EnviroShop
Energy • Sustainability • Efficiency

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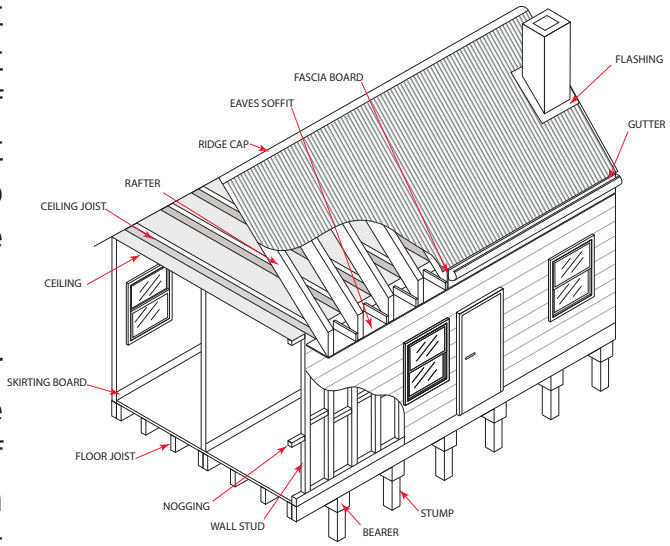
ASSESSING AND IMPROVING YOUR HOME ENERGY EFFICIENCY

You can add as many solar panels as you can fit on your roof and install the best heat pump hot water and split systems, but if your home itself isn't efficient then you're still wasting significant amounts of energy and money. It's important to look at the whole picture and go beyond just the big shiny things.



There is a lot that can be done to make your existing home more efficient which will make it cheaper and more comfortable to live in. If you're building a new home or renovating then you should incorporate energy efficiency right from the start, not as add-ons at the end.

The questions we hear most often are :

How can I make my home more comfortable?

Most homes in Australia are not well designed for the climate and as a result get blisteringly hot in Summer and freezing cold in Winter or cost a fortune to keep at reasonable temperatures.

How can I reduce my impact on the environment?

Human influenced climate change is a reality, despite what certain vested interests try and tell us. We are also heavily polluting our land, water and air and wasting valuable non-renewable resources, leaving our planet a worse place for future generations to live. There is no need for this and there are many ways we can work towards living sustainably, starting with your home.

How can I save money?

Inefficiency means unnecessary waste. Would you just throw a percentage of your pay packet out the window every month? That's what you're doing if your home is inefficient. Energy prices have risen dramatically in the last few years and will continue to rise, which is having a major impact on household and business budgets. Energy efficiency, when done well, can have excellent paybacks and great returns on your investment.

How do I work out what to do?

It all starts with getting an understanding of your current situation. Once you understand the energy flows into and out of your home then you can start to identify the areas with the best scope for improvement.

Where do I start?

The answer is in the questions above. Work out what changes are going to have the biggest impact on your comfort, environmental impact and budget and start there, then work your way down the list.

Assessing your energy flows.

First, do an audit or assessment of your home (and lifestyle) to identify the weaknesses

Whether you do the audit yourself or pay someone professional, the more that you can educate yourself the better positioned you are to assess the best solutions for your individual situation, now and into the future.

How do I 'audit' my home?

An audit is a systematic review or assessment of something, in this case the energy efficiency of your home. *Basically, it is about identifying the energy flows into and out of your home.*

'Audit' is a legal term these days, with related Australian Standards, and is expected to meet high standards of accuracy. An audit is typically done for businesses and Government to be able to quantify projected savings and estimate complex payback periods. For homes we prefer to use the term 'assessment', for the purpose of gaining an understanding of where your energy is going rather than a set of figures to analyse.

You can move onto a more accurate self-audit of your energy use after the initial assessment and use the figures to calculate payback periods on changes if that's your thing, but as long as you have a solid understanding of the basic principles then you are well positioned to improve the efficiency of your home.

The basic questions to ask are 'Where is the energy coming from?' and 'Where is the energy going to?'

Where is the energy coming from?

The easiest energy flows to see and measure are the ones you are billed for, i.e. electricity and gas. It is relatively easy to 'audit' these, as most appliances have ratings on them, so you simply have to multiple the rating by the hours of use. Be aware that many appliances are not using their full rated power at all times. A simple to understand example is a hi-fi system. It might be rated at 300 watts, but that is at full blast, it's likely to use 10% of that power in normal use. The accurate way to measure appliances like these is with a plug-in energy meter.

There are also other forms of energy flowing into your house, including heat energy during Summer, the water supply and all of the food and products you bring into the house. Don't forget fuel for your vehicles if you're doing an assessment of your lifestyle.

Everything we grow or manufacture has 'embodied energy', which is the energy required to produce, package and transport it. This also includes things like treating water and delivering it to your home. When a product is unnecessary, 'disposable' or poor quality and ends up in landfill, or even worse in sensitive environments like the ocean, it is a huge waste of energy.

Remember to Reduce, Re-use and Recycle

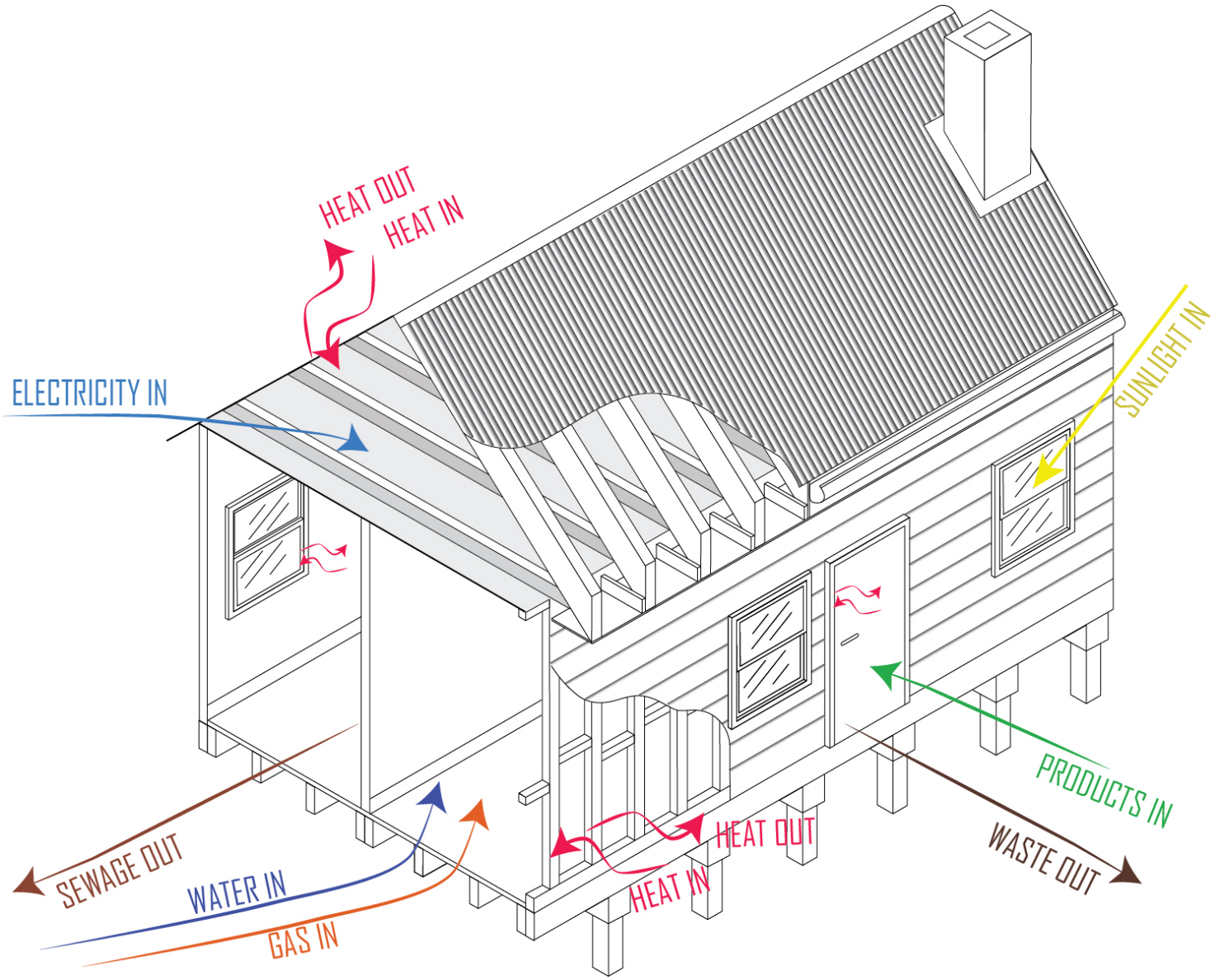
Where is the energy going to?

All of the energy flowing into your home has to go somewhere. It mostly ends up as waste heat, which then escapes from your house to the atmosphere, but can also leave in the form of rubbish, sewage etc.

Take some time to investigate, think about and document the energy flows into and out of your home. The following sections will help you with this.

The Building Envelope - Heat Energy

The greatest energy flows are usually in and out of the building envelope, which includes roof, walls, floor, windows, doors etc. Identifying these and gaining control of them is the starting point for making your home more efficient.



HOW DO I FIND 'WASTED' ENERGY?

1) Examine the energy flows in your home and identify the energy uses and conversions.

e.g. electricity into light in your light bulbs.
e.g. gas into heat in a central heating system

2) Decide if that energy is actually required in the first place

e.g. use a lamp to read instead of lighting up the whole room brightly
e.g. does the whole house need to be heated, or just the main living areas?

3) Investigate if there is a more efficient way to convert the energy

e.g. LED instead of incandescent light bulbs
e.g. use a heat pump instead of a gas furnace

4) Investigate if there is a way to use the energy more effectively

e.g. use pendants instead of downlights so you are lighting the bright ceiling instead of the dark floor
e.g. make sure your insulation, draught proofing etc is up to scratch to minimise losses

ORDER OF PRIORITY

The best way to work out what order to do things in is to work out the return on investment. This is not always financial though. Something like improving the insulation value of your home may take quite a while to pay back in running costs, especially if you are already in the habit of rugging up instead of just blasting the heating, but the difference it will make to your quality of life is significant. Being able to keep your living areas comfortable year-round is a great return for the money invested.

In most cases the order of priority is as follows :

1. Solar Control

Making sure the sun isn't heating the house excessively in Summer and can help heat it in Winter.

2. Draught Proofing

Controlling airflow in and out of the house.

3. Ceiling Insulation

Most of the heat enters and exits through the ceiling

4. Improving Windows

Typical windows have almost no insulation value, leaving big thermal gaps

5. Appliances

This includes many areas such as hot water systems, lighting, heating and cooling etc. Priority depends on the individual situation.

6. Underfloor Insulation

Can make a great difference in old weatherboard houses due to lots of gaps between the boards.

7. Waste Management

This is something that should actually be in parallel with all the other actions. Compost your food waste. Reduce, Re-use, Recycle.

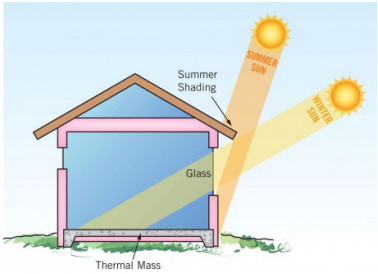
8. Other expensive or low-priority actions such as roof cavity ventilation, possibly wall insulation retrofits, window replacements etc etc.

