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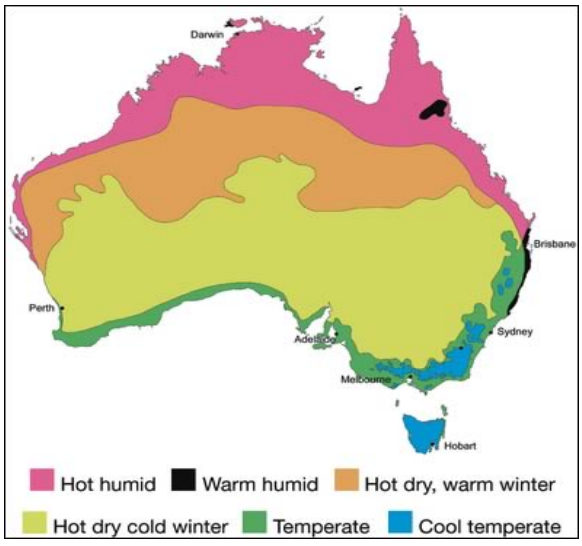
INTRO & CLIMATE

The planet is changing, and whether you believe in global warming or not, there only exists a finite stock of resources. And even more importantly, the health of our children, and the effects of pollution and environmental destruction on their growth and existence, is unquestionable. As a company representative of the building industry, we want to play our part in minimising as much as possible, our impact on the environment, and ultimately doing all we can to ensure a healthy existence for future generations. This booklet has been put together and provided to you as a resource to help you understand the part we play as designers, and you as the client. As well as going through some of the implications and issues we deal with as responsible designers, we have provided a list of internet based resources at the end of this document. They will allow you to further investigate the topics we have discussed here.

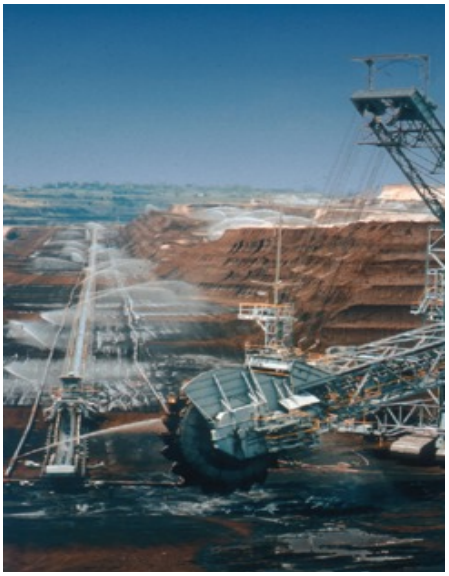


Victoria falls into three climatic zones, them being hot dry cold winter, temperate and cool temperate. The Melbourne metropolitan area falls within a temperate zone. The State as a whole experiences a wide range of climatic conditions. These range from the hot summers of the Mallee to the winter blizzards of the snow-covered alps, and from the relatively dry wheat belt to the wet eastern elevated areas. Conditions of extreme summer heat may be experienced throughout the State except over the Alpine areas. February is the hottest month of the year, with January only slightly cooler. Average maximum temperatures along the coast, are in the low 20s. Temperatures fall rapidly during the autumn months and then more slowly with the onset of winter, with average maximums being lowest in July. Night temperatures are like the maximums, being highest in February. In mid-winter, average July minimums are between 6° C and 8°C along exposed parts of the coast and in Melbourne's CBD. Other climatic factors to effect Victoria, including Melbourne, can involve varying quantities of rainfall, wind, humidity, thunderstorms, dust, bushfires, snow, drought, flood & flash flooding.

No auxiliary heating or cooling is required in a temperate climate with good design and favourable siting.

The climate we live, no matter where we are in the world, dictates how we should design our homes. Modern technology and transport has allowed us to overcome the constraints of local materials and any bursts of severe weather, be it a cyclone or drought. As a result of our local climate, there is a sensible way to design a home in order to work with the climate and weather, so as to limit our impact on the surrounding environment we occupy, as well as the effect on our pockets through saving money on energy consumption. Our temperate environment enables the following design factors to work best in our climate.

