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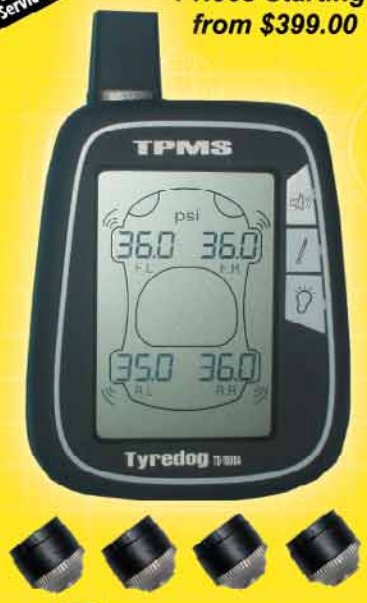

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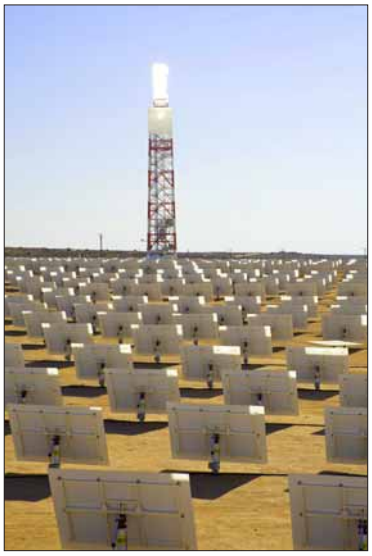
features



Find out about large scale solar on page 66, and see our household solar panel buyers guide on page 56.

Two summer projects: a wheelie bin rainwater system on page 40, and a simple solar dryer on page 42.

Beautiful mud brick walls: on show page 52.

regulars

Staff can't get it right when recycling? The Eco Bin system should make it easy. Products, page 82.

From the Editor

About ReNew

ReNew has been published by the Alternative Technology Association, a non-profit organisation that promotes energy saving and conservation to households, since 1980. *ReNew* features renewable technologies such as wind power, solar power and alternative modes of transport. *ReNew* includes practical examples of water conservation or reuse, recycling materials or ways to achieve energy efficiency at home. *ReNew* provides practical information for people who already use sustainable processes and demonstrates real-life applications for those who would like to.

ReNew is available from newsagencies, by subscription and as part of ATA membership. ATA membership costs $65 per year and offers a range of other benefits.

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Next advertising deadlines: Booking 22 January 2010. Advertising copy 29 January 2010. Next editorial copy deadline: 22 January 2010.

Keeping it simple and sustainable

When planning this issue we wanted to focus on what makes a home comfortable and liveable in summer. To do this it was necessary to look at the flip side and what makes a house intolerable. Leading the discussion was dark-coloured roofs.

Temperatures inside the roof cavity can reach 60°C in summer, even higher if the roof is black. Research from California's Lawrence Berkeley National Laboratory shows that replacing conventional roofs with cool roofs, such as heat reflective materials or simply painting them white, could reduce average air conditioning use by 20% to 30%. This is a simple action that's great for the environment in terms of greenhouse gas emissions and helps reduce the heat bank that builds up in cities.

It seem that house design and choices are often based on trends, hence the plague of dark roofs we see around us. Some councils have regulations on how light a roof colour can be, most likely to maintain the long-standing neighbourhood character of largely dark roofs. Taking a broader view on Australian housing it's the bad trends or sometimes cost-cutting measures that result in air conditioned hot-box housing. A black roof in the Australian sun? Avoid the upfront cost of eaves on a sun-drenched house? The householder pays for this in future electricity bills.

As is often the case, it's the really simple knowledge gathered over centuries that keeps a house cool. Those classic white houses in countries around the Mediterranean are merely coated in paint. The earth tubes houses we've profiled in this issue sound a bit space age, but their main function is simply to enable air flow to bring down the base temperature and reliance on artificial cooling, as they've done in the Middle East for centuries. Brian Woodward's mud brick home in the centre pages has a straightforward cooling system; good passive solar design and cross ventilation.

I guess the main message is to learn from the past and maintain good habits for functional, sustainable buildings.

Looking ahead

At the time of going to print a watered-down version of the Carbon Pollution Reduction Scheme was being debated by our federal parliamentarians and world leaders were preparing for the Copenhagen Climate Change Summit. We hope your summer is 'all white' and we look forward to some action on climate change next year.

Jacinta Cleary

Cover photo: Richard Taylor, Historic Houses Trust NSW

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Terms and Conditions

(1) The competition is open to anyone in Australia who subscribes to *ReNew or Sanctuary* or joins the Alternative Technology Association (ATA) during the competition period, including existing subscribers and ATA members who renew their subscription or membership during the competition period.

(2) The prize is not redeemable for cash. Price includes GST.

(3) Paid ATA staff, members of the ATA board and members of their immediate families are ineligible to enter.

(4) The competition runs from 22 August 2009 to 5pm on 15 March 2010, and subscriptions/memberships must be paid by this time and date.

(5) The competition will be drawn at 10.30am on 19 March 2010 at the Alternative Technology Association, Level 1, 39 Little Collins St, Melbourne VIC 3000. Two separate winners will be drawn, one for each Dux Airoheat.

(6) Both winners will be contacted by phone and notified in writing. Both winners will have their name announced in ReNew 111 and Sanctuary 11, released in March and May 2010 respectively.

(7) The competition is open to individuals only. Corporate entities, collectives and organisations are ineligible.

(8) To enter, subscribe or join the ATA using the subscription form in ReNew issue 109 or 110 (or a copy of it), or the form in Sanctuary 9 or 10, visit our websites (www.ata.org.au and www.sanctuarymagazine.org.au), or call the ATA on (03) 9639 1500.

(9) The competition is only open to Australian entries and includes delivery and installation within 200 kilometres of Australian capital cities. Dux Hot Water will cover standard installation costs up to the value of $650. Any additional costs will be covered by the winner. These include, but are not limited to, tank relocation and additional pipe work costs. Dux reserves the right to select the installer, but may also pass this responsibility back to the winner should no clear choice be available.

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(12) Each prize includes the supply and installation of a Dux Airoheat heat pump valued at $4500.

(13) The winner agrees to assign any REC's (Renewable Energy Certificates) generated on this system to Dux Hot Water.

The *ReNew*/Dux Australia subscriber competition is proudly sponsored by Dux Australia, ph:1300 365 115, www.dux.com.au

350 photos—thank you!

LAST ISSUE we asked you to send us photos of you living sustainably for the 350.org International Day of Climate Action on October 24. The idea was to promote a safe target of 350 parts per million of CO_2 concentration in the atmosphere, alongside community groups and individuals around the world.

The photos have been posted on an online gallery at www.ata.org.au so that you can see the full results.

Thanks to everyone who sent in their photos, including Aussie Kanck, pictured above, with his solar hot water system, photovoltaics, skylights and passive solar house design. His house will be featured in an upcoming issue of *ReNew*.

Hundreds of ATA's members contributed photos to the gallery, joining the call for the world's political leaders to create an equitable global climate treaty at the United Nations Climate Change meeting in Copenhagen.

"There are photos of people on their roofs with solar systems, a plethora of energy-efficient house designs and many have invented new approaches to water use and conservation. This is an exhibition of people who are leading the way in achieving sustainability in their communities," says ATA CEO Ian Porter. ✻

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Up front

Energy efficient stars

Energy efficiency standards are improving, with televisions, air conditioners, fridges, freezers, hot water systems, CFLs and even swimming pool pumps set for new labels or standards in the coming months.

Some changes have already come into effect, with Minimum Energy Performance Standards (MEPS) for all televisions sold in Australia since October, meaning that all televisions will now carry an approved energy label or 'star rating'.

The energy rating scale for fridges, freezers and air conditioners has also been increased from six stars to 10 stars. *ReNew* columnist Alan Pears notes that the best air conditioner on the market is 13.2 stars, hence the urgent need for an expanded rating system. Air conditioners will need to carry the new 10 star labels from early next year.

The phase out of incandescent globes began in October, and minimum standards for CFLs have been improved.

Energy guzzling swimming pools are on the agenda, with energy labels for swimming pool pumps available from 2011.

Electronic recycling

While on the topic of electrical appliances, there's good news regarding their recycling.

Householders will be able to drop off computers and televisions at local collection points for recycling free of charge thanks to a new National Waste Policy agreed on by Australia's environment ministers.

"Under the new product stewardship scheme, 80% of all TVs and computers are expected to be recycled by 2021," said Federal Minister for the Environment Peter Garrett.

The program is likely to commence in 2011 and is timely, with many televisions otherwise destined for the rubbish heap with the switch to digital television in the next couple of years.

The ministers also agreed to the development of an industry led scheme for the recycling of used tyres. In 2007/08 only 13% of tyres were recycled.

New feed-in tariff for NSW

More news on the feed-in tariffs front with the New South Wales government announcing a progressive gross feed-in tariff in November. Householders will be paid 60 cents per kilowatt-hour for all electricity generated on wind and solar systems up to 10kW capacity. Net feed-in tariffs, where households are paid only for electricity sent back to the grid, are more common in other states.

