Environmentally Friendly Housing using Timber – Principles

contents

What makes a house environmentally friendly?

The design of a house has to take into account various base requirements – such as aesthetic, functional, and financial considerations. A good design solution typically varies with location, the requirements of the prospective householder, the climate and materials availability to name a few.

The design of houses must always be concerned with people's wishes and needs and it is from these that design objectives emerge. The design of environmentally friendly houses must be based on these wishes and needs, as it ultimately is the people who use the house in an 'environmentally friendly' way or not: the house must be designed to provide the best 'setting' to allow this to happen.

This Guide sets out the principles for building environmentally friendly houses using traditional timber construction to allow informed decision-making for developers, designers, architects, builders, home buyers, building authorities and others.

The design recommendations are applicable for a broad range of urban, suburban and rural settings.

design objectives

The question of what makes a house environmentally friendly is a complex one. There are no set benchmarks, and new research findings and technologies constantly change any attempt to settle on one definition.

The environmentally friendly design principles presented in this guide are based on the latest research findings. They are broader in concept than other energy-efficient design strategies. The main environmentally friendly design objectives assumed in this guide are:

Low Life-cycle Greenhouse Gas Emission and Energy Consumption

- Minimise the use of non-renewable energy in production, construction and operation of the house.

High Thermal Comfort

- Provide a house design that allows its occupants to live their lifestyles comfortably while consuming minimal *non-renewable energy.*

Cost-effective Design

- Minimise both the initial and future costs of operating the house.

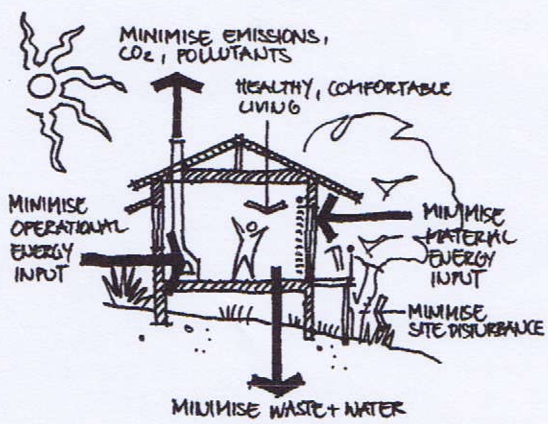
Low environmental impact

- Minimise environmental impact from the construction and occupancy of the house, including the use of environmentally sound materials and finishes.

Sustainable Design

- Maximise the longevity of the house by good design, detailing, and selection of appropriate materials.

Many aspects contribute to the environmental qualities of a dwelling, starting from the appropriate location and the orientation of the house on the site, energy-efficient design and construction, selection of appropriate materials, good construction details, to the selection of environmentally compatible finishes and efficient appliances. Environmentally friendly design is possible for almost all variations of housing types, and can thus be adapted to the particular market demand. *However, there is no single 'environmentally friendly design' that can be duplicated for all applications.* To achieve a good result the design must respond to the project requirements and the site-specific situation. The following Sections of this Guide explore these issues in relation to the key design objectives.



The Environmentally Friendly House

note

This Guide refers, where appropriate, to information on the design and construction of timber buildings available from your local Timber Advisory Service.

This Guide forms the first part of a three part series discussing environmental and thermal efficiency issues in timber housing design and construction.

Principles; This publication introduces the issues of environmentally friendly housing design and gives general background information.

Publications to follow in this series will include,

Designing a Snug House; introduces the principles for designing an environmentally friendly lightweight timber house which is well insulated. This design concept can apply to places in cool climates, such as Canberra, Hobart, and Melbourne, and to temperate areas such as Sydney, Perth, and Adelaide. (see page 7)

Designing the Naturally Ventilated ('Breeze') House; illustrates the design solution of the open, light, naturally ventilated house, a concept ideally suited for the hotter humid climates. This design concept can apply to places such as Brisbane, Central and Northern Queensland, Northern Western Australia and Darwin. (see page 7)

definitions

The following terms are used throughout this guide;

Timber lightweight construction

Dwelling construction where the supporting structure is of timber, that is, a timber frame is used for external walls, floors, and roofs. A number of non-structural claddings, linings and finishes can be used in conjunction with the frame for external cladding, including weatherboard, brick veneer, fibre cement sheet and metal. Lightweight timber construction has a long tradition in Australia.

Environmentally Friendly Design

Building design that aims to minimise impact on the natural environment by using materials and adopting design practices that reduce total greenhouse gas emissions and the use of non-renewable energy over the life of the building.

Environmentally friendly design offers high standards of comfort and aesthetics, together with a healthy environment at an affordable cost.

Greenhouse Gases

Greenhouse Gases are those gases, such as water vapor, carbon dioxide CO_2, tropospheric ozone, nitrous oxide, and methane, which are transparent to solar radiation but opaque to longwave radiation. Their action is similar to that of glass in a greenhouse. Most greenhouse gases occur naturally but the combustion of fossil fuels mainly in industrialised countries over the last 200 years has caused an increased concentration of these gases, in particular carbon dioxide.