- The use of solar passive design principles.
- High thermal mass solutions are recommended.
- Use high insulation levels.
- Maximise north facing walls & glazing.
- Minimise east & west glazing.
- Use heavy drapes with sealed pelmets to insulate windows.
- Minimise external wall ares, especially east & west.
- Use cross ventilation & passive cooling during summer.
- Encourage convective ventilation & heat circulation.
- Site new homes for solar access, exposure to cooling breezes & protection from cold winds.
- Draught seal thoroughly & use entry airlocks.
- Use reflective insulation to keep out summer heat.
- Use bulk insulation to keep heat in during winter. Bulk insulate walls, ceilings and exposed floors.



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WATER

CONSERVATION– With water becoming a scarcity over the past 30 years, water conservation has become a priority in our day to day lives. Dam levels are at record lows, natural springs are drying up and once thriving ecosystems are drying up. As far as the function of a house and its site is related, most conservation is easily achieved through careful selection of water wise fixtures, fittings and household goods As well as having native species in the gardens and the use of a grey water recycling system. The market contains a plethora of water conservation products and systems, and with a Victorian Government rebate available, these become a wise choice.

A tap leaking at the rate of one drip per second will waste more than 12,000 litres of water per year.

Another factor in saving water, is the fact that many of our water delivery systems are aging amongst our modern developments. Many old taps and pipes continue to leak undetected, wasting an unknown quantity of water. When it comes to renovating or extending an existing house, it may pay to have the existing plumbing checked, and instead of re-using old toilets and the like, perhaps upgrading them to a more water efficient product.

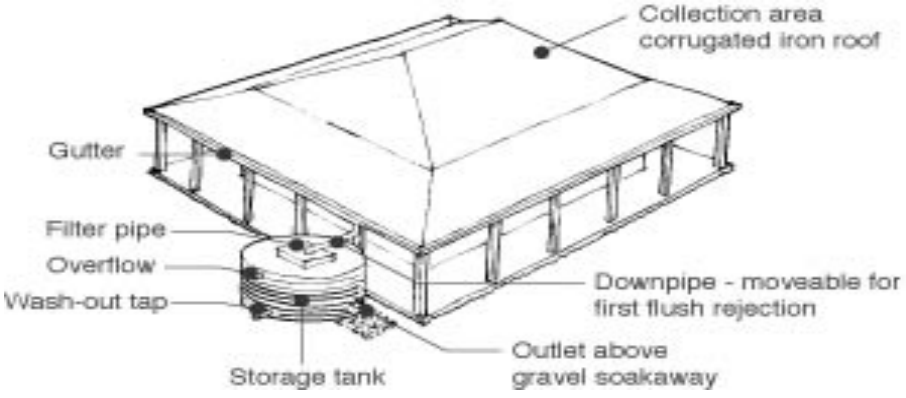
COLLECTION– Rainwater tanks and storage systems come in a wide range of styles and materials. Some of the available tanks and storage systems are:

- corrugated iron tanks, an above ground storage system with a traditional look and comes in an array of sizes.
- polyurethane & fibre reinforced tanks, similar to the above tank, but in same instances can be placed below ground. Very durable.
- slimline polyurethane & corrugated iron tanks, come in a variety of shapes, sizes & colours. Great for smaller block sizes & easily blended into landscaping.
- bladder tanks are a flexible & low profile bladder that sits on the ground and is best concealed under a house or deck, they can be custom sized to suit an available space.
- underground systems are a modular submersible tank that come in a variety of sizes, shapes & configurations.

A recent study has found that rain water tanks are a more cost effective alternative to other water saving measures.

Some of the benefits of installing a rainwater tank is that a tank allows you to control and monitor your own water storage, reduce the need for new dam construction, conserve any remaining flows in rivers, reduce the energy use in pumping water & thereby lowering greenhouse gas emissions, allow greater flexibility through times of drought, save on water bills and add value to your property.

