Building the GreenSmart Way

GUIDANCE NOTES

for designing
and building new homes
and renovation projects

HIA GreenSmart®

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Welcome to HIA GreenSmart

WHAT IS GREENSMART

GreenSmart is a registered brand of the Housing Industry Association (HIA).

It is an industry-driven program that aims to encourage a mainstream application of the benefits of environmentally responsible housing.

GreenSmart is a voluntary initiative that focuses on educating builders, designers, product manufacturers and consumers and it provides appropriate market recognition for environmental endeavours in the residential construction industry.

MAKE THE DIFFERENCE TODAY – BUILD THE HIA GREENSMART WAY

Demonstrating environmental leadership in the housing industry

As Australia's peak residential building and construction body, HIA provides leadership in the recognition of environmentally responsible residential building and land development through its GreenSmart program.

GreenSmart was established by HIA in 1999 to promote practical, affordable and durable environmental solutions for residential design and construction. The growth of the HIA GreenSmart concept since its inception has been significant and is now widely recognised as a leading industry initiative for achieving more sustainable housing and land development.

GreenSmart is the only program of its kind in Australia that provides an over arching response to the construction and promotion of environmentally responsible housing along with an educational campaign to HIA members and consumers. It achieves this through a well established GreenSmart Professional course and supplementary short courses; accreditation of housing projects; national Awards; partnerships with businesses; forums and events; and communication channels.

Making the commitment to build the HIA GreenSmart way is simple and generates many benefits.

For you and your clients:

- Lower construction costs through reduced waste and efficient use of materials.
- Lower home running costs for users.

The environment benefits through:

- Reduced greenhouse emissions.
- Reduced water consumption.
- Less construction waste, leading to less landfill.
- Avoiding use of non-renewable materials.

Your clients and their communities benefit through:

- Increased level of personal comfort in their houses.
- Community participation in working toward environmental solutions.
- Cleaner indoor quality to create a healthier home.

What are the Principles of "Building the GreenSmart Way"

The primary objectives of "Building the GreenSmart Way" are to:

- Develop, demonstrate, and promote the technologies, design principles and practices that can significantly improve the quality of Australia's residential built environment;
- Improve the uptake of best practice environmental management approaches and their integration into normal business practice;
- Facilitate change in industry approaches to housing, while meeting community expectations with regard to housing types and costs; and
- Identify market driven mechanisms to encourage the adoption of environmental innovations in the building industry.

Marketing the GreenSmart brand

HIA GreenSmart has generated a range of licensing protocols for different housing types that provides a way to promote and market businesses that offer environmentally responsible housing. (NB. Products are not issued with a GreenSmart license).

GreenSmart's marketing advantages are strengthened by the respected industry position of the Housing Industry Association, communication streams to our membership, consumers, promotion of GreenSmart Leaders, Partners and Professionals, and the GreenSmart Awards.

GreenSmart Professional Training and Accreditation

HIA's national GreenSmart training and accreditation program provides Australia's housing and land development industry with environmental awareness and skills for more sustainable residential design and construction. HIA members who successfully complete of the course, and adhere to the HIA GreenSmart Code of Practice, will be recognised as a HIA GreenSmart Professional. HIA members are provided with the GreenSmart Professional logo, and information and material to promote GreenSmart principles in residential building and land development in the marketplace

GreenSmart Homes

GreenSmart accredited homes are a showcase of environmentally responsible housing design. The main goals are to:

- Improve the energy, resource and water efficiency of the homes;
- Enable home-owners to waste less and recycle more;
- Reduce the waste from the building process;
- Create healthier homes for occupants; and
- Improve site management during construction.
- Benefits of a GreenSmart home include lower energy and water bills, a warmer house in winter, a cooler house in summer, a healthier home for the occupants and less waste going to landfill.

GreenSmart Residential Communities, Developments and Villages

GreenSmart accredited Residential Communities and Developments demonstrate high level environmental performance in land development, optimising solar orientation of lots, improving water quality, protecting and rehabilitating the natural landscape, implementing waste minimisation and management techniques and providing the foundation for liveable residential communities.

GreenSmart Display Villages comprise homes that incorporate responsible environmental practices and are accredited as GreenSmart homes. The Display Villages are open to the public for inspection, demonstrating to consumers the advantages of the GreenSmart approach. HIA works in collaboration with land developers and builders to promote their environmental achievements and provides advice to consumers on the application of GreenSmart principles for new homes.

GreenSmart Partners

Companies or organisations that commit to the HIA GreenSmart Code of Practice and are part of the GreenSmart Partners program are involved in one or more of the following:

- Accreditation of GreenSmart Residential Communities, Display Villages or Homes.
- Provision of products or services that assist industry and consumers to meet GreenSmart principles.
- Promotion and demonstration of support for the GreenSmart program and its environmental principles.
- Advice and knowledge of environmental initiatives through research, practical experience or training.
- Involvement in GreenSmart forums and events.
- Information and networking opportunities to promote environmentally responsible practices by industry.

All GreenSmart Partners employ at least one senior manager who has successfully completed the GreenSmart Professional training and work to advance the goals of GreenSmart in their business. HIA promotes the environmental initiatives of its GreenSmart Partners through promotional material, newsletters, magazines, a website and other forums.

GreenSmart Awards

The HIA GreenSmart Awards are the original and longest running awards dedicated to recognising excellence in environmentally responsible home design, construction and renovation. Success in the form of a winning entry means increased industry exposure, peer recognition and valuable publicity opportunities. Winners are presented with an awards plaque at a gala presentation and receive an official awards logo to promote their win.

