shifting warm air that has accumulated near the ceiling back down to floor level, warming you up from the feet, instead of dumping air directly back down onto you as a regular cycle does.

More info

resourceSmart - http://www.resourcesmart.vic.gov.au/documents/SRI_cooling.pdf

Your Home - http://www.yourhome.gov.au/technical/fs62.html#cooling

SUPPLIERS

G warehouse - www.gwarehouse.com.au - Ph. (02) 6581 2411

Hunter Pacific - www.hunterpacific.com.au - Ph. (03) 8339 0985

Martec - www.martecceilingfans.com.au - Ph. (02) 8778 7500

Heaters

Building a new home is a great opportunity to be able to design your home so as that you can limit the amount of energy you need to use on heating. By following solar passive design principles, making sure your house is well insulated and draught-free, fitting good glazing or protected windows, you can make your home more energy efficient and can reduce the amount of active heating that is needed.

The ideal surrounding air temperature for the human body is around 23°C. However, this is for a body at rest, with light clothing, so there is no reason to run a heating system at this temperature. Generally a home will be comfortable with the thermostat set to around 20°C or even a bit lower, depending on what you are doing and what you are wearing. For every degree above 20°C that you set the thermostat, you use around 15% more energy to maintain that temperature

Reverse cycle air conditioners

Reverse cycle air conditioners work not by using electricity to make heat directly, but by using it to move heat from one place to another. In a reverse-cycle air conditioner, heat is taken out of the cold air outside and dumping it inside where it is needed. Because the electricity is only being used to run the fan and compressor motors, it is not unrealistic for an air conditioner using 2000 watts (2kW) to generate the equivalent of 6kW of heat.

This gives them an effective efficiency of well over 100%—in this example, the efficiency, or more accurately, the coefficient of performance (COP), is 300%, or a COP of 3. This makes the reverse-cycle air conditioner a better option than an electric radiant or fan heater—you get far more heating capacity for the energy dollars spent.

However, the initial purchase price is much higher—up to $1000 or more, depending on the size of the machine—but this may well be recovered by much lower energy bills in just a few years.

Radiant heaters

Electric radiant heaters are cheap to buy but expensive to run, and may be suitable for short-term uses such as in bathrooms—where you only want to heat you, not the whole room—as they are quick to heat up. Another version of these are the heat lamps found in many bathrooms. These are basically a large incandescent (which means glowing) element inside a glass bulb, and are designed to produce heat more so than light, although they do produce both. These bulbs are usually rated between 250 and 500 watts, making them similar in energy use to small radiant bar heaters. However, if they are used as lights and not just heaters, they can end up using a lot more energy than they should.

Gas heaters

Gas heaters use a gas flame to heat ceramic plates to orange heat, which then radiate heat into the room. They usually have a circulating fan that causes hot air to exit from the grill at the top of the heater, and indeed many units, usually known as wall furnaces, produce all of their heating in this manner.

They are ideal for heating large individual rooms or pairs of adjoining rooms, but can't heat an entire home unless it is relatively small and open plan. They are best suited to homes with relatively low ceilings. They also need to have a flue exit through the roof or wall of the home, which can detract from the look of the installation in some cases. Efficiency of this type of heater is quite good.

Some gas heaters are unflued, but these require good ventilation and so are less efficient, as outside air must continually enter the room to keep combustion gases to safe levels. They are not recommended.

Gas fake flame heaters (gas log fires)

If you love the look and feel of real flames, then a gas log fire is a possible option. They are far cleaner than an open fireplace, in both terms of maintenance and pollution produced, and many of them are quite convincing and look great. Efficiencies of these heaters vary somewhat, so you must ask about their heating ability compared to fuel consumption when buying.

Gas log fires have similar attributes to wall furnaces and similar gas heaters, and indeed are often considered to be in the same class as far as heating systems are concerned.

Gas central heating

The most common form seems to be gas ducted central heating, which has a large gas furnace outside or in the ceiling which pumps heated air to ducts in the ceiling or floor of each room. A system that can heat a whole home will use a lot of gas, so you must expect gas bills to jump up to several hundred dollars a quarter during the winter months. Obviously, this cost also corresponds to a similarly high production of greenhouse gas, although emissions from gas heating systems are usually much cleaner than electric heating systems.