GREY WATER– Rules and regulations of grey water systems differ between the states and territories. There are three broad categories of grey water systems. The simplest being the diversion system, this method requires the least management but is potentially the most hazardous. The diversion & filtration method utilises a filter mechanism outside the house, this method provides a basic straining system removing any particles of hair etc from the water, providing for better irrigation options than the diversion system. The Diversion and treatment systems are more complex and vary from highly mechanised systems, such as aerated wastewater treatment systems (AWTS), to sand filters. Check to see if your chosen system requires approval by local councils or water authorities. The advantage of installing a treatment system is that the water will have a far lower nutrient and solids content, as well as having a reduced pathogen load. Treated greywater can be used safely in more direct irrigation systems, such as dripper lines, and possibly inside the house for toilet flushing and laundry washing. Treatment systems can be expensive to install and often require a lot more room than filter systems. Any greywater system should be further planned with your plumber and council.



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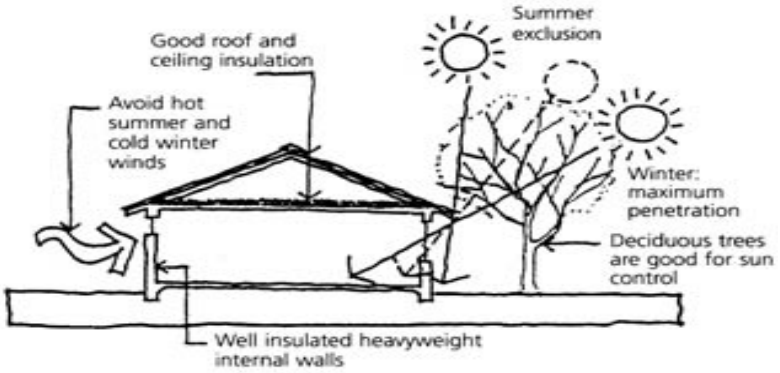
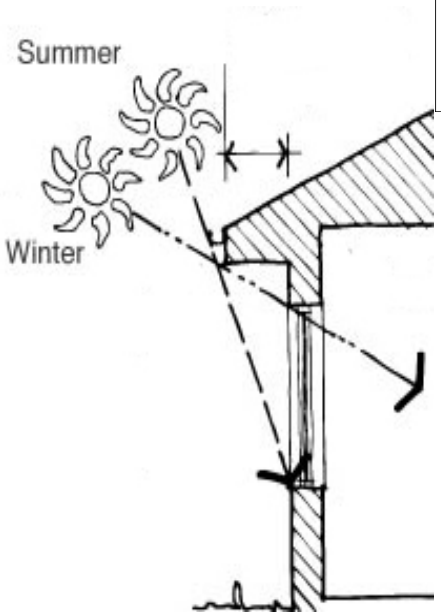


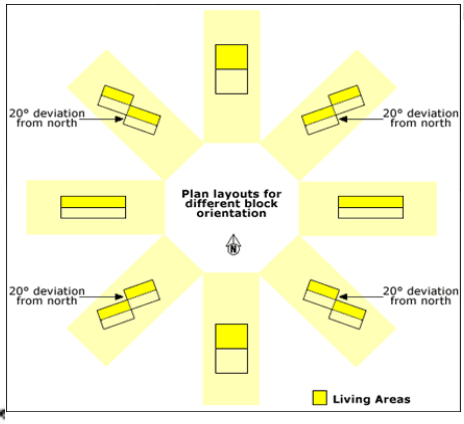
PASSIVE SOLAR

PASSIVE SOLAR entails designing a building so as to take advantage of the natural energy patterns from the climate for natural heating, cooling, lighting and overall living comfort. During winter in a temperate climate, the low northern sun can be utilised to heat a house during the day, heating thermal mass internally, which then slowly releases this heat in the evening. During summer the opposite applies, and we keep the sun off the thermal mass so that it stores 'coolth' to keep the house cool, as well as utilising the cool summer breezes to flush the house of heat. Summer is also when the eaves come into effect, keeping the sun off the walls and away from windows so as the prevent heating.

Many homes are built without eaves to save as little as $2,500. Builders may then add an air-conditioner to counteract the overheating effects of the sun.



Glazing to the north walls also provides great natural lighting during the winter months, providing a brighter, happier home. Overall, the use of the natural elements to heat, cool and light a home provides it with an increased level of comfort, not to mention health benefits. ORIENTATION is a key factor when considering passive solar design at higher latitudes, the better the orientation, the better the energy efficiency of the house. Whether it be a new home or renovation, most homes can be orientated in a more favourable direction. Ideally, the living areas are best placed on the north side of the dwelling, with the highest amount of glazing also. This then places the bedrooms and other areas at the rear of the house, where less time is spent. Through the use of clerestory glazing light and winter heating can still be gained at the rear of the house, however not all renovations are open to such design elements.



