SMART LIVING

At Home

A guide to sustainable building and renovating.

bright FUTURES

EAST GIPPSLAND SHIRE COUNCIL

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Foreword

Creating a Bright Future

This booklet results from major energy efficiency upgrades being undertaken by East Gippsland Shire Council. East Gippsland Shire is leading by example to reduce emissions and create a bright future for its residents and visitors.

East Gippsland Shire Council will save $500,000 and reduce emissions by over 1,500 tonnes every year, by undertaking the following energy efficiency projects:

- replacing old 80 watt mercury vapour residential street lights (close to 3,000) with new 18 watt LED fittings – to use a quarter of the energy for the same amount of light
- at the Bairnsdale Aquatic and Recreation Centre, cogeneration will create electricity from natural gas and will use leftover heat to warm the centre, and pool blankets and LED lighting will generate big savings also
- new air conditioning at the Corporate Centre (with an economy cycle and fresh-air intake) combined with LED office lighting
- installing air sourced heat pumps, pool blankets and LED lighting at the Lakes Entrance Aquadome

East Gippsland Shire Council has contributed $1.3 million towards this project and acknowledges the contribution of $1.8 million from the Australian Government.

As we continue to improve where we live, we encourage you to look for more ways to create energy efficient practices in your own home. Together we can create a bright future for East Gippsland.

Australian Government
Department of Industry and Science

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Introduction

Why build a sustainable home?

Your home and the way you live are two of the main ways in which you can influence your impact on the planet. This guide for residents has been designed as a resource to help you create an environmentally sustainable home and lifestyle.

Some of the benefits of making your house more sustainable are:

- a more comfortable environment to live in
- cheaper heating and cooling
- reduced exposure to harmful chemicals
- better connections to the external environment
- reduced reliance on mains water
- fewer new and non-renewable resources used in building and maintaining your home
- attraction of native birds and other wildlife
- improved biodiversity.

The main objective of building sustainably is to reduce the pressure of your home on natural resources and the surrounding environment, both during the building or renovation phase, and throughout its life. Household energy use accounts for about 26 per cent of Australia's total energy use, with the main sources being petrol, electricity and natural gas. If you think that your efforts alone don't matter, consider what the impact on our health and the environment would be if everyone across the Shire or even Victoria decided to make their homes more sustainable.

About This Guide

This guide aims to provide information on more sustainable choices for residents building new homes or renovating existing homes.

Climate change is bringing about new climatic challenges with an increase in the intensity and duration of summer heatwaves, milder winters, lower rainfall and more intense storm events. Heatwaves typically result in everyone trying to cool their homes at the same time by switching on mechanical cooling systems. This causes electricity demand to peak, requiring an expensive gold plated grid to be able to meet high demand periods.

Housing design is rapidly evolving to meet the challenge of climate change, and new products are being developed to enable greater energy efficiency in the home. If you are building or renovating it is important to do your research and to keep as up-to-date as possible on the latest developments, or to engage a designer or builder who meets your needs.

A hands-on management approach of actively opening or closing windows, blinds or doors will also greatly improve the movement of heat energy into and out of your home.

Rising energy costs have impacted on all households recently. It makes a lot of sense to have a home that doesn't require large amounts of energy to heat, cool and light, yet remains comfortable and pleasant to live in.

Re-using building and landscaping materials, minimising the use of harmful chemicals around the home and eating locally produced foods can all contribute to a healthy and satisfying life.

Household Energy Usage

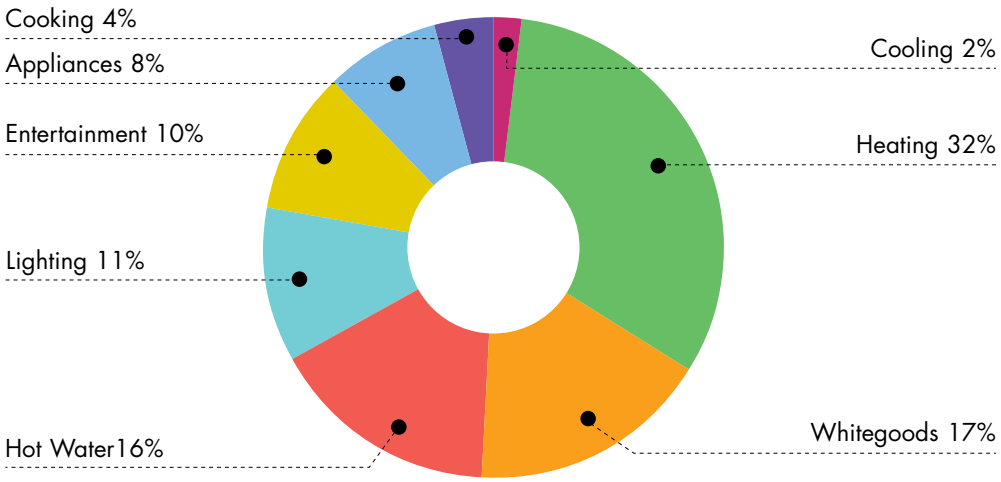
Every household situation is different. Factors that will contribute to your household energy usage include:

- the climate where you live
- the size and features of your home
- the energy standard of your heating, cooling, lighting and appliances
- the habits and lifestyle of people in your home
- the number of people in your home
- how much time you spend at home
- your choice of energy retailer

An important first step is to identify the big energy eaters in your home and consider what you can do to reduce usage.

Our greatest challenge in creating a comfortable home is to design and renovate to cope with heatwaves of increasing frequency, intensity and duration.

The following provides a general breakdown of Victorian household energy expenditure.