Embodied Energy

The amount of energy used to extract and process raw materials into finished building components. The embodied energy of a material is expressed in the units MJ/kg and that of a sheet building component or element MJ/m^2.

Life-cycle Energy

The total energy consumed by a building during its life-cycle (including manufacture of materials, construction, in-use, renovation, & demolition) derived from non-renewable resources. It includes the embodied energy of the building components. Life-cycle energy is usually expressed in terms of source energy, that is, the energy content of the primary fuel before generation, distribution and other losses.

concepts of the environmentally friendly house

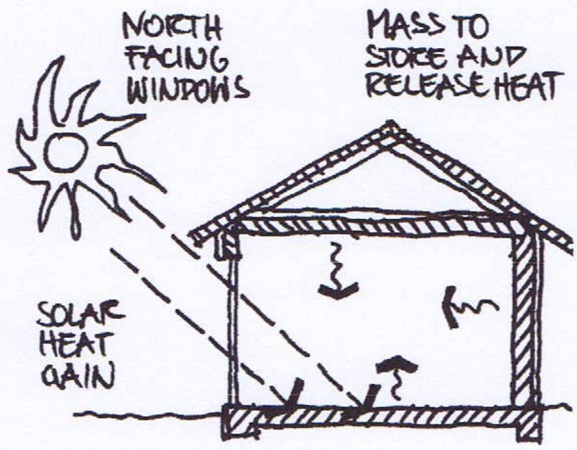
With the focus on low energy and energy-efficient design during the 1970s and 1980s, the 'solar-efficient house' appeared as the most widely acceptable concept of a low energy or energy-efficient house in Australia. This design concept emerged in areas where space heating requirements are assumed to be a central design consideration, and has as its main environmentally friendly feature the collection of the heat of the sun to reduce this energy consumption.

In principle, a correctly designed solar-efficient house gains much of the heat needed in winter from the sun. Heavyweight building materials provide the thermal mass to store the heat and insulation in the ceiling and walls enable this to be released over time to create comfortable indoor living conditions. In periods of hot weather the massive building materials can absorb heat to reduce the internal temperature swings.

The main design features of this type of house are,

- *Zoned design with living rooms to the north and bedrooms* to the south. Main heating in living areas.
- A length-to-width ratio of approximately 1 to 1.5 on the E-W axis.
- Cavity/solid brick and slab-on-ground construction.
- Ceiling and walls insulated (recommended values vary with climate).
- North facing windows, sometimes with a recommended area given as a function of floor area.
- No or minimum glass facing east and west.
- Shading devices to windows during summer (often expressed as an eaves projection or by using deciduous trees or vines for north facing windows and blinds etc. for east and west facing windows).
- Minimum winter ventilation rate.

Most Australian energy-efficient design guides today utilise this concept, and further advice can be readily obtained from various sources, including your local Energy Information Centre, and recent publications such as Australia's Guide to Good Residential Design[1], and Energy Efficient Australian Housing[2]



The Solar House

The solar-efficient house model can be very successful in reducing the operational heating and cooling requirements when the location is suitable, the allotment is oriented and sized adequately, and when it is used appropriately. However, it has certain limitations and in order to operate properly, it requires:

- clear exposure to the sun on north facing windows for living rooms (attractive views in other directions may compete with this requirement or solar access may be restricted by vegetation or buildings)
- a site that allows for a long rectangular building on the East-West axis (to allow large north-facing façade & windows)
- householders who are prepared to leave living room (and *other) windows 'unscreened' during winter days to allow* sunlight penetration (this may conflict with privacy considerations, especially in denser developments)
- a construction method that allows for wall and ceiling insulation (it is difficult to place insulation in cavity brick walls).

In addition, the massive or heavyweight construction required for a solar-efficient house employs materials that generally have a high embodied energy component. If for some reason one of the design features cannot be met, for example solar access cannot be guaranteed, the solar-efficient house could very well result in high life-cycle energy use and associated greenhouse gas emissions.

The 'Lightweight' Timber Solution

The lightweight timber environmentally friendly house concept offers an alternative model with great flexibility while at the same time providing excellent environmental performance. In the lightweight method, a structural framework supports the building, and other materials are used to provide spatial separation and infill. The typical example is the lightweight timber frame with a brick veneer or light cladding material such as weatherboards, fibre cement or metal sheeting. The lightweight timber model is generally more cost effective and more flexible in design than the massive solution, and is in fact the most common house construction type in Australia.

Benefits of a Lightweight Timber Model

- Provides a dwelling with reduced life-cycle energy consumption and greenhouse gas emissions.
- Being less sensitive to orientation and solar access it provides much more flexibility for siting on a block than the massive solution.
- Greater flexibility in design, layout and zoning, as northern orientation is not critical.
- Reduced capital and life-cycle costs compared with an equivalent massive (solar) house.
- Ease of construction – no cut and fill on sloping blocks, easy installation of insulation in walls and ceiling.

