Designing and Constructing your home

How to spend your life's savings on a home that:

- faces the right way
- is built out of appropriate material
- is comfortable to live in all year round
- saves you money on energy and water bills
- is cheaper to insure and finance
- attracts a premium price when sold

MOUNT BARKER
DISTRICT COUNCIL

A sustainability initiative of
the Mount Barker District Council

Achieving Good Design

The information in this document produced by the Mount Barker District Council will help you design a comfortable home with features that reduce environmental damage and will save you money. This “How-to” booklet is a guide to meeting the requirements set out by Council.

Follow the sections as they guide you step-by-step through your process, showing you how to make your home more water efficient, energy efficient and thermally comfortable.

The Mount Barker District Council has set the way for you to participate in building for a better future.

Go to **www.mountbarker.sa.gov.au/eco-friendlybuilding**

Your home

This booklet is designed to prompt you to think about sustainability in relation to your existing home or your future home.

each topic reads as an open page spread

The 3D model home used in this publication is not perfect... in fact, if you study the information contained within this document you may be able to identify how to make this home more energy efficient.

All of the principles outlined in this document are steps in the direction of sustainability. When integrated into the design and construction of your home, they all work together, producing the most effective results.

Contents

Let's dissect the home and see how it can best operate!

Summer

sun rise

sun path high in the sky

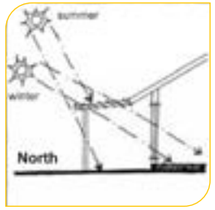
Winter

sun rise

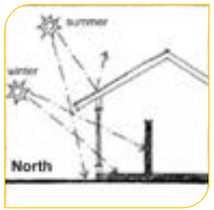
sun path low in the sky

Check your floor plan.

A pergola lets sun through in winter and blocks sun in summer.



Eaves keep summer sun out and allow winter sun in.



Orientation 1

Designing for Comfort

Correct North facing orientation is about bringing the sun's warmth into your home in winter and cooling breezes in summer.

Orientation allows winter sun warmth through living area windows and natural breezes and healthy air movement throughout your home.

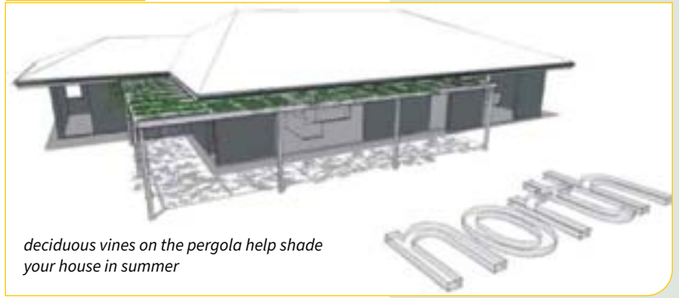
Orientation for winter sun access in combination with adjustable shading devices maintains comfortable temperatures within your home all year, with little or no need for mechanical assistance (heaters, fans, air conditioners etc).

Design your floor plan to ensure passive solar gain to the rooms that most need it.

In general, group living areas along the north face and bedrooms along the south or east faces.

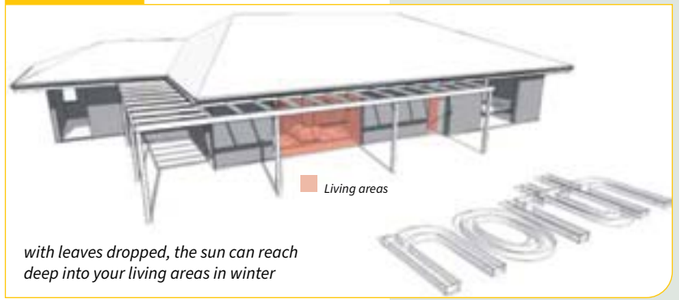
The diagrams show how sunlight can be accessed through your windows in winter to gain the greatest natural heating benefits.

Summer



deciduous vines on the pergola help shade your house in summer

Winter



with leaves dropped, the sun can reach deep into your living areas in winter

Window glazing

Windows well placed for light, warmth, outlook and views add value to a building. The right amount and type of glass will result in cost savings by reducing heating and cooling energy costs.

Too much glass will mean the inside of your home will heat up or get cold quickly. Too little will reduce the amount of heat gained in winter. Wrongly placed glass could miss the warm winter sun and catch the hot summer sun.