Once all the major things are under control then you can start considering longer term plans for actions that are more expensive for less return.

1 SOLAR CONTROL

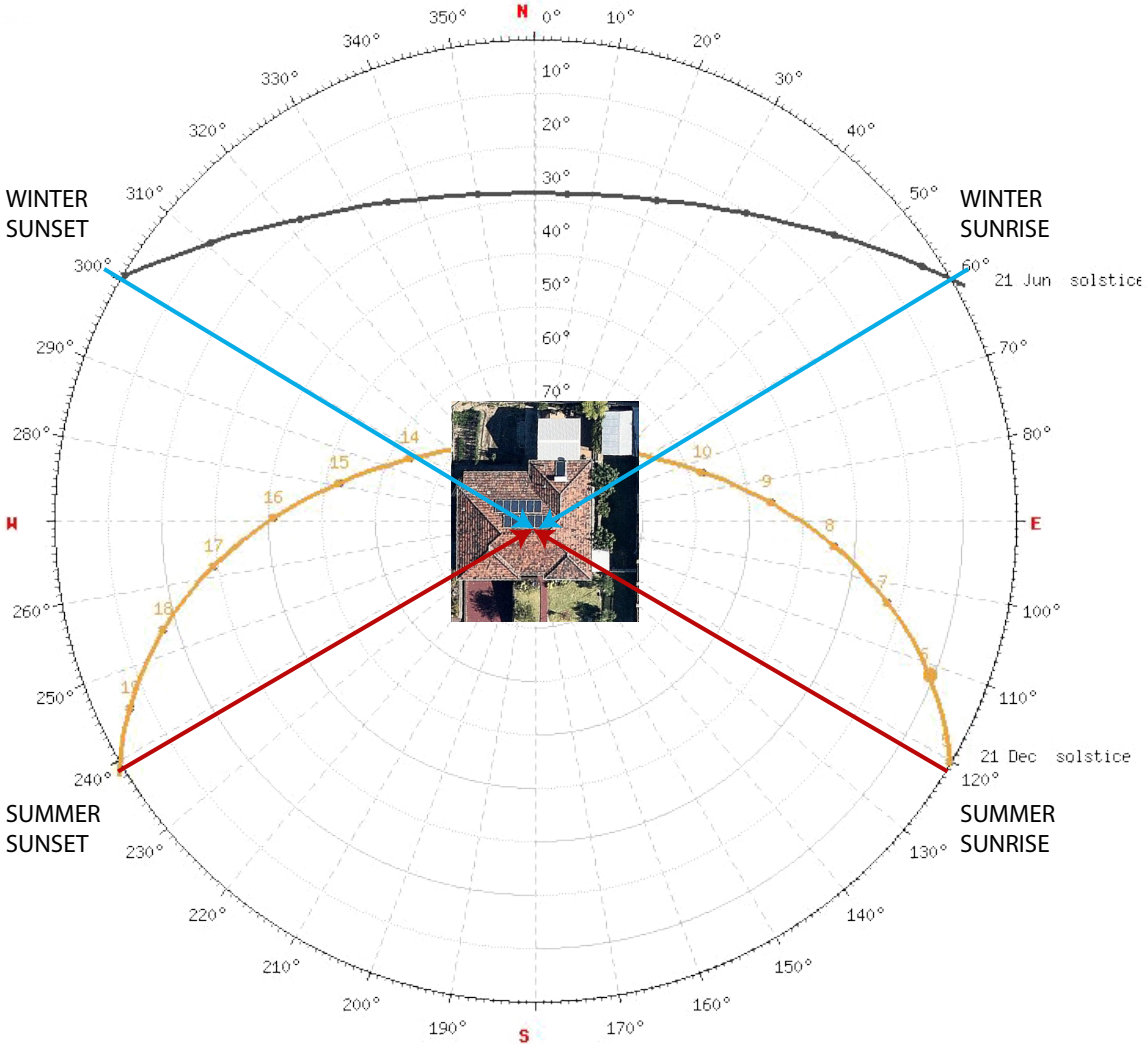
Passive Solar Design - Radiation

The first step is to analyse the passive solar aspects of your home. It may sound a bit fancy, but it just means to let the sun enter in Winter to help warm the house and keep it out in Summer. This means having good windows facing North, East and West to catch the Winter sun when it's out, but keeping them well protected from the hot Summer sun with eaves, external blinds, deciduous plants, shadecloth etc.

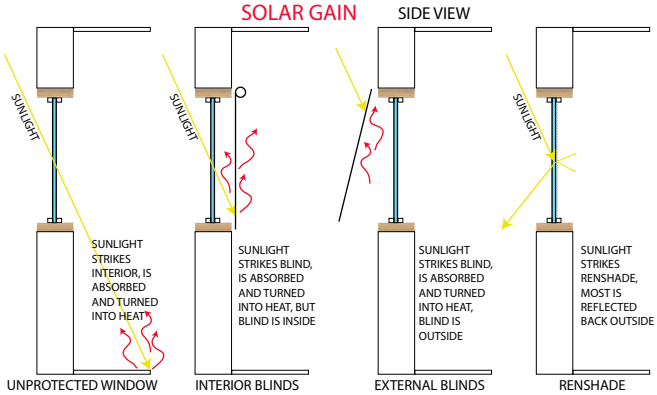


It's fairly easy these days, you can simply look up your home on one of the online mapping services and get an idea of the directions your windows are facing. On the solar path diagram below you can see the angles that the sun rises and sets at the Summer and Winter solstices in Melbourne.

Remember that the sun is very high in the sky at noon in Summer, so eaves will effectively shade most North facing windows, but it's lower in the sky at the start and end of the day, so East and West windows are more difficult to protect.



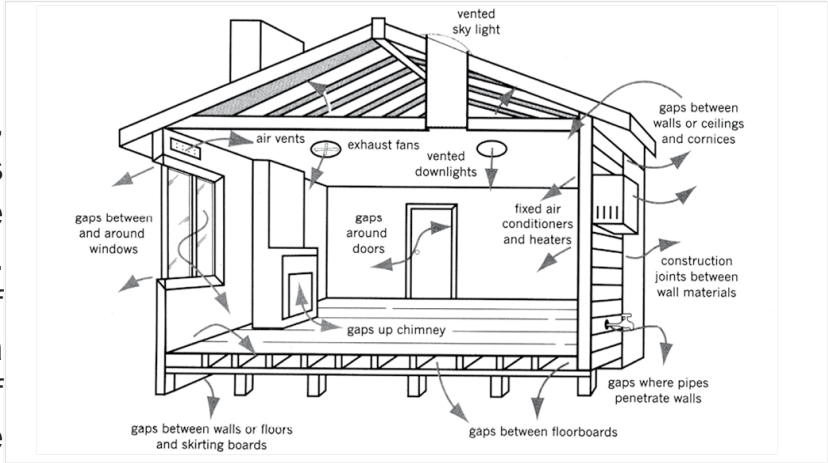
It's important to stop the sun before it hits a window, internal blinds will absorb most of the heat and still release it into the room. If you have windows that can't easily be shaded externally (e.g. upstairs) then reflective products like Renshade can be very effective.



The sun can still be quite hot very late in the day in Summer, so be aware that even South-facing windows can get direct sun.

2 DRAUGHTS

Draught Proofing – Convection

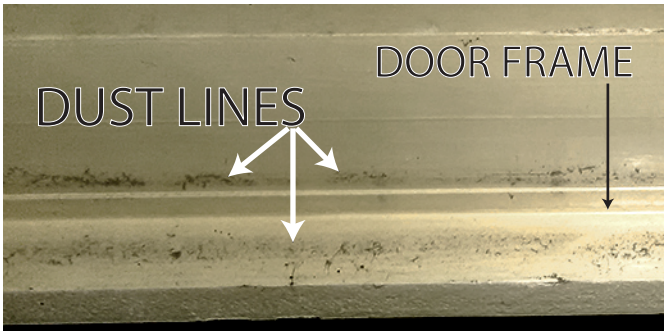


Source :http://www.yourhome.gov.au/passive-design/passive-solar-heating

Even if your home is well insulated, draughts through gaps around doors and windows and in the structure of the building will simply bypass the insulation. As well as being a very efficient way of moving heat in and out of your house, a draught will make you feel colder even if the room is at a comfortable temperature by evaporating moisture from your skin. It is important to be able to control the airflow in and out of your home by opening doors and windows in nice weather, but being able to shut it down tight when actively heating or cooling.

Where are they?

Draughts most commonly come from gaps around doors and windows, with the gaps under the bottoms of doors the most likely culprit. They can also come from gaps behind skirting boards, around the door and window frames themselves, wall vents and ceiling roses. An easy way of tracking down drafts is to light a stick of incense on a windy day. Walk around the house and wherever the smoke is moving sideways instead of straight up there is a draught. The smoke will move away from the draught, so follow it back to its source and note it down for action. You will also see a little line of dust along the frame of any doors or windows with a regular draught, where the dust is dumped as the air slows down through the gap.



How to deal with them

Once you've tracked down all the sources of draughts in your home it's time to work out the best way of controlling them.

Doors

Gaps under doors can be dealt with by a simple 'door snake'. Advantages are they are cheap and simple, disadvantages are that they require you to continually reposition them securely against the door. A more permanent solution is to use draught strips screwed to the bottom of the door. There are many different styles to suit different situations, such as uneven floors and different floor finishes.

Gaps around the door frame can be filled with Weather Stripping, usually a soft foam with adhesive tape that is sandwiched between the door and the frame to seal the gap. For a longer lasting solution, Draught Dodgers for Doors have a compressive seal mounted on the door frame that lightly touches the door when closed, which gives a much more even seal and doesn't make the door harder to close.

Windows

Windows often have gaps between the opening and fixed parts of the frames which can let draughts through. Weather stripping or Draught Dodgers are usually the best answer to this, but different types may be required depending on the opening mechanism of the window. E.g. awning vs sliding, vs double hung windows.

Other draughts

Other sources of draughts can be gaps in the building structure, such as floorboards, around skirting boards, cracks in brick walls and around the outside of the frames of doors and windows. These are best dealt with using some kind of permanent gap filler, such as a flexible caulk sealant. Large gaps can be stopped up first with a foam rod, then sealed.

Wall vents used to be mandatory in houses but in recent years the requirement has been removed. They are unnecessary and are mostly a legacy of gas lighting, kerosene heating and unflued gas heaters to vent noxious fumes and allow oxygen in. They should be blocked up to prevent airflow in and out of the house. The easiest method depends on the design of the vent, with gap filler often working well, or a solid covering plate such as a piece of thin ply painted to match the wall. Ceiling roses can also be vented into the ceiling, especially in older buildings where they used to house gas lighting. They should also be blocked up, either with a panel fitted from above in the roof cavity or with gap filler from below.