The NSW government's shift away from previous plans for a net feed-in tariff is a clear signal the Rees government is committed to building a green collar workforce in NSW, says Damien Moyse, ATA's Energy Policy Manager.

Moyse says NSW and the ACT have shown real leadership in the move to a low carbon economy. The ACT is the only other part of Australia with a gross feed-in tariff, paying 50 cents per kilowatt-hour.

"This feed-in tariff recognises that solar households, irrespective of whether the electricity they generate is being used

in their own home or powering their neighbour's air conditioner, can make a significant contribution to reducing the nation's greenhouse gas emissions."

The scheme will run for seven years and comes into effect from the start of 2010.

Insulation changes

The federal insulation rebate released as part of the economic stimulus package has been reduced from $1600 to $1200. Meanwhile, the insulation rebate for rental properties has increased from $1000 to $1200, bringing it in line with the rebate for householders. Regulations to tighten up insulation standards include a list of de-registered installers and appropriate covers over downlights and ceiling appliances.

One savvy *ReNew* reader has recommended three easy steps for rental households to get insulation installed. Step one is to download the guidelines from the federal government website www.environment.gov.au/energyefficiency/insulation/homeowners/guidelines.html. Write a cover letter to your landlord, and then prepare three copies of the agreement (one for you, one for your landlord and one for the government). For sample letters and full instructions go to www.ata.org.au. Easy!

Capital cities to cut emissions

Let's face it, a lot of us live in cities, 50% of the world's population in fact, so it make sense for cities to develop their own strategies for cutting greenhouse gas emissions.

Members of the Council of Capital City Lord Mayors (CCCLM) recently committed to a range of initiatives to help reduce greenhouse gas emissions. Cities were responsible for 125 megatonnes of carbon dioxide emissions in 2006; it is estimated this can be reduced by 57 megatonnes a year by 2020 with the strong action.

Some of the actions the cities will focus on include a 40% reduction in lighting electricity consumption by 2015, diversion of 50% of waste from landfill to produce methane for electricity generation and improvements to public transport and cycling infrastructure.

State-by-state strategies include electricity generated from waste at the Shoal Bay Waste Disposal site for 1000 Darwin homes, classes for Perth residents to encourage sustainable lifestyles and a carbon neutral action plan for Adelaide City Council.

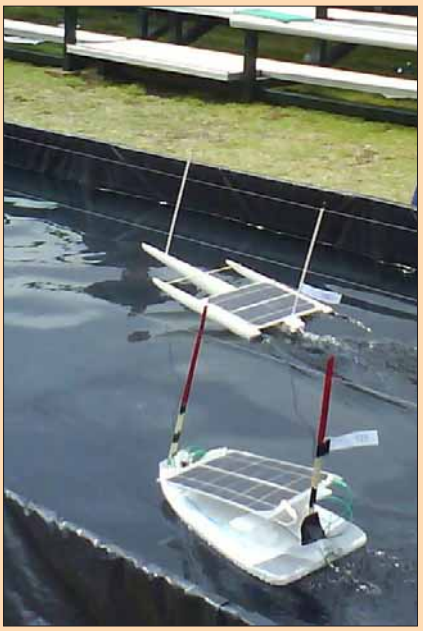
The City of Sydney also recently announced plans to move away from coal-based electricity generation as part of the Sydney 2030 plan. The commitment includes 70% of the electricity supply by 2030 to come from trigeneration—converting natural and waste gas into electricity, heating and cooling. The plan is for 25-30% of energy comes from renewable energy by 2020, with the whole gamut of renewables being mentioned as possible sources (solar, wind, marine, geothermal and GreenPower.)

From little things

For school students learning about renewable energy, the simple act of running a kit car off solar electricity can teach them a lot. This is where the annual model solar car championships fit in, with the recent championships their 20th anniversary.

ReNew columnist Alan Pears was present with the model solar vehicle that kicked it all off, a vehicle he built in the late eighties and believed to be the first model solar car made in the world. Most model cars entered in the 2009 competition appeared to be more aerodynamic than Alan's early model, but it was a good catalyst for a competition that has grown over the years. In the model car category, best engineered car went to Box Hill High School.

The solar kit car and solar boat championships were held in overcast conditions. Most solar boats were made out of lightweight recycled polystyrene, with some heavier looking timber models. The championships will be held again next October.



Students' solar boats racing in the championships held at Scienceworks, Melbourne.

High seas

A new report shows up to 247,600 existing residential buildings could be at risk from sea inundation by the year 2100, if sea levels rise 1.1m as predicted.

The *Climate Change Risks to Australia's Coast* report, released by the Department of Climate Change, details the risks to coastal infrastructure, services and industry in Australia as a result of climate change.

"The science tells us our climate is changing faster than first projected and the impacts are likely to be more severe as sea-level rises and extreme storms and floods become more frequent," Senator Wong said.

Climate Change Minister Penny Wong also announced the creation of a seven-member Coasts and Climate Change Council which will advise the government in the leadup to the Coastal Climate Change Forum in early 2010. The council will be chaired by Professor Tim Flannery.

Up front

An economic focus

A recent report *Shaping Climate Resistant Development* by the Economics of Climate Adaptation Working Group found that by 2030 climate risks could cost nations 19% of GDP, with developing nations most vulnerable. The report also states that cost-effective measures exist that can prevent 40-68% of expected economic losses.

And CO_2 emissions rose 2% in 2008 despite the Global Financial Crisis, according to the Global Carbon Project. According to their latest report, the higher rate of emissions was largely from higher use of coal.

Thanks...

A big thank you to Energy Matters for donating ten 5W solar panels for display at the ATA presented Green Loans talks, which are scheduled to start in January. For full details check www.ata.org.au in late 2009.

Online subscriptions

Last issue *ReNew* launched online subscriptions, with quite a few of you deciding to make the switch to a paperless copy for environmental reasons.

To subscribe electronically go to shop.ata.org.au and select the electronic subscription option or call the ATA office on (03) 9639 1500. Upon the release of each issue of *ReNew*, we will send you an email with a direct download link to a PDF. Subscriptions, both electronic and printed, cost $30 for four issues. Current ATA members or subscribers are welcome to make the switch to e-subscriptions by calling the ATA office.

Shooting for 9 Stars

Houses that exceed the 5 Star energy rating can be hard to come by, as are homes that reach 7 or 8 Stars. Who would have thought that Victoria's old Waverley Park football ground would be home to Australia's first 9 Star display home.

Admittedly the home by Mirvac is in a display village and the house is a prototype so not available for the public to buy just yet, but it's a sign that some developers are taking sustainable housing seriously.

The home features a 3.6kW photovoltaic system, 20,000 litre rainwater tank and greywater system as well as some recycled materials including timber from the old football stadium. The developers used reverse brick veneer construction, with bricks on the inside and timber on the outside to maintain even indoor temperatures, along with lots of double glazing and high levels of insulation in the walls.

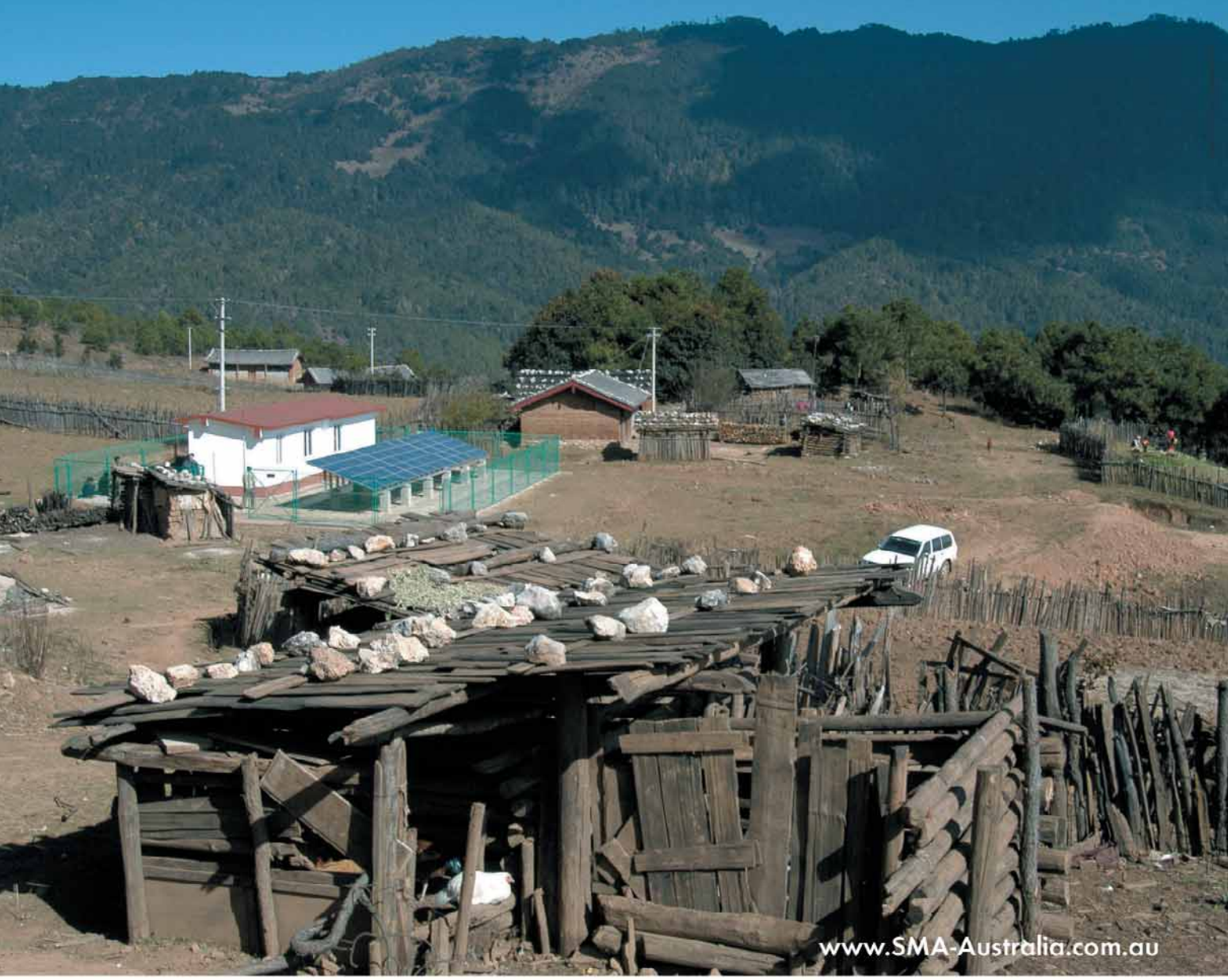
9 Stars, in display mode only.