Double glazing and some laminated glass with an R value of 0.25 or greater acts like insulation, reducing the speed at which heat moves through the glass. This reduces the rate of heat transfer but does not reduce the need for shading to remove direct heat contact on glass. Other glass types act to reflect radiation, but similarly do not remove the need for shading. Standard 4mm float glass has an R value of approximately 0.02.

North facing glazing is ideal for Mt Barker's cool temperate climate. It allows maximum solar access in winter and can be easily shaded in summer.

On east and west facing facades for views and valuable cross ventilation, an ideal solution is to use smaller windows, with insulating glass to reduce unwanted heat loss and gain. Summer radiated heat gain can then be controlled with adjustable external shading.

On South facades if windows are necessary for light and cross ventilation or views, use only small well insulated windows.

Amount of Glazing

(windows and doors)

Windows need to be as big as they can be on the North face to admit maximum free solar heating, without producing uncontrolled heat loss/gain elements. Rule of thumb is to occupy 70% of the North face with well insulating windows. Avoid or minimise placing windows on the South, East and West facades. Windows that insulate well (have a high R-value) but do not reflect radiation (sun's rays) maximise radiated heat gain and minimise convective heat loss in winter. Windows that reflect radiation in summer will also reduce the amount of radiation in winter.

R-value refers to the Australian Standard Measurement for the time taken for heat to transfer. The higher the 'R' value the more efficient your home will be to heat and cool.

North

South

Have you asked your builder how much more it would cost to make your windows 10 times more thermally efficient?

Check your windows... Are most facing north? Do you have too much unshaded glass facing east and west?

Shading

The correct North facing orientation of your home ensures maximum access for winter sun radiation into your home and outdoor living spaces. The next step is to design for shading, so that your living areas are naturally comfortable during summer. Shading of glass is a critical consideration in passive design. Unprotected glass is the single greatest source of heat gain in a well insulated home. Outdoor living areas adjacent North facing windows and openings also need to be shaded during summer.

Summer Sun Protection

Correct shading will protect living spaces from uncomfortable summer heat load. Your home will be naturally cooler with protective shading and cross-ventilated air movement from breezes at night.

North Shading

The sun moves higher across the sky in summer enabling effective shade for northern facing windows using eaves, covered pergolas (vines, shade cloth or blinds) or vertical screens (shutters or blinds).

East & West Shading

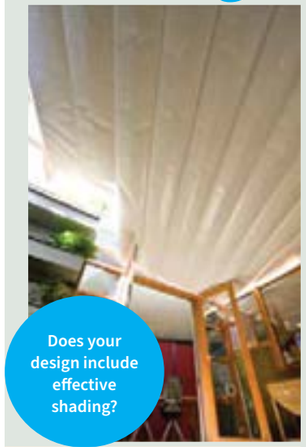
Windows facing east or west get a lot of almost horizontal sunlight in summer and require extensive shading from hot summer sun radiation. To achieve energy efficiency, your house needs full external shading to all windows from October or earlier to March and possibly beyond. Lighter-coloured shading devices reflect more heat. Internal shading is relatively ineffective in preventing heat gain.

Important technical and energy saving information about glazing is available on www.yourhome.gov.au

East

West

Window Glazing and Shading



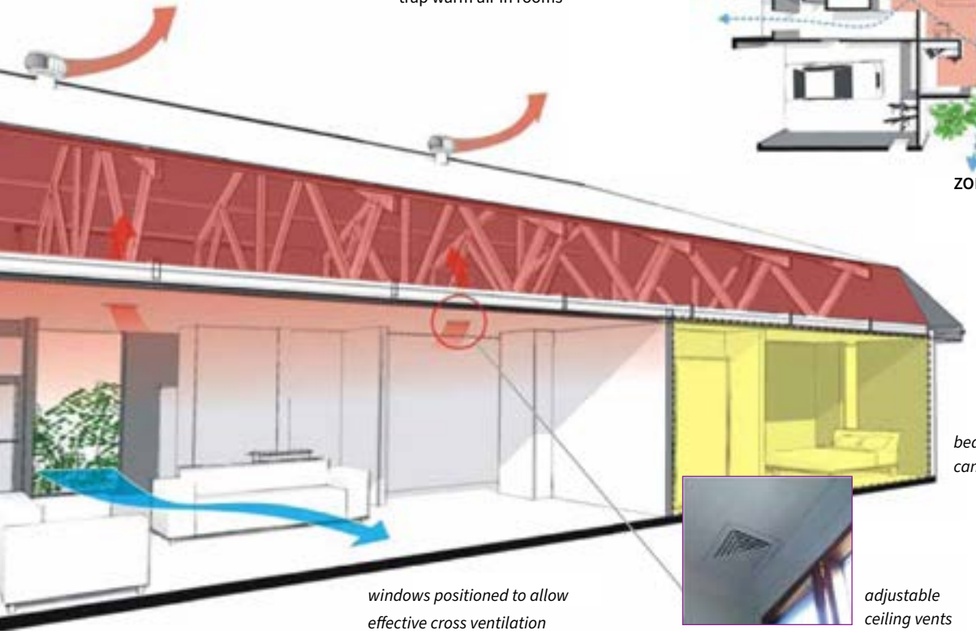
Does your design include effective shading?