Source: Sustainability Victoria 2013

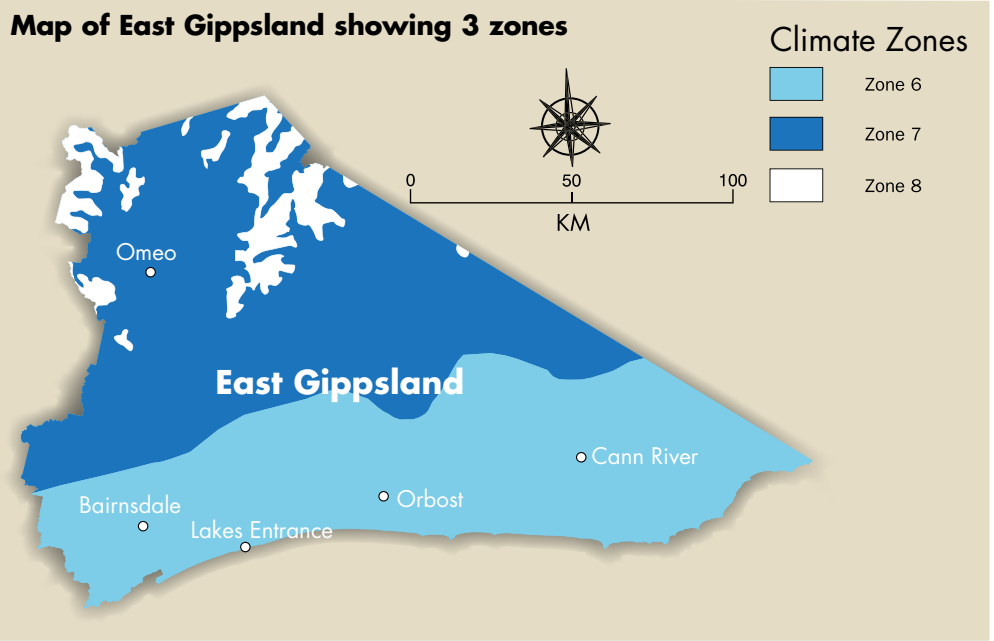
On the basis of the above, most households would benefit from especially targeting reducing energy usage for the big energy users such as heating and hot water, however, any reduction of usage in any area of the home will contribute to a lower energy bill.

Many energy retailers are now providing free online energy usage services for customers with smart meters. You simply log in to your own personal web portal to see graphs and statistics of your energy use over time. Contact your energy company for details.

If you have a smart meter you can also contact your retailer and request an interval report for several months energy use. This report will often be sent as an excel file, showing energy use in half hour intervals.

East Gippsland Shire Council libraries have Powermate energy meters to borrow free of charge. It is an energy meter that shows how much energy your household appliances use and cost.

Our Climate East Gippsland Climatic Zones



Main characteristics of Zones

Characteristic	Zone 6 Mild temperate	Zone 7 Cool temperate	Zone 8 Alpine
Day/night temperature range	Low near coast. High inland.	High	High
Winters	Mild to cool. Low humidity. Can exceed human comfort zone.	Cold to very cold. Low humidity. Majority rainfall. Exceed human comfort zone.	Cold to very cold. Low humidity. Majority rainfall. Some snowfall. Exceed human comfort zone.
Summers	Hot to very hot. Moderate humidity. Can exceed human comfort zone.	Hot. Low humidity. Exceed human comfort zone.	Warm to hot. Low humidity.
Autumn/ Spring	Ideal for human comfort.	Variable conditions.	Variable conditions.

For details on the recommended design response for your climate zone visit: www.yourhome.gov.au/passive-design/design-climate

Planning

- Check Council's planning controls. Each property sits within a planning zone, and each zone has specific requirements for building and earth works. The planning scheme can be accessed online at www.eastgippsland.vic.gov.au
- Planning scheme overlays cover many properties i.e., heritage, design & development and environmental overlays which may influence building material, design choices, location of building sites and vegetation removal/ retention.
- A Pre-application Meeting with a Planning Officer is a valuable way to determine the type of planning controls affecting your site.
- Consider the desired outcome of your new home or renovation. What would you like to achieve in terms of the aesthetics and functionality from your project?
- Consider the site orientation and access, views and how you can utilise building design to gain your ideal living arrangements.
- Consider which building materials would be most appropriate to deliver a completed home that meets your objectives.

Top 5 Renovation Regrets

- Inadequate insulation
- Air leakage
- Poor lighting
- No double glazed windows
- Poor design

Source: Sustainability Victoria 2014

This booklet addresses each of these issues, plus more.

NATIONWIDE HOUSE ENERGY RATING SCHEME ®

Resources

www.yourhome.gov.au/passive-design/design-climate

www.sanctuarymagazine.org.au

www.ata.org.au

Energy Ratings Explained

The energy rating is a calculation of how much energy would be required to heat and cool the house for a year given local climatic conditions and the construction of the house.

A one star house would require very large amounts of heating and cooling, whilst a ten star house at the other end of the scale, would require little or no mechanical heating or cooling. A six star rating is somewhere in the middle. Six stars are the minimum legal requirement, but there are many opportunities to achieve a better rating for little or no additional cost.

Some of the factors considered in an energy rating are:

- type of floor and floor coverings
- type of walls and roofing material
- colour of walls and roof
- type and R-value of insulation to roof, ceiling, walls and floor
- types of window glass and frames and the direction they face
- any permanent shading structures
- sealing of openings such as exhaust fans, down lights, doors and windows.

Some of the factors **not** considered in an energy rating are:

- the embodied energy of building materials
- type and efficiency of heating and cooling
- number and efficiency of household appliances
- water efficiency of tapware and appliances
- stormwater management
- type, quality and chemical composition of cabinetry, furnishings and paint
- any renewable energy system installed.

The tips included in this guide will help to achieve better energy ratings as well as addressing many other sustainability issues.

Energy ratings must be performed by an accredited Thermal Performance Assessor using approved software. You may engage your own assessor or ask your designer or draughtsperson to organise the report. You may also request that the assessor make recommendations to improve the energy rating.

Accredited Thermal Performance Assessors can be found at:

- Building Designers' Association of Victoria www.bdav.org.au
- Association of Building Sustainability Assessors www.absa.net.au

Further information about energy ratings can be found at www.nathers.gov.au.