HIA GreenSmart programs vary around Australia, so please call the HIA Memberline on 1300 650 620 and ask to speak with your local Planning and Environment staff member for details.

Heating and Cooling Homes Naturally

A well designed home incorporates passive design principles reducing the need for mechanical heating or cooling. This includes maximising cooling air movement and excluding summer sun. In winter, the building should trap and store heat from the sun and minimise heat loss to the external environment. The house should be orientated on the site within the range 15°W-20°E of true or 'solar' north to take advantage of these passive systems.

PASSIVE SOLAR HEATING

Design for passive solar heating is about taking advantage of natural heat sources to heat the home. This can be achieved by:

Orientation of daytime living areas and appropriate sized glazing to the north:

- Locating thermal mass where it is exposed to direct solar radiation to store heat; and
- Insulation of walls, ceilings and floors and draught sealing around doors, windows and extraction fans.

Floor plan zoning, based on heating needs for the occupants:

- Living areas and the kitchen located towards the north.
- Bedrooms located along the east or south façade.
- Utility and service areas (e.g. bathrooms and garages) should not be located on the northern façade or orientated where they can block cooling breezes.

If mechanical heating is required, consider the use of: geothermal or solar slab heating; solar vented or heat recovery ventilation systems; or energy efficient heaters which should be placed next to internal high thermal mass walls and away from windows and passageways.

Courtesy of HRV

PASSIVE COOLING

Passive cooling maximises the efficiency of the building envelope by minimising heat gain from the external environment and facilitating heat loss. This can be achieved by:

- Orientation of adequate sized windows to cooling breezes to maximise ventilation;
- Reduce internal air path barriers to increase natural ventilation;
- Install ceiling fans to assist in air circulation;
- Avoid extensive glazing on east and west facing facades to minimise heat gain;
- Where glazing is located on these facades, effective shading should be employed (see Designing for your Climate Zone for more information);
- Adequate levels of insulation to at least the minimum recommended for your climate zone (see Designing for your Climate Zone for more information);
- Appropriate use of thermal mass determined by the daily temperature changes in your region; and
- Use light coloured roofs and walls to reflect solar radiation.

In certain climate zones, mechanical cooling maybe required. Where necessary energy efficient air-conditioners should only be installed in rooms that:

- Minimise external air infiltration;
- Use high levels of insulation;
- Have minimal glazed areas;
- Are located in cooler zones of the house i.e. rooms with lowest exposure to external temperature influences;
- Employ air-locks to doors that are commonly used; and
- Use airtight construction detailing, particularly at wall/ceiling and wall/floor junctions and around doors and windows.

DESIGNING FOR YOUR CLIMATE ZONE

Australia has been grouped into 8 climate categories, each with specific characteristics affecting envelop design for human comfort (refer to the Climate Zone Map).

Climate Zone 1

- Shade whole building summer and winter (consider using a fly roof).
- Use reflective insulation and vapour barriers. Use bulk insulation if mechanically cooling.
- Ventilate roof spaces.
- Choose light coloured roof and wall materials.
- Elevate building to permit airflow beneath floors.
- Provide screened, shaded outdoor living areas.

Climate Zone 2

- Shade whole building where possible in summer. Allow passive solar access in winter months only.
- Use reflective and bulk insulation (especially if the house is air conditioned) and vapour barriers.
- Use elevated construction with enclosed floor space, where exposed to breezes.
- Choose light coloured roof and wall materials
- Provide screened and shaded outdoor living.

Climate Zone 3

- Use insulated thermal mass.
- Consider convective (stack) ventilation, which vents rising hot air while drawing in cooler air.
- Shade all east and west glass in summer.
- Use bulk insulation in ceilings and walls.
- Build screened, shaded summer outdoor living areas that allow winter sun penetration.

Climate Zone 4

- Use well insulated thermal mass.
- Build more compact shaped buildings with good cross ventilation for summer.
- Minimise all east and west glazing. Use adjustable shading.
- Provide shaded outdoor living areas.
- Use evaporative cooling if required. Avoid air-conditioning.
- Use reflective insulation to keep out summer heat. Bulk insulation for ceilings, walls and exposed floors.

Climate Zone 5

- Use insulated thermal mass. Maximise solar access in winter.
- Minimise all east and west glazing. Use adjustable shading.
- Use double glazing to insulate windows.
- Use cross ventilation and passive cooling in summer.
- Use reflective insulation for summer heat, bulk insulation to walls, ceilings and exposed floors.

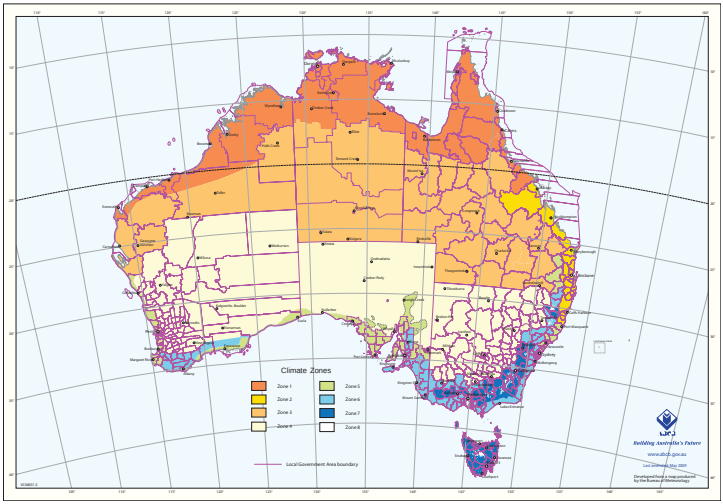
Climate Zone 6 & 7

- High thermal mass solutions are recommended.
- Use high insulation levels, especially to thermal mass.
- Maximise north facing walls and glazing, especially in living areas with passive solar access. Minimise all east and west glazing.
- Use double glazing and heavy drapes with sealed pelmets to insulate windows.
- Site new homes for solar access, exposure to cooling breezes and protection from cold winds.
- Use reflective insulation to keep out summer heat.
- Use bulk insulation to walls, ceilings and exposed floors.