Summer condition

heat from roof space is expelled through roof vents drawing the warm air from inside through ceiling vents

Winter condition

close roof vents to keep heat in roof - allow roof heat to enter living spaces (fan may be used) close ceiling vents to trap warm air in rooms



windows positioned to allow effective cross ventilation

adjustable ceiling vents

bedrooms zoned from living areas can heat or cool separately

Ventilation, Sealing & Zoning

It's possible and healthier to cool your home at night through natural ventilation. When you design your home, locate windows, doors and ventilation shutters to encourage cross flow ventilation, and catch natural breezes.

High level windows, ceiling and roof space vents will exhaust heat and encourage air movement when open. In winter they are closed to prevent escape of warm air.

Doors and windows which are well sealed will exclude drafts, and reduce your winter heating costs.

To encourage good air movement, make sure your floor plan and building form maximises the indoor/outdoor relationship and is zoned to maximise comfort for daytime activities and sleeping comfort.

For cross ventilation locate windows, doors and ventilation shutters at each side of your home with clear paths between.

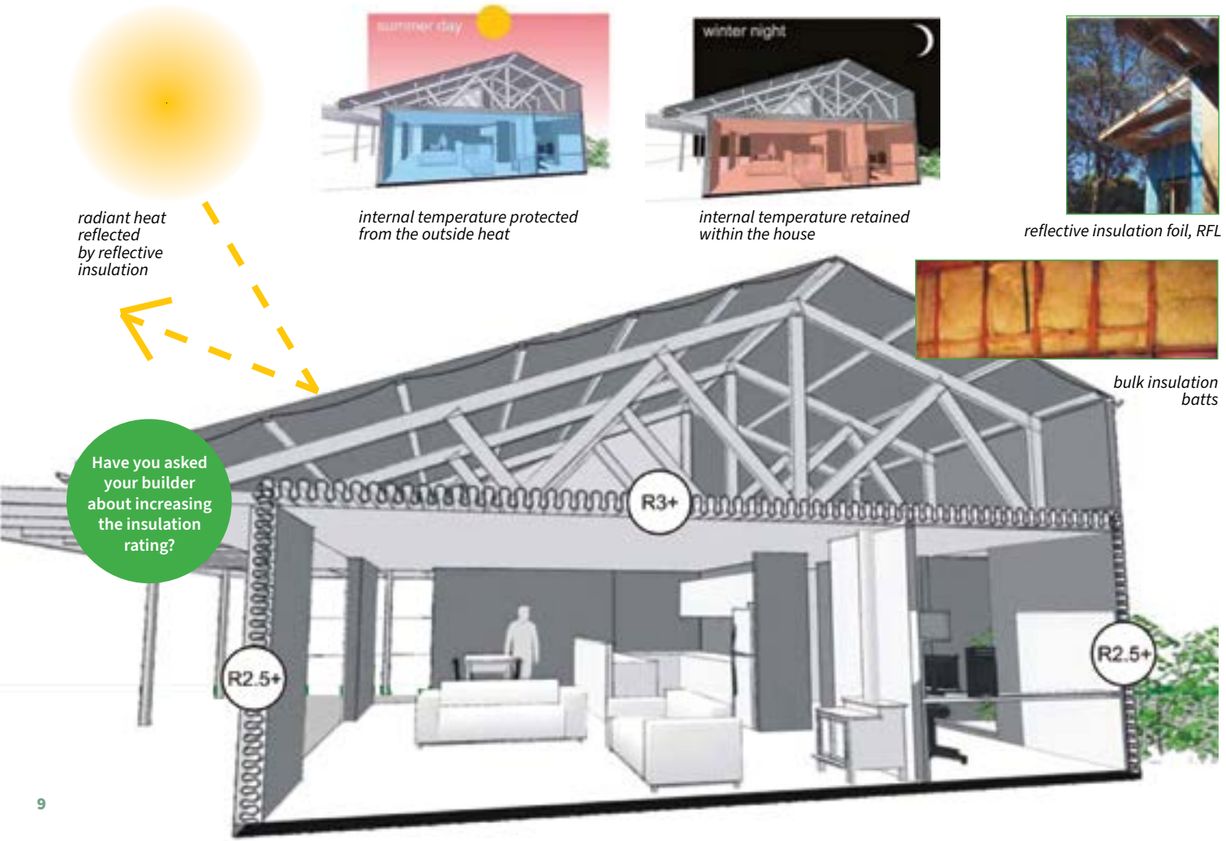
- For heat ventilation install closable vents in the ceiling, for venting through the roof (roof vents) or high level open-able windows.
- Seal all openings (windows & doors) to prevent air movement (draughts and air leaks) in winter.
- Divide your home into zones of different temperature needs for comfort e.g. bedrooms separated from living areas. Also enable closing off living areas from other unoccupied rooms, making heating and cooling more efficient.

