Bundanoon Low Energy Cottage Constructed Nov 2012 – May 2013 @ 30 Hill St Bundanoon N.SW. Southern Highlands Climate Zone 6

Owner - Designer : Glenn Robinson
Design Advice : Jim Anderson, Patrick Fitzgerald, Craig Perrot and Katherine Frome
Carpenters: Jim Anderson & Bill Zaraftis Plumber: Sam Nott
Electrician: Kay Rectinwald Concreter: Chris Crebbs

. This quote reflects the thinking behind this house

"The scale of our homes should be derived from the real needs of our daily lives,
Not from vanity, insecurity or a need for public display.
Home should be the setting for life not the measure of it"

James Gauer

Have had an interesting journey researching and building this house, have learnt heaps from weighing up the myriad of housing options. The most amazing thing learned was that how you build your house is of minor importance, the big factor in energy use is where it is built. In our village of Bundanoon residents often travel to Bowral 27k's away , in an average petrol car this uses 43kWh of power for 1 return trip. This is more than 4 times the energy our new house uses daily, so having your housing closer to where you work and play has a far greater effect on energy use than any building design you can come up with.

Discovered that is neither expensive nor complicated to make a house that way outperforms the current 6 star building standard

Things that cost little or no more that add up to make a difference

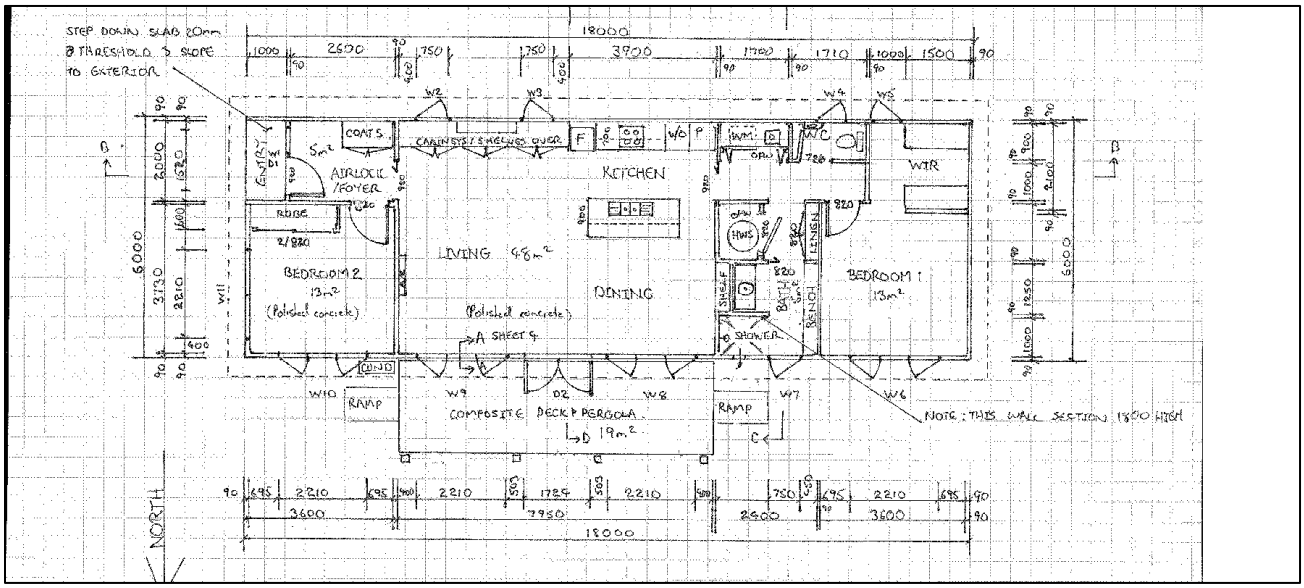
- Get involved in the design and construction process. Did not find any off the shelf designs that perform as well as our simple house without going to very expensive options. Our place cost $1600m2 , similar performance and level of finish from prefabs or specialized builders costs over $3000m2
- Use simple ,standard, readily available quickly errected materials assembled in a thoughtful way
- Make your house a small as is practical
- Locate storage against the south wall to act as extra insulation
- Select a site with full day solar access
- Build a simple rectangle on an east west axis
- Put most of your glazing north
- Have no west glazing
- Face your entrance away from prevailing wind
- Build on a slab and have no fixed floor coverings
- Avoid exterior sliding windows and doors
- Don't use downlights
- Seal the house well, just a mater of being careful how you put it together.
- Use pale exterior colours
- Arrange eaves to shade glazing in summer
- Use zoned building design, cluster living areas to heated zone and enable thermal isolation from sleeping and entry zones
- Keep to one level, hard to create even temperatures otherwise.
- Get winter sun into every habitable room
- Keep ceilings as low as is legally allowed
- Design in 600mm modules to minimize waste