One thing to watch out for with central heating systems is the placement of the thermostat controller. If it is placed away from the living areas and where there are no heating ducts, it will rarely give an accurate indication of the temperature in those living spaces, and may have to be set much lower than the temperature required.

Maintenance for these systems can be higher, and for roof-mounted systems, much more difficult. Installation can also be more expensive, especially for roof mounted systems, as part of the roof usually has to be lifted to install the heater as they are too large to fit through the average ceiling manhole.

Ducted systems also need (or should have) regular duct cleaning to remove any build-up of dust. This should be done for performance and hygiene purposes, as well as to reduce any possible fire risks.

Another advantage of ground-mounted systems compared to roof mounted is that floor mounted heating outlets can usually be closed, so you don't have to heat the entire home, but rather, just the area in use. There will usually be a minimum number of vents that must remain open.

Gas hydronic heating

Hydronic systems use heated water to heat the home by piping it through radiators in the major living areas of the house or pipes placed in the concrete slab of a home. The radiators heat objects nearby directly, as well as by heating the air in the home. These systems can be quite efficient and have the advantage that the radiator temperature can never exceed the boiling point of water, so can never be a fire hazard. This makes them ideal for drying clothes, or for homes with children.
Hydronic systems are usually gas fired, but can also source their heat from heat pump water heaters or even wood fired boilers.

Hydronic systems are best installed at the time of house construction so that the plumbing can be placed either in the concrete slab or through the walls.

There is also option for solar hydronic heating.

Solar flat plate and box collectors

These consist of a large area glass-covered flat box that is used to heat air which is then pumped into the home using a fan. Small (1 x 2 metres) flat box heaters can be used to heat rooms individually, while larger (3 x 4 metres) roof-mounted collectors can heat an entire home, at least when the sun is shining. These types of solar heaters have the advantage that they can be added to any home that has good solar access—meaning it has some roof space or window space facing north without being overshadowed by trees or other obstructions.

More info

resourceSmart - www.resourcesmart.vic.gov.au/documents/SRI_heating.pdf

Your Home - www.yourhome.gov.au/technical/fs62.html#heating

SUPPLIERS

Ecosmart Fire - www.ecosmartfire.com

Greenheat - www.greenheat.com.au

HRV - www.hrv.com.au - 1800 478 123

Jet master - www.jetmaster.com.au - Ph. 1300 538 627

Real Flame - http://www.realflame.com.au/

Smartbreeze - http://www.smartroof.com.au - Ph: 03 9510 3484

Solar Venti - www.ges.com.au

Sun Lizard - www.sunlizard.com.au

Wood & pellet heaters

Wood can be an excellent fuel because it is a renewable energy source, if sustainably harvested. However, air pollution from wood fires and the transport of firewood to urban areas are environmentally detrimental. About 20% of Australian homes use wood for heating, but the wood is often obtained from unsustainable sources. If you have a wood heater, use only sustainably-harvested wood to avoid habitat destruction and rare species extinction, and do not use treated timbers that may give off toxic pollutants when burned.

Burn wood only in high efficiency, low emission heaters. Open fireplaces lose up to 90% of the heat straight up the chimney, making them the least efficient of all heating technologies. Even worse, the hot air rising up the chimney draws large amounts of cold air into the room to replace it, making whatever heating effect the fireplace has even less effective. On the other hand, a well made and properly installed slow combustion heater can achieve up to 60% efficiency, assuming it is operated correctly.

Using wood for heating - what to do

- Use only an AS/NZS4013 approved slow combustion wood heater
- Use clean, dry wood from sustainable sources
- Keep the air damper open to allow the wood to burn efficiently with minimal pollutants
- Fill the firebox to a reasonable height to allow good airflow around the wood, making sure that there is at least a 25mm airgap between each log
- Keep the flue and the inside of the wood heater clear of ash, debris and creosote buildup
- Regularly check seals around the heater doors and ash removal trays.
- Close off flues and chimneys when they are not being used—this helps to prevent unwanted drafts.

What not to do

- Don't use damp or scrap wood that you happen to find lying around, without knowing its origins
- Never use treated pine or wood that may have been painted with toxic substances
- Don't overfill the firebox or else your wood won't burn efficiently
- Don't load up the firebox and turn the air damper down to let the fire smoulder all night
- Don't let the creosote build up in your flue—you risk having a flue fire.