Passive Building Design

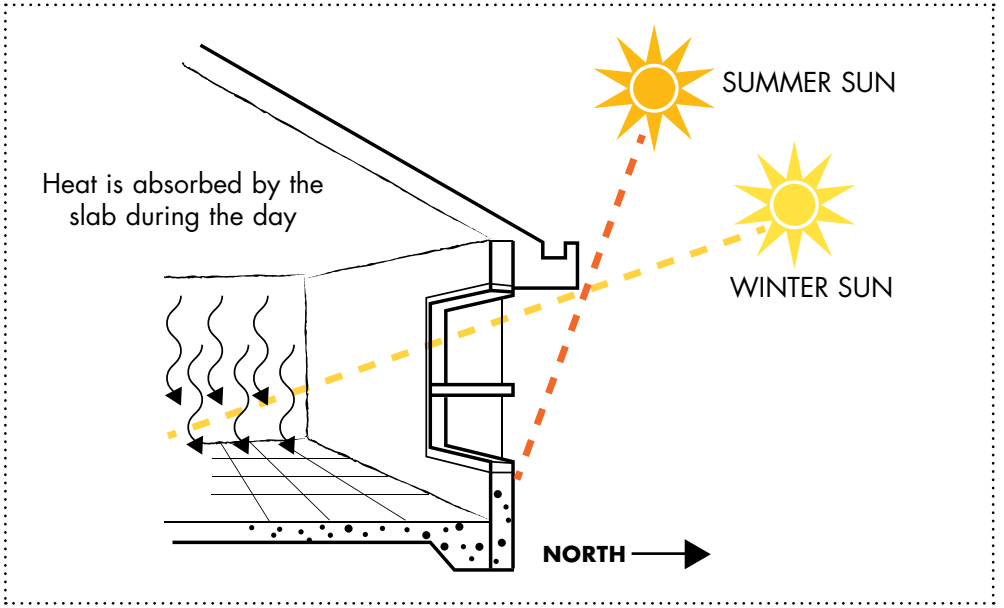
An energy efficient house is designed to work with your local climate to create a comfortable living space throughout the year.

Passive design refers to a number of elements of a home that are designed to take advantage of the path of the sun and prevailing winds throughout the year. Passive solar heating keeps out the summer heat and lets in the winter sun. Passive cooling shades your house in summer and accesses cooling breezes. Good passive design can result in a significant improvement to the energy rating of a house, as well as lower your running costs by reducing the need for mechanical heating and cooling. Passive design includes a combination of elements such as building orientation, shading, sealing, insulation, thermal mass, glazing and skylights.

Orientation

The path of the sun varies seasonally. The position of your house on its site should be designed to take advantage of the sun and prevailing winds. A well-orientated house is usually north-facing with minimum east and west-facing walls and windows. In East Gippsland this means maximising north-facing external walls and minimising east and west-facing walls. This will allow access to the low winter sun and reduce exposure to the hot summer sun. By shading the northern walls and windows in summer with eaves, adjustable shutters or deciduous trees you can restrict the amount of solar heat entering from the north. In winter the lower position of the sun will enable solar heat to enter and warm your home.

West-facing walls receive the strongest sun at the hottest part of the day in summer. Keeping west and east-facing walls and windows to a minimum will reduce the amount of solar heat entering your house. Small, well-shaded windows that open will increase east-west cross-ventilation through your house. Consider the type and position of windows and doors to maximize opening up your house to cool evening breezes in summer.



Consider the type and position of windows and doors to maximize opening up your house to cool evening breezes in summer.

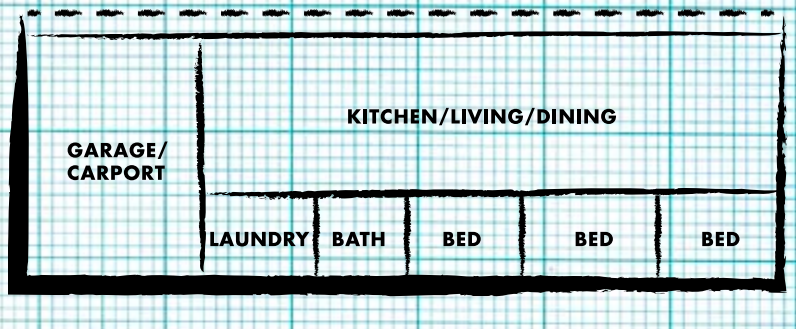
Windows should be predominantly north-facing and sized at a minimum of 12-15% of the floor area of the room (Zone 6), 15-20% (Zone 7) and 20-25% (Zone 8).

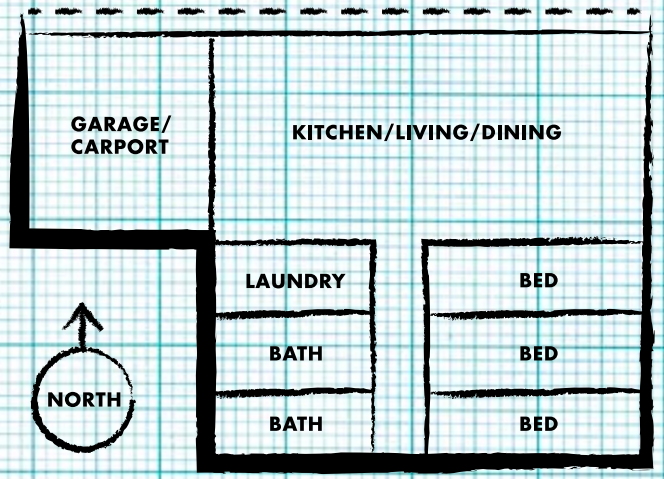
The floor plan of your home should also factor in the path of the sun and prevailing winds. In general, living areas should be located to the north, with utility areas (bathroom and laundry) on the west or south side. For a comfortable night's sleep avoid locating bedrooms on the west side of the house, the south side is much better. A garage or carport on the west side of the house helps to exclude the hottest summer sun from the house.

Avoid being overshadowed by trees or neighbouring buildings, especially on the north side. Solar access for solar electricity, solar hot water and clothes drying should be factored into siting your home on your property.

If you are building a two-storey house ensure your design is focused on the fact that hot air rises and cool air descends. Open stairwells and balconies should be avoided and ensure the upper levels can be closed off to control heat flow within your house.

Some suggested floor plans:





Consider also creating a space specifically for heatwave respite. A highly insulated, well-shaded cool room with small or no window area is highly effective. Heavy drapes (if you have windows), closeable doors and a small, energy-efficient mechanical cooling system can create a sanctuary in the worst of the heat.

RENO TIPS

1. Can you change how you use rooms in your home? If you have north-facing bedrooms, could you change them into living areas and move your bedrooms to the south side of the house?
2. Make your home flexible so that you can separate rooms that need to be heated or cooled. Consider where you could place a wall or door so that you don't need to heat or cool the whole house if you are only using part of it.

Shading

Eaves, adjustable shutters, window awnings, louvers, pergolas, shade cloth and deciduous trees or vines can block up to 90% of direct solar heat. Shading glass windows and doors is the most effective way of keeping heat energy out of your house. Shading your roof area through landscaping also helps.

Shading materials should be light coloured to reflect solar heat. This also includes roof materials.