Climate Zone 8

- Use high levels of bulk insulation.
- Insulate thermal mass including slab edges. Insulation under slabs is recommended.
- Maximise north facing walls and glazing, especially in living areas with passive solar access.
- Minimise east, west and south facing glazing.
- Use double glazing and heavy drapes with sealed pelmets to insulate windows.

Source: Your Home Manual



For larger maps go to
http://www.abcb.gov.au/index.cfm?objectid=73874813-28B9-11DE-835E001B2FB900AA

Glazing and Frames

Glazing has a major impact on the energy efficiency of the building envelope. Poorly designed windows, skylights and glazed surfaces can make your home too hot or too cold. If designed correctly, they'll help maintain year-round comfort, reducing or eliminating the need for artificial heating and cooling.

GLAZING AND THERMAL PERFORMANCE:

There are several aspects to consider:
Climatic conditions in your location.

- Building design – the form and layout of the building.
- Building materials – the amount of mass and insulation.
- The size and location of windows and shading.
- Thermal properties of glazing units.

The impact of glazing is the result of the interaction of each of these aspects. For example, hot and cold climates benefit from different types of glazing. High mass buildings can benefit from larger areas of glazing than would be optimum for a lightweight building. Double glazing is beneficial for almost all orientations. High performance toned, double or low-e glazing will be more beneficial in specific orientations of the building.

PASSIVE SOLAR DESIGN:

- Locate and size windows and shading to let sunshine in when the temperature is cold and exclude it when it is its hot.
- Use thermal mass to store the sun's heat and provide night-time warmth in cold conditions.
- Locate window and door openings to allow natural cooling by cross ventilation.
- Provide seals to openings to minimise unwanted draughts.

Courtesy of Third Ecology

HEAT FLOW:

- **Conduction** – conduction is the movement of heat energy through the glass and frame materials from the air on the warmest side to the air on the colder side. The greater the difference in temperatures – the more heat flow
- **Convection** – convection is the movement of heat energy by air that passes over the surface of the glazing unit, taking heat away from the glass and frame. Higher air speed causes greater convected heat transfer.
- **Radiation** – radiation is heat that is transmitted as electromagnetic waves. They can pass through space, in the same way as visible light moves through space, until reflected or absorbed by materials.

Courtesy of Trend Windows

TYPES OF GLAZING

- **Single glazed** – the oldest technology, single layer of glass.
- **Double glazed** – becoming much more popular having been used extensively in Europe and North America. The wider the gap, better the soundproofing but at the expense of heat retention. Often gas filled cavity to increase efficiency.
- **Triple glazed** – as double glazed but with another layer of glass and gas. More expensive but very efficient.
- **Low-e glazed** – low emissivity glass has a special coating that reduces the heat transfer but allowing good light transfer. Often incorporated into double or triple glazed units.

TYPES OF FRAME

- **Aluminium** – strong and durable but good heat conductor, lowering window efficiency unless a 'thermal break' is built in.
- **Timbe**r – good insulator but high maintenance needing more upkeep. More natural look, should have good wetherstripping.
- **Composite** – wood or upvc frame with aluminium outer, improving durability and raising performance.
- **uPVC** – similar insulation to timber, can be easily moulded but generally made from oil derived plastic.

WINDOW ENERGY RATING SCHEME

The Window Energy Rating Scheme (WERS) rates the energy and energy-related performance of residential windows, skylights and glazed doors in accordance with AFRC procedures.

WERS provides the system (window and frame) heat transfer values as well as air infiltration, condensation rating, fading protection and visible transmittance. It also provides a star rating of glazing units according to their heating and cooling performance. It includes thousands of specific products from most manufacturers, listed according to the types of frame and glazing. WERS-rated windows, skylights and glazed doors carry a sticker and a certificate specifying their performance. It provides manufacturers, designers, consumers and regulatory authorities with certainty that the glazing products meet the required performance specifications.

Source: Your Home Manual

Insulation

Insulation acts as a barrier to heat flow and assists in keeping the home cool in summer and warm in winter. By reducing reliance on artificial cooling and heating the home owner can reduce both their energy bills and greenhouse gas emissions (GGE).

Insulation works most effectively when combined with good passive design. For example, insulation in a house that is poorly shaded during the summer season can actually trap heat inside, creating an oven effect.

The most efficient time to install insulation is during construction or major renovation. However, if this is not possible some areas of the home can still be easily retrofitted, for example, ceiling spaces and suspended floors.

CHOOSING INSULATION

There are two main types of insulation, reflective and bulk. These are combined into a composite material on occasions.

Reflective insulation mainly resists radiant heat due to its high reflectivity. The main types of reflective insulation include:

- Single sided poly weave foils
- Double sided antiglare foils
- Bubble foil

Bulk insulation resists the transfer of conducted and convected heat. It relies on pockets of trapped air within its own structure. Bulk insulation is typically constructed of glass fibre, wool, polystyrene or polyester.

Composite insulation types include:

- Foil faced blanket
- Antiglare reflective EPS board

R VALUES

All insulation products have an R value. This value represents the product's ability to resist heat flow, the higher the value the better its resistance to heat flow.