All Australian climates require some degree of cooling.

THERMAL MASS– As a way of storing daytime heat, Thermal Mass allows this heat to be re-released back into the house at night to offset heat loss to colder night time temperatures. During summer, Thermal mass protected from the sun, preventing it from 'heating up', can release 'coolth' into the house as outside temperatures rise.

Generally, night time 'coolth'

is stored for use during the day in summer and conversely, daytime warmth from the sun can be stored to offset the colder nights in winter.

A few methods of incorporating thermal mass are possible. Concrete or tiled floors are a great way to store heat or 'coolth'. However if a floor using light weight construction is required or preferred, then thermal mass walls and other elements incorporated into design can also play a major role in storing heat or 'coolth'.

Put simply, design for passive solar heating/cooling is about keeping summer sun out and letting winter sun in.

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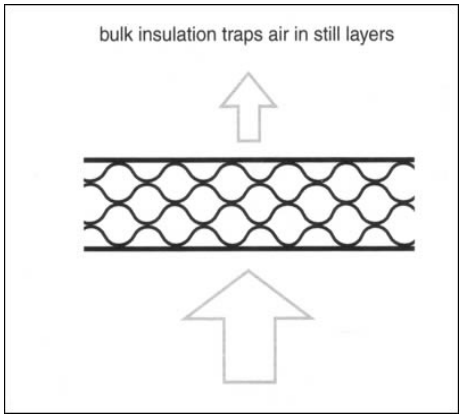
INSULATION

INSULATION– An important part of passive solar design, is the need to ensure good insulation is still applied. The aim is to prevent the house heating up in the first place in summer, and ultimately cooling in the first place in winter. Insulation plays an extremely important role in both instances. When dealing with insulation, we refer to it as a Value of R. This R represents the ability of a product or building element to resist the transfer of heat through it.

The higher the R-value, the better the thermal performance.

Different construction techniques provide different R values, as do different products. One of the biggest problems with aluminium window frames is that aluminium has an R value of 0, while timber window frames have an R value of between 0.12 and 0.25 for every 25mm of thickness. Aluminium comes into its own as a reflective insulation, reflecting 'radiant' heat, however, poor in resisting heat conduction.
The above wall construction techniques give an R value but don't take into consideration the circumstance of use. Cavity brick for example, accounting for over 95% of Perth's construction, is perfect in autumn and spring, but poor in the extremes. Once they heat up during summer, due to the bricks ability to store heat, stay hot for days even after it has cooled off. To offset this, air-conditioning is required to prevent the inside leaf from heating in the first place, or cavity fill with insulation to increase the R value and slow the heat transfer from the outside to the inside. Winter is reverse, once the bricks cool, and this effects the inside, the rooms in the house stay cold for days, even if the sun is shining outside. This is where good design comes into play, keeping the sun off the walls during summer in the first place, and allowing the sun into living spaces during winter to heat.

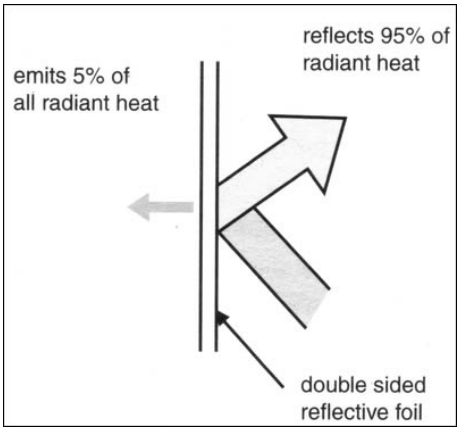


The same occurs here in Victoria with brick veneer construction that contains no insulation in the timber framing leaf of the wall. Too hot during summer, too cold during winter. The advantage of weatherboard, is that there is no brick to store the extremes, so while it may get extremely hot during a summer day, this heat dissipates quickly in the evening allowing a comfortable sleeping temperature. But reverses during winter, freezing temperatures for sleeping at night, but comfortable during the day as it heats quickly. Passive solar design then comes into play with all construction techniques, providing insulation is used, and natural elements taken into account, comfortable temperatures can be achieved generally all year round with no help of artificial heating or cooling required. All states have regulations to adhere to when it comes to minimum R values in walls and ceilings. Victoria has a required minimum value of 3.0 for ceilings and 1.5 for walls.

