Sunbury VIC

NEW HOME

ZONE 6: Mild temperate

Topics covered	
Passive design	
Renewable energy	
Energy efficiency	
Rainwater harvesting	
Greywater re-use	
Indoor air quality	
Sustainable materials	
Construction waste avoidance	
AccuRate (thermal comfort)	6.0 (regulatory)

This house, known as the EcoHome, was designed to be a resource efficient, low allergy home for a family of two adults and three children, incorporating good passive solar design, active solar systems, rain water and greywater re-use, and a high level of indoor air quality.

The conventional construction methods used in the the EcoHome make this type of building system readily replicable. The low-tech approach encourages occupants to understand how the building systems operate and work with them.

Site

The site is a hilly exposed location on top of Jacksons Hill, Sunbury, in the Urban and Regional Land Corporation's (URLC) energy efficient subdivision 'Sunset Heights'. The first 21 house sites in the subdivision were fully equipped with active solar systems (grid-connected photo-voltaic arrays and solar hot water systems) in a green field development.

The EcoHome was the first house to be built in this new sub-division. The site lends itself towards a panorama of the surrounding Sunbury Hills and long distance vistas. The block has an area of 556m^2.

Impact on the site was reduced through careful excavation, with minimal cut and fill used in site preparation.

Excavated site material was used by the Urban and Regional Land Corporation as road base in the new sub-division. [See: Choosing a Site; 5.3 Waste Minimisation]

Climate

The location is in a temperate dry climate zone, with cooling summer breezes from the south and blustery cold south-westerly winds in winter. [See: 4.2 Design for Climate]

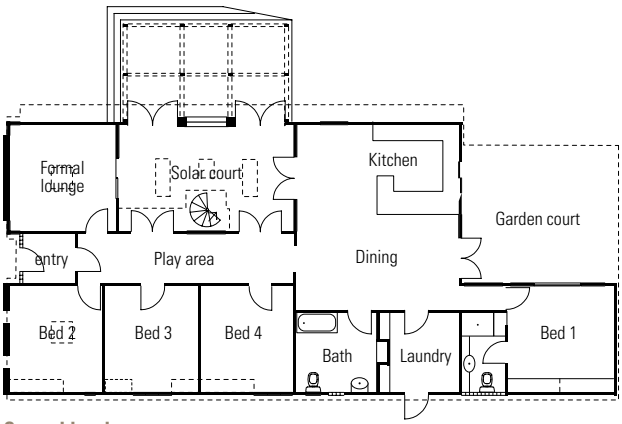
Orientation

The house has a street address to the west and the living spaces are orientated to the north.

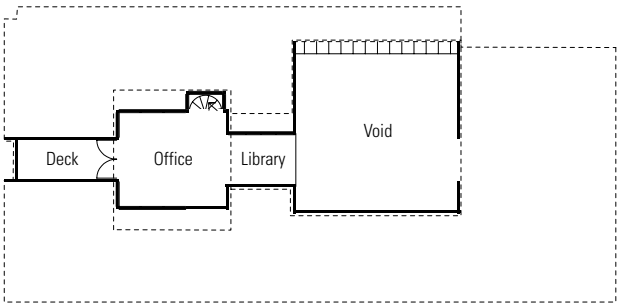
The west frontage has long distance vistas of the surrounding Sunbury hills. The garage provides some shading from early morning summer sun.

The living areas, solar court and garden court are located on the northern side for maximum solar access. Bedrooms and utility rooms are on the cooler southern side.

Flexibility was an important principle in the design of the living areas. The doors and glass walls can be opened to increase house size in summer, providing a larger volume and



Ground level



Upper level

higher ceilings to improve air stratification and circulation. In winter they can be closed to reduce room size for more effective heating. [See: 4.3 Orientation]

Shading

Eaves shade windows on the north side.

A solar pergola ensures the solar court does not overheat and provides a shaded external living area. The reflective solar film on the skylights minimizes overheating of the solar court.

The west facing double glazed windows and front door assembly also utilise solar film, reducing solar penetration in the morning. [See: 4.4 Shading; 4.10 Glazing]

Glazing

All external windows and glazed doors are Victorian Ash timber framed double-glazed units. The timber was sourced from sustainable timber plantations. There are insulating glass brick walls and windows in the bathrooms.