When considering shading we are usually focused on reducing summer heat. We need to ensure that our shading does not block out the winter sun. Adjustable shading allows for seasonal variation.


Decidous vine in winter


Decidous vine in summer

Orientation	Shading
North	Horizontal adjustable or fixed shading e.g eaves, pergolas with louvers. Deciduous trees.
East & West	Vertical adjustable or fixed shading e.g. awnings. Deep veranda. Pergola with deciduous vine.
South	Deciduous trees.

Windows and glazing

Windows are windows, right? Not these days! There are two important aspects to your windows.

Windows let in light and cool air. They provide views to the outside world. They can also be responsible for the loss of up to 40% of home heating energy and 87% of heat gain in summer. The position of windows and the types of windows and their frames are an essential consideration for an energy efficient home.

Position

Larger windows traditionally have been located on the north side of the house with a fixed or adjustable shade. However, in an extended heatwave, even well-shaded windows will gain significant radiant heat from the surrounding air. An option is to limit the size of all windows including north-facing windows, or to cover them with insulating shutters.

East and west-facing windows should be small and placed to allow only winter sun access and provided with vertical adjustable shading to exclude the summer sun. South-facing windows should be small. All windows should be openable and positioned to allow for cross-ventilation, particularly summer evening breezes to help cool your house.

Double glazed window

Type

The types of windows and their frames should be considered. Windows are usually the weak link in the construction of a thermally efficient building. Standard single glazing offers little resistance to heat flow, so the windows in most homes are a windscreen at best. Double glazing, secondary glazing, coatings and some window films are effective at reducing the amount of heat lost or gained through windows.

There are two factors used to work out how well a particular product will work in different circumstances:

- U-value. This figure relates to the rate at which heat will travel through the window. Generally, the lower the U-value the better the resistance to heat flow.

- Solar Heat Gain Coefficient (SHGC). This figure relates to the amount of heat that will travel through the window. Generally windows on the south, east and west aspects of a house benefit from a window that has a low SHGC so that the heat entering from the summer sun is reduced. North-facing windows that receive good winter sun should have a higher SHGC to allow the heat into the house. External shading on these windows prevents the summer sun from entering the house. Low-e coating is a product applied during the manufacturing process that reduces the SHGC and also prevents heat loss during winter.

Frames

Simple aluminium frames should be avoided as they conduct large amounts of heat. Timber, u-PVC, thermally broken aluminium and composite frames work best because they don't conduct heat well. "Thermally broken" aluminium frames provide a gap filled with a non-conductive material between the interior and exterior layers of the frame to prevent heat being conducted. Timber generally has the lowest environmental impact of all framing materials. u-PVC frames are a petroleum product, and aluminium requires a very large amount of energy in the manufacturing process. These considerations also need to be balanced against any bushfire risk and cost.

RENO TIPS

1. Do you have north-facing windows? Moving windows is usually not as difficult as it seems. Consider whether you could add a north-facing window to your living area and reduce or remove east or west-facing windows.
2. Retrofit your timber window frames with new double glazed units. You can do this yourself or hire an expert. This is a much cheaper option than replacing the entire window.
3. Secondary glazing can be applied to some windows. Typically this consists of a sheet of clear acrylic placed inside the existing pane of glass, using a spacer to create an air gap and it is held in place by strip magnets.
4. Window films can be applied to existing glazing. These products are useful where access, height or heritage issues do not allow for double glazing or external shade devices. Ensure the film will perform correctly by checking the WERS website.

The position of windows and the types of windows and their frames are an essential consideration for an energy efficient home.

Skylights

Skylights, roof windows or tubes and shafts are all very effective ways of increasing the amount of light entering a home and reducing our need to switch on a light. It is estimated that a skylight can emit more than three times as much light as a vertical window. Solar heat gain can be greatly reduced through double glazing and insulated tubes and external shades. The Window Energy Rating Scheme (WERS) maintains a comprehensive, independent database of energy-rated skylight products called WERS for Skylights (WERSfs). For further information visit: www.wers.net/werscontent/skylight-products.

Sealing

Heat loss through air leakage can account for 15-25% of winter heat loss. Use weather sealing and caulking to seal cracks and gaps between the wall, floor and ceiling, around doors, windows, skirting boards, exhaust fans, fireplace, heating ducts and plumbing outlets. There are different sealing products available for different situations, so consult your retailer. Seal off door draughts with door 'sausages' or commercial door seals.

Make a Door Sausage

Cut a rectangular piece of fabric about 40cm wide and at least 4cm longer than the width of your door.

Fold in half and sew lengthways. Sew one end closed. Make sure the stitching is tight so your fill cannot leak through.

Turn inside out, so the raw edges are on the inside. Fill with kitty litter or sand.

Sew the open end shut and decorate.

Thermal Mass

Thermal mass is the term used to describe the capacity of building materials to absorb and store heat.

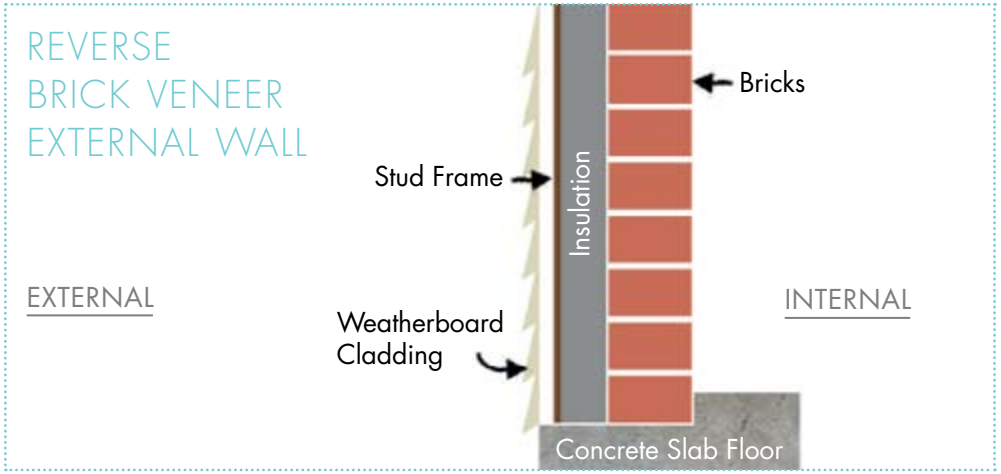
Typically brick, strawbale or concrete have a high thermal mass, while corrugated iron or weatherboards have a low thermal mass. Thermal mass works by absorbing heat during the day, storing it and releasing it at a later time, usually over 6 to 10 hours. The process helps to stabilise the internal temperature of a house and is usually incorporated into the floors and walls.