WALL CONSTRUCTION	OVERALL R VALUE
Weatherboard	0.55
Brick veneer	0.51
Cavity brick	0.53
Solid brick (230 mm thick)	0.44
Solid concrete (100 mm thick	0.23
Solid concrete (200 mm thick)	0.30
Aerated concrete (100 mm block)	0.78
Aerated concrete (200 mm block)	1.54
Mud brick (300 mm block)	0.40

Save up to 45 percent of heating and cooling energy with roof and ceiling insulation.

Internal walls are not required to have any sort of insulation, but it is still an important factor to consider. With insulation in the internal walls, a house can be segregated into 'pods', enabling living areas, if being artificially heated or cooled especially, to be heated and cooled independently to the rest of the house, saving energy and costs. Another benefit to internal wall insulation is noise. Bulk insulation has a high acoustic properties. Especially important in a family home, or surrounding certain rooms of the house ie. Laundries, bathrooms.



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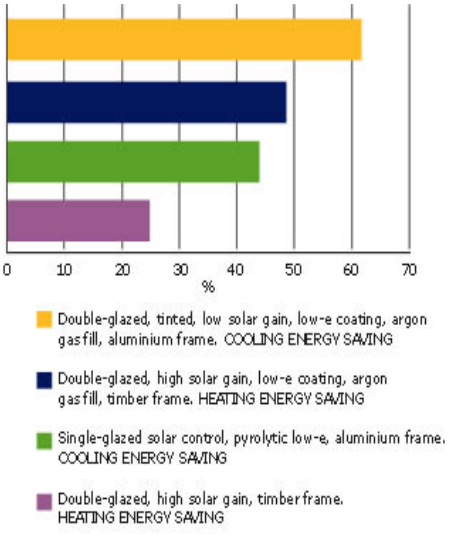
GLAZING

GLAZING– Windows and doors (glazed or unglazed), play a huge part in the transfer of temperatures from out to in and vice versa. As well as allowing the flow of air, and natural light through rooms. Australia traditionally hasn't been a big utiliser of double glazing, whilst generally the rest of the world has, especially colder climates such as Europe. The benefits of double glazing speak for themselves, and the near future may bring a requirement that all glazing be double glazed in Australia. Especially when it comes to energy rating requirements. There are many factors to consider when selecting a window, some may include, finished glass treatment, material of window frames, single or double glazing and manufacturing costs. The following are tables that may help you in choosing a style or type of window.



Even with advanced glazing and framing systems, glass areas remain the single greatest source of heat loss and heat gain in a house.

Heat loss through various glass treatments	
Unprotected single glazing	100%
Vertical or ventian blinds	100%
Unlined drapes or Holland blinds, no pelmet	92%
Heavy lined drapes, no pelmet	87%
Unlined drapes or Holland blinds, pelmets	79%
Double glazing	69%
Heavy lined drapes, pelmet	63%
Double glazing with low-e coating	57%
25mm Polystyrene shutters, good airseal	50%
Double glazing, heavy drapes, pelmets	47%

Energy ratings are already playing a major role in glazing requirements. Energy raters are already requiring certain designs in certain areas to have double glazing on west facing walls, and can play a role in the amount of glazing a home has in total.
Some other factors to consider when dealing with window and glass selection are as follows-

- Internal thermal mass
- Air-tightness of frames & opening sashes
- Light transmittance
- Ventilation and placement of opening windows
- Noise control
- Any ongoing maintenance
- Condensation
- Life cycle costing
- Fly screening
- WERS energy rating

Heat loss through various window frames	
Single glazed industry typical aluminium	100%
Singe glazed thermally improved aluminium	87%
Single glazed timber or P.V.C	82%
Double glazed industry typical aluminium	72%
Double glazed thermally Improved aluminium	60%
Double glazed timber or P.V.C	54%

