House – temperate
Newcastle

This case study looks at an energy efficient display home which was built by Landcom, the NSW Government's agent for land development. It is essentially a project home built to demonstrate energy efficient and environmentally friendly building principles to project home buyers. The materials and techniques used are close to standard, and the home is a good example of an affordable, resource efficient and attractive house for home buyers.

BUILDING TYPE: New home, suburban site, all normal services, heavyweight	
CLIMATE: Temperate - Newcastle New South Wales	
Topics covered	Suburban Sustainability
Orientation	Excellent
Design for climate	Excellent
Passive heating	Excellent
Passive cooling	Excellent
Insulation	Excellent
Thermal mass	Above average
Glazing	Excellent
Shading	Excellent
Reduced water demand	Above average
Water harvesting	Excellent
Water re-use	Above average
Material selection	Good
Energy use – PV	NA
Solar hot water	Excellent
Electric lighting	Above average
Greenhouse Gas reduction	Excellent
NatHERS Rating	★★★★½ (5 stars with pelmets and curtains)
Seda Scorecard	★★★★★

INTRODUCTION

Landcom recognised the need for an energy efficient home that was part of the 'project home' end of the mainstream market.

In November 1998, with the support of Maitland City Council, Landcom instigated a competition for the design of an "affordable energy efficient and environmentally friendly home" that complied with SEDA's five star energy rating.

Glen Spicer of EJE Architecture won the competition with a practical, uncomplicated design approach. Landcom funded the construction of the winning entry and for the next 3-5 years will use it as a regional sales office for all Landcom estates in the Hunter area. At the same time it will serve to educate the public on energy efficiency. People will be encouraged to take away ideas from this house and incorporate them in their own homes. At the end of this time it is to be sold off.

THE BRIEF

The brief for the competition asked for the house to be affordable, energy efficient and environmentally friendly, and for it to appeal to the mainstream market. It did not ask for an architectural masterpiece or for cutting edge design.

The brief also asked for a three bedroom home with two living areas, ensuite to main bedroom, and a double garage – a fairly standard project home, with a project home budget of $110,000. It was to be on a corner site at Landcom's Melaleuca Estate at Metford.

DESIGNING THE ENERGY EFFICIENT HOUSE

Orientation was the most important factor for the design of the house. Correct orientation allows most of the energy saving processes to follow.

The simple principle of keeping the living areas to the north and the bedrooms and bathrooms to the south allows for the house to take advantage of passive solar design to help keep the house temperature range to a minimum in winter and summer. The challenge was to maintain good street appeal while not compromising energy efficiency too much.

[See: Orientation]

Heating and cooling

The objective was to design a house with minimal need for artificial heating and cooling.

The large windows to the north allow the winter sun to penetrate deeply in to the living spaces, heating the concrete slab. The heat is then stored in the thermal mass of the concrete slab and released during the evening, keeping the house naturally warm. A waffle pod slab was used. It is a very common construction in the project home industry, is affordable, and the polystyrene content (available in a CFC free form) gives good insulation for the slab in winter. [See: Thermal Mass]

Wider than normal eaves help protect the inside from the hotter summer sun by stopping the sun from falling on the slab. Again the thermal mass of the slab is used, this time to keep the house cool. [See: Shading]

Gas bayonets are installed in each of the living areas to boost the temperature of the house in very cold conditions. Gas was chosen because it is usually cleaner than electricity and can quickly heat the reasonably large living areas.

Concertina aluminium foil insulation is used in the walls and ceiling. Aluminium foil insulation does not absorb heat or moisture, and it stops radiant heat with its high reflectivity and low emissivity. It is easy to install, as well as non-toxic and non-allergenic. R1.5 fibreglass batts were used under the foil ceiling batts to assist in the retention of winter heat. [See: Insulation Overview]

Cross ventilation is created by windows located at opposite sides of the house. This allows the house to be cooled very quickly.

Louvre windows were used as they allow 100% openable area, unlike conventional windows. They are divided into panels allowing different parts of the window to be opened separately.

Ceiling fans can be a cheap way to keep a home cool in summer and here they have been incorporated into the living areas and bedrooms. In the bedrooms, the fans were selected for quiet operation and a low air speed on the minimum setting. The fans for the living areas were selected for their ability to move large volumes of air and ventilate a large area. [See: Heating and Cooling]

Roof ventilation is achieved with louvre panels instead of fibre cement sheets in the gables. The system works well but could be improved by incorporating a whirly bird towards the rear of the house where there is no gable section.

Internal zones can be separated from each other to help keep draughts out and heat in. The zoning has been achieved within the house which remains a substantially open plan.

An air lock is used at the front entry. This prevents the main part of the house being exposed to cold draughts, and keeps the heat of the house in when the front door is opened.

Draft protection alone can result in savings of up to 25% on winter heating costs.

Lighting and appliances

The architects wanted to maximise the use of natural light in the house. As well as enhancing the internal environment, this reduced the need for artificial lighting and money is saved on energy bills.

The living areas are oriented to the north with large windows allowing maximum penetration of natural light into the spaces on the south side of the house.

Morning and afternoon sun comes through smaller windows around the east and west corners of the house. Enough additional light comes through these windows to extend the time adequate natural light enters the living area.

Skylights allow additional natural light to filter into the house. Panels of louvres on the northern roof gable have been replaced by polycarbonate sheeting allowing light into the roof space, which then filters down through diffusers in the ceilings of the bathroom, toilet, and kitchen. The architect admits that this is an experiment which doesn't work as well as hoped. The principal is good, but the reality is that the amount of additional light reaching the living spaces is not always adequate.

Efficient compact fluorescent light globes have been fitted where possible.