If you are building a two-story home, zoning is even more important, as all the energy for heating your living areas will escape up your stairs. Exhaust venting at the head of your stairs will help to remove excess heat in summer, as upstairs will gain heat from below, as well as from the sun, as it is more exposed than downstairs.

Important technical and energy saving information about glazing is available on www.yourhome.gov.au

Ventilation Sealing and Zoning

Does your house design allow for sufficient cross ventilation across all living and sleeping rooms?



radiant heat reflected by reflective insulation

internal temperature protected from the outside heat

internal temperature retained within the house

reflective insulation foil, RFL

bulk insulation batts

Have you asked your builder about increasing the insulation rating?

Insulation

Insulation stops heat flowing into or out of the building. Choosing the right insulation for walls, ceiling and/or roof space and in some cases under the floor will reduce uncomfortable indoor temperature fluctuations. Unwanted heat gain or heat loss will occur without the right type and amount of insulation.

Insulation products come in 2 main categories - bulk and reflective. These are sometimes combined into a composite material. There are many different products available.

The R-value of insulation is the measure of resistance to heat flow and not reflectivity: the higher the R-value the higher the level of insulation.

Recommended Insulation

Greater than R3 between roof and ceiling and R 2.5 in walls. Bulk insulation's effectiveness is measured in "R" values.

It is recommended that this form of insulation be used in roof spaces and in wall cavities to trap heat in or prevent it from getting into the home.

Insulation types & their applications

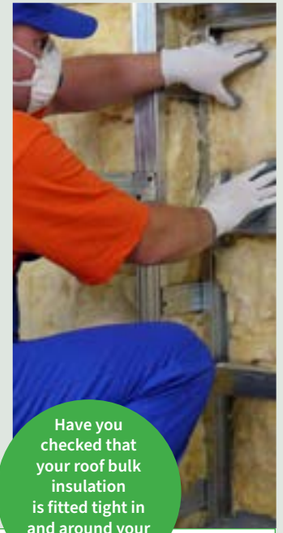
Bulk insulation relies on pockets of trapped air within its structure. Its thermal resistance is essentially the same regardless of the direction of heat flow through it, and is measured as an "R-value".

Reflective insulation simply reflects the sun's heating rays away from the house. Insulation works systematically with the other key elements of passive design. For example, if bulk insulation is installed but the house is not properly shaded, built up heat can be kept in by the insulation creating an 'oven' effect.

A well designed and well insulated home will provide near year-round comfort, cutting cooling and heating bills by up to half.

There is a wide range of materials to choose from.

Foil insulation (reflective) should be located at the external surface of walls and roofs to maximise its capacity to prevent the sun's radiation from entering.



Have you checked that your roof bulk insulation is fitted tight in and around your roof trusses?

This information and more is available at www.yourhome.gov.au

Summer

At night allow cool night breezes and/or convection currents to pass over the thermal mass, drawing out all the stored energy.
During the day protect thermal mass from excess summer heat with shading and insulation.

internal heat soaked up by thermal mass
- well insulated external walls to keep cool in and heat out
- shade from sun

internal heat in thermal mass purged into cool night air
- open windows to allow cross ventilation

Winter

Allow thermal mass to absorb heat during the day from direct sunlight or from heaters. It will reradiate this warmth back into the home throughout the night.

heat from sun and heater stored in thermal mass
- well insulated external walls - allow sun in

stored heat re radiates into the house
- well insulated walls to keep heat in and cold out

Thermal Mass

In the Mt Barker climate zone, houses need correctly placed dense materials like concrete, bricks and other masonry which have “thermal mass” properties. Thermal mass materials (concrete block etc.) have the ability to absorb and store heat energy. The heat is absorbed from the sun’s radiation, from warm air, and any other source of heat.

