THERMAL EFFICIENCY

Included in this fact sheet:
- Passive Design
- Air Flow
- Insulation
- Floors
- Windows and Doors
- Auxiliary Heating

Using passive solar design, the Sustainable Lifestyle House allows for storage and transfer of solar energy and is constructed using materials that reduce heat loss during winter. Good winter solar access allows for areas of thermal mass to be heated by the sun. Efficient design of walls and windows and the use of insulation provide for effective retention of heat during winter, whilst reducing heat gain during summer.

NatHERS (Nationwide House Energy Rating Scheme) evaluates the thermal efficiency of a house using a star rating from 1 to 10. It measures the natural ability of the house to stay cool in summer and warm in winter, with the higher the rating the less heating or cooling is required. Houses built around 1990 averaged around 1 star on the NatHERS scale, however new houses are currently required to be designed to a minimum equivalent of 4.5 stars under BASIX, which is expected to rise to 6 stars in 2012.

The Bathurst Sustainable Lifestyle House has a NatHERS star rating of 7.1

Passive Design
Using passive design principles (see Passive Design Fact Sheet) in conjunction with good thermal mass is the cheapest way to heat your home. Thermal mass describes the ability of a material to absorb, store and redistribute heat energy. Thermal mass describes the ability of a material to absorb, store and redistribute heat energy. High density materials such as concrete, brick and tiles have high thermal mass whereas lighter materials such as wood have low thermal mass. The Sustainable Lifestyle House uses high thermal mass in several areas including the floor and walls in areas where direct solar heating is available.

Air Flow
The Sustainable Lifestyle House is designed to have good controllable air flow between inside and outside, so that in summer evenings, cooler breezes can flow through, but on cold days, infiltration is eliminated. An air-lock has been created at the front door to reduce heated or cooled air being lost. Vents in the bathroom areas are self closing and turn off automatically after use.

Insulation
Insulation is used under the floor slab, in all walls, ceilings and roofs. This is essential in maintaining a stable temperature. Insulation’s effectiveness is measured by its R-rating. The higher the R value, the more effective it is in limiting heat movement.

Internally, brick walls work like concrete slabs, by absorbing the heat that reaches it, either through direct solar energy or ambient heat from the room. In winter, this is reradiated into the interior after the sun goes down. In summer, it works in reverse, soaking up heat from the interior during the day, and releasing it slowly overnight.

Double brick walls, insulated with R0.85 Foilboard in the cavity, are used in areas that receive winter sun, thereby adding to the amount of heat released into the house during cooler months. In summer, these walls are protected by large eaves or shade sails to reduce heat transfer, as well as the cavity insulation.
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R3.0 insulated timber framed walls with lightweight Weathertex cladding are used in areas that do not receive direct winter sun, where thermal mass is of little extra value. This type of wall system is well insulated and cheaper to construct.

**Floors**
The concrete slab floor is a waffle slab, with large rigid foam void, forming insulating boxes shaped into its underside. This not only provides cost-effective structural stiffness on reactive soils, but also provides R1.0 insulation to the thermal mass of the floor, isolating it from cooler ground temperatures in Bathurst’s climate.

During winter, the sun is allowed to penetrate inside the house and heat up the tiled floors. This heat is then gradually released throughout the evening, providing increased warmth and reducing the need for artificial heating. The floors in the bedroom areas are carpeted which improves the aesthetics of these rooms whilst still maintaining thermal efficiency. The embodied energy in the concrete slab is also reduced through the use of waste fly-ash as a concrete additive (see Material Selection Fact Sheet).

**Windows and Doors**
The glass in the windows are double glazed, argon filled cavity, with the inside pane being Low-E glass, which are as well insulated as any window commercially available in Australia. It must always be remembered that glass can never be as well insulated as the walls that surround them, so glazing areas need to be in balance with the volume of the room.

The outward facing low-E coating on the inner pane of glass (called ‘surface 3’, being the third surface counting from the outside inwards) means the glazing acts like a one-way heat valve: it allows heat in but restricts it going back out.

By having windows that reduce the transfer of heat, the heat created during the day in winter is not lost at night. Conversely, during hot days, the external ambient heat is kept outside providing for comfortable conditions year round.

All the windows have a U-value of 3.6 and Solar Heat Gain Coefficient (SHGC) of 0.34. The glass doors have a U-value of 3.7 and SHGC of 0.57. The U-value describes how well the windows restrict radiant heat flow, and is the inverse of the more common R-value. The SHGC describes how much solar energy is allowed to pass through both skins of the glazing.

**Auxilliary heating**
Using passive design reduces the need for additional heating. Sometimes the weather is so inclement that there is insufficient solar radiation to provide all the heat needed for commonly accepted comfort levels. That’s when the high efficiency gas heater will be used. It is flued, to keep the exhaust gases out of the home. There is a warm air transfer system, which sucks hot air from ceiling level directly above the heater, and delivers it via insulated ductwork it to an outlet at floor level in the front living room.

Ceiling fans running slowly on winter cycle (upwards air flow) also help to break up stratification, where all the warmest air usually collects at ceiling level. This helps distribute it evenly through the whole room, without causing draughts.

**For further information**
www.nathers.gov.au  
www.yourhome.gov.au  
www.livinggreener.gov.au

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