The openable skylights are argon gas filled double glazed units with solar film.

The internal glass walls facing onto the solar court are single glazed and enable this space to be separated or included in the main living areas without visual exclusion.

The single glazed louvre window in the upper floor office facilitates exhausting of heat from the solar court and lower levels by the stack effect. A flexi-glass frame is fixed over this louvre window during colder months, providing a weather seal and maintaining the insulation integrity of the building envelope.

The west windows are designed as 'zen' picture windows to frame the view, limiting the thermal load and solar penetration. [See: 4.10 Glazing]

Insulation

The roof is insulated by a layer of reflective foil insulation and R3.5 *Rainbow* batts made from recycled PET bottles.

External walls are insulated by R1.5 *Rainbow* batts. Particular attention was paid to installation of the insulation to ensure effective cover without gaps.

Double glazed timber window and door frames avoid thermal bridging. [See: 4.10 Glazing]

Infiltration has been minimised by locating power points and switches on interior walls, installing surface mounting light fittings rather than using down lights (to avoid penetrating insulation), application of foam seals around window and external door frames, and using a breathable membrane vapour barrier. [See: 4.7 Insulation; 4.8 Insulation Installation]

Ventilation

Natural ventilation has been achieved by window placement that allows for cross ventilation and night-time ventilation for summer cooling.

Plants and water features strategically located in the solar court and garden court provide natural evaporative cooling.

High windows induce a stack effect and exhaust hot air via the upstairs library and home-office windows. [See: 4.6 Passive Cooling]

As indoor air quality is a primary concern, winter ventilation is provided by an air filter and mechanical ventilation system to control humidity levels and remove pollutants. A heat recovery unit conserves energy.

Embodied energy

Materials used are relatively low in embodied energy, largely due to the lightweight construction technique.

Local building materials have been sourced where practical to reduce transport energy.

Victorian Ash timber framed windows and doors from a sustainable timber plantation were used in preference to imported cedar windows and doors.

Plantation pine was used for the frame and bulk insulation was manufactured from recycled PET. [See: 5.2 Embodied Energy]

Renewable electricity

The house is equipped with a 1.6 kilowatt peak grid-connected photovoltaic array installed on the north facing roof, which is pitched at 30° to maximise efficiency of the array in winter.

The energy needs of the household are substantially below average due to the use of passive solar design, natural ventilation, day lighting and the contribution of the active solar systems.

The active solar component of the EcoHome contributes approximately 1560kWh annually to the electricity needs of the household. The photovoltaic array is generating around one quarter of required household electricity. [See: 6.6 Renewable Energy; 6.7 Photovoltaic Systems]

Greenhouse gas emissions are reduced by at least 6,500kg per annum due to the active solar system.

Hot water

Hot water is supplied by a 300L gas boosted, close coupled solar hot water system mounted on the north-facing roof above the kitchen in order to be close to the most frequent draw-off point.

Heating and cooling

Auxiliary heating is supplied by an efficient force-flued gas heater, mainly to provide additional winter early morning heating to children's bedrooms which are located on the south side.

Ceiling fans are used to provide cooling air movement in summer, and are reversible to push warm air back down from the ceiling in winter.

A heat exchanger is utilised on the mechanical ventilation system.

The water feature acts as a natural evaporative cooler. [See: 6.2 Heating and Cooling]

Lighting and appliances

The house is designed to take full advantage of natural daylighting.

Energy efficient light fixtures, which allow for compact fluorescent lamps, have been installed.

Separate switches for separate lights have been installed so lights can be turned off if not needed.

The skylights above the solar court and the high windows of the living spaces admit sufficient light for reading on full moon nights without the need for artificial lighting.

Window placement allows the occupants clear vistas through the home to observe the passage of the sun and changing climatic events.

Any new appliances are 5 Star rated. [See: 6.3 Lighting; 6.4 Appliances]

WATER MANAGEMENT

Rainwater is harvested and stored in a 5,000L tank for garden use. [See: 7.3 Rainwater]

A greywater recycling system with a mechanical filter provides water for toilet flushing and waters garden beds via a gravity flow sub-surface irrigation system. [See: 7.4 Wastewater Re-use]

Water efficient WELS 4 Star rated clothes washer and dishwasher have been installed.