To be effective, thermal mass must be integrated with passive design techniques, including the right amount of glazing facing North, with appropriate levels of shading and insulation. In winter the stored heat is released from walls and/or floors with thermal mass properties where it is retained during the day into room spaces at night

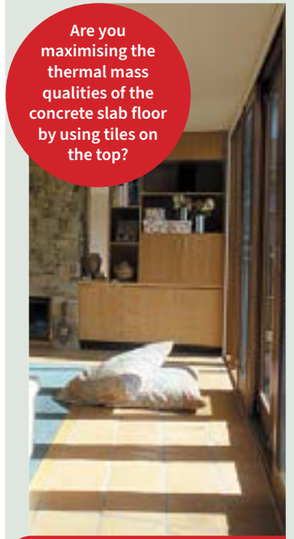
In summer, the heat released at night from walls and/or floors with thermal mass properties is purged through high windows and vents, drawing in cooler night air through low-level windows.

Important facts relating to thermal mass:

- Thermal mass is not a substitute for insulation. Thermal mass stores and re-radiates heat. Insulation stops heat flowing into or out of the building. A high thermal mass material is not generally a good thermal insulator.
- Thermal mass acts as a ‘thermal battery’. It absorbs and stores heat energy.
- During summer, the absorbed heat energy released from the thermal mass at night rises and will naturally escape through high level vents. Lower level windows will provide openings for cooler night air to be drawn into the house. This kind of ventilation is called “vertical stack ventilation”.
- In winter, all window, door and vent openings are closed and well-sealed from draughts so that stored heat energy from the sun or heaters enables the home to stay warm.
- Draught sealing is important, as draughts can account for up to 25 percent of heat loss from a home in winter.
- Thermal mass is particularly beneficial where there is a big difference between day and night outdoor temperatures.
- Floating timber boards on a concrete slab significantly diminish the effectiveness of the thermal mass qualities of the floor. The air gap between the boards and the slab acts as an insulator.

Thermal Mass

Are you maximising the thermal mass qualities of the concrete slab floor by using tiles on the top?



This information and a lot more about thermal mass can be found on www.yourhome.gov.au

Preferred Building Materials

Materials need to be strong, longlasting, low maintenance, and free from toxins that could harm you or the environment while not depleting non renewable sources, or poisoning the environment in manufacture and transport.

Choosing building materials advice:

- Understand how chemicals used in the manufacture of some materials might affect your health.
- Use fully recycled materials or materials with recycled content.
- Choose materials with a lifespan equivalent to the projected life of the building.
- Design to extend building lifespan (current average 50 years - aim for 100+).
- Avoid over-ordering, to minimise the amount of waste during construction.
- Consider how and where the materials are sourced and the impacts this causes.
- Minimise the energy used to transport materials by using locally produced material.

Materials manufacture is constantly changing and there are guides to choosing materials, EcoSpecifier is available to all builders, designers, architects, and owner-builders.
It is a comprehensive database of environmentally preferable products and materials. Other sources for information include :

GECA

https://geca.eco
www.ecospecifier.org

Sustainable building design takes into account:

- **What** a building is made of, to suit local climate
- **How** it is made, to achieve passive heating and passive cooling
- **How** long it will last
- **How** to minimise construction waste
- **How** to avoid out-gassing which is harmful to occupants and harmful to the environment

Construction Systems

In the Mt Barker climate zone, **high mass construction combined with passive solar design and high level insulation** is an ideal solution. This is a long lasting and solid wall construction option, unlike the familiar brick veneer walls which are not well-suited to cope with our hot summers, or for retaining internal warmth in winter.