Compared to more massive construction, a lightweight building does not store significant amounts of heat within the building structure, and therefore will warm up quickly when heated, and cool down quickly over night. Insulation of the building envelope is important to achieve more constant, comfortable indoor conditions in cool and temperate climates – in cold seasons to keep heat inside, and in hot seasons to keep it outside. Due to framing details, the lightweight timber house is extremely easy to insulate.

It is also possible to combine aspects of the massive and the lightweight house: It is not a simple decision of either-or! If for example the site allows real access to some northern sun, mass can be used in particular places to make use of that solar heat. Housing construction 'hybrids' are also possible and commonly used. For example using concrete slab-on-ground (instead of an elevated timber floor) combined with lightweight walls, is a very widely used concept.

Timber House in Urban Setting

Timber House in Rural Setting

meeting people's wishes

Research clearly shows that when most people buy or build a house their prime consideration is not environmental issues. This is not because they don't care about these issues, they do. It's just that at this critical time, factors such as a design to suit their lifestyle, their budget and getting value for money, and a house appropriate for the location are generally seen as more important.

Design principles that do not lay down hard and fast rules, but allow scope for flexible and imaginative solutions are likely in the long run, to be more successful than the one-dimensional approach often used at the time of writing this guide.

environmentally friendly timber houses

Lightweight timber construction offers a range of design solutions to achieve environmentally friendly housing. Timber frame construction is an appropriate construction method for the design of environmentally friendly houses in almost all climates and conditions. Timber frame housing is a popular construction mode in the cool to temperate regions of Europe and the Americas, with fine building examples also found both in very cold climates of Scandinavia and Canada, and in the very hot tropical climates of South East Asia. Timber frame houses can be found throughout Australia from Tasmania to the *tropical north*.

The design of an environmentally friendly house in the hot humid tropics obviously requires a solution different to that of a house in the cold Snowy Mountains. In order to avoid over-simplification, and to keep information applicable, the principal design approaches for these basic design models are explored separately.

- The Snug House: A lightweight construction, well sealed and insulated to keep comfortable temperatures inside. The ideas are suitable for cool and temperate climates. *Refer to separate guide for details.**
- The Breeze House: A lightweight construction, with an open design for natural ventilation. These recommendations are suitable for tropical conditions. *Refer to separate guide for details.**

Both solutions can be tailored to meet various design challenges such as difficult sites, environmentally sensitive sites, small budgets, or to optimise the performance of particular appliances. Both can be achieved at competitive prices within the price range of standard design solutions. Good design does not cost the Earth!

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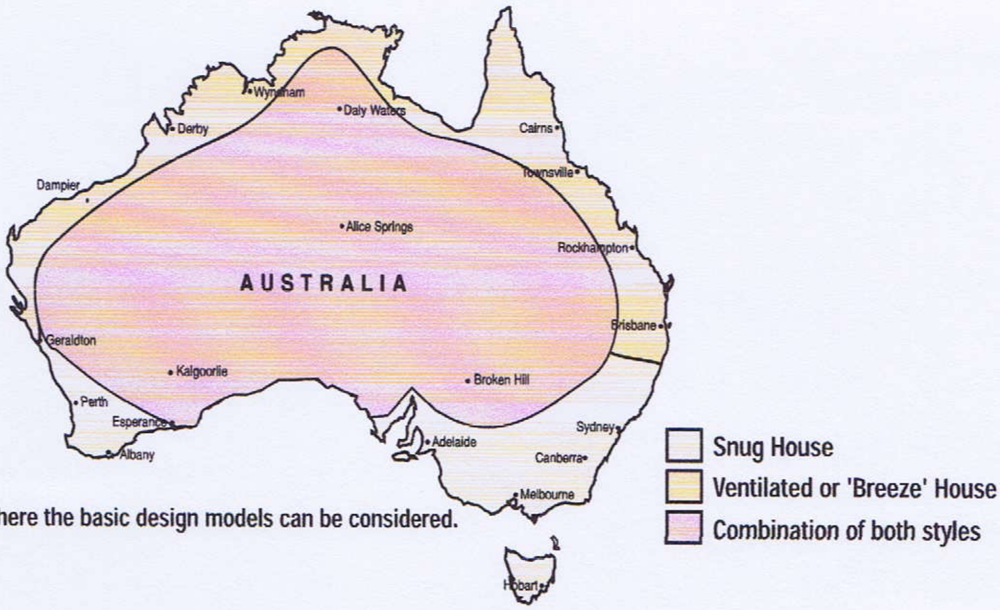
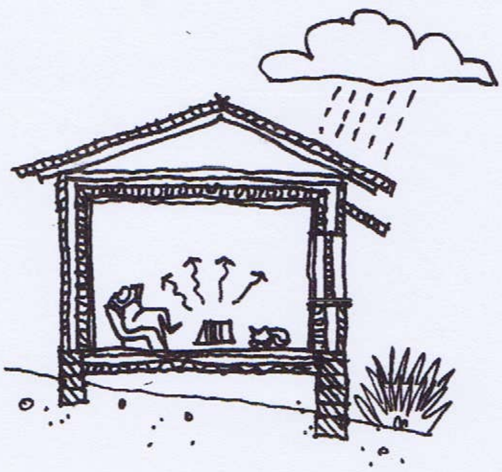
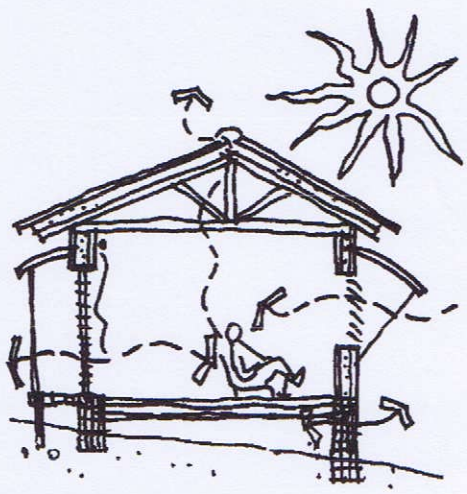
* These guides in production at time of writing.