R values are often quoted as separate "up" and "down" values.

- The up value represents the resistance to heat flowing upwards (often quoted as winter R value).

- The down value represents the resistance to heat flowing downwards (often quoted as summer R value)

The most appropriate type of insulation and the amount required is largely influenced my climatic conditions. It should be established if the insulation is required to predominately keep heat in or out (or both in some cases).

- To keep heat out select insulation with high down and low up values. Suggested minimum R1 for roof/ceiling and R0.5 for walls. Higher R values should be used for air conditioned homes.
- To keep heat in select insulation with high up values. Suggested minimum R3.0 for roof/ceiling and R1.5 for walls. Higher R values should be used for homes with central heating and/or cooling.
- To reduce heat gain and loss select insulation with close to equal up and down values. Suggested minimum R1.5 for roof/ceiling and R1.0 for walls. Higher R values should be used for homes with central heating and/or cooling.

Source: Your Home Manual

Indoor Air Quality

The ability of a home to offer a pleasant and safe environment for its occupants is affected by many factors, with indoor air quality being one such factor.

Indoor air quality is influenced by a mixture of gases and airborne particles that may be pollutants, but it's important to note that not all pollutants contribute to poor indoor air quality, this depends on:

- Type of pollutant
- Amount and rate of release of the pollutant from the source
- Degree of ventilation occurring in a home

STAR RATING OF HOMES

The increase in energy efficiency of homes has resulted in draft reduction, with houses being better sealed. However, this prevents air movement through leakage between outdoors and indoors, requiring better consideration of door and window types and use of mechanical ventilation systems.

Occupants affect indoor air quality of their home through:

- Use of household cleaning agents
- Personal care products and pesticides
- Selection of furniture and window coverings
- Generation of tobacco smoke
- Ventilation and cleanliness of a home
- Choice of material selection during the construction and renovation of a home

WHAT MATERIALS CAN INFLUENCE INDOOR AIR QUALITY?

Volatile organic compounds (VOCs), a range of chemical substances that become airborne at room temperature. They are given off by many paints, paint strippers, wood preservatives and glues.

Formaldehyde, released from some manufactured wood products such as plywood, particleboard, fibreboard and furniture made with these products.

Respirable particles from fireplaces, wood stoves, kerosene heaters, tobacco smoke and other combustion sources.

Carbon monoxide and nitrogen dioxide from unflued kerosene and gas space or water heaters, leaking chimneys, wood stoves, fireplaces, gas stoves, automobile exhaust.

Xylene and toluene solvents in paints, glues and carpets as well as polyurethane.

Vinyl chloride monomer styrene in vinyl floor coverings, blinds, textiles, synthetic rubber underlay, two part fillers and paints.

Isocyanates in polyurethanes, glues and fillers.

Glycol Ether and derivatives used as solvents in water based paints, varnishes and glues.

Epoxy resins used in tile, wood and metal glues, cement and surface binder.

'Natural' materials are generally preferable to synthetic, however some natural materials can have significant environmental and health impacts, such as timbers treated with chemicals against biological attack and to increase durability.

HOW CAN YOU REDUCE POLLUTANTS ENTERING THE HOME?

- Choose untreated products or those that contain low pollutant emissions.
- If manufactured wood products such as MDF or particleboard are used, cover all surfaces and edges with laminates or seal them with low emitting paint or varnish to reduce emissions of formaldehyde. Choose those made with phenol formaldehyde rather than urea formaldehyde as they are less harmful.
- Select materials which have been pre-dried, are quick drying, use water as the solvent or are classed as zero or low VOC.
- Externally flue gas stoves or heaters. Follow the installation and maintenance procedures for chimneys and flues to prevent gases and particles entering the room. Buy only 'low-NOx' heaters.
- In cooler climates use air preheated by the sun for ventilation, or flush the house at the warmest time of the day. In hot climates flush the house with cooler night time air.
- Use physical termite barriers made of granite or stainless steel, or termite barrier blankets.
- Use alternative floor coverings like ceramic tiles, concrete, timber finished with plant based hard oils or waxes, linoleum or cork glued with natural rubber latex, sisal, coir, jute or seagrass matting.
- Ask carpet suppliers to unroll and air out the carpet before installation and use mechanical fixing. If adhesives are needed use low–emitting water based types.

Source: Your Home Technical Manual

PASSIVE VENTILATION THROUGH MANUALLY OR AUTOMATED SYSTEMS

Air quality can be improved by ventilating the house. If too little fresh air enters a home, pollutants can accumulate to levels that can impose health and comfort problems on the occupants.

Contributors to indoor air pollution include:

- Use of synthetic building materials, or high emissions from a few materials finishes and furnishings which release pollutants;
- Use of pesticides and household cleaners; and
- Biological sources such as insects, mould, and other fungi.

Factors to consider:

- Emissions – some materials will emit more contaminants than others.
- Toxicity – the potential harm a compound can inflict immediately or over time.
- Quantity – Low emissions from large quantities of materials, or high emissions from a few materials can result in high total amounts of chemicals emitted.
- Proximity – The location of the material compared to occupants.