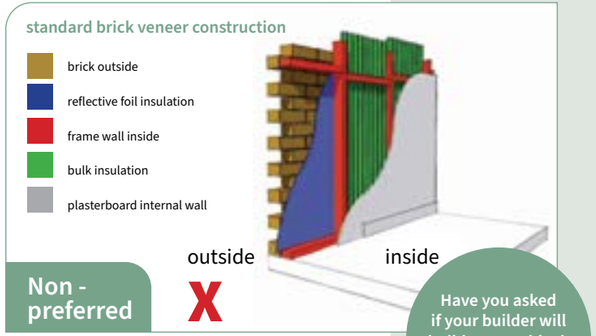
Solid masonry walls (blocks, concrete, stone, rammed earth, mud brick, etc.) in conjunction with concrete floors inside your home will provide much greater levels of comfort, and if insulated on the outside (reverse block veneer) will provide maximum comfort. External insulated light weight walls can reflect unwanted harsh summer sun, keep high air temperature out or warm air in, while the solid masonry part absorbs and re-radiates heat inside your home for your winter comfort.

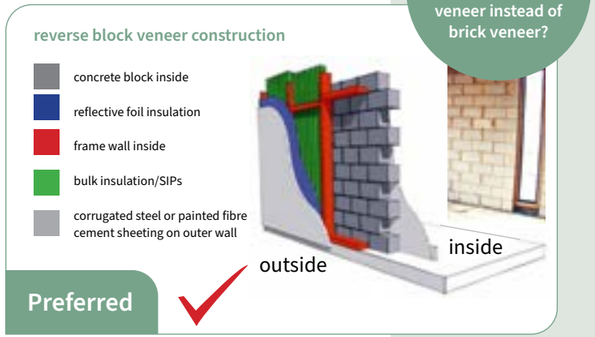
Locating high mass materials

- **Good solar access is required in winter to heat the thermal mass.**
- **Thermal mass should be located predominantly in the northern half of the house where it will absorb the most passive solar heat during winter and can be easily shaded during summer.**
- **Use thermal mass dividing walls between north facing living rooms and south facing bedrooms. Thermal lag may distribute some of the heat to bedrooms, while retention of heat will serve all rooms in summer.**
- **Consider using structural insulated panels (SIPs) a high perfomance building system that is being used more and more**

Standard brick veneer construction concentrates thermal mass outside insulated walls where it is of no benefit in winter and of negative benefit in summer. In summer it absorbs and holds heat and transmits some heat inside, even after the sun has set.

Framed houses rely on reflective and bulk insulation for internal thermal comfort.





Have you asked if your builder will build reverse block veneer instead of brick veneer?

The manufacture of all building materials and transport energy needs to be considered

Embodied Energy

One of the environmental factors often overlooked when designing a new house is the amount of energy/ emissions required to create the materials we use. Of course, energy is required to make all building materials, but some require less energy than others to produce. The energy used to collect raw materials and manufacture products is called **embodied energy.**

Low embodied energy materials are preferable in many cases. Try to find building materials made and sold locally. Long distance transportation is expensive and wastes energy. Always try to use non-rainforest, locally sourced plantation timber. Even better, use recycled materials whenever possible!

Some higher embodied energy materials work better for energy efficiency than their low energy counterparts, by reducing long term energy demands.

This is part of their life cycle contribution. A recommended materials list isn't able to take this detail into account. Cement, glass, plastics, steel and aluminium are all high in embodied energy, but their use can reduce energy demands over the life of a home. Making decisions about using high embodied energy materials instead of their lower energy counterparts can be easier only when you know their use actually does contribute to this saving.

In a nutshell

Important considerations for choosing the materials with the least embodied energy:

- Windows and doors should be timber rather than aluminium. Aluminium window frames can reduce maintenance, but can transmit heat, and are high in embodied energy. Choose aluminium that is made using renewable energy – ask your supplier for evidence.
- Wall material should be concrete block or stone rather than fired clay brick. Fired clay bricks can be beautiful, and some use less energy to make than others. Ask your supplier
- Roof metal sheet rather than clay or concrete tiles
- Roof frame timber rather than steel
- Light weight wall frame system timber rather than steel
- Significant use of recycled material that is sourced locally rather than new materials sourced from great distances
- Be aware that some recycled materials are transported long distances. This can counter the energy benefits of selecting these recycled materials.

For comprehensive information, go to www.yourhome.gov.au

timber window frames

cement block walls

metal roofing

Appliances

Your choice of appliances can either save or cost you money during their operational life.

Energy Information Centre provides South Australians with information about appliance efficiency.

Toll free: 1800 671 907
www.energy.sa.gov.au

Electrical appliances

Choose an appliance with the highest number of stars (Energy Rating Label). A larger model will use more energy than a smaller one with the same star rating. Always check the energy label for the number of kWh (units of electricity) used per year. Sometimes an efficient appliance may cost a little more to buy, but it will soon pay for itself in reduced energy bills. Standby switching can consume significant amounts of electricity unnecessarily.