A passive solar thermosiphon hot water system has been mounted on the roof providing free hot water for most of the year. The system operates on the natural recirculating process of thermosiphoning (hot water rising, cold water falling), and therefore does not require a support pump, condenser or compressor. [See: Solar Hot Water]

The solar hot water system is expected to provide up to 80% of a family's hot water needs. The system will thus generate a reduction in greenhouse gas emissions of around 2.0 tonnes each year. It has a payback period of less than 5 years and so makes good economic sense and is good for the environment.

Water recycling

Rainwater is free, and in most parts of Australia, very pure. The architects decided to build a house which collected a lot of its own rainwater and used water efficiently. The house would be connected to mains water to provide backup in times of drought.

Three water tanks are installed to collect all rainwater caught on the roof.

Two above ground corrugated steel tanks sit on concrete pads on the northern side of the house. One near the covered outdoor area provides water for the gardens and lawns. One on the western side of the garage provides water for a permaculture garden and for washing cars. A large 22 500 litre concrete underground tank is situated on the south side of the house and provides water for internal use in showers, the bath, vanities, to flush toilets, and wash clothes. It is also connected to the hot water system.

Mains water is connected as a backup. A diverter valve is installed so that as the tank gets close to empty the house can be converted to mains pressure. Backflow devices ensure that no mains water contaminates the tank. As soon as the tank is full again, a simple flick of the switch connects the house back to rain water.

A clean water supply is ensured by a three part process.

1. A special gutter system eliminates up to 94% of all pollutants from the rainwater. This is a concealed gutter system where the water flows inside the gutter.
2. Aspecial diverter valve directs the first flush of contaminated water away from the tank directing only clean water to the tank.
3. The diverter valve's stainless steel filters then screen the water to less than 100 microns prior to storing it in the tank.

Polyethylene pipes take the water from the diverter valve to the tank.

A standard electric pump is used to supply the house from the tank.

A water saving shower head is not used. At the time the house was designed, the architect was not aware of one that produced anything much better than a fine mist. However, technology is improving so a more efficient shower head may be considered for future projects.

The rainwater collection is expected to save at least 90% of water usage costs, assuming a 'user pays' system.

The gutter system also acts as an effective leaf guard reducing gutter maintenance, bushfire risk and corrosion.

Large savings in the cost of stormwater drain systems would be made if all homes collected their rainwater. Stormwater pipes would then only need to take the water that is collected from the roadways, and so could be a lot smaller. [See: Rainwater]

Waste recycling

The architects wanted to make it easy for the home's residents to recycle their waste.

A specially designed bin system has been incorporated into the kitchen cupboards near the sink to allow for easy 'at source' separation and storage of recyclable articles and compostable waste.

A compost bin is located in the permaculture garden.

A storage room is located next to the laundry. A ventilated storage shelving system allows for easy sorting and storage of items like glass, paper, cardboard, wrapping paper, bottles and jars, tins, old clothes, etc. Wire storage baskets are useful for organising washing into darks, whites, towels etc. This makes it easy to see when it is necessary to do a full load of washing, saving on water and energy.

Roof storage is easily accessible, and sheets of plywood laid in the roof space mean the space is ready to use.

As long as storage space is used wisely, it can encourage the reuse of old possessions and help to reduce waste. It is important that the storage spaces are easily accessible and make efficient use of available volume.

CONSTRUCTION PROCESS

The house was designed for the project home market, and was constructed by Jones' Homes. The affordability of project homes comes from the use of standard techniques and materials. This allows the contractors to work with little supervision or guidance, straight from the plan. There is usually a foreman who has to split his time between a large number of houses being built at the same time, and the architect has almost no input after the plans have been delivered.

The drawback of this approach is that even small changes to construction methods can be expensive.

Only basic documentation was produced for the house - plans, elevations, sections, wet area details and electrical plans. No construction details were produced.

Building a project home is not like building a standard home where if something is built incorrectly the builder has to change it at their expense. Generally the architect is not involved. The design has to be easy for the subcontractors to build. This means simple construction detailing, fairly standard materials and educating the builder about any changes to the standard method.

AWARDS

The house has won eight awards to date, including:

Special Commendation for Energy Efficiency in the 2000 NSW Urban Design Institute Awards (prior to it even being completed).

The Bill Hudson Award for Small Scale Residential Development in the 2001 Lower Hunter Civic Design Awards.

Best Project Home Under $150,000 in the 2001 Hunter Region MBA Excellence in Building Awards, and the Judges Award for Energy Efficiency.

The Energy Efficient Housing Award in the 2001 Housing Industry Association, Hunter and Central Coast Housing Awards, going on to win Energy Efficient Home of the Year in the 2001 NSW Housing Industry Association Awards.

The National Environment and Energy Efficiency Award for projects under $500.000 at the 2001 National MBA Awards in Canberra, as well as a Commendation in the Open Category.

PERFORMANCE

It has been estimated that the Landcom energy efficient home can achieve:

> a 40% reduction in the annual energy consumption of an average family;

> a resultant annual saving of 32% on energy bills;

> a reduction in greenhouse emissions of more than 2.5 tonnes per year.

The house achieved a five star rating with the SEDA scorecard.

A NatHERS assessment of the house rated it at 4.5, or 5 stars with the inclusion of pelmets and drapes. These were not installed because the house was being used as an office and display home.

CONCLUSION

At this stage Jones' Homes are yet to adopt the design of the home and sell it to clients. Despite the home winning several awards Jones' Homes seem to feel that the public won't be interested in this house.

The architect is currently in discussions with other various project home companies and builders to produce the home.

Overall, the Landcom home is a very successful example of an energy efficient house which has been built using the materials and working methods of a project home. It looks and costs about the same as a standard project home, but is cheaper to run and more pleasant to live in. Like all energy efficient, environmentally aware homes it benefits many by having a lower environmental impact than a standard home.