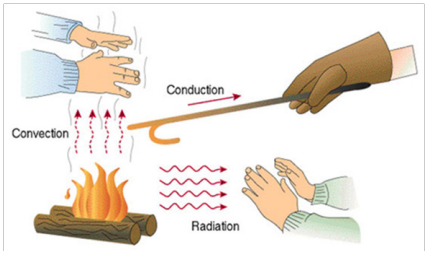
Draughts from lighting and fans

Other areas to be aware of are gaps such as downlights in the ceiling (including many LED downlights), exhaust fans and other appliances. Halogen downlights should be replaced with sealed LED fittings. Halogen or vented LED downlights can move a lot of air out of your room and into the ceiling cavity by acting as small heat chimneys, with the hot air produced by the very hot lamps rising up and drawing air through gaps in the fitting. They also allow a lot super-hot air to enter from the roof cavity in Summer. Exhaust fans can have covers fitted with flaps that only open when the fan is operating and then drop down to seal the fan when it is off.

3 INSULATION

Principles of Insulation

Heat naturally travels from a warmer place to a cooler place, and the rate at which it moves is determined by the temperature difference between the two places and the thermal resistance between them, or how easily the heat energy can move. To keep a room at a comfortable temperature you have to counter this flow of energy, replacing heat lost in Winter and heat gained in Summer.



There are three methods of heat transfer :

1. ***Conduction***

Conduction is heat travelling through a solid object e.g, heat transferring through your ceiling plaster

2. ***Convection***

Convection is heat travelling via fluid motion, which is primarily air movement in houses. This includes the 'hot air rises, cool air falls' principle but also the movement of air through draughts.

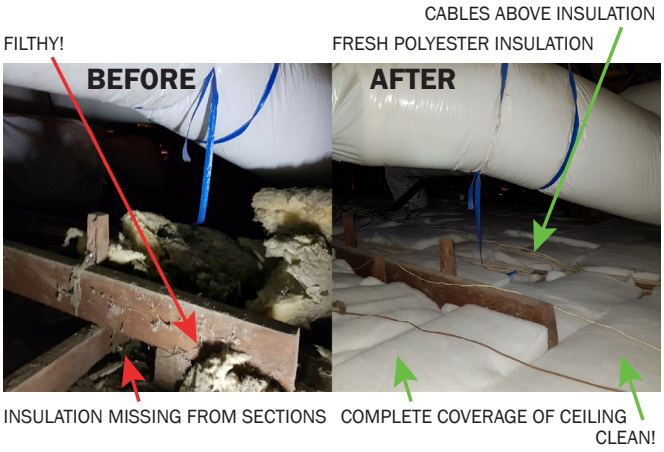
3. ***Radiation***

Radiation is the transfer of heat as infra-red energy. This can be clearly felt as heat radiating off a hot brick wall in summer and is significant in many ways around the home.

Thermal image showing clearance around downlight and missing batts.

Insulating a house is about controlling these methods of heat flow by increasing the thermal resistance. Air is a very good insulator if it can be held still to stop convection. This is how insulation batts work, by trapping lots of air in small pockets, and is also the principle behind double glazing.

Thermal resistance in insulation is measured by the R-value, with higher being better. It is a standardised measurement, so you can compare different types of insulation. R4 means R4, whether it's polyester batts or a scientifically calibrated bunch of chickens roosting in your roof. This applies best to conduction and batts, but is also used to compare reflective insulation. Be aware that the R value of reflective insulation may not indicate it's true effectiveness in a given situation. e.g. it is very effective under a hot tin roof.



The recommended minimum insulation value for ceilings in Melbourne is R3, but we recommend R4 - R5 as the sweet spot, with prices increasing after that for little extra practical insulation difference. Be aware that sometimes the recommended R value given is for the whole roof structure. The roof cladding, plaster air gaps etc have some insulation value in addition to the batts etc. R4.1 is commonly recommended for Melbourne, which usually means R3.0 batts for most roof structures.

Insulation Installation

Getting a good installer is critical to having good insulation. Gaps and incomplete coverage will severely compromise the insulation value more than you would think, with 5% gaps resulting in around 20% loss of insulation value. There are also possible dangers, like keeping appropriate safety clearances around downlights and keeping electrical cables clear of insulation.

Like any good tradie, a good installer will take care of your home and clean up after themselves. A reputable installer will also have proper insurance to cover the possibility of any damage to your home.

What about existing insulation?

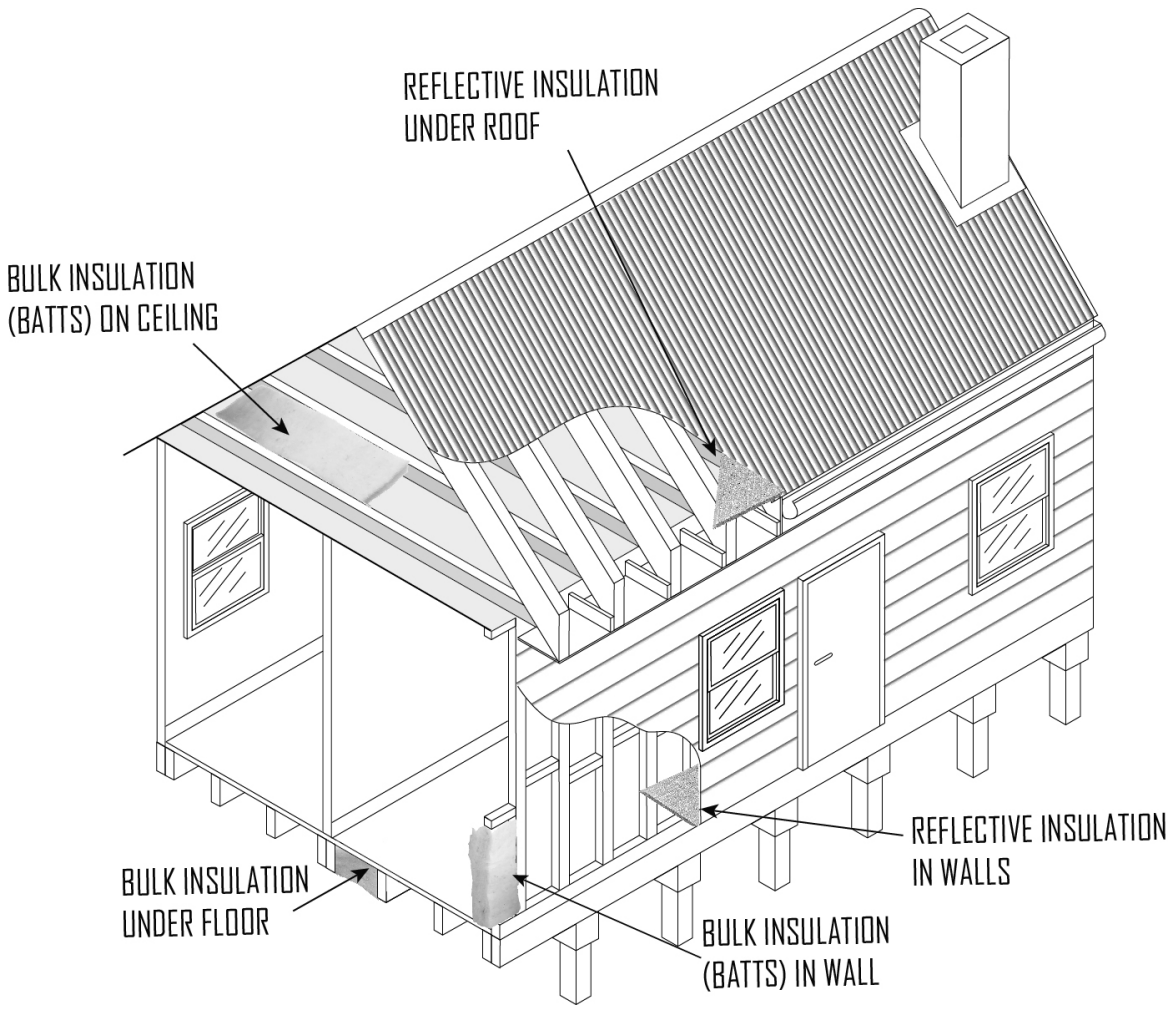
Insulation degrades over time, with different types having varying life spans. Loose fill insulation, especially paper-based cellulose, is the shortest, with polyester generally lasting the longest.

If your insulation is too far gone, we recommend replacing it and getting your roof cavity cleaned to remove all the dust and other debris that builds up.

Sometimes your existing insulation is still in good condition, but has been poorly installed or not replaced properly after trades have worked in your roof. You can also organise a re-install and top-up with some fresh batts if that is the best solution.

What about a flat roof?

Flat roofs or cathedral ceilings are difficult. They're rarely well insulated and the smaller gap between roof and ceiling means greater heat transfer. Insulating them requires getting a roof plumber to lift the roof, install insulation and then replace it. This can be expensive, but is usually well worth it for the improvement in comfort and efficiency.



Reflective Insulation

Reflective insulation works like a mirror, reflecting infra-red radiation away. It requires an air gap so the heat gets turned into radiation, otherwise it will simply conduct the heat. It also helps in winter by reflecting the heat from the interior back inside. Sarking is one form of reflective insulation, but there are improved versions with a few mm of insulation between the two reflective layers. Reflective insulation is vastly more effective when it is an airtight layer, acting like a foil hot food bag. Depending on construction methods used it can be important to use vapour permeable film to help reduce condensation issues. One side is usually coloured, but it is just as reflective in the infra-red range as the shiny side. It is coloured to reduce glare as a safety measure for the installers.

Reflective insulation should be installed under any exterior cladding, particularly roofing material.

Underfloor insulation

Underfloor insulation can be very effective for improving the comfort of homes. We mostly recommend polyester insulation for underfloor, because it is permeable for moisture management, strong and won't sag or fall apart under it's own weight and usually won't attract rodents to nest in it. We also recommend some reflective insulation products for underfloor use. Underfloor insulation can be very difficult and expensive to install if access is limited, but if you have good clearance it can be an easy DIY job.

Wall insulation

Walls should also be well insulated in every new build, but retrofitting existing walls is very difficult and expensive to do effectively. If you are removing internal or external cladding for repairs or renovation, definitely get some batts and reflective insulation into the wall while you have the opportunity, but in our opinion there are other things you can spend the money on that will make a bigger difference to your home than attempting to retrofit wall insulation. One example is windows, they are a much bigger hole in the thermal envelope of your house than a solid wall.

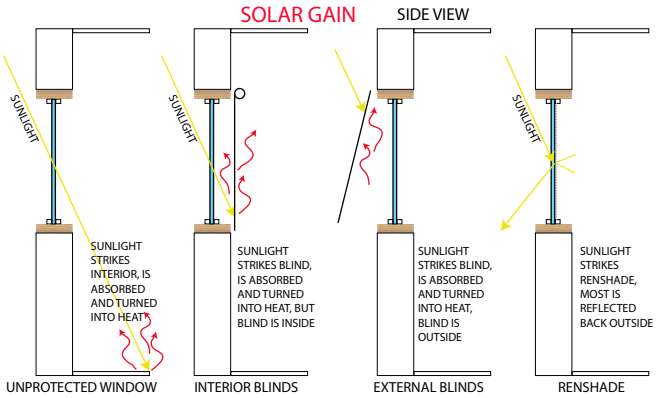
4 WINDOWS

The Problems with Windows

Windows can severely compromise the energy efficiency of your home by being responsible for major heat gain in Summer and heat loss in Winter. According to Your Home Technical Manual, windows can account for up to 40% of a home's heat loss and 87% of it's heat gain.