Cooking, Lighting and Clothes Drying

Energy efficient choices include:

- Energy efficient appliances such as refrigerators that have a high star rating reduce emissions and can save you hundreds of dollars in the long run.
- External clothes lines in place of fuel driven dryers.
- Compact fluorescent lights and LED lights in place of some low voltage high wattage fittings.
- Small sized skylights, to take advantage of free sunlight without over heating your spaces.

Hot Water Service

Solar hot water heaters significantly reduce the amount of “other” power you need to heat your water. Heat pumps are an increasingly popular way to provide hot water. Heat pumps cost more to buy than other services but can save energy and reduce energy bills and greenhouse emissions.

The right selection can lower your energy bills and reduce environmental impact without compromising lifestyle.

Criteria for government rebates based on highest efficiency systems can vary.

Heating and Cooling Systems

Good design will greatly reduce the need for artificial heating and cooling, because effective passive design alone can keep the entire house comfortable for the greater part of the year.

In the Mt Barker climate zone there can be need for additional heating. Cooling from ceiling fans can be enough for most warm days. Evaporative Cooling is an efficient option if necessary.

Any “mechanical” heating system should be selected on the basis of appliance efficiency.

Consult the Energy Information Centre on www.energy.sa.gov.au for up to date information.

Purchase of renewable electrical energy supply (Green Power) is recommended.

Heating and Cooling Options include:

- **Solar-boosted Hydronic InFloor heating**
- **Ceiling fans throughout (other than bath, toilet etc)**
- **Evaporative cooling system**
- **Reverse cycle 6 star minimum, used only in zoned areas and powered by 100% green power.**

Avoid centralised air conditioning systems. If used, ensure that your home is well insulated and shaded and have zone controls and thermostats.

Have you chosen energy efficient appliances?

Have you considered a compressed saw dust pellet fire instead of a standard slow combustion fire?

Water Use

Reducing water use requires a 4-way strategy:

- Collect store and use rainwater
- Utilise grey water
- Conserve use of all water
- Select landscape carefully to not over use fresh water

Have you asked your builder if your rainwater tank can be plumbed to the whole of house?

In this way, consumption of 'potable' mains water is reduced.

Rainwater can be plumbed throughout the house, or at least to toilets, laundry and gardens.

- A 2KL rainwater tank may serve toilet and laundry.
- A 20KL rainwater tank may serve the house.
- Underground rainwater storage is a good option for tight sites. Consider a tank under your driveway. Either look at concrete tanks or 'EnviroModule' tanks.

Need more information on rainwater tank use?

Go to www.natural resources.sa.gov.au for fact sheets and other information about collecting and using rainwater

Consumption of water can be reduced by installing AAAA Dual flush toilets and AAA showerheads, and taps.
Re-use of water can be greatly assisted by installing an onsite grey water treatment and reuse system.

For information go to www.health.sa.gov.au or phone Wastewater Mgt Section, Dept. Of Health, Environmental Health Service (08) 8226 7100.

Irrigation of our gardens can consume large amounts of our mains water, unless we select low water use plants, place mulch, and arrange subsurface or dripper irrigation systems.

Renewable Energy

You can choose to invest in Renewable Energy supply as a way of reducing harmful greenhouse gas emissions that result from production of electricity.

Renewable energy can be purchased from your power provider. (Green Power)

Renewable energy can be produced onsite by a renewable energy system such as photo voltaic (PV) panels. This requires initial capital investment that will be returned over time through reduced purchased power costs. Wind power may be arranged at home too, but you need to check with Council before installation.

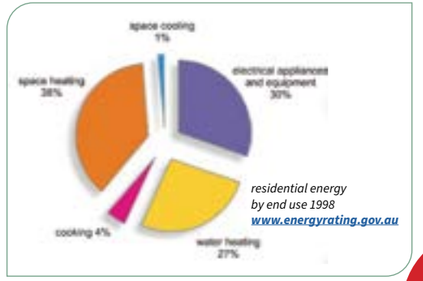
Contact the Australian Green House Office on 1300 130 606 for up to date information.

Energy Saving

If you can answer 'yes' to these bubbles, your savings could be significant.