Some systems to employ to enhance indoor air quality include:

- Provide adequate cross-flow ventilation to allow fresh air to move through each room;
- Install ceiling fans to assist in air movement;
- Install extractor fans in rooms without natural ventilation e.g. bathrooms, kitchens etc.
- Employ measures to avoid dampness to minimise the growth of mould and fungi such as insulated walls, controllable vents and double glazed windows;
- Select mechanical fixing methods for floor coverings;
- Select natural untreated floor coverings eg linoleum, cork and natural fibres;
- Externally flue all gas stoves and heaters or provide an air path to allow these pollutants to escape;
- Follow correct installation and maintenance procedures for chimneys and flues;

- Ensure that where internal access from garages exist that these are well sealed from the house and the garage has appropriate ventilation measures installed;
- Install only low-NOx heaters and avoid using them in confined spaces;
- Install an automated or manually operated ventilation system to enhance internal air movement;
- Select low or no emission paint and varnish finishes for cabinetry and flooring;
- Select low emission products for internal timber work;
- Select commonly used indoor plants to absorb emissions and if pesticides are used ensure this is undertaken outside; and
- Install an air filter where homes are located on a main road or in an industrial area.

Source: Your Home Manual

Courtesy of Style Plantation

Hot Water Systems

Water heating accounts for around 25% of household energy consumption. Your choice of water heater can dramatically reduce your energy costs and your household's Greenhouse Gas Emissions (GGE).

TYPES OF HOT WATER SYSTEMS

- Electric storage: uses a heating element inside the tank to heat the water, similar to an electric kettle. These are the most expensive to operate and responsible for very high GGE.
- Heat pumps: highly efficient water heaters that extract heat from the air to heat water. They can use less than one third the electricity of electric storage water heaters. Heat pumps can operate effectively in temperatures as low as -10°C.
- Gas water heaters: generate far fewer GGE than electric storage units because both natural gas and LPG burn much cleaner than the coal used to generate the electricity to power electric storage units.
- Solar: depending on your climate, up to 90% of your hot water needs can be provided from the sun's energy. To supplement the sun on cloudy days or when household demand is high, solar heaters have either electric or gas boosting. Solar systems can have both the collectors and storage tank mounted on the roof or split with the storage tank located at ground level.

CHOOSING A HOT WATER SYSTEM

When selecting your system some of the most important factors to consider include:

- Household size: consider not only your current household but as far as 15 years into the future.
- Cost: not only the price of the system and installation but consider the operating costs over the life of the system.
- Available energy sources: natural gas may not be available in your area.
- Your local climate or shading from neighbouring trees or buildings may limit solar access to your roof.
- Identify whether you have any planning or building controls that limit solar panels being placed on north facing roofs.

REDUCING YOUR ENERGY COSTS

In addition to selecting the correct system for your household's current and future needs your energy costs can be reduced by:

- Good design: by grouping wet areas together (i.e. kitchen, bathroom(s) and laundry) and placing the storage tank close to the area's of the home where it's needed, the lengths of hot water pipe will be reduced resulting in less heat loss.
- Insulation: heat is lost through the walls of the storage tank. Try wrapping the tank with extra insulation. Also insulate hot water pipes, particularly exposed pipes leading from the tank to the house.
- Switch it off: when going on holidays it's a good idea to switch your system off.

Source: Your Home Manual

Courtesy of Apricus Australia

Lighting the Way

A well designed home incorporates passive design principles reducing the need for mechanical heating.

How many builders does it take to change a light bulb? This isn't a variation on the old joke — the traditional incandescent light bulb is no longer the dominant light source in our homes. Energy efficient products have come to the fore to provide a greater array of affordable choices to light the home.

Demographic research tells us there are fewer people per dwelling now than at any stage in our history, but the use of energy through lighting is increasing. We're building larger homes and installing more light fittings per home.

LIGHTING OPTIONS

One of the factors that should be considered at the design phase of the home is achieving the best possible solar orientation so that the most habitable rooms have good natural daylight. The amount of lighting required in the home is influenced by the tasks performed in different areas. As a general rule, kitchens, bathrooms and study areas require greater amounts of light than corridors and laundries.

So following natural light what is the best solution for the residential industry?

Incandescent lamps have been the most commonly used type of lighting. They are inexpensive to purchase but expensive to operate. This flows on to a high operating cost, as they only last between 800–1,000 hours. Incandescent lamps are appropriate only for use in rooms that are used infrequently and for short periods of time, for example toilets, laundry or storage rooms.

Verdict: short lifespan, low efficiency, expensive to run.

Halogen downlights are a type of incandescent lamp with a narrow beam that lasts up to 3,000 hours. First used within the home as a design feature, these are increasingly being used in the home for general lighting because of their compact look and inexpensive purchase cost. They incorporate a transformer and can produce a significant amount of heat; consequently they require ventilation, whilst insulation must not be placed within 200mm of the fitting. The transformer alone may consume 10–30 percent of the lamp's energy. This reduces any efficiency gain and could compromise the ceiling insulation

properties of the home. Low voltage downlights with reflectors are also now available; however it is the wattage of the light not the voltage that is the key to energy efficiency.

Verdict: low efficiency, expensive to run, only appropriate for task lighting.

Fluorescent lamps are an energy efficient form of lighting for households. Fluorescent lamps use 70 percent less electricity than incandescent lamps to provide the same light and produce less heat, keeping your home cooler. Although slightly more expensive to buy, they are much cheaper to run, with quality products lasting over 8,000 hours. New technology, including improved ballasts, have removed many of the traditional concerns such as size, shape, colour and flickering are no longer a problem.

Verdict: Reliable and inexpensive to run.

Compact fluorescent lamps provide all the benefits of fluorescent tubes in a more compact size. Able to be fitted to a range of fittings, a 20 watt compact fluorescent provides the same amount of light as a 100 watt incandescent and costs approximately $10 to buy and $20 to run over its lifespan of between 6,000–8,000 hours. Over the same lifespan you would require eight incandescent 100 watt globes, which would cost $8 to buy and around $103 to run.

