house – temperate

Home Design for lifestyle & the future

North West Melbourne

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 grey water re-use, and a high level of indoor air quality.

Building Type:	New detached house
Climate:	Dry temperate North west Melbourne
Topics Covered	**Success Level**
Passive Design	Excellent
Renewable energy	Excellent
Energy efficiency	Excellent
Rainwater harvesting	Very good
Grey water re-use	Excellent
Indoor air quality	Excellent
Sustainable materials	Very good
Construction waste avoidance	Excellent
First Rate rating – 5 star	★★★★★

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 & Regional Land Corporation's 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 556 square metres.

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 & Regional Land Corporation as road base in the new sub-division.

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.

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.

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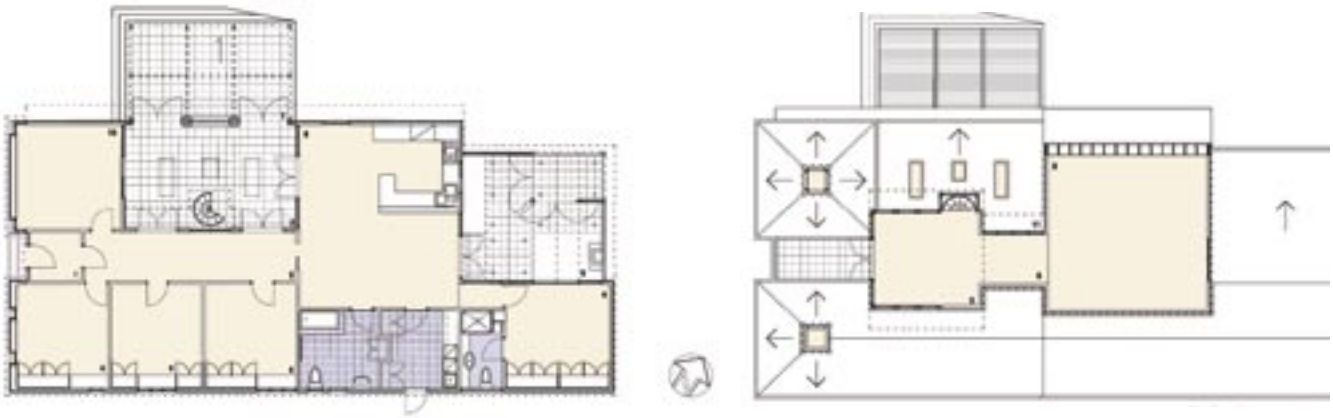
1. solar pergola 2. solar court 3. play area 4. bedroom 5. office 6. library
7. airlock/entry 8. dining/litchen 9. garden court 10. formal lounge 11. roof over solar court



Ground floor plan ***Upper floor plan***

PASSIVE DESIGN FEATURES

ZONING

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 higher ceilings to improve air stratification and circulation. In winter they can be closed to reduce room size for more effective heating.

CONSTRUCTION AND THERMAL MASS

The floor is a concrete slab on ground with a ceramic tiled surface. This slab, which is exposed to winter sun, provides thermal mass.

The roof is a lightweight timber frame structure with roof vents, clad in light-coloured metal.

The walls are lightweight timber frame, clad in fibre cement sheet with a rendered finish.

The highly insulated external walls and roof are sealed from air infiltration. Expandable foam insulation has been applied around window and external door frames, and between the stud wall and bottom plate.

The limited thermal mass of the lightweight walls avoids a prolonged building time lag and allows a quick indoor response to changes in weather conditions.

The aerated concrete 'sandstone' tile cladding to the exterior wall base and the exterior window and door surrounds are for aesthetics, to provide a sense of solidity to the thin wall construction.

GLAZING

All external windows and glazed doors are Victorian Ash timber framed double-glazed units. The timber is sourced

from sustainable 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.

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: Glazing Overview, Shading]

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: Glazing- Cool Temperate]

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: Insulation Overview, 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: 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. [See: Indoor Air Quality]

BUILDING ENVELOPE RATING

A 5 Star First Rate House Energy rating was achieved, with a First Rate score of 18.3 points.

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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: Embodied Energy]

OPERATIONAL 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 annual electricity bill for this family of 5 in the EcoHome is $240.00, and the annual gas bill is $160. 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: Renewable Electricity Overview, Photovoltaic Systems]

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

HOT WATER

Hot water is supplied by a 300-litre 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. [See: Solar Hot Water]

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: Heating & 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: Lighting, White Goods]

WATER MANAGEMENT

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

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

Water efficient AAAA rated clothes washer and dishwasher have been installed.

Showers and sink and basin taps are AAA water efficiency rated. [See: 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 provide uplift to protect the house from the wind. [See: Sustainable Landscape]

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 & 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. [See: Indoor Air Quality]

MATERIALS & 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 wood burning heater.

Insulation is manufactured from recycled PET plastics.

Windows are made from plantation sourced Victorian Ash.

Roof metal scrap was recycled.

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

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EVALUATION

The home achieved a 5-star energy rating using the First Rate software tool. The lightweight walls, often considered best suited to warmer climates, have proven to work well in Melbourne due to high levels of insulation. This construction system has lower embodied energy than a heavyweight system, but the house still maintains adequate thermal mass through the 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 occupants say that the EcoHome is their favourite home out of all homes that they have lived in.

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 has stated that he could not believe that the EcoHome is only 230sqm in area due to the efficiency of space planning.

Awards:

MBA (Master Builders Association) National Environment & Energy Building Efficiency Award for Housing - Under $300,000 - 2002

The Architecture Show Magazine & The Francis Greenway Society Green Buildings Awards 2003 - Silver Medal

PROJECT DETAILS	
Architect	Bridget Puszka, BP Architects
Client/Owner-Builder	Mr. Jan Brandjes, EnviroBrokers Australia
Suppliers	BHP Steel – Colorbond roofing James Hardie – CMX wall cladding