Indicative zones where the basic design models can be considered.



The Snug House



The Breeze House

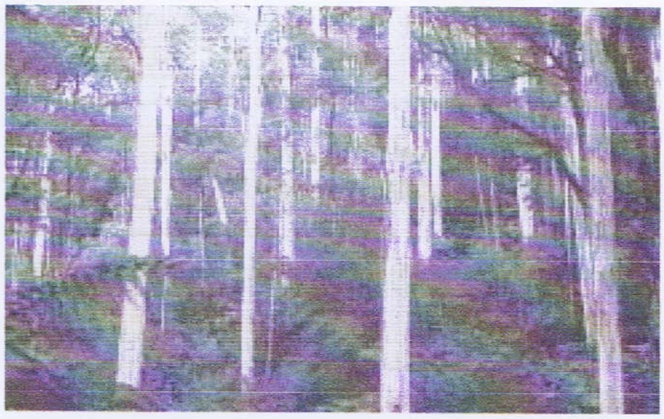
timber building products

Apart from solid timber, there are also many timber building products which are composites or made of components that can be used in lightweight construction. These include plywood, particleboard, fibreboard and engineered products such as glue laminated timber (Glulam) and Laminated Veneer Lumber (LVL). The environmental properties of these different timber products vary, but in general, all have very low embodied energy, little to no waste or hazardous by-products, low greenhouse gas emissions and they can be re-used or recycled. Also, unlike most other building materials, timber is a renewable resource.

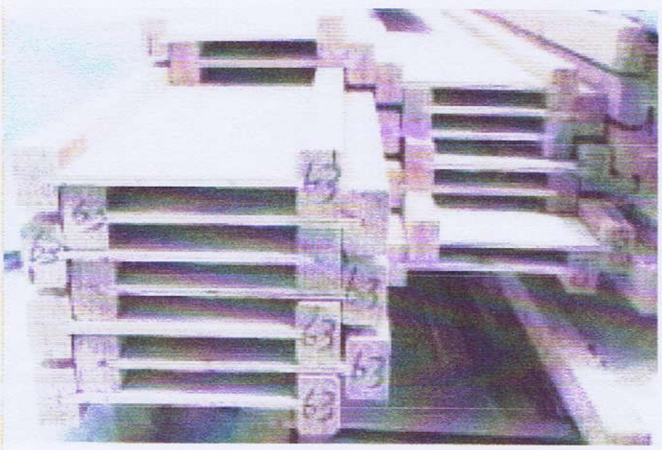
Using plantation timbers and timber products manufactured from sustainably managed forests is an important aspect in environmentally friendly house design. Information on the sources of timber products and comparison of the environmental impact of various building materials is readily available[3] and should become an integrated element in design decision making. Detailed information on particular products is available through the manufacturers, and through your local Timber Advisory Service.

Growing timber is also beneficial for the environment in various ways, in its function as a 'carbon sink' (storing CO_2), as an air filter, soil stabiliser and for ground water absorption.

Plantation Timber



Native Forest



life-cycle energy consumption and greenhouse gas emission

Minimising the life-cycle energy consumption together with reducing greenhouse gas emissions are principal objectives in the design of an environmentally friendly house. Energy is consumed in a house in basically two ways: in the production of the house (including energy used to fabricate building materials) called the 'embodied energy' and in the operation of (or living in) the house.

Heating and Cooling

In Australia, a substantial part of the energy (and therefore the annual energy bill) consumed in a house is used to provide thermal comfort for the occupants; operating heaters in cold weather and coolers and fans in hotter weather.

When looking at reducing household energy consumption, a look at the occupants' thermal comfort requirements, and ways to design for increased comfort, is therefore crucial:

A house that by design provides comfortable conditions will reduce energy consumption

The design of a house can contribute greatly to maximising comfort, and to minimising non-renewable energy consumption. Design with regard to energy-efficiency, including the use of efficient appliances, can help save non-renewable energy consumption in the order of 60-70%, according to a recent Victorian study[4].