Good work IPG

The multi-skilled and incredibly useful ATA International Projects Group has been shortlisted for the Victorian Premiers Community Volunteering Awards in the Community Volunteering Achievement Category. Other nominees include AMES Volunteer Program, Ardoch Youth Foundation, Inclusion Melbourne and TADVIC Cooperative.

Over the past six years hard-working and highly-skilled volunteers have travelled to East Timor to install photovoltaic panels on community buildings or clean lighting systems for entire villages.

The winners will probably be announced by the time you read this (winners announced early December, see ATA website www.ata.org.au for details). However, whatever the outcome, it's great that the group's work has been acknowedged, with 17 people volunteering in East Timor this year and many others working behind the scenes in Australia.



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The Future of Solar Technology

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Letters

SHW system wasting energy?

People are encouraged to install solar a hot water system to reduce energy consumption and save money, but from my experience there is a situation whereby your system could be costing you money without you knowing it.

Typically in a solar hot water system with a ground mounted storage tank, the water heated in the collectors during the day is returned to the tank using a small pump. At night, when the collectors cool, a non-return valve prevents the hot water in the tank rising to the collectors, something it would naturally do.

My Dux system was installed in December 2003 using a 170°C rated non-return valve. In July 2006, I became aware that the recirculating pump was operating after dark. I took comprehensive observations of the collector and tank temperatures as shown on the controller and soon realised that hot water was rising to the collector. Dux were very good to me and even sent a senior man across from NSW to try to figure out what was going on. They reconfigured the pipe work but still the problem persisted. Finally it was concluded that the non-return valve had failed and it was replaced with a similar unit in September 2006.

The same thing happened in September 2007, my system was sending hot water to the collector and the non-return valve had to be replaced.

Now for a third time, in August 2009, the non-return valve has had to be replaced. Each time it has been with the same brand of unit. The faulty valve shows no sign of salt build-up or any other foreign matter coming from the water.

It is bad enough for the solar heated water to be returned to the collector for cooling during the night, but when the power boosted water is used to heat the night sky, then you are really wasting money. Typically, if the water in the tank has not heated enough during the day, then the booster will come on during the off peak time in the middle of the night. If the non-return valve has failed then this hot water will rise to the collector, the collector sensor says it is hot and the pump will run for a short while to bring water back to the tank, then the cycle starts all over again, running like this all night, dissipating heat out through the collectors, forcing the booster to input more energy in to the system than is really necessary.

In the morning you will still have hot water, but unless you have heard the pump running, you will not be aware that your solar system has been a traitor to the energy saving cause!

The easiest way of testing your unit is to see if the pump runs at all once the sun goes down. The only time this should happen is if it is so cold that hot water is pumped to the collectors to stop them freezing. Otherwise on a warmer night, especially early in the evening, the pump should not run. If it does, then your non-return valve may be faulty. If you want further confirmation of the situation then you can observe the temperatures of the collector and the tank as displayed on the control panel. If the collector temperature rises after dark, then it is likely that you have a faulty valve.

Ralph D Byles

Write to us!

We welcome letters on any subject, whether it be something you have read in *ReNew*, a problem you have experienced, or a great idea you have had. Please limit letters to 350 words. Due to space restrictions we can't guarantee to publish all letters received.
Send letters to: *ReNew*, Level 1, 39 Little Collins St, Melbourne VIC 3000, Australia,
email: renew@ata.org.au

Gross feed-in tariffs flawed

While I'm not a member of ATA, I do support responsible efforts to maintain our environment and reduce waste.

I write, however, to express my disappointment with the misguided calls for a gross feed-in tariff scheme. Such a scheme would encourage waste of electricity, allows rorts and comes at the expense of the solar panel bonus scheme because funds would be diverted to the feed-in tariff.

Surely the aim of such bonus schemes is to maximise the amount of solar power generation. If so, it makes more sense to make installation affordable to the highest number of households rather than give kickbacks to a much smaller number of well heeled householders seeking to advertise their green credentials. This is where the federal government's revised solar panel bonus scheme is so disappointing in that it provides nebulous rebates based on RECs and requires householders to put in much larger contributions to installation, taking these out of the reach of pensioners with a house and little else.

Meanwhile, the developer next door to me has fitted 'street' lighting which lights up the galaxy and wastes more (subsidised) power than a dozen solar power installations can provide.

Let's get serious folks—tax the waste and maximise genuine renewable energy systems.

K Tietze
Maleny QLD

Simple solenoid solution

In response to the letter in *ReNew 109* by Ronald Watts, we too became aware of the limitations of using solenoid valves to operate garden dripper systems on tank water.

A year or two ago we set up a new system but instead of using a computer and solenoids we went for a different approach, which has turned out to be very successful. We now use a battery operated timer manufactured by Pope, which costs about $40.

This type of timer uses a servo operated ball valve which requires very lit-

tle energy to activate and as long as water flows from your tank you will get flow through the valve.

We have three set up around the garden and have been very happy with their performance. Being battery operated, they do not suffer from power outages and at the end of the irrigation season, the timers are easily packed away for the winter with batteries removed ready for a new set of AAA batteries next season.

M and C Holloway
Strathalbyn, SA

ACT feed-in tariff

I read with interest in *ReNew 108* about the different state and territory feed in tariff systems. The comment by one ACT reader about having to tell the electricity retailer that he was connected to the grid may sound surprising.

When my PV system was being installed, the work was observed from start to finish by a cadet engineer from the retail supplier and I saw the meter installer do his work, so the retailer certainly knew that I was connected. I think that it shows the reluctance of the retailer to be involved in a feed in tariff system.

To take this reluctance a step further, the ACT retailer requires that, in accordance with the contract, an individual wanting to be paid their credit for energy produced must apply in writing for the credit to be paid into the consumers bank account. This is required even though the retailer is taking monthly direct debits from the consumers bank account.

John Leane
Melba ACT

Getting paid for your solar

There's been a fair bit of comment in *ReNew* and otherwise from ATA about the Victorian feed-in tariff legislation. Specifically, that you can only use the credit to offset your costs—if you have a net credit at the end of the year, it disappears. Well, I'm with Red Energy and their terms and conditions for their new offer state that if I have a credit on the anniversary of my contract, they will pay it to me (provided that it's over $10, which is fair enough).

I don't know what other offers are out there, but this seems pretty reasonable and gets around one of the big complaints that ATA had about the new laws in Victoria.

Graham Denney
Korumburra, VIC

A number of retailers including Origin and AGL have now indicated that they will pay any outstanding credit. It's best to make sure you read the fine print when establishing any new contract to ensure that this is part of the deal.

Damien Moyse
ATA Energy Projects and Policy Manager

SHW tank elements

In his letter in *ReNew 109*, Bob Hutton decided that he had two 'problems': the location of the heating element half way down the tank and his location in Pakenham Upper in Melbourne's outer south-east.

Bob's hot water system supplier is correct in his selection of tank, both in size and type. A 27-L solar hot water system should be adequate for two people, even in chilly Melbourne. Having the element half-way up is specifically designed to reduce electricity consumption and thus carbon pollution by *not* heating the whole tank every night. Bottom element tanks are standard 'off-peak' tanks and are so designed as they only get one bite at the cherry and have no choice but to heat a whole tank of water, once a day, when the off-peak switches on late at night.