During winter, this process helps to reduce heating costs by absorbing direct sunlight during the day and releasing the heat into the house overnight. Insulation is obviously important, including under the concrete slab to prevent heat loss to the ground. In summer, thermal mass absorbs heat during the hottest parts of the day, drawing heat out of the surrounding air. The heat is then released overnight as outside temperatures drop.

However, as our climate is changing to prolonged heatwaves, we need to carefully consider how best to use thermal mass in a house, if it all.

In fact it is now suggested that we got the classic brick veneer house wrong! The bricks should be on the inside as they are more effective at regulating internal temperature, while the outside cladding (e.g. corrugated iron) is more responsive to temperature change, resulting in a cooler house in summer provided good insulation is used between the internal and external layers.

It would seem our focus needs to be more on careful design to keep the summer sun screened out through glazing treatments and adjustable shading than thermal mass.



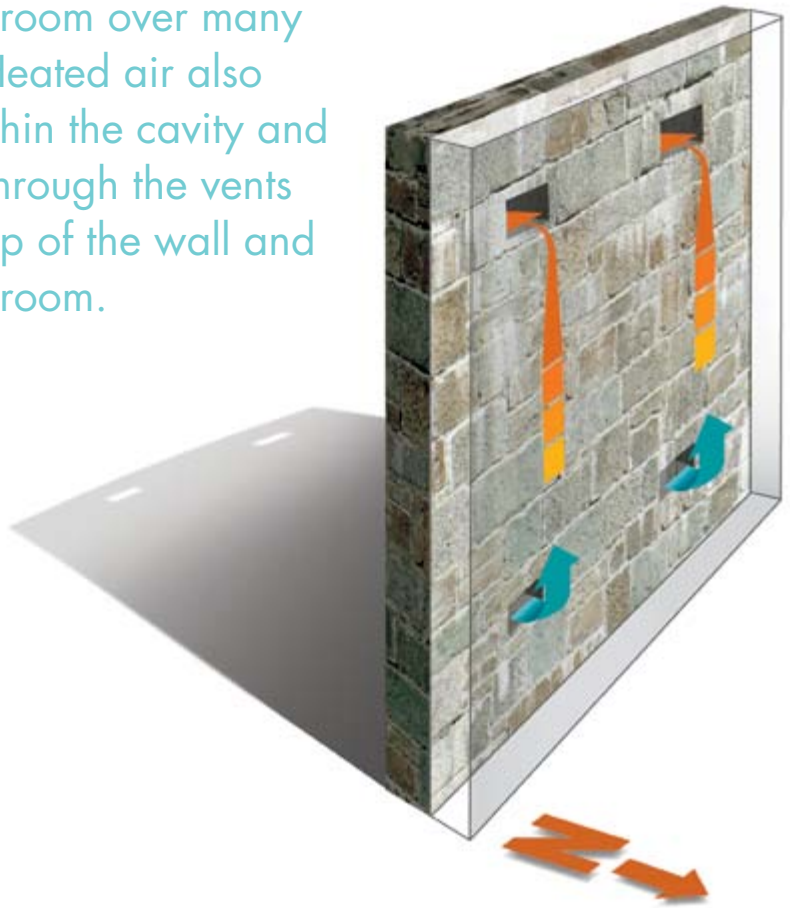
Trombe Walls

A Trombe wall is a thick masonry wall that sits inside a sealed north-facing pane of glass. There are vents located in the top and bottom of the wall.

The sun warms the wall through the glass during the day. Some of the heat then moves through the wall and is released into the room over many hours. Heated air also rises within the cavity and moves through the vents in the top of the wall and into the room.

Cooler air from inside is drawn through the vents at the bottom of the wall to be heated. One-way flaps installed over the vents prevent heat moving in the opposite direction at night.

A suitably sized eave should be designed to stop summer sun hitting the glass and allowing unwanted heat into the house.



Phase Change Materials

Phase change materials are substances that melt and solidify at certain temperatures. These substances store heat and release it at desired times to stabilise the internal temperature of a home. They work in a similar way to thermal mass but are generally much lighter weight products.

Insulation

Insulation comes in many different forms, but its primary purpose is to keep the heat in during winter and keep the heat out during summer. Insulation works best in conjunction with passive design. For example if a house is not adequately shaded in summer, built-up heat can be kept in by insulation to produce an 'oven' effect. Insulation is most economically installed during construction, but it can be added during renovation. Some construction materials such as strawbales and aerated concrete blocks, have good natural insulating properties, while others such as timber and iron are ineffective at restricting heat flow.

Insulation should be incorporated into the roof, ceiling, walls, floor and, in the case of Zone 7 & 8, underneath and around the vertical edge.

Avoid downlights and recessed lights in the ceiling as safety requirements stipulate that insulation must be removed from around the lights and transformers to prevent fires. This creates a Swiss cheese effect in your insulation reducing its effectiveness.

R-value

The resistance to heat flow is labelled as the R-value. East Gippsland has large temperature fluctuations, requiring a higher R-value than somehwhere with a lower temperature range, such as Brisbane. There are optimal levels of insulation, so avoid over-installing for only minor performance improvements at extra cost.

Location	**Minimum required** (with a light coloured roof)[1]
Ceiling	R4.1
Walls	R2.4
Under Floor	R2.25

Note these R values include building materials used in the construction of the roof, ceiling, walls and floor to give a total R value.

[1] National Construction Code 2013, Australian Building Codes Board.