Verdict: Careful design means you can replace incandescent and halogen lights in most situations.

Light emitting diodes (LEDs) are a cool–running semiconductor device and one of the latest lighting products. They are used for illumination, strip lighting and as a replacement for halogen downlights, with some models using 10 times less power than fluorescents and lasting more than 100,000 hours. It is estimated that, using LEDs for localised and low–level lighting, a household can reduce power consumption by approximately 85 percent.

Verdict: Efficient, longest life span, inexpensive to run, higher upfront cost.

LATEST DEVELOPMENTS

The latest advances within this sector have been the development of affordable 240 volt compact fluorescent downlights that do not require a transformer, LED downlights and strip lighting, which use as little as 3

watts and are available in a range of beam spread. These developments are important alternative solutions to traditional light fittings. If changing 12 volt downlights in an existing home consider replacing 50W halogens with lower wattage bulbs or LED downlights. If selecting replacement bulbs, be vigilant to ensure that those selected will fit within the downlight fitting. A 240 volt compact fluorescent downlight can only be fitted with an adaptor kit that connects to the existing transformer. In new homes or in renovations consider installing 240 volt compact fluorescent downlights, fluorescent lamps or LED downlights. As with all new developments the most efficient and long lasting products can appear costly upfront, however the return on investment with some bulbs lasting over 50,000 + hours makes these new products a great alternative for our environment and offers a reasonable payback period.

STEPS TO ENERGY-EFFICIENT LIGHTING

By considering the following points, a new or existing house can become a more energy efficient home:

- Maximise the use of daylight instead of artificial lights.
- Within the home's interior consider double glazed skylights, light shafts or highlight windows.
- Use light coloured paint in the home, dark wall colours absorbs light.
- Use the lowest wattage bulb that is necessary to complete the task.
- Use reflector–backed downlights or insert reflectors to the back of fluorescent lights to maximise light output.
- Install multiple switches to control lighting around the home.
- Use timers or movement sensors to control light operation.
- Fit downlight protectors to ceiling downlights to prevent air movement into the roof cavity.
- For exterior security lighting consider fluorescent or LED lighting with a motion sensor.
- To illuminate pathways and garden features consider solar powered LED lamps.

The type of lighting selected will affect the amount of energy used and the amount of greenhouse gas emissions produced. Whilst some of the products discussed are only available from specialist lighting and environmental stores or online retailers it is worth devoting a little time to the layout and type of light fittings to best suit the home design. Such decisions can help to improve light quality and reductions in energy costs.

Water Conservation and Alternative Supplies

With stocks of water diminishing across the country it is more important than ever for all households to try to reduce their reliance on mains water supply.

This can be achieved by:

- Reducing household demand for water
- Incorporating water from other supplies

Households can reduce their water use dramatically and at relatively minor initial costs

- Install water efficient shower heads (3 stars), toilets (4 stars) and appliances such as washing machines and dishwashers with the highest star rating you can afford
- Use drought resistant plants in the garden, including grass and use mulch to reduce evaporation
- Sweep paths instead of hosing
- If water restrictions allow the washing of cars, caravans and boats then wash them on grassed areas

The 2 main alternate water supplies for households are rainwater and reused wastewater.

Rainwater tanks are available in a variety of sizes, shapes and colours. Typically tanks are constructed from steel, polyethylene, concrete or fibreglass. Properly collected and stored rainwater can be used inside the home for toilet flushing, clothes washing and if properly treated for showering, drinking and cooking. Outside the home rainwater is ideal for watering the garden and washing cars, etc.

There are two types of wastewater created during the regular operation of the home, greywater and blackwater. Greywater is from showers, basin taps and washing machines, whilst blackwater is generated from toilet and kitchen plumbing fixtures. Greywater requires less treatment than blackwater to make it suitable for reuse in or around the home. If greywater is untreated, it must be used within 24 hours of capture.

Depending on the treatment of greywater it may be used for toilet flushing, washing clothes, washing cars and on the garden.

Regular and thorough maintenance is required for both wastewater reuse and rainwater collections systems. Without ongoing maintenance these systems can become a breeding ground for many types of vermin and pathogens.

An additional source of recycled water is available in certain areas, called Class A recycled water. This is also known as 'Third Pipe' or 'Purple Pipe' due to the distinctive purple colour used to identify pipes and the water meter. This supply can be used for toilet flushing and outdoor use, such as car washing and on the garden.

Source: Your Home Manual and South East Water (VIC)

Courtesy of South East Water

Using Raw, Reconstituted or Recycled Materials for Cabinetry and Bench Tops in the Home

Understanding and giving careful consideration to the selection of materials for use in cabinetry and bench tops can influence the environmental impacts of a home. The underpinning principle here is to promote resource efficiency.

WHAT ARE THE ENVIRONMENTAL BENEFITS OF BEING RESOURCE EFFICIENT INMATERIAL SELECTION?

- To conserve natural resources: Recycling reduces the demand for raw materials;
- To conserve energy and water: Typically less processing is required with recycling than raw material extraction;
- To reduce air and water pollution: Recycled manufacturing is generally a cleaner process as it can use less energy;
- To reduce landfill: Materials are recycled instead of being dumped as landfill; and
- To protect our environment and health: Potentially harmful substances are removed from the waste stream.

FACTORS TO CONSIDER

- Efficient use of resources in material production and installation stages.
- Select materials that are highly durable and require limited maintenance.
- Choose material that has the ability to be reused or recycled at end of life.