With a solar HWS, the element is a back-up and is designed to top-up the solar heating. If Bob couples an off-peak tank to his solar heating panel, while he may have a lot more hot water available, he will end up using not much less electricity than he did before installing the system in the first place, and will certainly produce more carbon pollution than he does now, even assuming the element is connected to off-peak supply.

Bob says he has a five litre per minute shower head and only takes a five minute shower each day. Even if the temperature valve is set so he uses only the hot tap, this is still only 50L/day for two. So the 135L (approx) that the element in the upper half of the tank is heating each night should be enough to last a couple of days, even with a load of washing thrown in. So perhaps Bob's system has additional issues that he needs to address.

Firstly, he doesn't mention whether his panel is aligned due north (or degrees either way), or whether it is part shaded part of the day, or whether it is on the right angle to maximise insolation. I'd investigate all three. For example, it may be useful for him to adjust the tilt of the panel higher in the winter months to maximise insolation and thus hot water production.

Assuming his tank is an 'on-ground' type with electric circulation pump, he might consider boxing it in and providing additional insulation for the tank. Even wrapping the exposed tank in an insulation blanket—and especially ensuring all piping is fully and thickly insulated—could help solve the problem by reducing radiant heat loss from the tank.

He might also consider using cold water for clothes washing, or if that's an issue, a compromise might be utilising warm water for the wash cycle only, helping reduce the hot water consumption.

Also, while this may seem counter-intuitive, turning up the thermostat on the heater may also help, for on the days when there *is* enough insolation to heat the tank fully, the hotter water will stay hotter for longer.

And, as *ReNew's* recent comparison of solar HWS concluded, an evacuated-tube solar hot water panel would probably have been a more efficacious choice, as they are significantly more

efficient in cooler climates with shorter insolation periods.

All of the above suggestions come from my experience educating the general public as a sustainability assessor, and are the result of research and experience in the field. Hope they are of assistance.

Mark Walker
Kempsey NSW

Heat pump problems

I am new to your excellent magazine and was interested to read the Q&A section. Six months ago we had a heat pump installed purely because our roof is shaded by large trees giving us a max of three hours sunlight in winter.

To cut to the chase, the heat pump has been a source of total frustration due to problems experienced. We still do not have an efficient system, with water at the hot tap nearest to the tank maxing out at less than 37°C. The complete unit has been replaced once and the most recent repair was a replacement internal pump.

I urge prospective heat pumpers to demand firm guarantees before going ahead and also speak with customers who are heap pump owners.

Our previous house had an Edwards solar hot water system and we had to have a link pipe (to the cold water) fitted as the water at the tap was close to boiling, and that was without the booster turned on.

Alan Ramsay

Pool filtration

Regarding the pool filtration letter from Lesley Hughes in *ReNew 109*, we have had a Floatron ioniser in our pool since November 2008. Like the Hughes, the pool was here when we bought the house and the pool pump accounted for a huge 24% of our total electricity use—more than refrigeration! This had to change, and we heard about this passive device that could reduce our chlorine consumption and pump run time.

The Floatron is a small solar device with a mineral electrode, manufactured in the USA, which controls the growth of algae in the pool by using a small solar panel to power the electrode that releases minerals to ionise the water. Once we installed the Floatron, we have found that we are not only using a lot less chlorine—less than half our pre Floatron consumption—but we are also able to use the pump less; we've reduced our total power consumption by 13%. We now run it for two hours in the winter and five to six hours in the summer. More information is available from the website www.floatron.com.

Nicki Walters

We have had a number of readers recently tell us about the Floatron. See the article elsewhere in this issue about one reader's experiences. Note that, due to Australian Standards that are somewhat behind current technology, the Floatron is not legal for pools in Australia. However, it is available for use in fish ponds, and what you do with it is really up to you!

Lance Turner

Solar panels and kettles

A couple of thoughts arising from letters in *ReNew 108*.

Although amorphous panels cover about twice the roof area that crystalline types require, if this area is available, isn't it an advantage to shade it with solar panels? The cost per watt is similar so you're not paying more for thin film panels, and you're getting some shade on your roof, if you want it.

Regarding the efficiency of kettles, you're right about heat loss around the sides. There's a big opportunity for efficiency increases, especially considering you can buy a six star instantaneous gas water heater. My mother used to have a European gas kettle with a skirt around the bottom to contain the flame and prevent heat escaping around the sides. Turning the flame down to reduce heat wastage just means the water temperature rises more slowly and there's more time for radiant heat to be lost from the kettle body.

The whole gas-good/electricity-bad mantra about water heating is very subjective and distorted by simplistic assumptions by governments. Does an electric instantaneous heater directly above the sink definitely generate more greenhouse gas than a gas heater three metres away from the outlet?

Also, there are also some strange assumptions about electricity transmission losses which some people think is fixed at 15%. These vary wildly according to voltage, number of transformers, air humidity, condition of insulators, load and other factors. The Electricity Commission of Victoria or NEMMCO might provide an interesting figure for reference—say the losses over 100km for a 330kV AC line in ideal conditions.

Alan Strickland
Lynton SA

A strange phenomenon

Since returning to Australia from the UK a few years ago I have been concerned about the increasing number of new homes built with black or dark grey roofs, especially in the past five to 10 years. My attempts to ascertain the reason for this from architects and builders have been less than fruitful.

In Australia, a dark roof radiates 15-20% more heat than a white one on cold days and on hot days heat absorption is arguably greater, according to a recent article in *New Scientist*.

Moreover, I often wonder if, when rain clouds approach Melbourne over the western suburbs, where black roofs are very prevalent, the radiated heat has an effect on reducing precipitation.

My letters to Tim Flannery and other climate change gurus have not been acknowledged. Maybe there is someone at ATA who is interested in this puzzling phenomenon?

(Dr) John Crowhurst
Port Melbourne VIC

It is indeed a strange phenomenon, and one we take a quick look at elsewhere in this issue.

Lance Turner

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The search for the best DIY electric bicycle

Electric bicycle enthusiasts, we want to hear from you! *ReNew* magazine invites you to enter the DIY electric bicycle competition. Entries close February 7, 2010.

Competition

We're looking for the best designed electric bicycle conversion!

Guidelines

Send a high resolution photo along with a 200 word description of your bicycle to renew@ata.org.au

The 200 word description should outline the materials used and the process for converting to electric.

Jay Summet, www.summet.com/blog

Criteria

We're looking for a finished working bicycle that can be used on a day to day basis.

Novel use of materials will be given extra credit, for example, the use of solar panels as an energy source (see photo).

Thought should be given to safety of the bicycle as well as compliance to local laws (such as restrictions on electric bike power, which is 200 watts maximum in most states).

Prize

The winner will receive a $150 gift voucher from online environmental store Todae www.todae.com.au

Winners will be announced in issue 111, to coincide with *ReNew's* electric bicycle buyers guide.

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Earth tube cooling

Earth tubes are a passive way to circulate fresh air in summer. Jacinta Cleary visits three new homes in Castlemaine, all with slight variations on the earth tube but all still super cool inside.

People have been using the earth's even temperature to cool buildings since Babylonian times. Architect and builder Andy McLeod of Sol Architecture has used this simple idea in three homes around the Castlemaine area in Central Victoria. "Hooray for old technologies," says Andy, and who can argue, especially on a hot afternoon.

The passive cooling systems he designed are largely based on ground-coupled heat exchangers, otherwise known as earth tubes. Earth tubes are more common in the United States because there is greater temperature variation, with one prime example installed beneath the Aldo Leopold Legacy Center, a very energy efficient environment centre in Wisconsin (see box).

Earth tubes are not as common in Australia but there is a lot to be learnt from the systems that have been installed here. Essentially, earth tubes have similar principles to vertical ground source heat pumps, that is, using the earth's stable temperature to regulate that of a building. See *A Geothermal farmhouse* in *ReNew 107* for a pioneering example of a residential ground source heat pump. In that example they drilled up to 30 metres underground where the earth temperature is stable and used water to circulate the cooling or heating effect.

This is where ground source heat pumps and earth tubes diverge because earth tubes use air. Earth tubes are laid horizontally in the ground and usually only up to two metres underground. They work on the stack effect, where high vents within the home, such as louvres, let the warm rising air out and at the same time the cooler underground air is drawn inside. Needless to say the three homes designed by Andy all have high awning windows.

Top: This house has two 225mm wide concrete pipes underneath as part of an earth tube system. Bottom: The upstand which buffers the earth tubes from unwanted wind-driven air.

Home with concrete pipes

Maurie and Lucy's new home is part of the Murnong Community; the small cluster of houses share a rainwater supply and a commercial greywater system that waters an orchard. The earth tubes and the composting loo went in before the slab, so the tubes were 'capped' to prevent concrete going down them. It was simply a matter of breaking the seal so the fresh air could vent through to the home.

This earth tube system comprises two 225mm diameter concrete pipes; one 16 metre pipe runs underneath the living area and a 20 metre pipe extends to the bedroom. Air is then transferred with a sniffer duct to the other bedroom. The pipes intentionally go to the home's north facing areas and the only signs of them in the house are two ordinary looking ducts in the living room and main bedroom. The system can be 'turned off'

Stuart's house has one plastic pipe which vents to two spots in the house. Right: Inlet pipe for this system.

by closing the ducts.