Things that are cost neutral or cost positive over time

- Insulate to suit climate zone. Allows you to buy smaller heating equipment and use it less often .
- Use high quality windows. We could have used single glazed aluminium sliders for $8K but chose to pay $23K for good quality units to save energy, improve comfort and improve future resale value. Canberra now has energy ratings on house sale contracts and it will come to NSW and impact on property values.
- Use LED lighting, lasts for yonks and uses barely any power
- Use efficient appliances , slight increase in purchase cost can yield major saving in operating costs
- Use solar powered water heating and electricity generation

Goal

To minimize dependence on energy from unsustainable sources and create a comfortable, affordable home suitable for occupancy through all stages of life.
(see www.beyondzeroemmissions) .
The cottage is a single story detached dwelling of 108M2 with 2 bedrooms and 1 bathroom with separate toilet. There is an adjacent carport/ store room of 60m2. Structures have been arranged to allow future addition of a 60m2 granny flat on the 900m2 property.



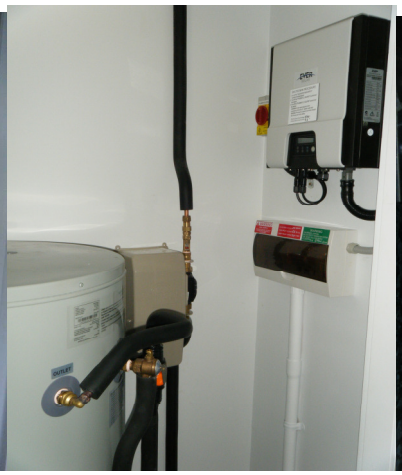
Building Envelope

- 25deg. Pitched gable roof. R3.5 poly batts on ceiling R1.5 anticon blanket under metal roofing. Trussed gable roof structure selected as the optimum roof as it uses minimal resources (no heavy beams), provides a dead air space to aid insulation, provides a service access for the length of the building, gives a north slope to mount solar collectors, gives a south slope to protect collectors from cold winds, does not suffer the moisture problems that are common in skillion roofs and allows easy longer term maintenance of the ceiling insulation. 25 deg pitch used as it gives the highest annual output from the photovoltaic array, needs no raised brackets for the array, drains well but is not to steep to safely walk around on. The colour is Colourbond “Shale Grey” which is the lightest colour we were permitted to use in seeking maximum heat reflection.

- 90mm stud walling with studs at 600mm centers. Tried to minimize the number of studs as at each stud location the insulation level drops to R0.5. Investigated using the American advanced stud walling technique to further reduce the number of studs but framing companies are unfamiliar with the system and it would have added 60% to the frame price. R2 poly batts used with reflective breathable sarking and Hardiplank weatherboards. Looked at many walling systems and none could compare when comparing speed, cost and durability. Timber weatherboards require preservative and paint applied to every cut (time consuming) and they are expensive plus they burn. Mudbrick is slow, hard work and poor insulation, ditto stone. Straw bale is labour intensive , thick walls limit light penetration so you need bigger windows, can't see the need for R8 walls as most heat loss is through the roof and windows and you are using a huge amount of extra floor and roof materials just to house the overly thick walls. Brick veneer needs extra footings to hold up the brick walls that really only serve the same purpose of a cheap coat of paint. Reverse brick veneer was considered but the energy involved in adding vertical thermal mass could not be justified for the small increase in thermal stability. Looked at structural insulated panels but planning the services got very complicated and the panels would be hard to match if future modification of the building was required. The fibrous cement boards we used are only $13.60 per 4.2metre length, are easy to cut with a hand guillotine and don't' rot or burn. Working with an experienced carpenter they go up really fast.
- Windows and doors are Stegbar Siteline . Auralast non toxic treated pine frames with an exterior colourbond coated aluminium skin. Opening windows are double gasketed. Glazing is 2 layers of 4mm glass with a 12mm argon charged gap. Low E coating is applied the exterior face of the inside pane. Specs are U < 2.5 SHGC > 0.5**.** All windows are casement , no sliding or double double hung units used as they do not seal well enough as they age. North window area kept under 20% of floor area to avoid winter overheating. Small openable windows to the south for cross ventilation, no west windows and a small amount of fixed glazing to the east .
- Concrete slab is a conventional raft structure 100mm thick. No floor coverings are fitted to couple the internal air with the thermal mass of the slab. As the floor is exposed 32MPa concrete was used for hardness and reinforcing mesh bars at 100mm ctrs was used to minimize cosmetic cracking. 50mm of foam insulation is fitted to the slab edge and protected with 4.5mm fibro. This gives an R2 slab. Under slab insulation was investigated but deemed unnecessary in our climate zone provided the under slab area stays dry and can temperature stabilize.