RANGE OF MATERIALS FOR USE

Natural Stone: Marble, Limestone & Granite

- These products are extracted from the ground.
- They can be used in large slab form for bench tops and splashbacks in kitchens and bathrooms – and in the smaller form of tiles.
- Each stone is unique and should be selected individually as colours vary considerably.
- New varieties are constantly arriving into the country from the wholesalers.

- Granite is extremely hard and durable, but it is porous so needs to be sealed yearly.
- Different stones have different hardness grading and are priced accordingly.
- Natural stone, when polished, scratches relatively easily.

Reconstituted Stone

- Reconstituted stone is man made predominantly from crushed granite and quartz (generally more than 90% content), colours and binders.
- Can be used for bench tops and splashbacks in kitchens and bathrooms.
- The newest and most innovative form of bench top.
- Large range from a variety of suppliers.
- Generally more resilient to breakages and more stain and heat resistant than natural stone, making them easier to handle during fabrication, cutting and transport.
- The colours are more consistent than the natural stones however there can be differences between batches.
- Can discolour when exposed to consistent direct sunlight.
- Often lighter and thus quicker and more economical to install.
- Require less ongoing maintenance than natural stone.
- Examples: Caesarstone, Quantum Quartz, Quarella, Silestone and Smartstone.

Natural Timber

- Can be used for doors, shelves, panels, cabinetry, bench tops, floors, kickboards & many other places in the home.
- A traditional and natural product. Natural timber comes in a variety of hardness, tones and species.
- The continued use of high quality solid piece timber in construction will impact adversely on timber reserves.
- Whenever possible, choose recycled timber.
- If this is not an option, use plantation timber that has been legally sourced from certified forests.
- Only then consider composite wood products.
- Modern veneers use relatively small amounts of timber – thus making them more resource efficient.
- If you need a glued product, ask for one made from plantation timber (as opposed to hardwoods from rain forests), plantation thinning or sawmill waste.

Recycled Wood Products (composite & reconstituted timber)

- As with natural timber, recycled wood products can be used for doors, shelves, panels, cabinetry, bench tops, floors, kickboards & many other places in the home.
- The use of recycled and reconstituted timber helps with the preservation of the environment and natural resources.
- These products are mainly manufactured using epoxy or formaldehyde glue with wood in different sizes and forms.
- In order to minimise chemical vapours and gases in our homes, choose products that use non-formaldehyde or minimal gas emission glues.

Glued-wood Products

Chipboard: Compressed wood chips that are glued together. It is preferable to use bark free raw material, formaldehyde-free adhesives and refined structural qualities.

Composite Products: Small dimension timber used to create large dimension composite beams and sheets. Less timber is required to make products that are lighter and stronger than single piece natural timber.

Finger-jointed Timber: Created from small pieces of timber and off-cuts, which otherwise may have been sent to waste, that are joined together to form longer pieces. Used extensively in floor boards.

Laminated Timber: Laminating is used to make large/long pieces of timber to cover extensive spans, make bench tops and stair treads. Examples are LVL (laminated veneer lumber) composite beams, Glue-laminated timber and Valwood.

Fibreboard: Medium Density. Often used for insulation. It is available as mouldings as well as sheets. Fibreboard is manufactured from plantation thinnings Substitutes rainforest timbers when used for decorative mouldings, doors and door surrounds, rails, cornices and skirtings.

Particle Board: Similar to fibreboard except the wood is reduced to small particles instead of fibre. It is the basis for much furniture when veneered with hardwood.

Hardboard: A manufactured board made from wood chips that have been reduced to fibres. It is reconstituted into thin flat smooth-faced sheets of varying thickness, and is easy to work with.
Plywood: Made from glued layers of wood veneer. Used mainly for door skins, wall panels and formwork for concrete. Australian-made plywood recommended as it is made from plantation grown trees.

Termite Management

Australia is a big and varied country, from cooler temperate climates to wet tropical ones. Such variation is important to remember when considering termite control methods. Should one particular method work well for one house, it may not prove appropriate for a second.

Unfortunately, new houses are just as susceptible to termite attack as old ones. And if it's a house you've built, it's your responsibility to put in measures to allow the homeowner to manage the potential attack and help prevent the attack of termites.

As a result of improved technology and increased knowledge, termite protection systems are becoming more effective, more environmentally friendly and less toxic to humans, pets and local wildlife. More and more termite management systems have removed dangerous chemicals and replaced them with improved formulations that are more environmentally friendly.

IMPORTANT THINGS TO CONSIDER BEFORE CONSTRUCTION ARE, THE:

- Location of the building
- Climatic conditions
- Local council requirements
- Home's design and type of construction
- Clients' preferences
- AS 3660.1 as 'deemed to satisfy' performance requirements for termite risk management

OPTIONS FOR TERMITE PREVENTION AND MANAGEMENT:

Physical barriers – They are constructed from durable termite resistant materials including; Galvanised Iron, Zincanneal Steel, Sheet Cooper, Stainless Steel, Stainless Steel Mesh, Aluminium Alloy, Graded Crushed Rock. Treated lightweight materials, such as timber can be used as a physical termite barrier where appropriate. Physical termite barriers are best suited for new buildings by deterring termite entry and preventing the spread of termite activity. Many physical barriers are proprietary products and require specialist installation. It is important to consider physical termite barriers at the time of construction as they can be very difficult to install after construction.

Chemical barriers – They are suitable for new and existing buildings but care must be taken when choosing an environmentally friendly chemical barrier. There are a number of environmentally safe chemical barriers available. Chemicals must be enclosed or impregnated and must not affect the air-quality of the home. If a chemical barrier treatment method is selected, please ensure that it is non-hazardous and does not pose a threat to persons, animals or vegetation.