The intention is to provide cool air in summer and fresh air in winter, with the predicted temperature underground around 12°C to 16°C over the year. "With a fan in winter, if the building drops below 16 degrees, or more like 12 degrees, to facilitate heat exchange, warmed air could be pumped into the building to reduce base heating requirements," says Andy. This means that the household heating systems don't need to work as hard, although with the sun hitting the concrete slab heating probably won't be needed a lot of the time.

Andy recommends using the natural vacuum created on the leeward side (opposite the windward side) of a building when operating his earth tube systems. If windows on the leeward side are opened, the vacuum created by the shape of the building increases suction from the interior. This is called negative pressure. With the windows on the windward side closed and the vents open, only the geothermally moderated air enters the building. High awning windows open to the north can let hot air in when it's windy.

"It feels like the buildings become more and more alive the more we utilise our observation of nature and the resulting potential in passive systems," he says.

Outside is a covered upstand, or a wide vertical pipe which goes two metres into the ground. Inside this the inlet pipe for the earth tubes can be seen around 1.6 metres down. With a thermometer the temperature around the inlet is measured at 12.3°C, which means there is potential for fairly cool air to enter the house. The air temperature on this warm day is around 26°C. "There's pretty regular change in the temperature of the first metre of soil but below that it is pretty standard," says Andy.

It's common to install earth tube systems on a slope to enable greater air flow. This wasn't possible with this home hence the need for an upstand, which acts like a baffle to protect against unwanted wind-driven air flow. Power and water can be connected within the upstand so that a misting cooling system can be installed down the track.

Andy has made the building envelope as tight as possible to create more passive suction for the earth tubes. Prestite bituminised acrylic foam has been used pretty much anywhere there is a junction to create a tight seal, along with lapped and taped wall and roof sisalation. The door frames are much taller than usual to allow more air flow.

Bushfire protection

This is a robust house designed with bushfires in mind; Andy is a lieutenant within the CFA so understandably designs houses that will stand up to a bushfire. The home is double concrete block with a locally-sourced lime render. The roof is designed to be naturally leaf shedding with ribs running north-south with Smart-Flo gutters. The windows are double glazed with a 12mm air gap and the northern windows are covered by one-metre eaves. An intermittent shade is intended to reduce reflected and radiant heat in summer so the eave is a little less than Andy would normally specify to maximise winter gain. The main entry has an airlock to help keep temperatures stable. In addition, the house uses a lime based mortar mix that ensures the house is easier to dismantle down the track—good for recycling.

The entire earth tube system cost around $4500, which includes the cost of the two concrete pipes, the upstand and excavation. Excavation took one day, hence the relatively low cost.

House with plastic pipes

It was a different story out at Stuart Jamieson's house. Excavation for his single pipe took a week due to the Castlemaine slate this area is famous for. Hence, the excavation through rock pushed the price of his earth tube system, including pipe, to between $8000 and $10,000. This stone house designed by Andy McLeod has one 450mm wide, 20 metre pipe two metres underground, using plastic Green Pipe instead of concrete. Plastic pipe allows for elbows, therefore a single pipe could be vented to two spots in the house. Plastic is insulative so not as good at providing heat exchange as a concrete pipe system.

Pipe inlet for the house with basement cooling.

There is a natural slope on this property so a vertical upstand wasn't needed.

The west side of the house is next to an earth wall and is built from the stone that was dug out of the hill. The vents within the house tend to be towards the western end. They are very cleverly placed—one within the pantry, offering a bit of a cool room effect which is good for storing fruit and veg, and one next to the wall just behind the fridge. This helps keep the fridge cool so it runs more efficiently, which is even more important when running a home off solar; this house has a 2kW grid-connect photovoltaic system. Stuart installs photovoltaic systems for a living under his business The Solar Bloke, hence he knows a thing or two about how to run a photovoltaic system efficiently.

Being quite clever he's also connected his solar hot water system to a hydronic heating system, with a tedson heat exchange coil for back-up. The heated water is passed through secondhand cast iron radiators and towel rails.

Standing near the earth tube vent the air coming inside is certainly cool. On this day the temperature within the inlet pipe outside is measured at 11.5 degrees. Stuart says the system works well; occasionally unseasonally warm days in March or October can throw the indoor temperature up when the sun is a bit lower in the sky but still has some kick in it. On days of extreme heat he might put on the evaporative cooler.

As with Maurie and Lucy's house, the pipe went in first, before the slab, and Stuart and Andy say that for anyone else the excavation process shouldn't be any different to setting out a sewer. Trench depth and shoring requirements should be considered carefully before proceeding as some soil types are much more susceptible to collapse.

Basement cooling house

Andy has designed another cooling system based on the same principles. This home outside Castlemaine is a combination of mud brick and stone and is quite elevated with a section of suspended slab. Buried under the main living area is a 1200mm wide and two metre deep concrete block basement with a pipe inlet that runs the east-west axis of the house. Fresh air passes into the house via three in-floor vents; high fly-wired awning windows let the hot air out and draw the fresh air inside.

Some say that earth tube or buried pipe cooling systems, particularly in humid climates, have the potential to grow mould or other bacteria which can be carried into the home. Keeping the pipes dry is essential and is why most systems are built on a slope or would have some sort of baffle to stop water collecting in the pipes. Andy comments that air movement tends to dry out environments, yet some moisture is inevitable.

Several factors contribute to how well an earth tube system works. "Conductivity of pipe material and the material the pipe is bedded on will have an impact. Surface water movement over the pipe in winter will provide an unwanted heat exchange with the surface. The surface area, the length and the speed the air travels through the pipe will also affect capacity for heat exchange," says Andy.

"The people who have built these systems accept that they are experimental and based on sound logic," says Andy. Installing an earth tube system won't instantly cool or warm a house, but combined with other sound passive design principles it can certainly reduce the need for artificial heating and cooling. ✻

For more information on Andy McLeod's designs go to www.solarchitecture.com.au

Next issue: retrofit options for buried pipe cooling.

Large-scale earth tubes

The Leopold Center is the headquarters of the Aldo Leopold Foundation, a not-for-profit organisation that promotes restoration of the land and conservation leadership. Fittingly, their building completed in 2007 has received Platinum LEED Certification from the US Green Building Council. The Leadership in Energy and Environmental Design (LEED) program awarded the Leopold Center 61 points of 69 possible points, more than any other building in the United States.

A particularly innovative component of the Leopold Center is a system of earth tubes designed to ventilate the building.

In the Leopold Center, the incoming air travels through a series of underground concrete tubes, taking on the ambient temperature of the earth. Compared to the extreme outdoor temperatures ranging from –28°C to 35°C, the air in the earth tubes after travelling though the system will have a minimum temperature of -8.3°C and a maximum temperature of 23.3°C.

The earth tube system contains 600 linear feet of 24 inch diameter concrete pipe, very much like stormwater drainage pipe, laid over a 465m² area and buried about three metres below the building. The sections are connected with a rubber gasket to prevent gases in the soil from leaching into the ventilation system. Permeability of the pipe allows evaporation of any water that condenses inside the tubes.

The pipes are connected at one end to a larger vertical pipe that extends above ground and serves as the air intake. At the other end the air enters the basement of the building, where it goes through a UV filter to eliminate mould and bacteria before being circulated throughout the building.

www.aldoleopold.org/legacycenter/

It's not all black and white

Many houses in the Australian suburbs have dark roofs. But in a land as hot as ours, why is this so? Lance Turner tries to answer this question.

It seems that almost every new home built in Australia has a dark coloured roof, with the majority ranging from grey to black. While they may blend into the landscape better than a light coloured roof, they are certainly not as good at keeping temperatures in the home livable.

The reason goes back to basic school physics of course—black (or dark coloured) surfaces absorb a great deal more heat energy than do white (or light coloured). Indeed, it's not unrealistic for a black roof to reach 80°C on a hot day.

The real problem though comes from the fact that the under surface of the roof re-radiates this heat into the roof cavity of the home. Unless the home has very high levels of insulation, this heat rapidly migrates into the living spaces through the ceiling. This can be felt on hot days by touching the ceiling. It's not unusual for the ceiling of a poorly insulated home to reach 50°C on a very hot day.

Now, all this is pretty obvious, but the reason so many homes in Australia suffer from this problem is less so. After doing some research, it became clear that there are at least three main factors in the black roof issue.

The first is that many people prefer the look of a dark roof because, as mentioned earlier, it blends into the surrounds better, although this depends on the surrounds of course. However, as can be seen in the photo above, in areas with lots of greenery, darker roofs do indeed stand out less.

The second factor seems to be the building industry. Unfortunately, the industry does tend to set trends based on what they perceive the customer wants (which is not always what they actually want or need). A great example of this is halogen downlights. Builders install these environmental disasters because they are cheap to buy and because they believe customers want a flush-fitting trendy light. The fact that they increase the running cost of the average house by hundreds of dollars a year doesn't enter the equation.

A typical suburb in Victoria. Lots of houses with dark coloured roofs and tiny eaves make for very uncomfortable living without a air-conditioner.