Solar Gain

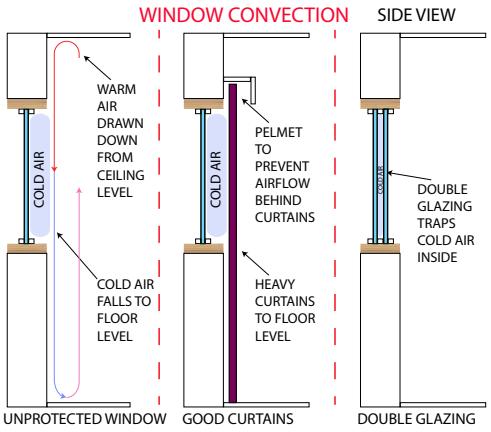
Sunshine through a window is a wonderful thing most of the time, but not on a hot Summer's day when the energy contained in the light is absorbed inside your home and converted to heat. In a two storey house heat from an exposed window downstairs will rise up and contribute to upstairs becoming an oven. The midday Summer sun typically has a power of around 1000W/m2. Not all of this will make it through the glass, but a good portion of it can, meaning a large window can be like running a heater on full in the room. North facing windows can be effectively shaded with appropriate eaves, but East and West facing windows are more difficult.



The best solution is to physically block the sun before it hits the glass, using eaves, trees and shrubs, external blinds, roller shutters or shadecloth. Internal blinds or curtains will cut down on glare, but they will usually absorb a lot of the sun, get hot and heat up the room.
You have to be careful with external shading that is close to the glass, like roller shutters or some blinds, as they will heat up the air behind them which is against the glass, allowing heat to transfer inside. Make sure you allow some ventilation, e.g. by keeping the roller shutters cracked open a little.
There are many situations where external shading is not possible or practical, like rentals, upstairs windows, skylights etc.
The solution is Renshade, a perforated foil-coated paper sheet. Simply cut to size and stick into the window using the provided velcro dots or other mounting method of choice, or make them into roller blinds. Around 80% of the light (and heat) is reflected back out the window, but some light still gets into the room and you can still see outside, getting the benefits of a window without most of the heat gain. Very simple and very effective.

Thermal Transfer

The roof, floor and walls of your house typically consist of several layers of structure, like tiles, timber, plaster etc, hopefully with layers of reflective and bulk insulation as well. Windows on the other hand are a significant area of a single layer of highly thermally conductive glass. The frames can also be good heat conductors, especially steel and aluminium frames, This means that outside temperatures are easily transferred through to inside. In the evenings you can close heavy curtains to seal them off, but during the day you want the light and view. Double glazing adds significant extra insulation value to a window.



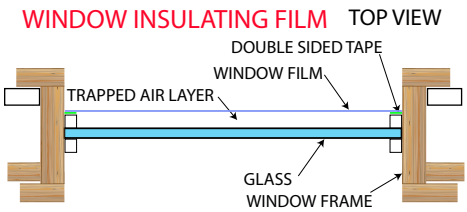
Window Frames

The glazing is a bigger issue, because it's a much larger area, but the window frame can also conduct quite a bit of heat. Timber and PVC window frames have decent insulation value, but aluminium and steel are very thermally conductive. Modern aluminium windows are 'thermally broken', meaning there is a layer of insulation between the inside and outside frame.

Double glazing

The insulation value of double glazing comes from the layer of air trapped against the glass. Moving air is a very efficient way of transferring heat (which is why draughts are bad news) but if you can keep the air still it is actually an excellent insulator. There are fancier versions of double glazing that use Argon or other inert gases in the gap, or triple glazing with 3 layers of glazing, but they are generally overkill in our mild temperate climate zone.

Double glazing also helps with condensation, which happens when the warm, moist inside air hits the cold window glass. By having a warmer internal layer separated from the cold outer glass, condensation is prevented. Double glazing will not help with hot sun coming through a window, although it will help with heat transfer through the window in Summer.



DIY insulating films - $10s /window

Because the insulation value primarily comes from the air, anything that effectively traps the air will work. Common in colder climates but only just appearing here are DIY double glazing films. They are a clear plastic film, similar to cling wrap, which is applied across the window frames using double sided tape. The depth of the frame leaves an air gap, which provides the insulation. If they are applied well they can last several years, but they can be easily damaged and because the film is flexible it provides none of the soundproofing benefits of rigid double glazing.

They are very cheap to buy, apply and remove yourself, so replacing damaged films is not a big deal. Ideal for rentals and people on a budget, we also recommend them to people considering the more expensive options to see how much of a difference double glazing will make.

Retrofit Double Glazing - $100s /window

The next level up is to retrofit a custom made internal frame with some acrylic glazing to your windows. This is a much more robust and permanent solution with some soundproofing benefits as well. They are usually made to be removable in case you need to clean the glass, repaint frames etc. Talk to us about reputable companies who can provide this service.

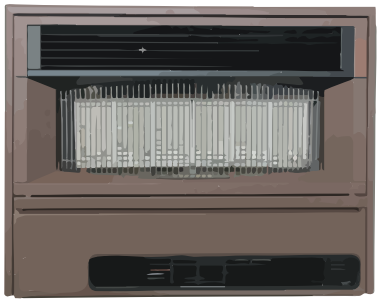
Replacing Windows - $1000s /window

The best but most expensive solution, especially with conductive frames like aluminium, is to replace the entire window and frame with a new double glazed unit. This can be very expensive and we don't generally recommend it unless the windows need replacing anyway due to age or damage. Speak to a reputable builder for pricing.

5 APPLIANCES
Heating and Cooling

Heating and cooling is the other major energy user in most homes. Everything else we've covered so far will increase the efficiency of your heating and cooling systems by reducing the amount of energy entering or escaping your home. Remember, the better insulated, draught-proofed etc your home is the more effective and efficient your heating and cooling is. And remember that the best heating system is your own body. Eat well, rug up and stay active.

Types of Heating Systems



There are two things to consider with heating systems : Where the heat comes from and how it is distributed. The most common source in Melbourne is natural gas, a non-renewable fossil fuel. You can also 'burn' electricity or wood. The best way is to simply shift heat from outside with a heat pump. The heat can be distributed by *local heaters* in each room or by a *central system* that heats the entire house. If you've already improved all the areas covered so far then you shouldn't need central heating in a relatively mild climate like Melbourne. We highly recommend using appropriate local heaters rather than a central system.

The other important aspect of efficient heating is the thermostat. This senses the temperature in the room and switches the heating on and off to maintain a set temperature. Be very wary of heaters without a thermostat, they can use a lot of energy and overheat a room. (e.g. blower heaters) You also need to be very careful of positioning of the thermostat to make sure it's actually sensing the area you want.

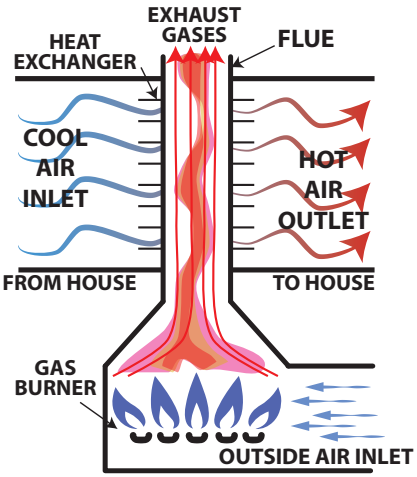
There are three main forms of central heating. *Ducted heating* uses a system of (hopefully well-insulated) tubes to move the heated air around the house, with a 'return' system to send the air back for re-heating. *Hydronic heating* uses hot water circulated around the house to either under-floor coils or wall-mounted radiators. *Resistive heating* is usually electrical wiring installed in a concrete slab to warm it.

While hydronic and resistive heating give the 'nicest' heat by being mostly radiant rather than convective (moving warm air) they are not very well suited to the changeable Victorian climate.

They are ideal for colder climates where it gets seriously cold and then stays cold for months on end, as they have a slow warm up and cool down time and lots of thermal mass to maintain a steady temperature. In a cool temperate climate like Victoria the temperature very rarely gets subzero, never for more than a few hours and we can get bursts of warmer weather, especially in Spring and Autumn. The slow reaction times of hydronic and slab heating are not very well matched for this type of climate, so you will need faster auxiliary heating for much of the year anyway.

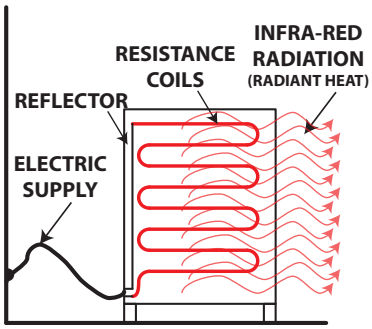
Gas Furnace

Most homes in Melbourne have gas heaters due to the historically very low price of gas in Victoria. They work by burning gas and blowing some of the heat created into the room using a fan (either local or ducted). They are fairly inefficient because a significant percentage of the heat escapes along with the exhaust gases, as well as contributing to greenhouse gases. They can also be very dangerous if some of the exhaust gases are able to leak into the room (open flued heaters are particularly dangerous). A modern, efficient, well maintained gas heater can be a reasonably efficient heating option, but we still recommend heat pumps as a better option.



GAS HEATER

Electric Radiant

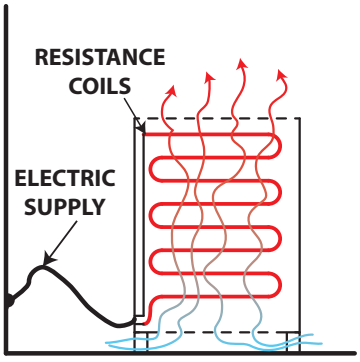


ELECTRIC RADIANT HEATER

Electric radiant heaters work by turning electricity into infra-red radiant heat. The old red-glowing radiators, oil column heaters, bathroom heat lamps and the black heat panels often seen in restaurants and pubs are all examples of electric radiant heating. They can be the most efficient option in large areas with lots of air movement such as outdoors, warehouse conversions or workshops because they heat you (and other objects) directly rather than trying to heat the air around you. They will still use a lot of energy, but not as much as trying to heat the air if the heat keeps escaping. You must remember that they are only effective when you are in the radiant zone. E.g. don't leave heat lamps on while you're in the shower or any other radiant source on when you're not in the room.

Electric Convection

Electric convection heaters use the electricity to create heat then use air to move it into the room. The little 'fan blower heaters' are a classic example. Oil column heaters and convection panel heaters are other examples, often combined with radiant heat output. These don't use a fan, but instead rely on the hot air rising away from the heater and drawing cool air in underneath. These can be good if they have a thermostat for short term use like a child's bedroom or for renters where you can't fit other heating, just don't run the thermostat too high. The fan blower heaters can use incredible amounts of electricity in a short amount of time due to high power and no thermostat, not recommended for most situations.