Insulation

Bulk insulation. As the name suggests this type of insulation is bulky and can be used in ceilings, walls and under floors. Generally, the thicker the product the better it performs, but some materials perform better than others. All bulk insulation products should be treated with fire - resistant chemicals and tested to Australian Standards. Bulk insulation comes in various forms:

a. **Glasswool,** made from spun glass or silica. This type of material should not be used without eye, skin and respiratory protection as it contains small glass particles that can cause itching, as well as eye and lung damage. Some products contain some recycled material.

b. **Rockwool,** made from spun volcanic rock. Good for sound insulation. This type of material should not be used without eye, skin and respiratory protection as it contains small glass particles that can cause itching, as well as eye and lung damage.

c. **Earthwool,** is a mineral wool made from recycled products and renewable organic materials. It contains a proprietary binder to reduce health issues associated with glass fibres. Earthwool is non-combustible and reduces sound.

d. **Polyester,** a petroleum-based product. No known health issues. Some products contain some recycled material.

e. **Wool,** straight off the sheep's back and treated with anti-vermin and fire-retardant products. A renewable resource.

f. **Expanded polystyrene board,** a petroleum-based product. Rigid board, resistant to moisture. Can be used in small ceiling cavities, on external walls which can then be rendered, or on internal walls attached to plasterboard. These boards can also come with foil attached for use in the ceiling.

g. **Extruded polystyrene board,** a petroleum-based product. Semi-rigid board. Can be used in small ceiling cavities and on external walls which can then be rendered.

Bulk insulation works by trapping heat in the small air pockets throughout the product. If bulk insulation is compressed it will not work effectively, so a batt should fit snugly into the allocated space, but not be squashed in.

Reflective insulation. This type of insulation helps to reflect heat. In East Gippsland we use most of our energy for heating, so it is installed with the shiny side facing into the house to reflect heat back inside. However, this type of product installed in the roof cavity also helps to reflect heat away from the roof in summer. Reflective foil insulation comes in various forms:

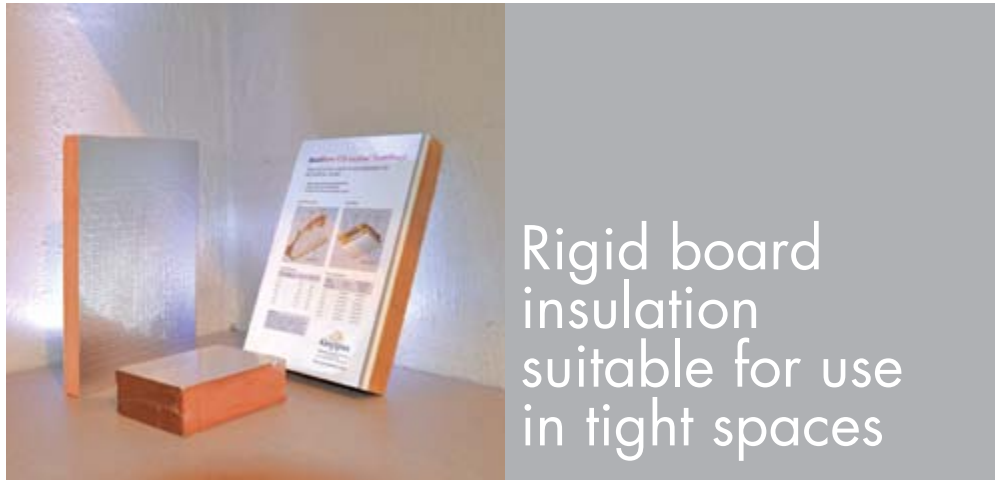
a. **Foil Laminate,** using glasswool reinforcement on one side. This is a thin layer, usually with only one shiny side (known as anti-glare foil).

b. **Multi-cell Foil Batts,** two or three layers of foil with layers of plastic containing air bubbles in between them. Slightly more effective than foil laminate.

Combination insulation. This is also known as builder's blanket or anti-con (anti-condensation) blanket. It is generally used under a tin roof to prevent the formation of condensation on the underside of the tin. Without the blanket, condensation can drip on roof timbers and ceiling insulation causing long term structural problems. It can also be used to line tiled roofs which can reduce the amount of breeze that travels through the roof cavity.

RENO TIPS

Renovations often involve removing internal plasterboard and ripping up flooring. This is an ideal time to add insulation to your walls and floor.



Rigid board insulation suitable for use in tight spaces

INSULATION PRODUCT GUIDE

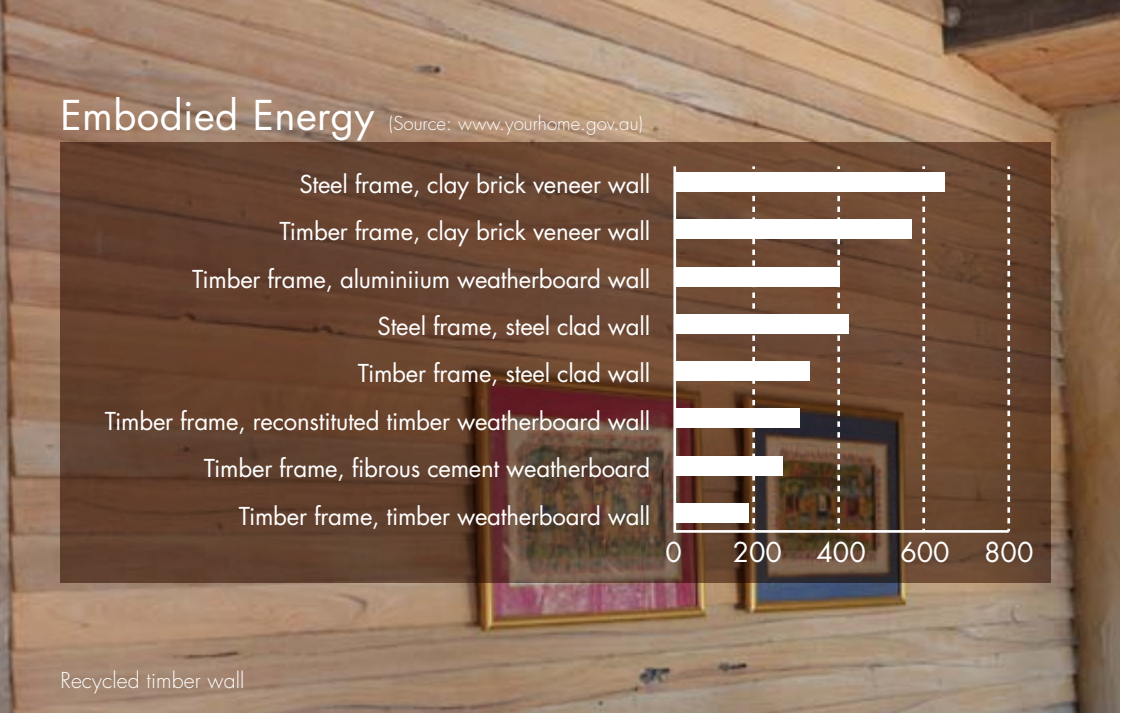
APPLICATION	PRODUCT	SUSTAINABLE FEATURES
INSULATION – REFLECTIVE	Air Cell	A range of products for different applications and ideal for limited spaces. Suitable for roofs, walls and under floors. Manufactured without toxic adhesives. Durable.
INSULATION – BULK	Wool and wool blend batts	Natural renewable fibre, treated with fire retardant.
	Polyester batts	Made from 80% recycled PET bottles, non-toxic and 100% recyclable.
	Kooltherm K8 Boards	Suitable for flat or raked ceilings and walls.
INSULATION – RETROFITTING WALLS	Rockwool	Molten rock can be blown in from inside through holes in plasterboard or from outside by removing weatherboards. Can be blown down into brick cavity walls by removing roof tiles.