Dark roofs come about from the same beliefs. Builders install them because they think customers want them, and customers want them because 'the building industry always uses dark roofs, so they must be the best option'. Unfortunately, not many people put much thought into such decision processes.

The third factor is local government. Many councils have restrictions on how light a colour you can use on a roof. The main reason for this seems to be that the majority of the housing stock already has a dark coloured roof, so new buildings have to blend in to some degree.

The lack of foresight is plain to see—if no-one changes the equation, we will be stuck with dark-roofed, thermally inefficient houses for evermore.

Cooling options

There are a number of ways to get around the dark roof problem. The first is simply to ensure that the roof space is as well fitted out as possible in respect to resisting heat transfer. This means using a double barrier of foil insulation under the roof material and bulk insulation on the ceiling. This combination will reduce, but not eliminate, heat flow into the home.

However, insulation can also be used in conjunction with forced ventilation

of the roof cavity, using a mains or solar powered fan. Wind powered fans just don't cut it, generally, as we often get hot, still days, and they simply don't move enough air to substantially reduce heat build-up. Ideally, you should be looking to replace all of the air in the roof cavity every 10 minutes or so in order to keep on top of heat transfer.

While these methods will work, it makes sense to stop heat entering the roof cavity in the first place. There are a number of roof paints available that are designed to reduce roof cavity heating by reflecting infrared radiation (the main heating component of sunlight). While many of these paints are quite light in colour, they are now also available in a range of colours, from white through to almost black. Typical examples are Cool Paints (www.coolpaints.com.au) and SolarCool (www.solar-cool.com.au).

This seems a bit counter-intuitive—how can a dark paint not absorb heat? But according to the various manufacturers of these paints, the particle size of the ceramic/glass/metal additives in the paint are such that they reflect the heat without reflecting visible light, so they look like a darker surface but perform thermally like a lighter one.

Of course, you could just paint your roof a much lighter colour, and indeed, standard light coloured roof paint can reduce energy absorption by a considerable margin—50% or more. But special coatings work better, at least according to the manufacturers.

Interestingly, special paint is not the only material said to reduce thermal absorption. BlueScope Steel have recently released a new Colorbond roofing range with a similar coating that reduces heat absorption while leaving the colour of the material unchanged. But does it really work? According to BlueScope, with the introduction of their Thermatech coating, the Colorbond colour named Dune has moved from a 'medium' classification to a 'light' classification under the BASIX scheme. In the darker colours, the solar reflectance of Ironstone and Woodland Grey have more than doubled. However, not all colours perform like this, and the average reduction of solar absorbance across all colours is 5%. Still a worthwhile gain, but in itself it won't make your home livable if it's currently a hot box in summer.

While these sorts of technologies can indeed reduce heat absorbtion by roofing material, this is not all there is to having a cool roof. The other important part of the equation is that the material needs to be able to re-radiate any absorbed heat back into the sky. Corrugated galvanised iron roofing is a good example of a material that doesn't do this. Even though it is light in colour, it doesn't re-emit well, and so heats up quickly. So, the material needs to be a good reflector and a good emitter, something a little more difficult to achieve.

Cool roofs

Around the world a number of energy efficiency advisory groups and programs are incorporating the concept of cool roofs into their information and calculations. For example, there's the Cool Roof Rating Council in the US (www.coolroofs.org) and the CoolRoofs Project in Europe (www.coolroofs-eu.eu), and the US Energy Star program is also including roofing material information in their recommendations.

A quick check of ratings systems here in Australia shows very little thought given to the colour of roofing materials, although the NSW BASIX system does mention roof colour as one option for gaining points in their program.

The Nationwide House Energy Rating Scheme (NatHERS), upon which the various state schemes are based, is rather unhelpful in this regard. Very little information is available on the NatHERS website (www.nathers.gov.au) as to whether roof colour is even considered in the rating system. Many of the state and federal government websites, such as the Your Home site (www.yourhome.gov.au) have some basic information such as 'a dark roof will make your home hotter in summer', but that seems to be about the extent of it.

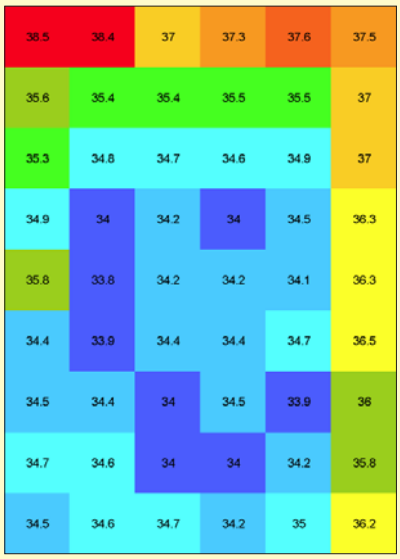
All in all, information on this subject is rather lacking, so it's not surprising that Australia has so many dark roofs. If the legislators don't prioritise the subject then how are builders and home owners going to know it is such an important issue?

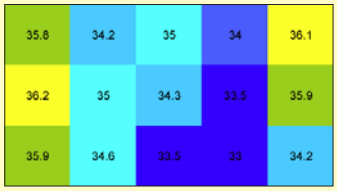
The same goes for local government. There seems to be little or no consideration at all in using light roof colours to reduce energy use. We could find almost no references to roof colour on any council website we looked at. Amazingly, it just doesn't seem to be on the radar for most regulatory authorities.

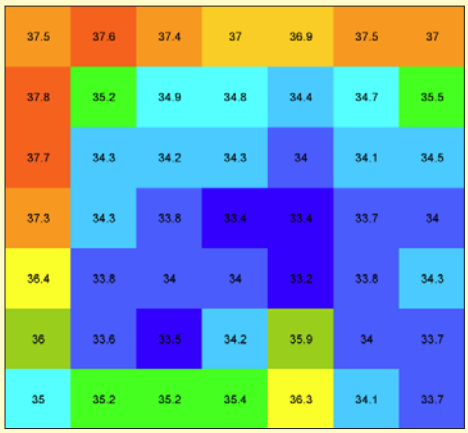
However, there is hope. In April the Council of Australian Governments announced that it would request the Australian Building Codes Board to increase the stringency of the Building Code of Australia energy efficiency provisions for all new housing to a 6 Star energy rating in BCA 2010. The enhanced provisions include light coloured roofs, so we may just see some long term improvement in this area.

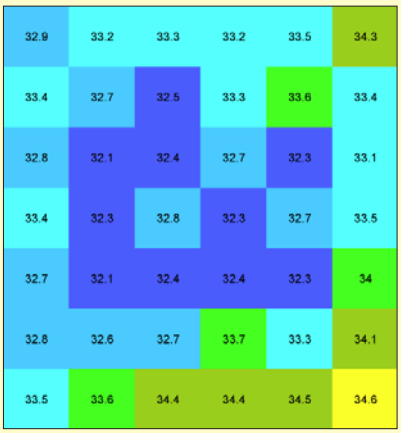
Doing it yourself

But why wait for the powers that be to make it happen? The best thing any home owner can do to make their home cooler in summer is to change the roof colour to a much lighter one. Talk to your council, see what their restrictions are regarding roof colour, and then talk to or letter drop your neighbours, explaining your plans and how the roof will look. Don't forget to explain why you are doing it. Once they realise they can cut hundreds of dollars a year from their cooling bills, you may just have a few people follow your lead. ✻









These 'thermographs' were taken of the ceilings of four different rooms (the kitchen, bedroom, living room and bathroom, clockwise from top-left) inside the same home by measuring the ceiling temperature at regular spacings. The temperature ranges were then assigned a colour for easy visualisation of temperature variations.
Clearly, some rooms have issues with insulation towards the edges of the room, implying that roof insulation may be reduced or absent near the outer walls. Indeed, on inspection it was found that the insulation in the roof, while fairly even, was very thin, showing the need for an upgrade.
Note the the diagrams are oriented with the top as north, and each square represents an area of 500mm x 500mm.

Finding the hot spots

If your home gets excessively hot in summer, there may be problems with your roof insulation. If you have none, then the remedy is simple—install it! Rebates large enough to insulate the average home are available for both home owners and landlords, so there's no reason not to have it done.

However, if you already have insulation, it may not be performing at its best. It's not uncommon for insulation to be displaced when electrical, plumbing or other work is undertaken in the roof cavity.

Areas where the insulation is less than adequate will show up as hot spots in summer and cold spots in winter. The best method of finding these variations is using a thermal imaging camera, which produces an image called a thermograph. This looks like an image of the ceiling, but instead of real colours, the colours represent the temperature of the surface. Colour usually ranges from dark blue for cold through to bright red for hot. An example of a thermograph can be seen below.

Unfortunately, thermal imaging cameras are rather expensive, running into the many thousands of dollars. While you can have a professional thermal imaging service come and image your home, this can also become rather expensive if you need to have it done more than once—for instance, if you want to check the result of changes made to the home.

However, there is a simple but slightly cruder way of getting a reasonable idea of thermal problems in your home. Until recently, infrared non-contact thermometers have been expensive, but now that several Chinese manufacturers are making them, they are readily available at prices under $100.