Heat gain through various various glass treatments	
Unshaded single glazed window	100%
Double glazing	90%
Internal vertical blinds/open weave drapes	76%
Internal venetian blinds	55 – 85%
Internal holland blinds	55 – 65%
Tinted glass	*A 40 – 65%
Solar control film/reflective glass	*B 20 – 60%
Trees-full shade to light shade	20 - 60%
1.0 m Eaves over north wall	30%
External roller shutter	25 – 35%
External awning	25 – 35%
2m pergola over north wall with deciduous vines or shade cloth	20%
Outside metal blind or miniature louves parallel and close to window	15 – 20%

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MATERIALS

MATERIALS– The materials that clad the external walls of your house can be compared to the skin. It has a job to do, But as well as providing a skin to the houses structural elements, it provides bracing, insulation, water repellent, UV protection, a wind barrier and aesthetics. There is a huge range of materials on the market today, ranging from natural products, through to synthetic products and a mix of the two. All building materials and products contain what is referred to as Embodied energy. Embodied energy is the energy consumed by all of the processes associated with the production of a building, from the acquisition of natural resources to product delivery. This includes the mining and manufacturing of materials and equipment, the transport of the materials and the administrative functions.

Embodied energy is a significant component of the lifecycle impact of a home. And as much as materials keep out the elements, some have more benefits than others, for various reasons. ie. Timber has a low embodied energy amount but wears quickly poorly when exposed and compared to other products, while aluminium wears extremely slowly, it also contains the highest amount of embodied energy in its production. With this being an issue, most people choose to use an aluminium window frame, avoiding the re-painting maintenance required from a timber frame for its protection. On the other hand, timber creates a feeling of warmth, comfort and has a natural look, that used over larger areas as weatherboards or panels, is easily maintained and creates the perfect aesthetics, balance and statement! Materials, historically, have been sourced locally and not travelled the great distances they do today. The life cycle of a material, that being the useful life of a product from mining to disposal, plays a big part in how much of an environmental impact a product has. Aluminium supporters argue that, once aluminium is mined, it is then 100% recyclable, offsetting its high amount embodied energy. But then you have to mould and fabricate the material into a product. Timber on the other hand, with a low embodied energy value, is the perfect material as far as the environmentally conscious is concerned. But that is soon offset when the client then chooses to use a tropical timber from the Amazon. The life cycle of this timber then becomes complicated, logged from unsustainable sources, then milled and transported great distances by truck, to be cut and treated into a product, and eventually put on a plane to be flown thousands of kilometres to be used in a house on the other side of the world. Bricks are a product from locally sourced materials, however due to them being a quarried material, leave a large hole in the ground and along the sides of hills. During the recent Perth property boom, a shortage of bricks soon arose. Instead of changing construction techniques to brick veneer, it was apparently more convenient to import bricks from the east coast of Australia. As can be seen, each product has its pros and cons. We have only touched on a couple of the more popular materials here, however many factors can be considered when choosing a material for your home.

MATERIAL	PER EMBODIED ENERGY
Kiln dried sawn softwood	3.4
Kiln dried sawn hardwood	2.0
Air dried sawn hardwood	0.5
Hardboard	24.2
Particleboard	8.0
MDF	11.3
Plywood	10.4
Glue-laminated timber	11.0
Laminated veneer lumber	11.0
Plastics - general	90
PVC	80.0
Synthetic rubber	110.0
Acrylic paint	61.5
Stabilised earth	0.7
Imported dimension gran-	13.9
Local dimension granite	5.9
Gypsum plaster	2.9
Plasterboard	4.4
Fibre cement	4.8*
Cement	5.6
Insitu Concrete	1.9
Precast steam-cured concrete	2.0
Precast tilt-up concrete	1.9
Clay bricks	2.5
Concrete blocks	1.5
AAC	3.6
Glass	12.7
Aluminium	170
Copper	100
Galvanised steel	38

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ENERGY

	20 W CFL	100 W INCANDES-CENT	65W HALOGEN
Running cost over 10,000 hours*	$20	$100	$75**
Average life	10,000 hours	1,000 hours	2,000 hours
Purchase cost	$25 1 lamp	$5 10 bulbs @ 50c	$20 5 lamps @ $4
Total cost	$45	$105	$95