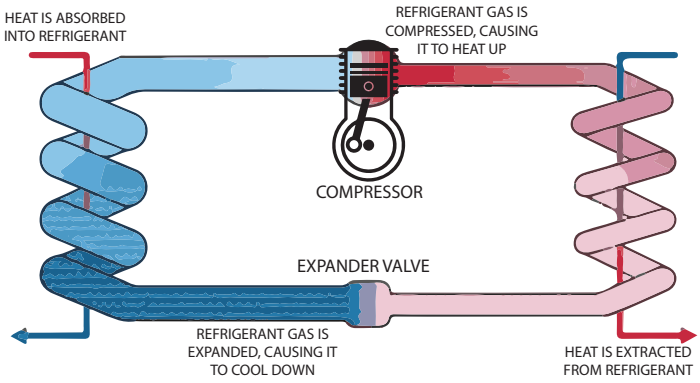
ELECTRIC CONVECTION HEATER

Wood Burners

Traditional open fireplaces and wood stoves look lovely and add a warm ambience to a room, but are an energy efficiency and pollution nightmare. Many Councils have banned them due to smoke pollution. Most of the heat from the wood is lost up the chimney. They also tend make the rest of your house colder by drawing air out of the room up the chimney which is replaced by draughts from gaps in the rest of the house. When they're not being used chimneys and flues are a big draughty gap in your insulation.

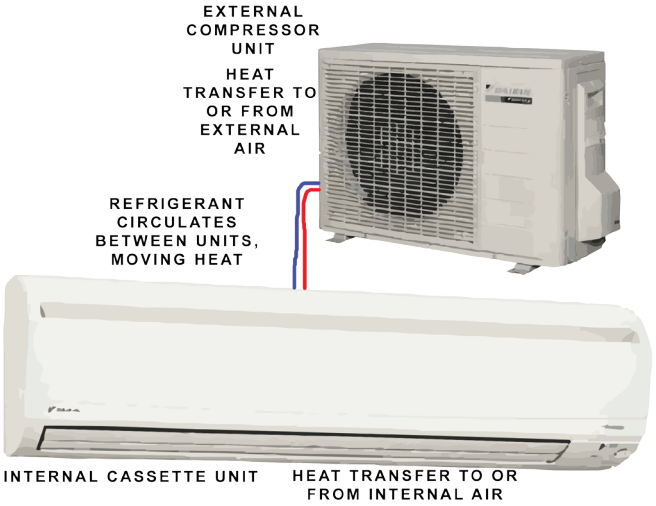
Heat Pumps

A heat pump uses the same principles as your fridge to 'move' heat. A refrigerant gas is compressed on one side, making it hotter and expanded on the other, making it cooler. You may have noticed this effect with spray cans getting cold with use and bike tyres getting warm as they're inflated.



Heat can be absorbed on the cool side and extracted on the hot side by running air or water over them. As long as the refrigerant is cooler than the air or water, heat can be extracted. CO_2 refrigerants run at around -30^{o}C, meaning they are useful in subzero temperatures. (Remember that 0^{o}C is only the temp that water freezes, 'absolute zero' is around- 273^{o}C)

It is a much more efficient form of heating, because it is simply using the electricity to move atmospheric heat rather than 'burning' electricity or gas. The only energy used is in the compressor and possibly a circulation pump. Many systems can also be run in reverse to move heat outside in Summer or into the house in Winter.



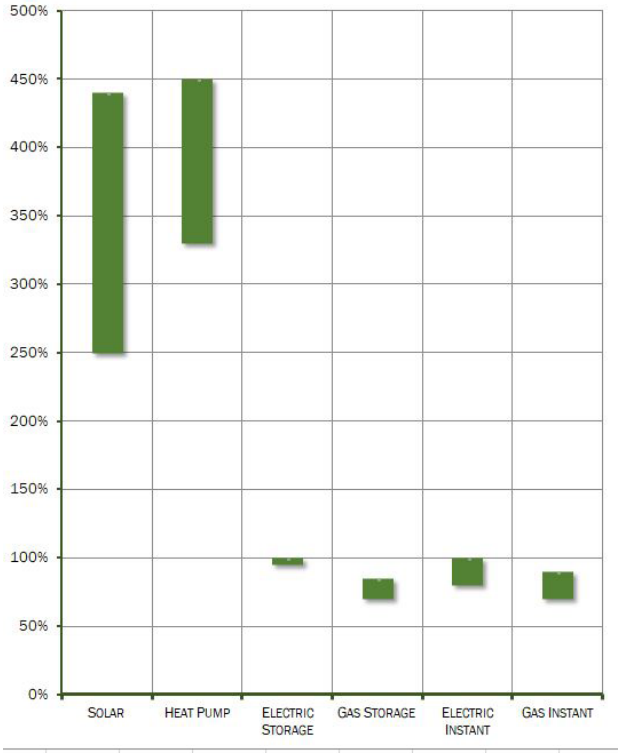
Many people think of their split systems as just air-conditioners, but they are actually the most efficient way of heating your home in most cases too. You can also get central ducted heat pump systems and heat pumps for hydronic heating systems.

A very interesting new concept, especially for renters, is personal cooling rather than room cooling. The Close Comfort portable air conditioner is designed to blow chilled air directly at you rather than trying to cool the entire room like a conventional air conditioner, including the portable units that connect to the window to vent hot air. They use very little energy while being very effective cooling, ideal for large spaces like warehouses and workshops as well as domestic use.

Efficient heating and cooling can also be used as energy storage in your home, like a battery but storing thermal energy rather than chemical energy. If you have a solar power system on your roof and a well sealed and insulated home, you can set your heat pump heating or cooling to run during the day off solar power, making it comfortable for when you get home at the end of the day. You can then turn it off and it should stay comfortable for several hours with no grid electricity usage. A heat pump hot water system works in a similar way, storing your solar energy as hot water for use later.

Hot Water

The average home uses about a quarter of the total energy consumption to heat water. As you reduce energy use in other areas, like lighting, heating and cooling, this percentage will become bigger and more significant. Finding the most effective hot water service for your situation requires knowledge of the different types of systems and their strengths and weaknesses.



Hot Water System Efficiency

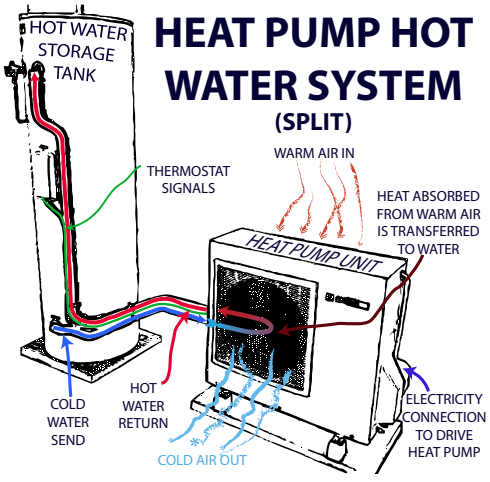
This graph shows relative efficiency of hot water systems in the Victorian climate by comparing energy consumed from gas or electricity to energy put into heating the water.

Heat Pumps

Heat pumps have been around for a long time in the form of fridges and freezers, for quite a while in reverse cycle heating and cooling systems and most recently as water heaters. They work by 'pumping' heat from one place to another, using a compressor and a refrigerant, (see the section on Heating and Cooling for more details.) In the case of your fridge it is pumping the heat from inside the cabinet to the room outside. In the case of a heat pump hot water system they are pumping the heat from the outside air, which has been heated by the sun, into the water storage tank.

They are very efficient at heating because instead of converting electricity (or gas) into heat it uses a much smaller amount of energy to move heat from elsewhere. In Australia we mostly use air-sourced heat pumps, but in colder climates ground-sourced heat pumps are more common.

The measure of efficiency is the COP, or coefficient of performance, a ratio of energy consumed to energy provided. Higher is better. Good units usually have a COP of around 4, which means they use around 75% less energy than an electric hot water system. When they are paired with a solar PV system to provide the electricity they can be 100% solar powered, with typically no running costs, compared to a solar hot water system that requires boosting in the Winter.



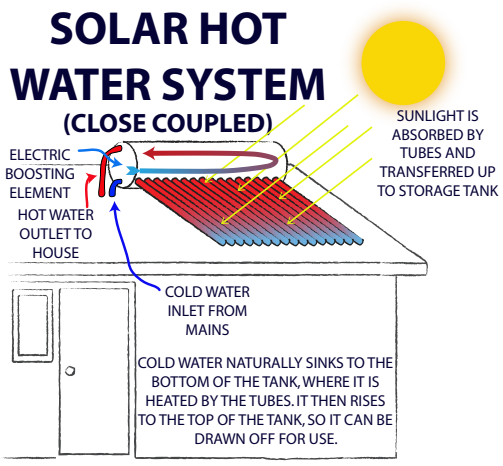
Like solar hot water systems, heat pump hot water can be split, with the tank separate to the heat pump, or integrated, where the heat pump is on top of the tank.

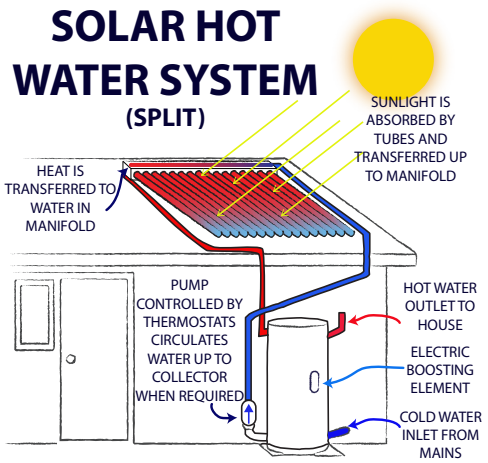
Solar Hot Water

Solar hot water works by absorbing sunlight and using it to heat water. The sun is free and renewable energy, but in Melbourne's climate zone it will only provide around 2/3 of the energy required to heat your water year round. The rest is made up by a booster, which is usually an electric element in the storage tank or an external instantaneous gas system.

There are two main types of solar collectors, flat plate and evacuated tube. Flat plate systems are pipes in an insulated box with glass at the front. While simple and cheap, it is difficult to insulate the pipes against heat loss while still exposing them to the sun.
Evacuated tubes work like a thermos, with two layers of glass with the air evacuated from between them. The inside is coated to very efficiently absorb sunlight, but the heat can't easily escape back through the vacuum. This makes them more efficient than flat panels when the air is cold.

Solar hot water systems of both collector types can be either close-coupled or split. Close-coupled systems have the water storage tank mounted above the panel. The water naturally circulates, with cold water sinking down into the panel where it is heated and then rises up to the storage tank by convection.
Split systems have the storage tank at ground level. A controller senses the temperatures in the tank and at the collector and controls a pump to move the water up to the collector and back.





Other Hot Water Systems

Electric Storage - a tank with an electric heating element in the water.

Electric Instantaneous - no storage, just a high power electric element that heats the water as it passes over it.

Gas Storage- a water storage tank with a gas burner under it.

Gas Instantaneous - no storage, just a gas burner that heats the water as it passes over it.