But what exactly is a comfortable and an 'energy-efficient' house?

Our living standards and comfort expectations change with factors such as lifestyle, income and the cost of energy, so that there are no general and universal benchmarks for acceptability.

An important aspect of acceptability however relates to the concept of 'design times', that is, the time of year and the time of day that causes the main performance concerns related to thermal performance issues. Design times are an important consideration because a householder who perceives some inadequacy in performance may at some stage seek to improve the situation by installing more energy consuming devices such as air-conditioning. A research project[5] asked people in four capital cities to choose from a list of possible times that they considered important in designing a house. The results are shown in Figure 1. Although all times were registered as important, slightly more weight was given in each location to 'Hot summer nights in bed' and 'Hot summer evenings' indicating the special importance which should be identified with maintaining comfortable sleeping conditions at those times.

Well designed lightweight timber construction can provide *good comfort conditions at the critical times. In particular, and* contrary to a lot of the current design advice, timber floors may be used in dwellings with good results. A timber floor has the big advantage of contributing to thermal comfort during hot summer nights in that it will cool down rapidly during this uncomfortable period, perhaps reducing the need to air-conditioned bedrooms.

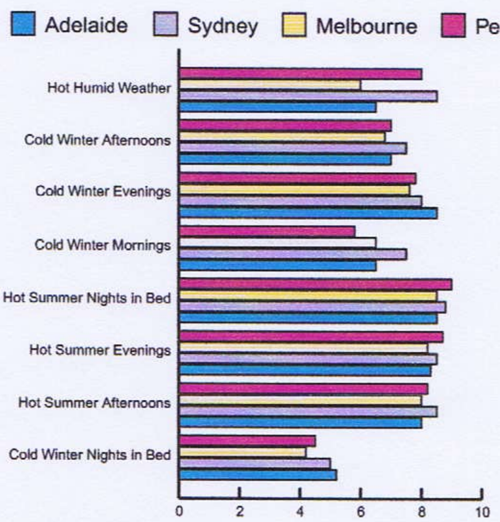


Figure 1: 'Design Times' Importance

Embodied Energy

Timber has a generally low energy requirement for production (embodied energy) compared with other common building materials. A building, which is constructed principally of timber, will require less energy to produce than buildings constructed of materials such as brick, concrete or steel.

The embodied energy of materials in houses forms a significant component of the total life-cycle energy consumption. As operational energy consumption of houses is

Table 1: Indicative Embodied Energy Values for Common Building Elements

Element	Description	MJ/m^2
Floors incl. flooring, framing, footings, reinforcement, DPC, membranes, etc.	Timber suspended, timber sub-floor enclosure	740
	Timber suspended, brick sub-floor wall	1050
	Concrete slab-on-ground	1235
Walls incl. as appropriate, framing, internal lining, insulation	Weatherboard, timber frame	410
	Brick veneer, timber frame	1060
	Double brick	1975
Windows incl. 3mm glass	Timber frame	880
	Alumin. Frame	1595
Roofs incl. plasterboard ceiling, R2.5 insulation, gutters, eaves	Concrete tile, timber frame	755
	Concrete tile, steel frame	870
	Metal cladding, timber frame	1080
	clay tile, timber frame	1465

improved (eg through energy efficient design), the embodied energy is likely to become proportionally even more significant.

A study of two softwood timber mills showed that the embodied energy of softwood timber framing products was in the range, 4.4MJ/kg to 9.2MJ/kg. These values include all energy expended from the timber growing stage through to the delivery of the finished product at timber merchants. They are based on the amount of non-renewable source energy used. The difference in these values is due to mill-specific factors such as different drying practices, materials handling techniques and the amount of waste timber that is recycled.

The process of calculating the total embodied energy of even a small project can be laborious and time consuming[6]. Often the embodied energy of materials is compared by weight (eg MJ/kg). In practice, it is more applicable instead to compare building elements by unit – such as per m^2 of wall as this gives *a better indication of the true value in practice.*

Table 1 gives an indication of the embodied energy in various common building elements expressed as the primary energy input value. While this list of different building products is only illustrative, because each house may be slightly different, it is useful to show the relativity that exists between various options.

Information on embodied energy values can be used as a reference for appraising materials options during the preliminary design phase and may assist in the decision making process. In this way, embodied energy efficiency in design need not be perceived as an imposition, but rather as a useful tool for responsible design.

The embodied energy of materials in houses will increase with the age of dwellings as maintenance, replacement and refurbishment occurs.

Greenhouse gas emissions

The makeup of the Earth's atmosphere is a principle factor in establishing the planet's temperature, and this in turn sets the conditions for all life on Earth. Without the heat-trapping properties of so-called 'greenhouse gases' which make up only a small fraction of the Earth's atmosphere, the average surface temperature of the Earth would be like that of Mars, that is around minus 16°C. In the last 40 years or so scientists have recorded increasing concentrations of these greenhouse gases in the atmosphere and scientific consensus suggests that this will cause a general global warming. Serious environmental impacts could possibly follow such as a rise in sea levels and climate change.