Should you choose to maximise the passive solar heating potential of your home and use solar hot water, it is estimated that the heating and water heating could use between 40 – 60% less energy (grid connect electricity or natural gas). Add this to an approximated 20 – 40% less consumption in the Electrical Appliances and Equipment area, due to careful energy efficient product choice, your home could potentially use between 50 – 60% less energy when compared to the Australian average.

Whilst some of the suggested systems and construction techniques may cost more up front, it is important to consider the medium to long term cost saving in ever increasing running costs.



residential energy by end use 1998
www.energyrating.gov.au

Are your windows facing north?

Which rooms face north?

If you have any windows facing east and west, are they small and shaded?

Are you maximising the thermal mass qualities of the concrete slab floor by using tiles on the top?

Have you asked your builder how much more it would cost to make your windows 10 times more thermally efficient?

Have you checked your site plan for the north point?

Is your thermal mass on the inside of your house?

Does your house design allow for sufficient cross ventilation across all living and sleeping rooms?

Check your windows... Are most facing north? Do you have too much unshaded glass facing east and west?

Does your design include effective shading?

Have you considered a compressed saw dust pellet fire instead of a standard slow combustion fire?

Have you asked your builder if your rainwater tank can be plumbed to the whole of house?

Have you asked your builder about increasing the insulation rating?

Have you chosen energy efficient appliances?

Have you checked that your roof bulk insulation is fitted tight in and around your roof trusses?

Have you asked if your builder will build reverse block veneer instead of brick veneer?

Are your tiles made locally?

Have you taken this planting list to the local nursery?

Need more information on rainwater tank use?

Site Characteristics - General Design Principles

The following factors should be considered carefully when designing your garden, remembering that a well designed and well kept garden will add value to your property and to the suburb as a whole.
The garden should relate to:

- the architectural design of your house
- any existing vegetation (native rather than exotic)
- the surrounding landscape context of the street.

The following generally make up the components of a garden:

- paving *(or other durable surface for walking on such as timber decks)*
- garden beds
- other permeable surfaces *(including lawn, gravel, mulch)*
- trees
- fencing
- furniture/ ornaments

A good way to provide landscaping in hard paved areas or on balconies or decks is to use pots or planter boxes.

Landscape Character

Landscape character should be identified through observation of the surrounding area in your street and suburb, and should include the following:

- plant species
- tree species
- fencing materials
- setbacks
- materials
- colours;
- other design styles *(for example native bush gardens, Tuscan gardens, English gardens).*

Ideally your design should respond to the surrounding character by interpreting these elements and harmonizing with them in your design.

Street Presence

As most visitors and passers by will view your property from the street, it is important to consider what you want people to be able to see and what you want to hide.

Your landscape design should:

- screen unwanted views
- highlight architectural features
- frame views
- define entry points
- reduce the impact of large / bulky buildings to the street
- provide privacy where desired.

Size and Scale

Landscape design should ensure that all garden areas are incorporated and proportioned appropriately to maximise planting, use and function.

Typical **small** space landscaping could consist of:

- groundcovers
- climbers
- native grasses.

Ensure the species and size of planting (particularly trees) is appropriate to the space available.

Typical **medium** space landscaping could consist of:

- groundcovers
- climbers
- native grasses
- small shrubs
- small trees.

Typical **large** space landscaping could consist of:

- groundcovers
- climbers
- native grasses
- small and large shrubs;
- small and large trees.

Ecological Sustainability

The Mount Barker District Council is committed to ecologically sustainable development, and is encouraging residents to embrace the following principles when designing and planting their gardens:

- retain all existing on site vegetation (native rather than exotic)
- select drought tolerant plants
- install drip irrigation to only those plants that really need it (no irrigation is preferred)
- group plants together that require similar watering regimes
- select only a small number of plants requiring higher water demands and plant them as a focal point in the garden that is easy to access for greater maintenance (for example near the front door)
- select fauna attracting plants
- select plants that provide habitat for native fauna
- use plants to control solar access (for example plant deciduous trees to north facing outdoor areas to provide shade in summer and allow sun through in winter)
- direct downpipes and overflow pipes onto garden beds to reduce water consumption and runoff
- provide permeable surfaces where possible to maximise on site infiltration and minimise runoff
- compost all garden waste
- select recycled materials or materials with a low embodied energy for garden elements (for example recycled hardwood timber for garden edging).

For more information on garden design refer to Council's Sustainable Landscape Design Information Booklet

A good way to improve biodiversity in your backyard is to provide nesting boxes in trees for indigenous fauna to nest in.

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