Pellet heaters

Pellet heaters work in a very different way to a conventional wood heater. Instead of loading up a firebox with large chunks of wood and controlling the airflow, a pellet heater is controlled by giving the fuel all the air it can use and adjusting the rate that the fuel is fed into the firebox. Pellet heaters don't use wood in its natural form, but rather, small pellets made from wood or agricultural waste, such as rice husks. The waste is granulised, dried so it contains almost no moisture, and compressed into tiny pellets of a consistent size and density. They have a large surface area compared to their volume, and so burn quickly

The pellets won't spontaneously combust, so there has to be an ignition source to get the ball rolling. This is in the form of a small electric heating element. Once the pellets are burning, the element usually switches off, but electricity is still used to run the fans and electronic control system. Because these heaters use electricity, you will have to pay for an electrician to connect it. Even though the wood pellets burn almost completely, they do produce some ash which has to be regularly removed from the heater. Also, the auger system can make some noise, so it is recommended you listen to the heater operating before you buy it.

More info

resourceSmart - www.resourcesmart.vic.gov.au/documents/SRI_heating.pdf

Your Home - www.yourhome.gov.au/technical/fs62.html#heating

Department of Environment air quality pages - www.environment.gov.au/atmosphere/airquality/index.html

SUPPLIERS

Clean Air wood heaters - www.cleanairwoodheaters.com.au - Ph. (03) 9740 7444

Pellet Heaters Australia - www.pelletheaters.com.au - Ph: (02) 6628 7477

Listed suppliers are a guide and are not endorsed by Green Cross Australia or the Alternative Technology Association.

Hydronic heating (cross reference water heating)

Solar hydronic heating warms your home by taking advantage of an environmentally friendly energy source—the sun. Hydronic heating systems are typically gas-fired and have been used in Europe for almost a century. Solar hydronic heating systems that use evacuated tube solar collectors as the primary method of heating the water needed for the hydronic circuit are now available on the market.

Solar collectors capture energy from the sun and heat the water in a storage tank to the required temperature via a coil in the top of the tank. If the solar system does not heat the water in the pipes sufficiently, a backup heat source comes on and boosts the temperature. A pump circulates the hot water through pipes around the hydronic circuit, and the heat is transferred into the room through wall mounted panel radiators or through piping laid in a concrete slab floor during house construction. A separate heat exchange coil in the tank can provide domestic hot water for household use.

The backup burner can be run off natural gas, solid fuel, LPG, or even an electric heat pump. If you live in an urban area the most economical and environmentally friendly fuel for the backup is natural gas. Solid fuel can be labour intensive and LPG can be up to two and a half times more expensive than natural gas and will significantly increase the running costs of the system.

Panel radiators are most commonly made of pressed steel and can be installed in existing homes or during the building process. Each panel can be controlled independently, which gives you the benefit of being able to shut off heating in rooms that are not being used.

In-slab piping or 'foil coils'—made from polyethylene—are generally installed during the building process, but a concrete slab can sometimes be introduced to an existing home during renovations. When considering in-slab piping for your home talk to a concreter who is familiar with your area to ensure that your slab is not likely to shift or crack. The piping can tolerate some kinks and movement, but in-slab piping will not be suitable for all land areas. The piping is usually laid out in a minimum of three zones, which gives you the benefit of controlling heating to only the rooms which are being used. Once heated, the concrete slab floor converts into a radiant heat bank that releases heat evenly throughout an area.

In-slab floors can be tiled or the slab can be finished as a polished concrete floor. Carpet is generally unsuitable, due to the carpet underlay acting as an insulator and preventing the heat being released, but floor rugs can be an option. Timber floors can be laid over in-slab piping. However, the thickness of the wood can impact on heat transference and may also affect the warranty on the timber as the wood may shrink and buckle if it is not already kiln dried.

Solar hydronic heating with evacuated tube solar collectors is ideally suited to the Victorian climate. The response time of the heating will vary depending on your ceiling height and the level of insulation in your home, but in a house with a 5-star rating you will feel warm in about 20 minutes. With in-slab piping, areas are warmed evenly from the floor upwards which means the entire air mass is not being heated, resulting in reduced heat loss. Once your home is warm it is only a matter of maintaining the temperature, particularly if the rooms are well insulated.