Baiting systems – These concentrate termites into a bait station and then feed the termite a bait – a palatable food containing an active ingredient. The termites collect the bait, return it to the colony, and so spread the active ingredient throughout the colony. If enough active ingredient is ingested, then it is possible to eliminate the colony. Baiting systems can be installed at the time of construction or at the time of the inspection of a house, acting as a continuous monitoring system. Bait systems require a more intensive inspection regime and may not be as effective as other systems, however they are environmentally friendly.

Please ensure that the termite management system installed is easily accessible for regular inspection, monitoring and maintenance and that homeowners are advised to monitor for termite activity around the home.

Courtesy of Ensystex

Universal Design: Principles and Practice

'Universal design is an approach to the design of products, services and environments to be useable by everyone, to the greatest extent possible, without the need for adaptation or specialised design. Universal design is an inclusive design philosophy which spans age, gender and ability'.

(Center for Universal Design, 1997)

Provide easy access for all people to enter the house

- Can a continuous pathway run between the street or car parking and the entrance to the house?

Have a level and covered entrance to the house

- Can a covered porch or garage/car port be included?

Have a room on the entrance level that can be adapted to become a bedroom and bathroom

- Ideally an entrance level bathroom is included, but how about ensuring pipe runs and other infrastructure are in place for easy modification?

Have a bathroom that is easily adaptable

- What about installing additional noggins in the bathroom walls that can later support grab rails near the bath, shower and toilet?

Have a shower that is easily used and adjusted by all people

- Can you have a detachable, hand-held shower and do away with an entrance step or lip to the shower?

Incorporate door and corridors that allow for easy access

- How much easier is it to make doors and corridors wider increasing accessibility when building than altering once built?

Have a kitchen that can be used by all people and designed for safe use

- Is kitchen layout and space enough for all people to move easily? Are storage units, cupboards, drawers, and work surfaces at a range of heights or can height be adjusted?

- If a hot dish is taken from the oven, is there an easily accessible place to put the dish down?
- Is the floor slip resistant?

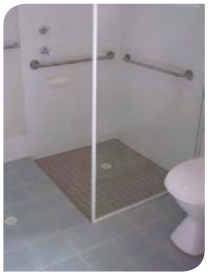
Incorporate handles and tapware that can be easily used by all people

- Can handles and tapware be reached?
- Are they easy to turn, with a lever rather than a knob?

Have switches and other controls that can be easily used by all people

- Can switches, sockets and heating or other controllers be accessed by all people?

Source: Adapted from GreenSmart House Accreditation Protocols and Australian Network for Universal Housing Design. See anuhd.org



Alternate Construction Systems

Residential design for comfort and energy efficiency are influenced by climatic considerations. There can be considerable differences between maximum and minimum temperatures in summer and winter, the diurnal temperature range (day/night differences) and the length of the heating and cooling seasons across Australia. To achieve the best results, housing design and construction materials should be appropriate to the climate of a region. Where you live will determine what level of thermal insulation you need and the thermal performance you should achieve.

Heavyweight and lightweight materials used in construction differ in mass content. Heavyweight construction systems are usually masonry and include brick, concrete, concrete block, tiles, rammed earth, mud brick, etc. **Lightweight** construction uses timber or light gauge steel framing as the structural support system for non-structural cladding and linings (eg. fibre cement, plywood and colourbond steel).

HEAVYWEIGHT AND LIGHTWEIGHT MATERIALS HAVE DIFFERING THERMAL PERFORMANCE AND ENVIRONMENTAL IMPACT DEPENDING ON:

- Where they are used (internally or externally).
- How they interact with or moderate the climate.
- How far they need to be transported.
- How much energy and water is used in their manufacturing process.
- Specific site requirements (eg. slope, aspect, noise control; fire resistance).
- Exposure to destructive forces of nature (fire, termites, rain, cyclonic activity, UV, humidity, etc.).

Material selection for a new home should be assessed in light of the above factors to reach the best possible solution. In most situations, a carefully designed combination of lightweight and heavyweight systems will produce the best overall outcome in economic and environmental terms.

Heavyweight Construction:

- Generally has higher embodied energy than lightweight construction.
- Improves thermal comfort and reduces operational (heating and cooling) energy use, when used in conjunction with passive design and good insulation.

- Is most appropriate in climates with large diurnal (day-night) temperature ranges, however, exceptions occur at more extreme climates.
- Is more beneficial in heating climates.
- Requires more substantial footing systems and could cause greater site impact and disturbance.
- Should be avoided on remote sites where there is a high transport component (eg. Darwin).
- Is often quarried or processed with high impact.
- Typically requires less maintenance and is more durable than lightweight construction.

Lightweight Construction:

- Generally has lower embodied energy than heavyweight construction.
- Can yield lower total life cycle energy use, particularly where the diurnal range is low.
- Responds rapidly to temperature changes and can provide significant benefits in warmer climates by cooling rapidly at night.
- Is preferred on remote sites with high materials transportation component.
- Usually requires more heating and cooling energy in cold to warm climates (where solar access is achievable) when compared to heavyweight construction with similar levels of insulation and passive design.
- Can have low production impact (eg sustainably sourced timber) or high impact (unsustainably sourced timber or metal frame).
- Typically requires more maintenance and is less durable than heavyweight construction.

Australia boasts eight different climate zones, insulation and thermal mass needs and requirements are climate determined. It is important to understand that different types and combinations of insulation and thermal mass must be considered to create an energy efficient, comfortable and long-term lower cost home.

Source: Your Home Technical Manual

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