Showers and sink and basin taps are 3 Star water efficiency rated. [See: 7.2 Reducing Water Demand]

The annual water consumption for the two adults and three children living in the EcoHome is less than half of the average Melbourne household.

LANDSCAPING

Plants and water features are strategically located to cool hot northerly breezes through transpiration and evaporation.

Native plants that are drought and wind resistant and rockeries are used on the exposed westerly entrance garden. These plantings provided the means to uplift the breezes over the house to protect the house from loss of heat. [See: 2.4 Sustainable Landscapes]

INDOOR AIR QUALITY

A high standard of indoor air quality has been achieved through the selection of low chemical emitting building products such as Low VOC paints and hard surfaced products.

A central ducted vacuum system minimises re-circulation of dust particles.

Low VOC building products, including paints, sealed timbers and fully sealed (top, bottom and all sides) laminates are used throughout the house.

Hard surface flooring is used throughout to facilitate effective cleaning and dust removal, eliminating a breeding ground for dust mites.

In all wet areas, laminates were used to minimise mould growth, and good ventilation levels were provided.

The kitchen range hood exhausts directly to the exterior.

MATERIALS AND WASTE MANAGEMENT

No waste from the building construction or site was taken to landfill. Construction materials were carefully chosen to minimise waste.

Fibre cement exterior cladding generated little waste and off-cuts were re-used. The rendered finish generated no excess material.

The EcoHome's framing is constructed from sustainable sourced plantation pine timber framing. The house frame includes Laser frame beams and rafters and timber-saving truss design to support the span over kitchen/living areas.

Framing was cut to size off-site according to a cut list. Any off-cuts were used for noggins or blocking, and the remainder used as fuel for a neighbours wood burning heater.

Insulation is manufactured from recycled PET plastics.

Window frames and glass door frames are made from plantation sourced Victorian Ash.

Roof metal scrap was recycled.

Excess excavated soil was used by URLC in the road base. [See: 5.3 Waste Minimisation]

EVALUATION

The home achieved a 5-star energy rating using the First Rate software tool (maximum rating allowed by the First Rate software at the time). The lightweight walls, often considered best suited to temperate climates, have proven to work well in Melbourne combined with high levels of insulation. This construction system has lower embodied energy than a heavyweight system. The house maintains adequate thermal mass with a concrete slab on ground.

The occupants enjoy the EcoHome as a family home and in particular appreciate the air lock entry which protects from the strong winds experienced on Jacksons Hill, Sunbury. The vistas through the home allow the occupants to view changing climatic events and enjoy the panoramic view of the surrounding hills.

The high levels of natural daylight within the house make it a pleasant place to be, and reduce the need for use of artificial lighting.

This family is particularly aware of energy and water conservation.

This awareness, in conjunction with the design of the home, has allowed them to reduce their energy consumption to one-third of what they previously consumed in another house in Sunbury. Their water consumption is one half of the Melbourne average for a family of this size.

The owner-builder stated that he could not believe that the EcoHome is only 230m^2 in area as the spatial quality and efficiency of space planning provided a sense of spaciousness within the home.

The climatic design of the house provided benefits in addition to thermal comfort, energy and cost savings for the occupants. The design established long distance vistas of the surrounding Sunbury Hills. There was a visual connection between the house and the environment, for near, middle and far distance environments, and for changing climatic events/ weather patterns. Skylights and high windows allowed for ambient lighting levels from moon-light. At the local school, the children that lived in the house used the EcoHome as an example of a Sustainable House at 'show and tell'.

Awards:

Master Builders Association *National Environment and Energy Building Efficiency Award for Housing 2002* – Under $300,000.

The Architecture Show Magazine and The Francis Greenway Society *Green Buildings Awards 2003* – Silver Medal.

PROJECT DETAILS	
Architect:	Bridget Puszka, BP Architects
Builder:	Jan Brandjes
Engineer:	Keith Altmann and Associates

Principal author:
Bridget Puszka