Costs will vary greatly depending on the installation requirements, control choices, the size of your home and the backup burner fuel. Upfront installation costs tend to be much more than traditional gas duct heating but you will save on running costs and create a comfortable, more sustainable home while reducing your household carbon emissions.

Provided the system is serviced and maintained according to the manufacturer's instructions, the life span of the system could quite reasonably reach 20 to 30 years. The pumps and valves may need replacing throughout the system's life but the replacement costs will be relatively small. The federal and Victorian government offer a rebate for installing solar hot water systems.

Solar hydronic heating can be a comfortable and reliable form of heating which allows for temperature control and zoning to heat only the necessary areas. The system is silent, so there are no draughts or noise from fans. This makes it ideal for allergy sufferers and asthmatics as there is minimal air movement or dust circulated throughout the house.

Solar hydronic heating also has the benefit of minimising carbon emissions by utilising energy captured from the sun. The running costs and greenhouse gas emissions of a hydronic system tends to be lower compared to conventional heating methods such as central heating, but again this will vary depending on the fuel source of your backup burner.

It is important to remember that hydronic heating systems need to be installed by an experienced professional and the addition of a solar component increases the complexity of the system.

More info

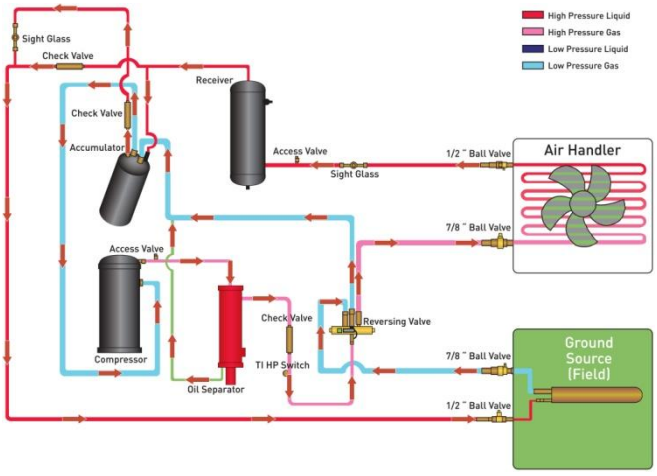
Sanctuary magazine - www.sanctuarymagazine.org.au

SUPPLIERS

Hunt heating - www.huntheat.com.au - Ph. 1300 00 1800

Solar hydronics - www.solarhydronics.com.au

Ground-sourced (geothermal) heat pumps



Relatively unknown in Australia, ground-source heat pumps are one way to reduce the amount of energy used in cooling and heating while still maintaining a comfortable home. Heat pumps are not a new technology and most households already have one—the fridge. The pipes at the back are hot compared to the inside of the fridge, as these pipes emit heat removed from inside. Usually heat moves from the hotter area to the cooler area but a heat pump reverses this direction.

Ground-source heat pumps transfer heat between the house and the ground. They make use of the fact that the temperature some metres below the surface is fairly constant over the whole year, varying between 10°C and 15°C. On a very hot day when the outside temperature is 40°C and the desired room temperature is 22°C, the reverse-cycle air-conditioner needs to provide at least an 18°C temperature difference between the condenser and the evaporator, while the ground-source heat pump only needs to provide a temperature difference of 7°C. This is easier to achieve and less energy is required.

Setting up a ground-source heat pump takes a bit of work because pipes have to be buried underground. When choosing horizontal systems, the pipes are laid up to 1.8 metres deep and a large area of ground is required. The other option is to drill several holes straight down to a depth of at least 80 metres. This is the most expensive method but uses only a comparatively small area. If there is some sort of water body available, such as a dam, pond, river or the ocean, this can also be used, but the pipes have to be covered by at least three metres of water.

The performance of heat pumps is measured by the coefficient of performance (COP). This is the ratio of the energy of the heat being moved to the electricity consumed. A modern reverse-cycle air-conditioner has a COP of three or so (which means that 1kWh of electricity moves 3kWh of heat) while ground-source heat pumps can achieve COPs of more than six.