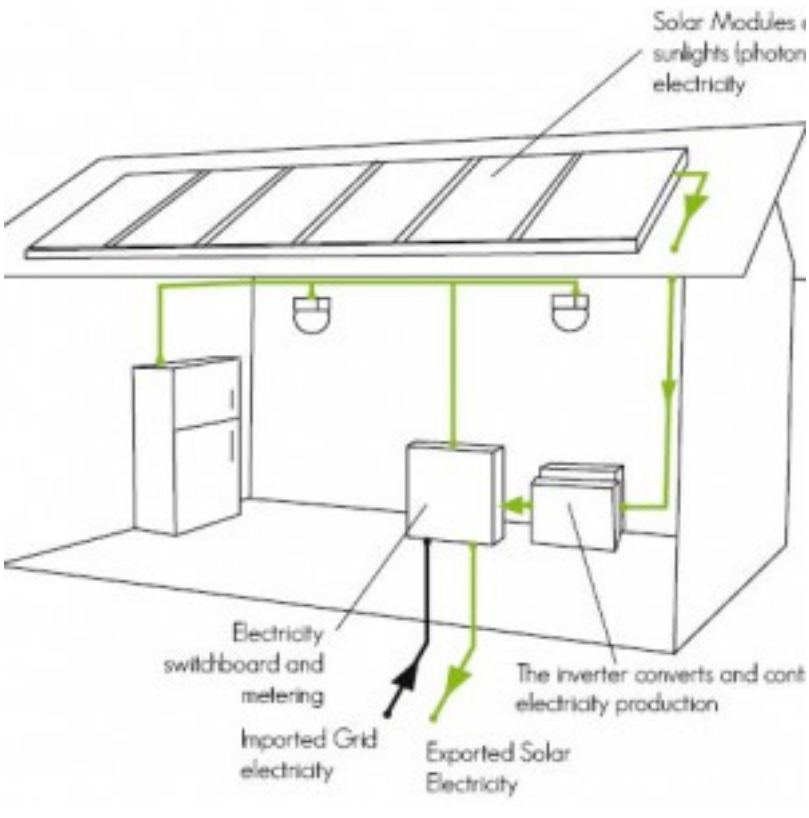
'Wetback' wood heating - a system that circulates water around a wood stove to provide hot water in Winter. Can be used as a booster to a solar hot water system.

Generating and Storing Energy

Solar Electricity

Solar panels work by absorbing photons from sunlight and converting them into electricity. They are a very good source of energy as they are nonpolluting, reliable, relatively cheap, noise-free and powered directly by the sun, so very efficient. The international market for solar panels has grown massively in the first two decades of the 21st century, bringing down prices, increasing efficiency of conversion as research and development $ flow and making significant impacts on our carbon emissions.

Electricity is a very easy form of power to use as we already have an extensive distribution grid in place. This grid is being used in new ways with the uptake in solar, to take the electricity being generated but not used on a site and send it back into the network for others to use. If the site is using more power than is being generated then the remainder required is transparently drawn in from the grid.



A grid-connected solar power system requires an inverter, a complex box of electronics that allows the solar panels to produce the maximum power available under the circumstances then converts this DC electricity into AC electricity that is matched to the grid for voltage and frequency. They also typically have other features like anti-islanding that disconnects them in the case of a blackout to protect the line workers and other safety features and some have handy things like energy monitoring and reporting modules.

Batteries

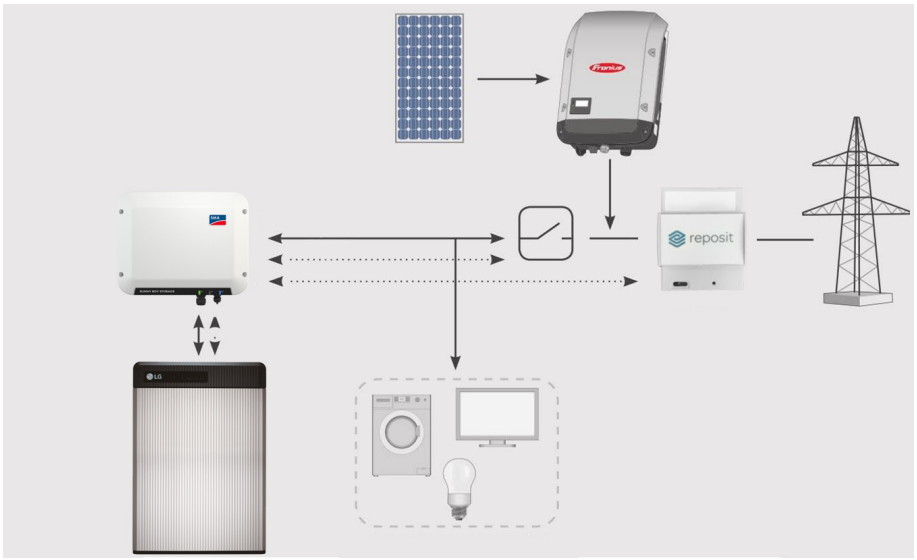
Solar power can also be used away from the grid in stand-alone systems. In this case you need a battery to store the energy generated so you can use it when required.

Batteries can also be very handy for grid-connected systems. One common complaint from people with solar power systems is that they are generating much more power than they are using but still paying a power bill. This is because their system is exporting power all day when they're at work and being paid a low feed-in tariff, then they get home of an evening and use most of their power from the grid at higher rates.

With a battery connected to the system the excess energy generated is used to charge the battery and then used to run the home overnight. The grid is still used as backup for times when it is overcast for a few days in a row or if energy use increases for a short-term event (like all the relatives staying for holidays).

Batteries can connect directly to the solar inverter in some cases, but usually they are an independent piece of equipment and don't require a solar system at all. There are advantages to having the systems communicate and some of the smart battery management systems will fully integrate the entire energy network of the house.

Battery technology is currently still quite expensive and doesn't have great financial paybacks for low energy users. We expect the market to develop rapidly over coming years though, just as solar power did. Higher energy users can get good payback times on a battery and smart battery management systems can help reduce the payback further.
Another factor to consider in payback calculations is possible losses if the power goes down for a few hours. This is rare in the inner city but in more rural areas it can be quite common. People in these areas will also tend to stock up on food in large freezers etc. Loss of power for a few hours can result in the loss of hundreds of dollars worth of food or other perishables, so having a battery for backup can save considerable amounts of money.



There are three main types of battery systems, Grid Connect, Grid Connect with Backup Power and Stand Alone. Basic grid connected systems will disconnect if a blackout occurs, same as a simple solar inverter. More advanced systems will disconnect the house from the power grid (to protect line workers in the area) but keep supplying the house until the batteries run low. Stand alone systems aren't connected to the grid at all and reply completely on the batteries, usually requiring a much bigger array to allow for the depths of Winter. They also usually have a generator to provide backup in extreme circumstances.

As mentioned earlier, batteries aren't the only method of storing your solar energy to use later. You can also store it as hot water in a tank or thermal energy in your home, as long as they're using the solar power to 'generate' the heat and you have done all you can to minimise the losses in the system. E.g. draught-proofing and insulating your home.

Lighting and downlights

Lighting used to be a significant energy user in the home, but now with affordable LED lighting using up to 90% less energy than the old incandescent light bulbs it's very simple to make it a tiny portion of your bill. There's still quite a few aspects worth knowing about to make sure you get the right results and don't go compromising other areas of your energy efficiency.

What is wrong with downlights?

Downlights have been the default domestic lighting in Australia in the last 3 or 4 decades. However, there are many issues with them. Until recently they've used halogen lamps. Most used 12 Volt transformers, which confused many people into thinking they were lower power than 240 Volt lighting, but they actually used 50 Watts per lamp just to light up a couple of square metres of floor. With 4 – 6 in a typical room this meant 200 – 300W to achieve lighting that could usually be bettered with a single 100W light bulb in a pendant fitting.

There's also a serious fire danger from halogen lamps running hot enough to set fire to insulation and timbers in your roof cavity. This means large insulation clearances are required around halogen downlights, and the heat rising off the lamps would actively draw air through gaps in the light fitting, amplifying the heat losses.

The most common solution in the past was to simply replace the halogen bulb with an LED bulb of similar size, shape and light output. The benefits are lower up front cost and easy DIY changeover. The downsides are that there are engineering limitations on the LED when you're cramming it into a halogen sized package, there can be compatibility issues with the halogen transformer, they often have large ventilation holes making them draughtier than a halogen lamp, and regulations say that if it is possible to revert to a halogen lamp in the fitting then it must be treated as such, with the large safety gaps in insulation etc.

A better way is to replace the entire fitting with a dedicated LED fitting. You get a better LED with no transformer issues and you can insulate right up to or even over the fitting, depending on it's rating. The downside is you're paying a little more and you need an electrician to swap the fittings over.

The best solution is to remove all of the downlights, patch the holes and repaint then redo your lighting design from scratch. You can achieve a much better overall result for lighting and insulation. If you're interested in this path give us a call or an email to talk about the possibilities. If you're capable and willing to do the patching and painting yourself the costs are often similar to replacing with LED downlights, due to less fittings being required overall.

Dimmers

Dimmers have a minimum load, below which they tend to flicker. You must use dimmable LEDs if you have a dimmer. They are specially designed to trick the dimmer into thinking it has a higher load. Older dimmers have a fairly high maximum load, newer dimmers have been designed for modern high-efficiency lighting and behave much better.

How do electric lights work?

The old incandescent lights work by running the electricity through a very thin piece of wire so it gets hot and glows. The glass bulb protects the wire from physical damage and also contains a vacuum or inert gases so the wire doesn't simply burn up. They are however very fragile and inefficient and don't have a very long lifetime. Most of the electricity is converted to heat instead of visible light.

Fluorescent lights work by having the right conditions inside a glass tube to create and maintain a giant spark. A coating of chemicals inside the tube absorbs the (mostly UV) light from the spark and converts it to visible wavelengths. They are much more efficient and long lasting than incandescents, but still very fragile and physically large.

Light-Emitting Diodes are a semiconductor light source. They are based on the same kind of technologies as computer chips and solar panels, where a very pure crystal of a substance is 'doped' with tiny amounts of other substances that change the characteristics. (This is quite a complex area that you can research if it interests you.) They are the opposite of a solar panel, where photons are absorbed by a semiconductor and converted into electricity. LEDs are known as solid-state lighting, because they are a solid substance rather than glass bulbs or tubes. As a result they are very physically robust and long lasting.

Because LEDs are so much more efficient they produce much less heat than other technologies and they are also physically very small, meaning they can be used in many situations that were previously impossible. The little bit of heat they produce is very concentrated in the small chip area, so if it's not drawn away it will overheat and fail, making heat management very important for LEDs.

EFFICIENCY
(LUMENS/WATT)

LIGHT SOURCE	L/W
CANDLE	0.3
TUNGSTEN LAMP	7 - 15
HALOGEN LAMP	15 - 24
MERCURY VAPOUR	35 - 65
COMPACT FLUORO	45 - 75
FLUORO TUBE	60 - 120
METAL HALIDE	60 - 120
LOW PRESSURE SODIUM	100 - 200
LED	50 - 150+

TYPICAL LIGHT OUTPUT

WATTS	LUMENS	
TUNGSTEN INCANDESCENT (OLD LIGHT BULBS)		
15	150	(100 - 225)
25	250	(180 - 375)
40	400	(280 - 600)
60	600	(420 - 900)
75	750	(525 - 1100)
100	1000	(700 - 1500)
MR16 HALOGEN OLD SPOTS AND DOWNLIGHTS)		
20	130 - 250	
35	350 - 550	
50	550 - 900	
FLUORESCENT TUBES		
18W T8	1500	
36W T8	3500	
14W T5	1350	
28W T5	2900	

Lighting Design

There are three main layers of lighting design:

1. Ambient Lighting

- To enable you to move around the space safely
- To make the room feel comfortable

Ambient lighting should generally be diffused and directed mostly at the ceiling and walls, where it is efficiently reflected back into the room. If the ceiling is well lit it feels psychologically comfortable at low light levels.