The burning of fossil fuels (coal, gas and oil) in power stations *to produce electricity (and directly in manufacturing processes,* for example manufacturing cement and bricks) is a principle contributor to greenhouse gas emissions.

The use of structural timber has a significant positive environmental impact with respect to greenhouse emissions. Carbon dioxide (CO_2), the most abundant of the greenhouse gases is absorbed by trees during photosynthesis. The carbon removed from the air is converted into the substance of the plant. Thus, trees (and other plants) act as 'carbon sinks', fixing carbon from the atmosphere in the form of wood. In measuring the effect of a timber product on the carbon balance, the carbon locked away needs to be offset against the carbon produced and the energy required in producing the finished material. Compared with other building materials, structural timber needs very little energy in its production. A little is used in extracting the timber from the forests, some more in cutting and drying it. The only other energy requirement is in transport to the merchant and then to the building site.

Manufactured structural materials such as steel, concrete and masonry all involve very substantial use of energy in manufacture. The net carbon equivalent for materials can be calculated by finding the mass of carbon released to the atmosphere in the production of the material. This is a complex and intensive undertaking. However, many studies confirm that timber products have a net carbon storage value: they store more carbon than is required in their manufacture. Typical results for various materials are shown in Table 2.

Approximately 75% of all energy required for the production of seasoned sawn timber is consumed in the drying process. The heat energy is, in most cases, generated by the *combustion of waste timber arising from cutting and docking* within the mill itself. Purchased electrical energy and gas constitutes approximately 15% of the total process energy requirement. To further reduce energy needs, the WA Department of Conservation and Land Management (CALM)[7] has recently developed an Australian Design Award winning solar assisted kiln. A number of mills currently use solar kilns. Of course, many timber products including some structural framing are supplied unseasoned.

In summary the use of timber for environmentally friendly house construction reduces greenhouse gas emissions by,

- reducing of the energy needed to manufacture the building element,
- providing a carbon sink,
- allowing for possible re-cycling of the material.

Table 2 : Carbon released in the manufacture of building materials compared with carbon stored in material[8]

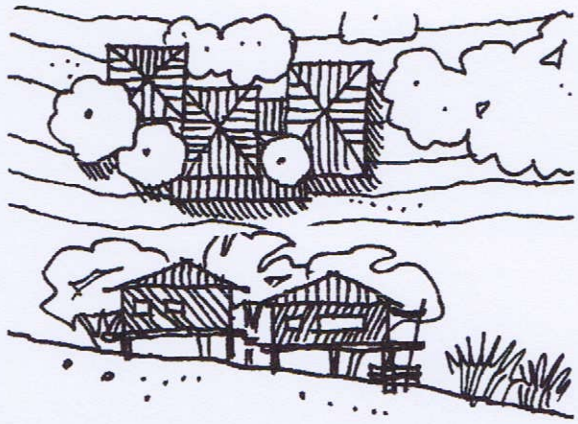
Material	carbon released (kg/m^3)	carbon stored (kg/m^3)
sawn timber	15	250
steel	5320	0
concrete	120	0
aluminium	22000	0

environmental impacts

Wastes, By-Products and Environmental Effects

Wastes and by-products of timber manufacturing are minimal compared to other building materials. The 'wastes' resulting from the production of timber building materials are organic and are being utilised in a variety of ways including use as mulch and heat generation for kiln drying. Plantation and native forest management practices are constantly being improved to reduce environmental impacts based on detailed research and response to market demands.

Native forests and plantations provide wildlife and flora habitat, recreational opportunities, and can contribute to soil stabilisation (especially on previously cleared land). Plantations (especially hardwood plantations) have also been successful in ameliorating soil salinity in locations where the local water table has risen to the point where soils are poisoned.



Site Sensitivity

site disturbance

One objective of environmentally friendly design is to minimise site disturbance and to respond to the particular conditions of the site. Lightweight timber building methods have a number of advantages to achieve this aim, including;

- planning flexibility, for example, to retain existing trees,
- suspended timber floor construction which follows the natural topography and avoids cut and fill, retaining walls, the need for extensive drainage works, etc,
- light and easy-to-handle construction elements which minimise the transportation and lifting of heavy materials,
- standardised and modulised elements which minimise construction time.

design for longevity

A further component in the pursuit of an environmentally friendly house is design for longevity. We have so far looked at minimising the energy needed to manufacture the building elements, efficient design to minimise the use of energy to 'run' the building during occupancy, and minimising the environmental impact of building material production. Design for longevity is concerned with 'appropriate' design and construction methods, to increase durability, and to enable recyclability.

Durability

A long life not only increases the value of a house, but is also economically and environmentally efficient. Appropriate design, detailing and specification are crucial factors in achieving durability. As organic building materials, timber elements have to be protected from biological damage (eg. insect attack such as borers and termites, and fungal damage). This can be readily achieved using standard building practices and detailing.