RENO TIPS

1. New types of insulation in rigid board form can have a higher R-value for the depth than traditional batts. As boards range in depth from 10mm upwards, there are boards available that will fit into flat or raked rooflines.
2. Insulation can be blown into the wall cavities of some existing homes. Wool or recycled polystyrene materials are usually used for retrofitting, although batts can also be used if weatherboards or plaster are able to be removed.
3. Elevated houses with timber floors achieve significant gains in comfort levels by insulating under floor areas. Installation can be done in sections to reduce the cost burden.

Construction Materials

Most people build a house from all new materials, so it is not surprising that the construction industry accounts for around 40 per cent of raw materials used worldwide. A large number of these materials are either not sustainably produced or are a finite resource. In addition, many new building materials incorporate harmful chemicals that can impact human health and/or air quality.



Recycled timber wall

There are a number of ways you can reduce the impact of your new house or renovation:

- use fully recycled materials, such as used timber, bricks, windows and decorative items, especially if you are demolishing an existing house
- use materials that have a long lifespan so they won't need to be replaced frequently
- choose a style that is classic so it won't need updating when the fashion changes
- use sustainably produced materials, such as FSC-certified plantation timber frames or insulation made from wool
- use materials that are locally produced to reduce transport emissions
- use materials containing some recycled content, such as insulation batts made from old PET or glass bottles, a concrete slab with fly ash, slag or silica fume and recycled aggregate
- consider the environmental and social impacts of the manufacturing process of any materials you choose
- consider whether your new house or parts of it can be pre-fabricated off-site to reduce waste and travel miles
- consider a building technique that uses natural, local, renewable and/or re-used materials, such as mudbrick, rammed earth, straw bale, or timber.

Mudbrick

Mudbricks are made by mixing earth with water, placing the mixture into moulds and drying the bricks in the air.

Straw or other fibres that are strong in tension are often added to the bricks to help add strength and improve the thermal performance.

Mudbricks have a high thermal mass, so they are a good way to stabilise the internal temperature of a home.

Mudbrick houses provide:

- very low environmental impact construction materials
- non-toxic materials
- good fire resistance
- high thermal mass
- long lifespan.

Earth Brick

Earth bricks are manufactured by compressing a mixture of water, earth and fine aggregate into a large block shape by machine. The blocks are uniform in size, shape and thermal properties. If local materials are used, the bricks are very low in embodied energy. Earth bricks are joined with a mud mortar, are quick to manufacture and erect and can be used in a large variety of applications. Earth bricks can be rendered or left in their natural state.

Earth brick houses provide:

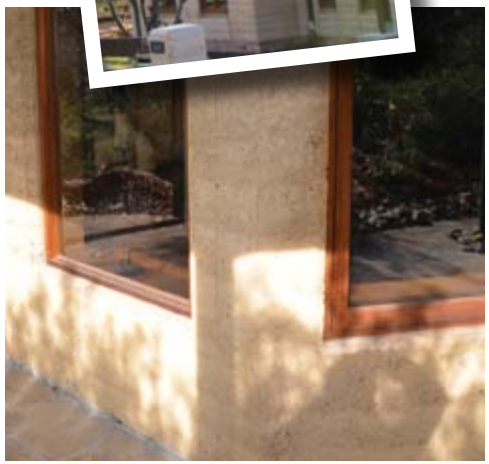
- low environmental impact construction materials
- non-toxic materials
- good fire resistance
- high thermal mass
- long lifespan.

Rammed Earth

Rammed earth walls are made by mixing a combination of clay, sand, aggregate and water and compressing the material into formwork on site. In Australia, a small amount of cement is often added to the mix as a stabiliser then coated with a permeable sealer, ensuring the walls are protected from the weather. Formwork can be re-used many times, although it is sometimes cut to the individual specifications of the building.

Rammed earth houses provide:

- low environmental impact construction materials if un-stabilised
- non-toxic materials
- good fire resistance
- high thermal mass
- long lifespan.



Straw Bale

Straw has been used as a building material for centuries. Straw is derived from the stalk of grasses like wheat and rice, which are high in tensile strength and have the grain head removed. Straw bales are a renewable building material with low toxicity.

Straw bales themselves have very low thermal mass, however, the walls are usually built on a concrete slab floor and with the use of earthen renders, a thick render skin of up to 75mm can be achieved, providing significant thermal mass.

A main feature of straw bales is their excellent insulation – both thermal and sound, which is the most cost-effective available.

Straw bale houses provide:

- renewable resource
- high thermal and sound insulation
- vermin resistance
- non-toxic materials
- a relatively easy medium to work with.

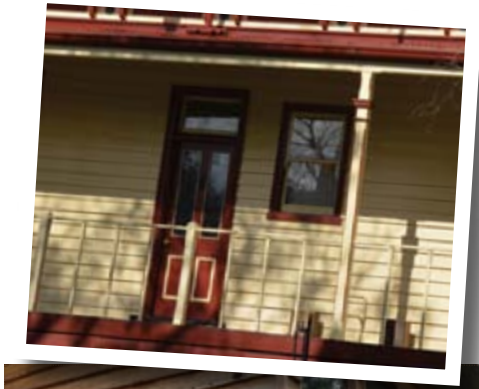
Weatherboard

The timber should be sourced from a FSC-certified plantation.

Weatherboard houses should contain large amounts of insulation to roof, walls and ceilings and contain some internal thermal mass to improve the thermal properties of the building.

Weatherboard houses provide:

- a medium level of embodied energy
- relatively low environmental impact as they use a renewable resource
- non-toxic materials
- low thermal mass.