ENERGY– With Global warming being such an issue in today's society, new and improved methods for energy generation are popping up all over the world. Most aren't practical for a small suburban site, but as long as your house has a roof, then energy self sufficient energy generation is an option.
The most obvious improvement a house can make, is to supplement its water heating with a solar hot water system. A solar hot water system can provide between 50% and 90% of your total hot water requirements. And with water heating accounting for about 30% of an average households energy use. Resulting in big cuts in greenhouse gas emissions, and big savings on bills. Government rebates and increased popularity are making solar hot water affordable, with a wide range of brands and systems now available.
Other methods of harnessing the natural elements for energy production vary immensely. The more common method is the use of solar panels on the roof, just the same as solar hot water is situated. Solar panels (photovoltaic) for electricity production are advancing in leaps and bounds. And with renewable energy targets set, residential housing will be playing a big part in achieving this national goal through the installation of such systems. However, solar panels are still a little out of reach for many families as far as installation costs are involved. Other methods of energy production un
der certain circumstances, ie. rural setting with land, can include wind turbines in open areas or where a consistent breeze is prevalent, and micro hydro generators where a natural stream or spring is available.

As previously discussed, the majority of, and if not all in some unique circumstances, of heating and cooling, can be achieved through the clever planning and design of a house within its siting. However, if required, heating and cooling can still be done consciously and efficiently.

Comparison of central heating system

SYSTEM TYPE	RUNNING COST	GREENHOUSE EMISSIONS
Hydronic zoned with wood / solar heat source	low	very low
High efficiency ducted natural gas	low	low
Hydronic zoned natural gas or heat pump	low	low
Ducted reverse cycle heat pump	medium	medium
In-slab high off-peak electric	medium	high

Gas heaters and efficient reverse cycle heat pumps produce as little as one third the amount of greenhouse emissions of standard electric heaters. With many heating and cooling options available, it is important to choose the right product for the right job. eg. Evaporative cooling systems, although more energy efficient than a split system air-conditioner, don't function in humid conditions.
Making it important to compare the efficiency and effectiveness of heating and cooling systems available.

Central heating can often heat a whole house, whether individual rooms are occupied or not. Space heating heats the one or two rooms that are in use.

Lighting is another area of importance related to energy use. Energy use associated with lighting in Australia, is increasing due to larger home construction and the installation of more light fittings per home. Some of the options available include; incandescent lighting, halogen lighting, fluorescent lighting, and a new technology when referring to house lighting, the LED light. The incandescent light is the most wasteful of the lighting systems, with the majority of its energy used up as the production of heat. The halogen light, pushed by marketers as a low voltage option, is deceiving in that it is not low energy use. The halogen light utilises an energy pack/converter, which itself is high energy use, to downgrade the voltage. Making the halogen nearly as energy hungry as the incandescent bulb. The fluorescent lights, to which there exist multiple options, is the most energy efficient of the popular lighting systems. And as the table shows, although more expensive to setup, is cheaper over the life of the system. Another option, relatively new to housing is the LED (light emitting diode). The LED is more expensive but puts nearly all of its energy into lighting, and as a result produces nearly no heat.

Comparison of space heating systems

	RUNNING COST	GREENHOUSE EMISSIONS
High efficiency natural gas	low	low
Slow combustion wood heater	low	low
Reverse cycle heat pump	medium	medium
Off-peak electric storage	low	high
Electric portable heaters and panel	high	high