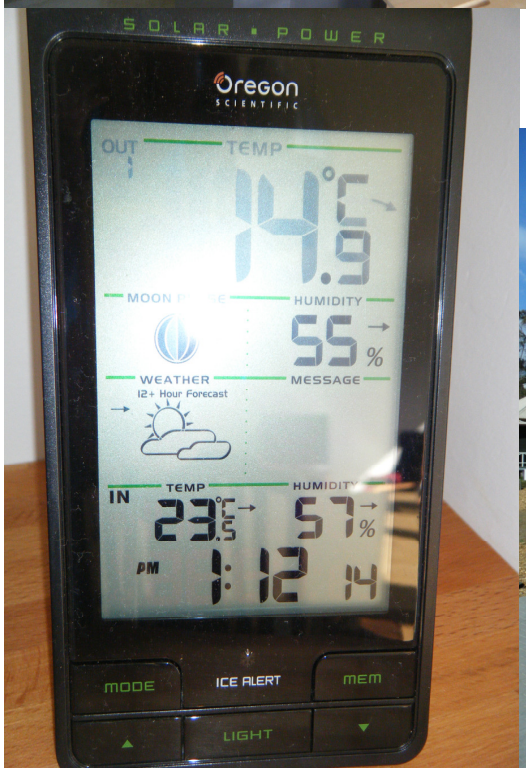
Passive Solar Heating / Cooling

- Building elongated east west
- Large north facing windows harvest solar energy
- Slab absorbs daytime heat and releases it to the building at night
- Eave overhang shades windows in summer
- Trees with early leaf drop planted to the north for summer shade
- Summer shade structure planned for north patio
- Double layer of bulky curtains, building design allows them pulled clear of the windows during the day.
- Ceiling kept to minimum legal height to retain warm air at the occupant's level.
- Opening windows positioned for summer cross ventilation.
- Pale roof colour and no west windows to reduce summer heat ingress.
- Airlock foyer to retain heat . entry sheltered and facing east to protect from cold winds



Systems

- All lighting is LED and no downlights are used to avoid interruptions to ceiling insulation
- Manhole is insulated and heavily gasketted
- Maintenance walkway extends for the length of the roof space. Truss bracing was specially designed to accommodate this.
- All exhaust systems are shuttered so building is sealed when fans are off
- Hot water is an Apricus 22 tube evacuated glass collector plumbed to a foam insulated 250l tank located centrally between kitchen, bathroom and laundry. Avoided roof mounted tank as the greatest losses are between the tank and the outlets so it pays to get the tank indoors and as close as you can to where the hot water is used. Tank has a mid level electric boost element so on the odd occasion boosting is needed we are only heating the top bit of the storage.
- Space heating is with a Daikin reverse cycle air conditioner. Amazing bit of gear, has a coefficient of performance of 5. i.e.800 watts of electrical energy in = 4000 watts of heat out. This is our first winter in the house and we have been amazed at how infrequently we put the heater on. If the day is not overcast we need no heating even when it hits zero deg outside. We located the condenser to capture the first morning sun rays and avoid freezing but as yet have not run it in the morning. Used heating allowance of 60watts per square meter but even this meager amount proved high.
- Cooking is with an induction cooktop, great bit of gear 40% less energy than a standard cooktop. No fumes like a gas cooker and really fast. For oven cooking we mostly use a microwave with a fan forced oven as a second stage of roasting.
- Laundry and toilet flushing is from a 10,000l rainwater storage. Avoided the use of an automatic rainswitch (to switch to town water when tanks are empty) as they don't seem that reliable and we wanted to keep the house a simple as possible. We have installed a mains water filler to use should the tanks run low.
- Washing machine is a water and energy efficient LG front loader
- Kitchen is located centrally for best access. Dishwasher is an efficient ASKO model. We mostly hand wash unless entertaining.
- All taps, shower and toilet are 4 star efficiency
- 2kW grid tied photovoltaic array has just been installed
- BBQ is electric
- Storage built along south wall to add to insulation on cold face of building
- South side sunk 800mm into ground to reduce wind exposure and give a level entry at north side
- Sheltering hedge to south of building.
- Low VOC paints used with the exception of the floor as the low VOC product we first used proved not to be durable


SOLAR POWER
Oregon
SCIENTIFIC
OUT
TEMP
14.6 14.9
HUMIDITY
55 %
WEATHER
12+ Hour Forecast
MESSAGE
IN
TEMP
HUMIDITY
23.5
57 %
PM
1:12
MODE
ICE ALERT
MEM
LIGHT