2. Task Lighting

- To light areas where tasks are being performed

Higher light levels are required for task areas such as kitchens, bathrooms, studies etc. You need to be careful of glare and shadowing affecting the work area.

3. Highlighting

- To highlight features such as artwork or architecture

Light and the contrast of shadows can really bring out features in your home, or distract from less interesting areas.

- A particular light fitting may actually fall into all three categories, but you`must ensure that all layers of lighting have been addressed when designing lighting layouts.

Lumens

We've traditionally measured light bulb brightness in watts. However, this is actually a measure of the electricity being used, not the light output. Because the efficiency has been largely unchanged for nearly 100 years this has been fine, but with increasing efficiency it's no longer a valid way to compare light output. Lumens is actually the measure of light output, and how you should compare light bulbs of differing technologies. See the table for some typical lumen values.

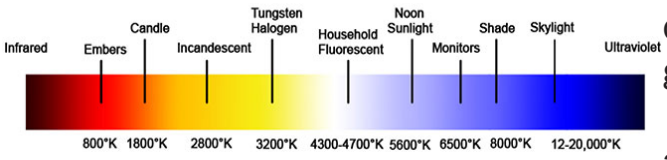
CRI

CRI, or Colour Rendering Index, is a standardised system for measuring the colour accuracy of light sources. It ranges up to 100 ('perfect', within the limited range of colours being measured by the system).

Sunlight is 100, the yellow sodium road lamps have a negative CRI (but are very efficient!). Old fluoro tubes were around 50, with modern ones capable of very high CRI. LEDs range from terrible (when efficiency is more important than accuracy) through to excellent, with some having a CRI of 95+. Most of the LEDs commonly available are 80 - 85 CRI, which is good. If you are a professional photographer, artist or otherwise colour-fussy person you will need higher CRI lamps though.

Colour Temperature

Colour temperature is a measure of the 'colour' of white light. It is measured in K, (degrees Kelvin) and indicates the temperature a theoretical perfect object would be at to emit that colour of light. Imagine a piece of metal in a fire glowing red, then orange, then white hot.



- Lower colour temperatures are 'warmer' with an orange tinge, with typical home lighting being 3000K or less.
- Neutral white is typically 4000K, with cool white being around 5000K.
- Daylight has a definite blue tinge, and is typically 6000K+

General Appliances

Most major appliances such as refrigerators, washing machines, dishwashers and TVs have an official energy rating score. The higher the star rating the less energy it uses to get the job done compared to other appliances of similar size or capacity. It can be worth paying more for a higher rated appliance as the lower running costs can pay back the difference quickly, leaving you ahead in the longer term. As a general rule, higher star rated appliances are better engineered and more likely to last longer as well.

You need to consider the embodied energy and product lifetime as part of your energy flows too. Appliances that fail early and are replaced not only cost you more in the long run, they contain a lot of energy in the materials, manufacturing and shipping of the unit before you even own it. Many products are difficult or impossible to break down for recycling and end up in landfill, or they are sent to less developed countries to be broken down in ways that often end up heavily polluting the region and affecting the health of the workers. Much better to buy a product that will last a very long time and is able to be repaired if it does break down.

Likewise, water consuming appliances are also rated for their efficiency. You can compare appliances at these official websites, as well as using reputable review and rating websites.

www.energyrating.gov.au **www.waterrating.gov.au**

Repair and Reuse

The internet is a vast resource of information on how to repair or upgrade your products to extend their life. Before throwing something out and buying a new one check online for information on how to fix it. Many issues are simple and too many products are thrown out when they could quite easily be fixed, even by a non-technical person. There are excellent step-by-step guides for many different categories of repair. Search for general guides on how to fix that type of appliance or object or do a specific search for the exact model number.

Be very careful with any electrical appliances, especially ones that create heat. Know your limitations and when to involve someone more experienced or a professional.

Look for local businesses that repair appliances, bribe your more technical friends with a nice dinner to come and solve some of your tech issues, get involved with a local men's shed or similar resource of experience, keep your eyes open for Repair Cafes happening in your area. .....

There are many ways and means of extending the life of your appliances and other products, saving you money and reducing your energy footprint. You might even develop new skills that evolve into a hobby!

Compost and Food Waste

Food Waste is a major contributor to greenhouse gas emissions. It's also a valuable resource that can easily be re-used to enhance your garden and grow more food.

Principles of Composting

Composting is the aerobic decomposition of organic matter into nutrient-rich soil, a valuable resource for improving poor quality soil or restoring nutrients taken up by plants as they grow. It requires a blend of microbes such as bacteria and fungi, air and the right moisture level. Fortunately these ingredients are available for free in the average garden.

You generally need about a 50 / 50 blend of what is commonly known as 'green' and 'brown' ingredients. Green ingredients are wetter, richer materials such as food waste, while brown ingredients are drier materials such as grass clippings, leaves and paper. They should be either mixed together or laid in layers. Moisture levels should be damp but not wet and air should be able to circulate through the mix. This can be done by manually mixing and turning the compost, or by using a product designed to aerate the mix, such as a tumbler.

Once the blend is right, all you need is time. The amount of time depends on the mix of ingredients and ambient conditions, tending to go a bit faster in Summer and take a bit longer in Winter, but is typically 6 - 8 weeks for a well-blended load. The decomposition will heat up the compost, which has been used for heating greenhouses and even domestic hot water by enterprising people with huge compost piles.

Worm Farms

Another option is using worms to do the work for you, by eating and digesting the waste then excreting a high quality compost. A traditional compost bin or pile is usually in contact with the ground, allowing the worms to enter and leave as they like, or you can get a 'worm farm', specially designed to give the worms a controlled habitat and contain them.

Bokashi

Bokashi is a system that uses anaerobic (air-free) fermentation to break down the food waste in a special bucket. It's kind of like pickling the food. You collect your daily food scraps as normal, then add them to the Bokashi bucket, add a sprinkle of Bokashi Mix, drain off any liquid that has built up and then close the lid. Because it's air-tight smells stay in and bugs stay out, although the contents barely smell when the process is running correctly.

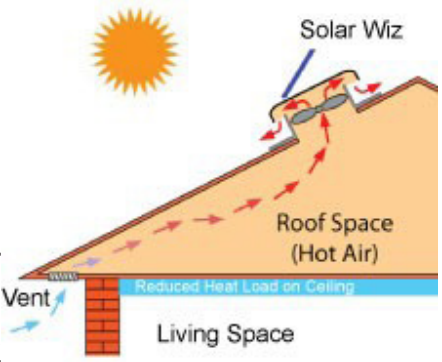
When the bucket is full, either add the contents to your outdoor compost bin, bury them in the soil or take them to a friend's house (or friendly community garden). Once it's in contact with the soil and other organic matter it breaks down quickly into high quality compost. The liquid is also very rich and can be diluted and used as fertiliser, or tipped down your drains to help keep them clean. (the microbes love eating the gunge that builds up in the U-Bend) The micro-organisms in Bokashi Mix build a healthier, stronger and more disease-resistant soil, rather like pro-biotics do in the human digestive system.

Roof Ventilation–Convection

Having a ventilated roof cavity is a very good idea. The heat load coming down through the ceiling in Summer can be significant, even with insulation, due to the extreme temperatures. In Winter moisture can be a problem, causing damage to timbers and reducing the effectiveness of your insulation. The solution to both these issues is to keep a flow of fresh air moving through your roof during the day. Passive whirly bird type vents help, but you need a lot to move enough air. A better solution is solar powered extraction fans.

Why ventilate your roof cavity?

Roof cavities in Australia can get incredibly hot in Summer. The sun blazing down on the roof heats up the interior and with no airflow to get the heat out it just builds up. They can easily reach 60 -70°C. This places a much higher load on your insulation and ducting and can also leak hot air directly through downlights, cornices etc. If you have ducted cooling such as evaporative or aircon the problem is even more severe, with lots of heat gain through the ducting runs. We've had customers complaining that their ducts were blowing warm air instead of cool on very hot days!



You might think a warmer roof cavity is a good thing in Winter, but that's when you can have problems with moisture build-up and condensation, especially if you have exhaust fans venting directly into the roof cavity. Moist batts lose a lot of their insulation value and excess moisture can lead to issues with mould and even timber rot in the framing.

The answer to both of these issues is to keep outside air flowing through the roof cavity, venting hot air to outside and equalising humidity levels to help prevent condensation. Simple roof cowls, vented ridge caps and eaves vents certainly help but unless you have a lot of them you won't be getting enough airflow to deal with the problems effectively. Whirly birds move a bit more air, as long as there's a breeze to help them along, but again you need more than you'd think to be effective.

Solar powered extractor fans have the advantage of moving much more air per unit, and the amount of air moved is proportional to the strength of the sun, meaning the hotter your roof gets the harder they work to keep it cool. They can also be ducted to help ventilate interior spaces that get very hot such as loft rooms.

It's also important to have enough well-positioned air inlets to ensure good and even airflow through the entire roof cavity. When deciding where to position the vents and solar extractor you need to image air flowing from one to the other and try and make sure as much of the roof is covered by the airflow as possible.

Summary

Hopefully you've now got a much better understanding of the main aspects that influence the energy efficiency and comfort of your home. There are plenty of resources available online if you want to dig deeper into any areas, with Your Home Technical Manual being a great reference for home efficiency for Australian conditions and building regulations.

Be careful though. A lot of people get carried away with some aspects after reading about them online, but you need to keep in mind that a lot of the techniques and equipment are designed for very different climatic conditions and regulations to what we have here. Very few areas of Australia are actually snow zones, let alone getting into serious sub-zero temperatures like a lot of Northern Europe and the Americas.

For example, the return on investment on *excessive* insulation is poor, as is money spent on complex equipment such as air heat exchangers when there is a fairly small differential in air temperature. If you assume 20 degrees is a typical indoor temperature (to keep the maths easy) then in Southern Australia external temperatures might range from maybe -5 overnight in Winter to maybe 45 in Summer, giving a maximum temperature differential of only about 25 degrees with it usually much less than that. In Canada it can easily hit -40 degrees in Winter, giving a 60 degree temperature differential! Houses here aren't closed up airtight for months on end like in zones with serious subzero Winters. The money would be better spent on some external blinds, double glazing, a larger solar array, a more efficient heat pump hot water system, a battery storage system etc.

Don't forget to think about other aspects of your life like your travel and purchasing habits, waste disposal (including composting) and any other significant energy inputs or outputs that you could improve. Apply your new understanding of efficiency to your workplace as well. Educate and encourage your family, workmates, employers, friends and relatives.

Go the next step and get involved with community groups and organisations who are making a difference. Lobby your political representatives at local, state and federal levels to lift their game and encourage the major industries to improve.

Reduce

The first and most important step is reduce the amount of resources you're using, and therefore reducing the amount of waste created. This applies to energy, food, water, products, transport, everything in your life. Do you really need something, or is there a better way of solving the problem? Is there an equivalent product with less excessive packaging? This also means considering the amounts and types of waste from the production process, transport and distribution.

Reuse

If you do need something, make sure it gets used as many times as possible. This means buying good quality products and appliances in the first place, not using disposable products like take away food containers and cutlery and trying to find other uses for products that have reached the end of their intended life.