Autoclaved Aerated Concrete (AAC)

AAC is a lightweight concrete product that provides an innovative alternative to concrete blocks and clay bricks. AAC is produced by adding a foaming agent to concrete in a mould before cutting it into blocks or panels and then autoclaving.

AAC has moderate embodied energy content and contains good thermal and sound insulation properties, due to the number of air pockets within the blocks. AAC also has moderate thermal mass properties.

AAC blocks have a long life and do not produce VOCs after installation. AAC has a high fire-resistance rating as it does not burn.

AAC houses provide:

- good thermal and sound insulation
- good fire resistance
- vermin resistance
- a relatively easy and fast medium to work with.

Corrugated Steel

Sheets of high-tensile steel are passed through rolling presses to create corrugated steel. Recycled content varies from 20-40%. Although the embodied energy of the product is high, corrugated steel is 100% recyclable and the product has a long life.

Corrugated steel has a low thermal mass making it responsive to temperature changes. Light colours can be selected and cladding can contain a solar reflective property. It can be an effective external wall cladding when used in combination with passive design and good insulation.

Corrugated steel is lightweight, making it more efficient and cost effective to transport. It has a high strength-to-weight ratio meaning you can have long, column-free spans and lighter structures that use minimal framing material. Less material is required to construct the building, minimizing waste and resource use.

Corrugated houses provide:

- low thermal mass
- good fire resistance
- low maintenance
- termite resistant
- easy and fast to work with.

Concrete

Concrete slabs or walls provide great thermal mass. However, the manufacturing process uses large quantities of energy and raw materials. To reduce the environmental impact of concrete substances known as supplementary cementitious materials and recycled aggregate can be added to the mix.

Concrete products can be factory made and delivered (precast) or poured on site (tilt-up). Choice is determined by site access, availability of local precasting facilities, the standard of finishes and design requirements relocated or recycled after use.

Concrete slabs or walls provide:

- high thermal mass
- can be insulated
- fire resistant
- termite proof.

CONSTRUCTION MATERIAL PRODUCT GUIDE

APPLICATION	PRODUCT	SUSTAINABLE FEATURES
Concrete slab, footings and drive-way – blended cement	Blended cement Ecoblend (GECA) Envirocrete E-crete	Supplementary cementitious materials are waste products from other manufacturing processes added to cement to reduce the use of new resources and embodied energy. They can also improve the strength and durability of the concrete. Most sites also use recycled water for washdowns.
Aggregate – recycled crushed con-crete	Ecobase Recycled common aggregates	Reduces raw material use by recycling old concrete. Comes in various sizes. This product can have varying strength.
Reinforcement – recycled mesh and bar	Reinforcing bar and mesh	Australian product with 90% recycled content.
	Ecoreo	Australian product with 66-89% recycled content.
	Mesh and bar	New Zealand product with 100% recycled content.
Formwork	Formply	Lower impact on biodiversity by using local plantation timbers.
Concrete slab – insulated slab system	Waffle Pod	Air pockets created by polystyrene blocks create an insulating layer between the concrete and the ground to reduce heat loss. Less concrete required for slab pour. Recycling of waste material from building sites.
	Unipod	
	Cupolex	Air pockets created by recyclable polypropylene structure create an insulating layer between the concrete and the ground to reduce heat loss. Less concrete required for slab pour.
Stumps	Concrete and steel	Concrete or steel stumps are lighter and stronger than timber and are resistant to termites. Fully recyclable.

CONSTRUCTION MATERIAL PRODUCT GUIDE

APPLICATION	PRODUCT	SUSTAINABLE FEATURES
Floor joists and bearers	Composite beam	I-shaped beam reduces resource use.
	Prefabricated beam	Plantation timber eliminates the use of old growth timber. Reduces waste.
	Flooring System	Lightweight steel joists and composite flooring system
	Recycled timber	Eliminates use of new resources.
Underfloor lining	EcoCore Multiply Plyfloor	Plantation timber, low VOC glue.
	R-flor	Laminated with foil on the underside of the board to improve the R-value of suspended timber floors. Made from plantation pine.
Steel frames	Zincalume	High embodied energy but durable and termite-resistant. Includes 20% recycled content and is 100% recyclable.
Thermal spacers for steel frames	Deckmate	Reduces the thermal conductivity of steel frames, but made from Styrofoam
	Polyair spacers	Polyethylene foam.
Timber frames	Studs, noggins, plates, LVL beams and roof trusses	Lower impact on biodiversity by using FSC-certified plantation timbers.
	Hybeam LVL beam	Reduced use of resources as this beam is I-shaped and engineered using recycled or reconstituted wood.
	Roof trusses	Recycled.
Bracing	Plywood	Uses FSC-certified plantation timber.

APPLICATION	PRODUCT	SUSTAINABLE FEATURES
Walls – brick or concrete block	AAC or Hebel	Autoclaved Aerated Concrete (AAC) contains lower embodied energy than bricks and concrete is lightweight and easy to use. It has relatively good thermal and acoustic insulation and is non-combustible.
Walls – concrete alternatives	Timbercrete	The main ingredient is recycled timber waste (cellulose), and it contains low embodied energy as it is air-dried. Timbercrete provides very good thermal insulation, is non-combustible and is very durable.
Walls – recycled brick	Blues and reds, creams, greys and bluestone	100% recycled.
Walls - weatherboard	Radially sawn timber	Efficient use of whole log.
Walls – weatherboard alternatives	Shadowclad ply cladding	Lower impact on biodiversity by using FSC-certified plantation timbers.
Walls – alternatives	Kooltherm K5 insulated board	Insulation attached with R-values up to 4.0. Requires rendering
	Mudbrick	A natural resource with very low embodied energy. Can be made on site.
	Compressed Earth Brick	A natural resource with low embodied energy. Can be made from on-site materials.
	Rammed Earth	A natural resource with low embodied energy. Can be made from on-site materials.
Internal walls	Durra Panel	Durra Panel has excellent acoustic and thermal insulating properties, proven durability, high impact and fire resistance. Made from wheat and/or rice straw fibres, contains no formaldehyde or additional chemical binders.
	LaFarge Plasterboard	The lining uses 100% post-consumer recycled paper and the production process has low water use. 100% recyclable. Low VOCs.
	Kooltherm K17 Plasterboard	The plasterboard is insulated to reduce heat movement through walls and ceilings. R-values range from 2.1 to 4.0.