These devices simply give a temperature reading of whatever they are pointed at on a small LCD. The better ones also include lasers for sighting, so that you know exactly where the reading is coming from.

By taking enough readings at relatively small intervals and assigning a colour to each reading (or rather, the temperature range the reading falls into), a crude thermograph can be created.

We tested a staff member's home, taking readings on a 500mm grid in four rooms on a recent hot day. The readings were placed in a spreadsheet and given colours according to temperature range. The results can be seen above, and they clearly show where the problems lie. For higher resolution, readings could be taken at smaller intervals.

The results of using this method, while not as accurate as a thermal imaging camera, are far more within the reach of the average householder.

A thermograph of a room with variable insulation.

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Staying green with greywater

Jacinta Cleary visits one experienced green thumb who keeps her garden thriving with greywater.

On a rainy Melbourne day a visit to Karen Sutherland's edible garden is a bit like a trip to the tropics, with feijoa, mango and avocado trees all surviving well. Admittedly, the mango tree is far from fruiting, but maybe one day if the weather continues to warm.

It's a combination of rainwater, greywater and a little bit of mains water than keeps this suburban garden absolutely thriving. Keeping a garden alive in dry periods is one thing, but taking it to the next step and growing healthy produce with minimal water requires some planning.

Household greywater is used every day in this garden and has made a big difference. Karen specialises in designing and installing edible gardens and importantly, helping people learn how to grow and maintain their own veggies, fruit and herbs. Her philosophy on gardening is very much tied in with sustainability and the fact that sourcing food locally can help the planet by reducing transport emissions. Through years of experimentation she can judge just how much water is needed for an abundant crop of fruit and veg.

Top: Lush garden. The small bed to the right is the vegetable patch. Bottom: The dripper system.

The greywater system

Karen and partner John had enough hands-on expertise to design and construct their own greywater system. Greywater can't be stored longer than 24 hours, so the system is only big enough to hold a day's worth of water. The header tank holds between 180 and 200 litres, with an overflow going to the sewerage system. Karen keeps track of how much water has gone into the header tank each day to ensure a minimum of wastage from overflow.

Water from the laundry and bathroom is diverted outside to a covered sump in the ground. In the laundry any water inappropriate for use on the garden is easily diverted just by moving the laundry hose. In the sump the water flows in on the right and any excess water overflows out the left to the sewerage.

Once the float within the sump reaches a certain level it triggers the pump into action. The water is pumped by a Davey D15 VA sump pump, passing through an Amiad 120 mesh disk filter.

A disk filter works by taking water from the outside through hundreds of plastic disks to the inside, whereas a mesh filter takes water from the inside and flows out, with very little surface area for filtration. The disk filter at around $300, is one of the more expensive parts of the system, but needs cleaning only once a month (and after any particularly fluffy wash such as towels).

A cheaper mesh filter at around $10 would need to be cleaned at least once a week. Deciding to have a better filter is one of the reasons this system is successful, as weekly cleaning would inevitably fall behind. The sump is cleaned around once a month too.

The water is pumped to a custom made stainless steel header tank, made with scrap metal sourced by Karen's dad. The header tank is strategically placed

Clockwise from left: The pump with the sump in the ground to the right; the four line manifold that distributes water to different parts of the garden; the stainless steel header tank made from recycled materials.

at a height of two metres, as the rule with gravity feed is the higher the water source the further the water will travel. From just over a two metre height the water travels twenty metres through a 19mm pipe with a water pressure of around 25kPa.

Karen found that the furthest parts of the front and back garden, with the longest lines, were not receiving much water, so those sections are only watered when the header tank is full, thereby giving more pressure. Smaller and closer areas such as the courtyard and the raspberry patch can be watered when the tank is partly full.

Karen's greywater system is designed perfectly for her garden; in a smaller garden the header tanks would be lower, generating less pressure so distributing less distance.

Water distribution

The greywater is distributed to four areas in the garden via a four-line manifold below the header tank. The pipe is 19mm diameter polyethylene with smaller 4mm 'take-off' piping delivering water to the plants via adjustable drippers. There's around one dripper every 25cm, with roughly 50 drippers on each line. At the end of each line is a plastic tap that can be opened to flush the line. This is done once a month to prevent blockages. The head is taken off each dripper once a year for a proper clean, but generally the system is low maintenance. Holes were drilled in the 19mm pipes to deliver water to one of the smaller areas, but this didn't really work, although some greywater enthusiasts swear by it. The water didn't distribute evenly to all parts of the line without the drippers, which help to maintain pressure.

Plants and greywater

The garden is abundant and healthy. The areas that receive greywater are thriving, including a selection of subtropical plants such as tamarillo, macadamia and avocado, as well as almond, a weeping apple and kiwi vines. Karen monitors carefully how certain plants react to greywater, noting that the raspberries had developed leaf yellowing, indicating possible problems with the greywater. The yearly spring application of compost, gypsum and organic pelletised manure has overcome this problem so far.

Although the greywater delivered by the system is sufficient to keep large established fruit trees alive, many had dropped fruit or fruited badly since its installation, especially the large feijoa and weeping apple tree. This was due to water not getting to the root zone.

The problem has been solved by digging pieces of flexible slotted agi pipe (40 or 50mm diameter) 30 to 40cm deep into the ground around the root zone. Greywater not currently connected to the existing system is then carried out by bucket and poured into these pipes, using a plastic funnel to help the process. Extra water is given to trees at

flowering to ensure good fruit set and then later when the fruit is getting larger, not long before picking.

All trees are now healthier and fruiting well, resulting in much bigger fruit, especially the feijoas, that are apparently amazing dried.

Veggie patch

The vegetable patch is smaller than expected but not a lot of space is needed to grow a variety of produce. Karen prefers repeat harvest and perennial produce plants rather than annuals that have to be pulled out at the end of each season. Greywater can't be used on the vegetable patch so only mains or tank water is used, with three 1200 litre Waterwall rainwater tanks down the side of the house. Even the first flush from the roof, which is normally diverted to the drain, is saved in a 300 litre tank for hand-watering.

There's also been some experimentation in the veggie patch with a wicking garden bed, where the water is delivered sub surface via agi pipe. Wicking beds are supposed to use less water than surface watered beds and grow better produce. The bed includes a layer of black builders plastic, a layer of gravel around the agi pipe, and some geotextile fabric under a lot of rich soil. Some people use greywater for their wicking beds, but fresh water is preferable.

Greywater essentials

According to Karen there are two essentials for a healthy greywater garden. Firstly, the soil must be well prepared. Karen tops up her soil with gypsum, compost and organic fertiliser every year. And the right household products must be used. Karen often hears of households having problems with greywater on their garden, but they're using laundry powder rather than liquids for instance, which can be damaging to the soil and plants due to its high salt content. Her preference is for low-phosphorous organic liquid laundry products from Enviro Clean, but to find out more about laundry products and greywater see the Lanfax Laboratories research at www.lanfaxlabs.com.au. And to see which bathroom products work with your soil see the *Soaps, shampoos and soil* article in *ReNew* 107.

More water

The water saving plans are still underway at Karen's place. There are plans for a double kitchen sink, enabling the really dirty kitchen water to be separated from the cleaner kitchen water such as water used to clean veggies, meaning a few more litres for the garden! ✻

Karen Sutherland offers classes and consultations via her business Edible Eden Design www.edibleedendesign.com

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Windows for your climate

Double glazing is generally associated with keeping the cold out, but a recent study has found that some glazing options can significantly improve the energy efficiency of homes in hot climates, writes David Sparkes.

If you live in a tropical, sub-tropical or hot and arid climate zone, having a comfortable home is all about keeping the cool in and the heat out. For Queensland, this fact has been driven home in the past decade with the increase in air conditioners in homes having a serious effect on the state's greenhouse gas emissions. The number of air conditioners in Queensland doubled between 2000 and 2006. It had been expected that by 2014, 60% of homes in Queensland would have air conditioning: this figure reached 70% this year.

These days we all know just how much energy those machines can burn up, especially if we have ever owned an air conditioner and paid the electricity bill. With this insatiable appetite for cooler housing in Queensland, combined with the fact that the state is Australia's fastest growing in terms of total dwellings, the pressure is on to come up with homes that reduce the need for air con by providing better thermal efficiency. As of March 2009, new Queensland homes require a mandatory thermal efficiency rating of at least 5 Stars, but nearly all homes were built before then.

A Queensland University of Technology study *The Role of Advanced Glazing in Queensland Homes: Reducing Electricity Load and Greenhouse Gas Emissions* examined the qualities of 16 different glazing options in five climatic regions of Queensland. The results should be of interest to all homeowners in warm climates.

The report shows that advanced glazing options such as tinted low emissivity (low-E) glass can play a significant role in reducing greenhouse gas emissions for homes in tropical, sub-tropical or hot and arid climate zones. The study analysed various single and double glazing options, as shown in the table on the next page. Options were chosen based on low U-values (i.e. good insulation), low solar heat gain coefficient (SHGC) and a light transmittance greater than 50% to ensure good natural lighting levels.