Recycle

When choosing products, try to find ones that can be easily and efficiently recycled, ideally by you. This also includes biodegradability, where nature recycles things back into soil and nutrients for plants. Also remember to buy things made from recycled materials to ensure the economic viability of recycling

Doing Your Own Home Assessment

The following pages are worksheets that we use as a guide when performing home assessments. Print out one of the exterior worksheets and one of the Interior worksheets for each room in your home.

Walk around the outside of your home and see it with new eyes, looking for things that will compromise the energy efficiency like unshaded windows and gaps in the external cladding, especially around doors and windows, that may lead to draughts inside. Think about where you could install rainwater tanks and what you could use the water for.

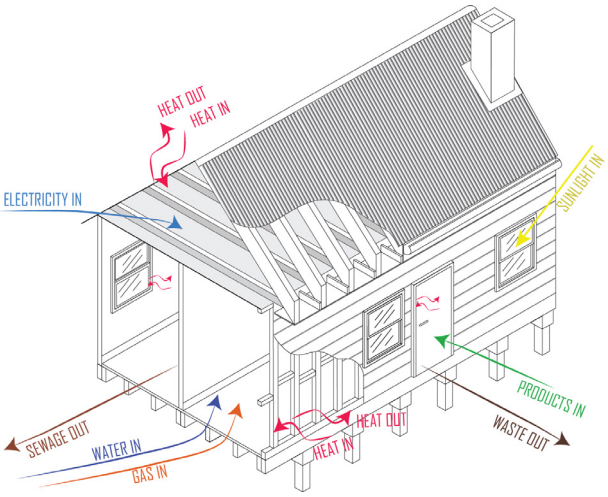
Spend some time looking at your roof with one of the online mapping tools and think about how much of it you could fill with solar panels to generate electricity. You'll need to consider the practical aspects like directions faced and area available, shading from trees and neighbours as well as possible legal aspects such as heritage overlays or body corporate rules. Call some reputable solar providers (like EnviroGroup 1300 430 430) and get some quotes to compare.

Next, work your way through each room looking at the aspects covered on the worksheet, observing details and taking notes. Look for things like dust lines in the frames of doors and windows as evidence of draughts and gaps where you can see daylight around external doors. Don't worry too much about analysing your findings yet or thinking about what to do about them, focus purely on observation. Think about how each room feels at different times of year, which rooms get particularly hot or cold and try to work out why.

This doesn't have to be done all in one session, you can spread it over a few days if it's a bit much to take in all at once. You could also try 'swapping' home assessments with a friend or neighbour, as we often become so familiar with our homes that we become blind to details that might be obvious to someone else.

Once you've got the worksheets filled in sit down, read through them and think about priorities. Assign a number to each finding based on how much difference you think it will make to your home compared to how much it will cost to implement. Do some research or contact some experts for advice on complex areas. Get quotes from appropriate people for the larger jobs like insulation or lighting.

You should now have your head around the energy flows in and out of your home and how much control you have over them. You can make a targeted list of actions to get stuck into and work your way down, improving the comfort and efficiency of your home.



EXTERIOR		Priority 1 - Do it now! It'll make a major difference to the comfort and / or efficiency of your home, giving a major return on investment.	Priority 2 - Do it soon! It'll make a significant difference to the comfort and / or efficiency of your home, giving a good return on investment.	Priority 3 - A bit more involved or expensive but will make a significant difference.	Priority 4 - Take it into consideration, do some more research, worth looking into.	Priority 5 - Not worth it now, but recommended if renovating or doing other major works in the future.		
Passive Solar Design								**Priority**
Exposed windows to North	Location							
Recommended shading								
Exposed windows to West	Location							
Recommended shading								
Exposed windows to East	Location							
Recommended shading								
Heavily exposed unshaded / uninsulated walls								
Notes :								
Insulation								
Ceiling								
Existing Insulation: Area 1		Type :		None	Poor	Good	Excellent	
Existing Insulation: Area 2		Type:		None	Poor	Good	Excellent	
Notes and Recommendations:								
Walls								
Existing Insulation: Area 1		Type :		None	Poor	Good	Excellent	
Existing Insulation: Area 2		Type:		None	Poor	Good	Excellent	
Notes and Recommendations:								

HOME ASSESSMENT WORKSHEET

Underfloor							**Priority**
Existing Insulation: Area 1	Type :		None	Poor	Good	Excellent	
Existing Insulation: Area 2	Type:		None	Poor	Good	Excellent	
	Clearance / access?		Sealed / draughty?				
Notes and Recommendations:							
PV							
Existing?	Size?	Inverter?					
Notes and Recommendations:							
Hot Water							
Existing	Type :	Gas Storage	Gas Instant	Electric	Solar		
Notes :	Age :				Gas Boost	Elec Boost	
	Location :				Flat	Evac Tube	
Potential for solar or heat pump hot water							
Notes and Recommendations:							
Rainwater							
Existing :							
Potential :							
Notes and Recommendations:							
Greywater							
Existing :							
Potential :							
Notes and Recommendations:							

INTERIOR

					Priority 1 - Do it now! It'll make a major difference to the comfort and / or efficiency of your home, giving a major return on investment.	Priority 2 - Do it soon! It'll make a significant difference to the comfort and / or efficiency of your home, giving a good return on investment.	Priority 3 - A bit more involved or expensive but will make a significant difference.	Priority 4 - Take it into consideration, do some more research, worth looking into.	Priority 5 - Not worth it now, but recommended if renovating or doing other major works in the future.	
Room :										Priority
	Doors	Draughty	Sealed	Notes :						
	External									
	Internal									
	Recommendations :									
	Windows	Draughty	Sealed	Sgl Glazed	Dbl Glazed	Frame Type	Notes :			
	1									
	2									
	3									
	4									
	5									
	6									
	7									
	8									
	Recommendations :									
	Lighting									Priority
	Downlights	Halogen		LED		Notes :				
		Tilt	Gimbal	Sealed	Unsealed					
	#									
	Other	Pendant	Oyster	Lamp	Other					
	#									
	Recommendations :									
	Draughts	Skirting		Floorboards		Wall Vents		Other		
	Recommendations :									
	Heating / Cooling		Type :			Location :				
	Appliances	Notes :								

INTERIOR

					Priority 1 - Do it now! It'll make a major difference to the comfort and / or efficiency of your home, giving a major return on investment.	Priority 2 - Do it soon! It'll make a significant difference to the comfort and / or efficiency of your home, giving a good return on investment.	Priority 3 - A bit more involved or expensive but will make a significant difference.	Priority 4 - Take it into consideration, do some more research, worth looking into.	Priority 5 - Not worth it now, but recommended if renovating or doing other major works in the future.	
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	#									
	Other	Pendant	Oyster	Lamp	Other					
	#									
	Recommendations :									
	Draughts	Skirting		Floorboards		Wall Vents		Other		
	Recommendations :									
	Heating / Cooling		Type :			Location :				
	Appliances	Notes :								

Background Information

What is energy?

Officially, energy is the property that must be transferred to an object in order to perform work on the object. It can be converted in form, but never created or destroyed.
This basically means the ability to do things, including moving them, heating them etc and has forms such as gravity, chemical energy, magnetism, momentum, electricity, light, elasticity, heat and many others. The energy is always coming from one form and being converted to another. E.g. electricity being turned into heat in a kettle.
You must remember though, each time energy is converted some of it is wasted. No energy conversion is 100% efficient, most conversions are very far from perfect with a lot of waste. The waste energy usually comes out as heat and noise.
Resources such as Wikipedia are great for educating yourself about energy, it's well worth doing some background reading to help your understanding.
How is energy measured?
It is measured in Joules, but also has other more convenient units such as kWh on your electricity bill.

Commonly used multipliers are k, for kilo or thousand, and M for mega or million. (So one kilo Watt hour (kWh) is 1,000 Watt-hours.)

It is also important to understand terms like Watts, a measure of how quickly energy is being used. How much energy you have actually used depends on how quickly you are using it and how long you are using it for.

Joules (or kWh) is like how much water is in a bucket, while Watts is a measure of how quickly the bucket is being filled. A kettle is like a tap on full, lots of energy flowing but only for a few minutes. Standby power is like a dripping tap, a very slow flow but it can really add up when it's dripping 24 hours a day.

It is important to get a feel for the units of energy so you have an idea of how much energy is being used and therefore potentially wasted. A very inefficient use of a very small amount of energy is not worth worrying about, while a fairly efficient use of a large amount of energy is worth looking at how it could be made more efficient.
Where does energy come from?

All of the energy is already here, built into the universe! Remember, it can't be created or destroyed, just converted into different forms. Much of it is in solid form as matter (the old E=MC2, matter is made of energy). A nuclear explosion is the conversion of matter into light, heat, radiation etc.

Here on Earth, there are only two main primary forms of energy. The biggest one is our Sun, which is the original energy source for solar power (obviously), wind energy, even coal and oil, as they were once plants growing powered by the sun. The other one is energy related to matter, including gravitational, geothermal, tidal and nuclear energy, all of which are originally solar energy too because the matter was converted in a star somewhere in the history of the universe.

What is energy efficiency?

The goal of energy efficiency is to make each conversion of energy as efficient as possible and reduce the number of conversions between the primary source and your final use. (Remember that the Sun is usually the primary source!)

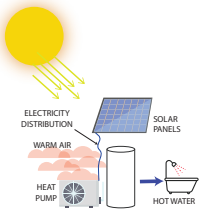
Efficiency is usually measured as a percentage, with 100% meaning there is no waste, every bit of energy is being effectively used to do the work you want. There are very few examples of this and none when you look at the bigger picture. For example, an electric radiator is 100% efficient at converting electricity into heat. But the bigger picture is that your goal is to maintain a comfortable temperature in a room and there are more efficient ways of doing that, including reducing the heat lost to the outside using insulation, using less electricity to move the heat into the room by using a heat pump instead of a radiator and using electricity from a more efficient source, such as solar panels instead of a coal fired power plant.

Let's compare the flow of energy from sunlight into your heater.

Coal fired power plant:

- Conversion of sunlight into coal – VERY inefficient and non-renewable! Photosynthesis is around 2% maximum
- Extraction of coal, processing and transport to power plant (varies, but let's be generous and say 80%)
- Conversion of coal into electricity – typically less than 30% in Victoria due to old power plants burning brown coal
- Losses in electricity distribution system – typically around 5% in Melbourne, so around 95% efficient

  Overall efficiency = 0.02 x 0.8 x 0.3 x 0.95 = 0.456% (being VERY generous for conversion of sun to coal)



Solar Panels:

- Conversion of sunlight into electricity – typically 15%, but over 40% in labs and increasing all the time
- Conversion of DC from solar panels to AC in inverter – average around 80% efficient

  Overall efficiency = 0.15 * 0.8 = 12% (being pessimistic for panel efficiency)

Who is the EnviroShop?

The EnviroShop is Australia's leading environmental products retailer, committed to the best sustainability outcomes possible through quality products, ethical buying practices and excellent service. Originally one business under The Environment Shop banner, EnviroGroup branched off to specialise in solar power while EnviroShop looks after everything else.

The EnviroShop does everything from compostable nappies and non-toxic cleaning products through to consultancy for efficient buildings, with many things in between. Because we sell a wide range of products and are committed to sustainability, we will recommend the best solutions that work together for the best results.

EnviroShop
Energy • Sustainability • Efficiency
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