However there are some problems with ground-sourced heat pumps. First of all there are not too many distributors of ground-source heat pumps in Australia. Unlike in other countries, especially Sweden, the ground-source heat pump is underdeveloped here and mainly confined to commercial buildings. Also, most systems that are currently available are too big for houses in built-up areas, especially when the residents have already tried their best to reduce their air-conditioning requirements by using exterior blinds, cross ventilation and other energy-efficiency measures. However, the currently available ground-source heat pumps would suit an apartment complex, the shared use of more than one house, or could be applied in a commercial or industrial environment quite well.

The most critical point at the moment is the price to install them. They are expensive and can be considered to be the Porsche of the air-conditioner world. Good technology has its price—they cost about four times what a conventional system would cost. The drilling adds about $10,000 to the cost above and beyond conventional air conditioning, but pays for itself in five to ten years depending on usage.

More info

ReNew magazine - www.renew.org.au

SUPPLIERS

Earth to Air Solutions - www.earthtoair.com.au - Ph. 1300 780 216

Geoexchange - www.geoexchange.com.au - Ph. (02) 8404 4193

Heat shifters and heat exchange ventilators

These are simple fans or fan and duct combinations that take the excess heat that accumulates near the ceiling in one room and use it to heat a second room. They actually work quite well, and almost heat the second room for free. You can buy them as kits, or make them up yourself from a fan, a bit of ducting and a vent cover or two.

Heat exchange ventilators

These devices are far more common in the energy-efficient homes of Europe than they are in Australia. When a home is tightly sealed, ventilation can be important to remove some of the stale air from the home. However, simply removing air and replacing it with cold air from outside has the effect of wasting heat and cooling the home—not what you want in an energy-efficient home. Heat exchange ventilators work by extracting heat from

the outgoing stale air and using it to warm the incoming fresh but cold air, thus reducing the amount of energy needed to maintain a suitable air temperature in the home.

More info

Your Home - http://www.yourhome.gov.au/technical/fs62.html

SUPPLIERS

Envirofan - www.envirofan.net.au

Shading

It's summer. The heat is intense and, somehow, it can seem nearly as hot inside as it is out. You have insulation and the blinds are drawn – what else can you do to raise comfort levels? The first thing you should look at is shading. Imagine that for every square metre of glass in your house receiving direct sunlight, you are receiving a single-bar radiator's worth of heat inside.

Clearly, reducing the amount of direct sunlight that comes through your windows is going to make a big difference to your comfort levels. The good news is you don't need to pull down the blinds and live in the dark to keep your house cool. With a little strategically placed shading, you can block up to 90% of all heat coming through your windows and still enjoy the view.

Shade structures can range from awnings to eaves, shutters, shade sails or trees. There is no one-size-fits-all solution. Your taste will be a factor, as will be the orientation of your windows. The side of your house that you can do most with is the north, where the trick is to employ horizontal shade structures such as eaves and awnings. In summer these will act like a sun visor to exclude the high and hot summer sun. In winter, the sun, travelling low to the horizon, will still peek under your shade structures to allow in precious winter warmth.

Adjustable shading gives you maximum control over how much sun you invite into your living space. Contemporary shade sails can introduce elegant lines and spaces to your home and allow you to choose exactly how much shade you get on any given day – particularly useful in spring and autumn. Mechanical awnings also offer choice and convenience.

In recent times the science of shading has taken a leap forward with attractive architectural louvres. These have spaces and angles specifically tailored to allow maximum winter warmth and summer shade. If you're looking for something more classical or naturalistic, pergolas hung with deciduous vines provide a cool haven, not to mention a beautiful garden feature.

After the north side, the east and west sides of your house are a little more challenging to shade effectively. At sunrise (east) and sunset (west) the sun hangs low in the sky. That means in summer it's going to get under your horizontal structures for an uncomfortably long period. The trick to shading morning and afternoon sun is fixed "vertical" structures such as trees or shrubs.

More info

Your Home - www.yourhome.gov.au/technical/fs44.html

SUPPLIERS

Brax - www.braxwt.com.au - Ph: (03) 5221 5533

Issey - www.issey.com.au - Ph. (03) 9429 3883

Luxaflex - www.luxaflex.com.au - Ph. 13 58 92

Vertilux - www.vertilux.com