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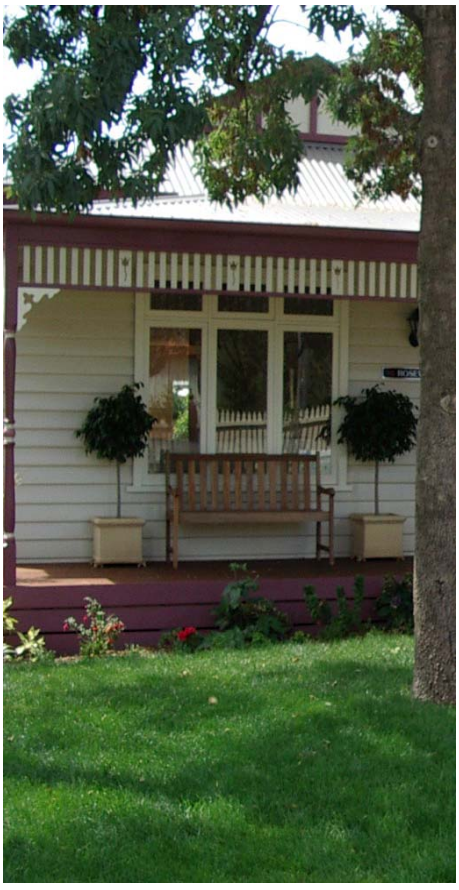
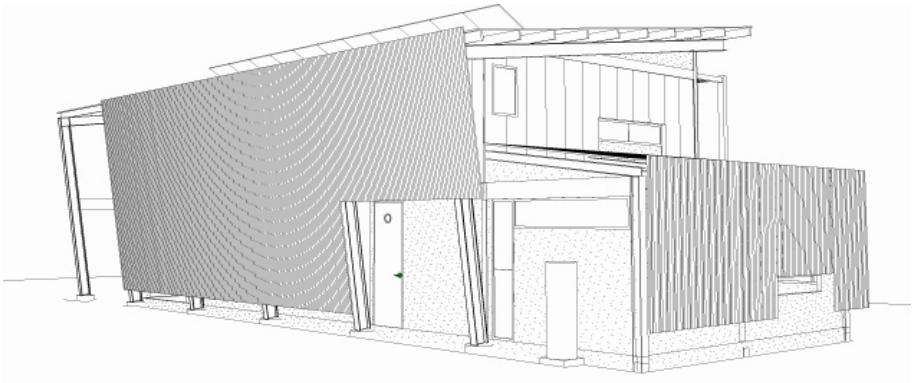
CONCLUSION

With the fast progression towards a sustainable society and less wasteful living, rules and regulations often lag behind the peoples progression towards the ideal. As a result, care needs to be taken when doing something out of the ordinary to your house. Experts need to be consulted with, and councils contacted to determine compliance with any current regulation. As the environment and resources become more precious, governments and councils will regulate many of the areas governing the construction of your new home.

It is already required that new homes are to be a certain energy rating before they can be approved for building, and renovations and additions are taking the same path. Much of what has been touched on is just a fraction of what goes into designing a energy efficient or sustainable house. The trend is towards each and every person having as little detrimental impact on his or her outside environment as possible, that includes the foot print that their home takes up. An aim of self sufficiency. A lot of what has been discussed is related to design, we are aiming to help you the client understand what it means and why we design things how we do. It is not required to have a solar hot water system as yet, but if you can afford it, consider it. As stated, all houses are heading in the direction of having their own energy rating, at the moment it is more a question of when, not if. Not only will regulations govern housing construction in the future, but trends and peoples wants and needs will also. People are wanting to do what's right to make the planet a better place for their children and the future generations. And as this increases, people will begin to shop for energy efficient, water wise, sustainable houses for purchase, and investment. Not only does it make sense, but it increases the value of your home for resale, lowers your day to day costs when it comes to bills. With a side benefit of a better living environment. Many products on the market utilise harmful chemicals to make their product. Plastics are linked to increased oestrogen levels in humans. Paints and carpets can off gas for years after installation with links to childhood asthma. ACC treated timber has recently been banned due to high level of the carcinogens. These are just a couple of the issue related to synthetic building products. A lot of what can be done to a home to make it a better place to live, is not possible in all areas. Wind turbines aren't effective in an area that doesn't receive regular wind or breezes. Site size and orientation may limit any opportunities for passive solar design and our sole views to a site may be on the west wall of the house, creating lots of glass on the hottest time of the day, requiring some planning on our part, and liaising with you, the client, to satisfy your wants and needs.





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http://www.todae.com.au/comersus2/store/comersus_index.asp

Science Initiatives & Developments:
http://www.csiro.gov.au/csiro/channel/_ca_dch2t.html

high impact for the client — low impact to the environment