Recyclability

What happens to a material when a house reaches the end of its life is an important factor, especially in the light of increasing depletion of non-renewable resources and the volumes of wastes which are dumped every day. The environmental impact and amount of energy that is needed to disassemble a building once it has reached the end of its 'life', and the possibility to re-use building elements should be considered in the design of an environmentally friendly house.

Because the life of a building material can be far longer than that of the building, the components can be utilised for other purposes, that is, recycled. In contrast to other, inorganic building materials, timber can be fully reused. Intact timber elements can be easily employed for other building applications; heavily worn timber elements can be used as furniture, fuel, pulped for paper production, or as it is completely biodegradable, composted.

performance analysis

To test the effectiveness of various approaches to the design of an environmentally responsible house the performance of a number of construction types has been assessed. Using advanced computer simulation the total life-cycle energy consumption and CO_2 emissions have been calculated for a typical new house of 210 sq.m. floor area (Figure 2).

Figure 2 : Computer Model of Typical New House Used for Performance Analysis

Various construction alternatives were modelled using the same standard house plan. These were,

BVS = Brick veneer construction with concrete slab-on-ground floor.

LWT = Lightweight cladding on timber frame construction with suspended timber floor.

BVT = Brick veneer construction with suspended timber floor.

BCSn = Solid brick construction, concrete slab-on-ground floor, ceiling but no wall insulation.

BCS = Solid brick construction, concrete slab-on-ground floor, ceiling and wall insulation.

Typical suburban surroundings, occupant lifestyle patterns and comfort conditions were assumed for Sydney and Melbourne locations. Several options for heating and cooling appliances were investigated in each case.

life-cycle energy

The life-cycle energy use was determined as the sum of the dwelling embodied energy and the primary energy required for heating and cooling (or fans) over a 50-year period. Typical plant efficiencies were taken into account in the calculations. Figures 3 and 4 show indicative results. In Figure 3 it can be seen that the embodied energy is a significant portion of the total energy. Because the dwelling analysed was relatively energy-efficient (good insulation levels, etc.) the embodied energy is often greater than that required for heating and cooling. In Figure 4 the influence of different heating and cooling plant options can be seen. Direct electric heating which is relatively inefficient in terms of primary energy provides the least desirable result in terms of operational energy consumption. Paradoxically however, using direct electric heaters is likely to provide the minimum life-cycle cost because of the relatively low purchase and installation costs of these appliances.

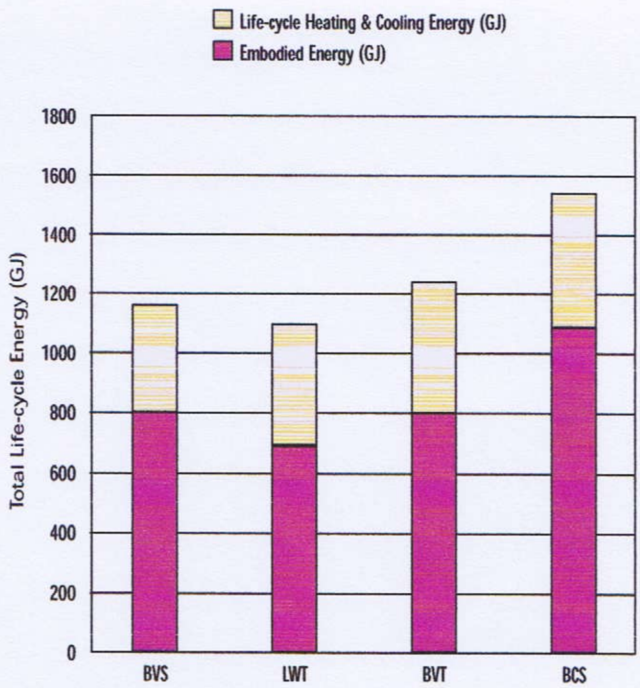


Figure 3: Total Life-cycle Energy for Various Construction Options – Sydney, Direct Electric Heaters & Fans for Summer

Lightweight cladding on timber and brick veneer construction result in the lowest life-cycle energy use.

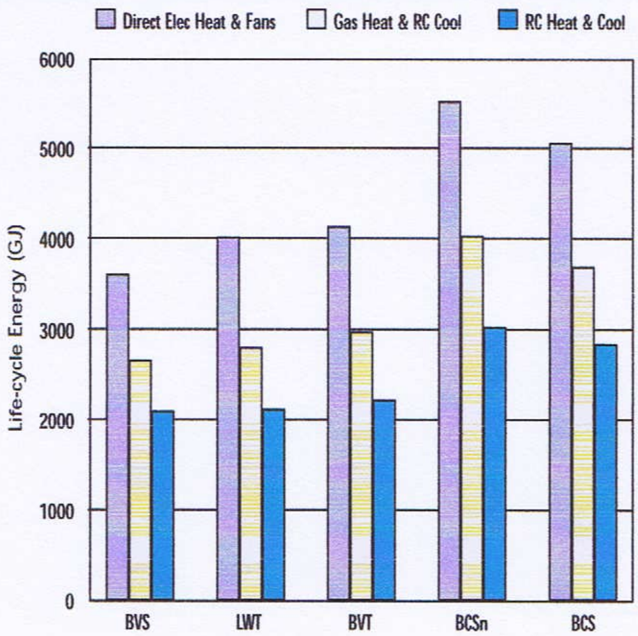


Figure 4 : Total Life-cycle Energy for Various Construction and Plant Options – Melbourne

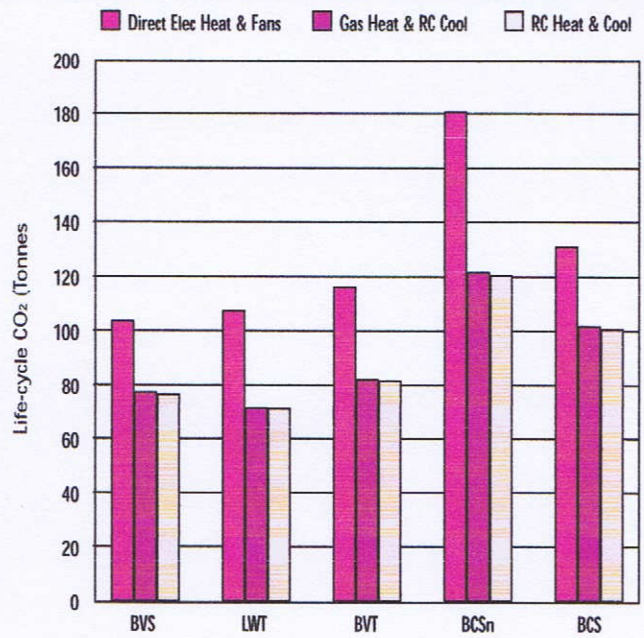


Figure 5 : Total Life-cycle CO_2 Emissions for Various Construction and Plant Options – Sydney

CO_2 emissions

In a similar way the life-cycle CO_2 emission has been calculated over a 50-year period. Full fuel cycle emission co-efficients[9] specific to each location were used to convert fuel consumption into CO_2 emissions. Figures 5 and 6 show typical results. Because in both locations electricity is produced mainly by coal burning power stations, the direct electric heating option produces the worst plant option in terms of CO_2 emissions.

Again, lightweight construction alternatives produce the best results with the lowest CO_2 emissions as compared with high mass construction.

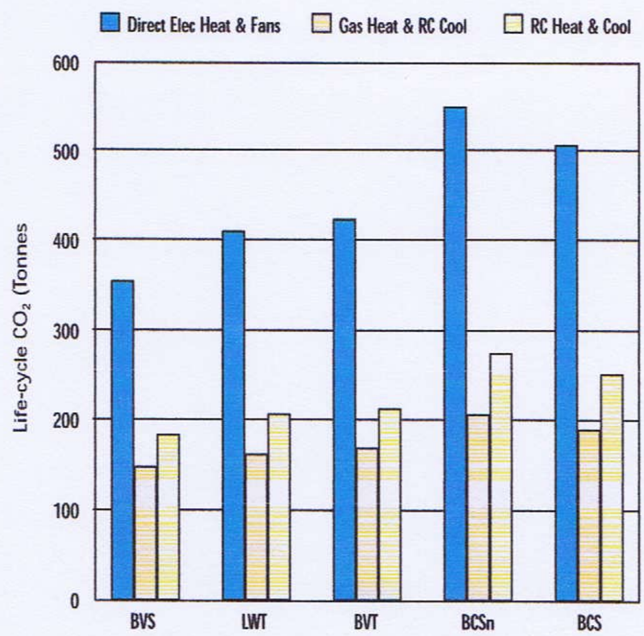


Figure 6 : Total Life-cycle CO_2 Emissions for Various Construction Options – Melbourne, Gas Heater & RC Cooler for Summer

summary

The results of this analysis show,

- The embodied energy of a lightweight timber dwelling is the lowest compared with other alternatives.
- Minimum total life-cycle energy consumption and greenhouse gas emissions are achieved when dwellings are well insulated in walls and ceiling.
- The choice of heating and cooling appliance has an impact on total energy consumption and greenhouse gas emission. Gas heating and reverse cycle air-conditioners generally produce the best results.
- The total life-cycle energy and greenhouse gas emissions is lowest for a lightweight timber construction compared with more massive construction (especially if this construction is not fully insulated).
- When benefits and costs of various housing solutions are considered lightweight timber construction generally rates as the best performer.

On a wider scale, timber also has other advantages. It is a renewable resource, and with well managed forests the product can have beneficial environmental side effects such as acting as a carbon sink, soil stabilisation and the provision of recreational space.

Lightweight timber construction methods also offer the flexibility needed to develop innovative designs for sensitive sites, for example, steep slopes and reactive soils, minimising cut and fill and eliminating wall cracking. These qualities make the lightweight timber construction an excellent choice for environmentally responsible housing design throughout Australia.