This is definitely a compelling set of numbers. The best double glazing option has a U-value of 2.53—more than twice as good as a regular pane of 4mm glass (5.88).The study worked on a number of house models, but the average single storey house had a glass to floor space ratio of 22.3%, which means the windows are providing a lot of surface area for potential heat transfer. It makes sense to keep that area insulated. This is even more important for modern homes with even larger areas of glass.

According to the study's analysis, the best glazing options improve a 5 Star home's efficiency rating by 1.5 to 2.5 Stars, turning it into a 6 to 7 Star home very easily. For existing homes that do not meet the 5 Star rating, installing ad-

Glazing Type	Light Transmitance	U Value	R Value	SHGC
4mm clear	89%	5.88	0.17	0.84
4mm green tint	74%	5.88	0.17	0.59
4mm low-E	82%	3.67	0.27	0.71
4mm to 6mm; low-E tint	58%	3.6	0.28	0.52
3/6/3; Double Glazed; clear/air/clear	81%	3.17	0.32	0.76
4/6/4; Double Glazed; Tint/air/clear	66%	3.15	0.32	0.48
4/6/4; Double Glazed; Tint/air/low-E clear	61%	2.53	0.40	0.43

vanced glazing is not nearly as effective as installing R2 insulation in the building fabric itself.

The best result overall was achieved with double glazed 4mm tinted glass, a 6mm air gap and 4mm low-E clear glass in a timber frame. This option reduced energy requirements by 25% to 45% depending on housing type and specific climate zone. Considering the amount of electricity consumed by air conditioners across Queensland, a 45% reduction would go a long way to reducing greenhouse gas emissions—and rising electricity bills!

Single glazing

With double glazing sometimes difficult to retrofit, advanced single glazing options were also found to be very effective. The 4mm low-E glazing (low emissivity glass has a special coating that allows light in but reduces solar heat gain) achieved a reduction in energy requirements by 11% to 32%, depending on house type and specific climate zone.

Low-E glass performed better than tinted plain glass in all situations. Interestingly, the best single glazed option varied depending on whether the house is in a region that requires any winter heating. In areas that do need some heating, such as inland Southeast Queensland, clear low-E glazing was the best option. However, in areas where homes require virtually no heating, tinted low-E glazing performed better.

The study also took into account potential differences between brick veneer houses and timber houses on stumps. Strangely enough, a 5 Star timber house in regions requiring heating would not have its rating improved by more than one star with the installation of new glazing options, but this still accounted for savings of over 11%.

As is the case in all climates, how well the advanced glazing options performed depended on whether the windows had aluminium or timber frames. Timber window frames outperformed standard aluminium framed windows for all glazing types in each of the zones, with few exceptions. Clear double glazed units with timber frames performed marginally worse than their aluminium counterparts in zones 5 and 36 (this includes Townsville, Maryborough and Gladstone, which are warmer areas with little heating requirement), with the reason for this to be explored.

The report came to the conclusion that advanced glazing options can significantly improve the energy efficiency of homes in a hot climate, however this reduction is more significant for houses that already have a 5 Star rating. For houses with a lower rating, it is suggested that advanced glazing alone will not bring the house up to 5 Stars—for such houses, it is best to apply other insulation methods first.

The rest of Australia?

So, what should you consider if you live in a mixed climate that suffers the extremes of both hot and cold weather? Double glazing can reduce heat flow out of the building and can also limit heat gain from outside. For northern windows with good summer shading, consider clear glass for the outside pane and low-E glass (low U-value) for the inside pane. This will allow winter sun to enter the house, whilst reducing the heat that escapes. For non-shaded windows, tinted glass for the outside pane (and low-E for the inside pane) would provide the best performance. If you want to keep existing timber framed windows, consider replacing just the glass: clear low-E in the north, and tinted low-E in other orientations.

For more details on what suits your climate check the Window Energy Ratings Scheme (WERS) which assesses both the cooling and heating performance of windows with a star rating from 0 to 10. The more stars the better. ✻

For more information on the Queensland University of Technology report contact Wendy Miller via W2.miller@qut.edu.au

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We are looking for good build-it-yourself style articles and will award a solargorilla (courtesy of powertraveller, www.powertraveller.com.au) to the author of the best article we receive.

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Easy swimming pool filtration

Swimming pool driving your bills up? Here's an easy, low-fuss way to keep your pool clean using renewable energy, writes David Rowe.

During an energy audit of my house I discovered that my pool was a major energy hog. Due to the salt chlorination system the filter/chlorinator needs to run for between two and 10 hours a day to maintain high chlorine levels. We run it longer in summer as the chlorine gets removed by sunlight (even with stabiliser chemicals).

We were using a common salt-chlorinated system where about 20A at 12V is passed through a special salt cell that causes chlorine gas to be made from the slightly-salty pool water. A few 25kg bags of pool salt are mixed into the pool every year to provide the chlorine ions, with the salt cell adding electrons to make dissolved chlorine. If the chlorine levels are high enough, it kills the algae that would otherwise make your pool bright green after about a week.

I attached my power meter to the pump/chlorinator and measured 860W (200W for the chlorinator cell, 660W for the filter pump). Based on an average run time of six hours a day, that's over 5kWh a day or around $300 per year at my current tariffs. Added to this is a new salt cell every three years (at $300 each) plus a legion of algacides, stabilisers and other exotic potions from the pool shop. All up I would estimate around $700 per year is spent on the pool, plus maybe $150 for every 'green pool event' which occurs if (well, when, actually) we are not diligent.

But it's the 5kWh a day that really bugs me. You see I want to install a PV solar array for my house that will generate perhaps 9kWh a day total. I don't want to use a good chunk of that power on a pool we hardly use. That sort of energy waste is just so 20th century! To be honest I would be happy to cover the top of the pool and turn it into a 60,000 litre rainwater tank, but on a good day it does look kind of nice.

David's pool and the Floatron that helps keep it clean.

Algae-zapping gadget

I started looking around for alternatives to chlorine. Some Googling brought me to the solar-powered Floatron. This gadget uses a completely different principle to zap algae—ionisation. Rather than using chlorine it injects small amounts of copper ions into the water, which apparently kills algae but doesn't bother us much. The cool thing is that copper ions last three weeks, regardless of how hot it is.

The testimonials looked good, so I tracked down the Australian distributor and bought one. It wasn't cheap when I bought it at $450 delivered (closer to $300 now). There was much 'wailing and gnashing of teeth' over the price by my wife, sick of spending money on that (add choice Italian swear word) *pool*, but I convinced her that if it worked it would pay for itself quickly. I was a little bit nervous about the purchase, I mean, if it's that good why can't I buy one in my pool shop? More on that question later.

I threw it in the pool and duly followed the instructions. As the copper levels built up I reduced the chlorine by lowering the time we ran the pool filter/chlorinator each day. So far so good, the pool is healthy and my energy use is way down.

With the Floatron trace amounts of chlorine are still needed (about 20% of what is normally required). As well as killing algae, chlorine also acts to keep the water clear. Initially, in my rush to reduce energy consumption I reduced the filter/chlorinator run time to just one hour a day. However, the pool water tended to be a little blue-green and cloudy. Any sort of green is normally a sign of algae breeding madly, so there was a moment of panic!

However, I think it was more a case

of dissolved (but benign) particles in the water rather than a runaway algae event. I upped the filter/chlorinator run time to two hours a day and after about three days we had clear blue water, about as good as I have ever seen our pool. The chlorine level was still very low (maybe 0.3ppm, way lower than 1.5ppm required normally), but the water was clear. Normally late in the year we would run the filter/chlorinator six to eight hours a day.

This management of the residual chlorine level gave me an added level of control. I could drop back to using the pump one hour a day if I wanted to. I might get cloudy water if I am not using it but there is no risk of an algae attack so I can rest easy. Then, if we have an imminent party or kid invasion coming up, I just increase the run time to two hours a day to get clear water. I like having this choice—previously I was forced to keep the run time (and expense) up, thereby wasting power and effort. If my pool ever went green it would take me two weeks and $150 of algacide treatment to fix it.

I started thinking about the whole salt chlorination system and the reasons why using ionisation (rather than chlorination) isn't that common. The Floatron has been around for 15 years, so why aren't we all using it?

Think about a salt chlorinated pool. If something goes wrong, e.g. the salt cell gets blocked or you flick a switch the wrong way, you can get a green pool quickly, as the chlorine level drops immediately, especially in hot weather.

The low power current from the mini solar panel releases ions into the water, controlling 'green attacks'.

The warmer it gets, the faster the chlorine breaks down, so the more you need to run your pump/filter/chlorinator. We varied between three and 10 hours/day over the year, more in summer if the chlorine levels were low, or if the salt cell was nearing the end of its life. Plus there was the expense of a $300 salt cell every few years (we went through two in seven years). Being chemically-challenged and slightly lazy we always had one or two 'green pool' events a year. This meant a trip down to the pool shop, $150 worth of shock treatments, algacides and much stress and head scratching while we worked out what we did wrong this time.

So the Floatron is a great thing for a pool owner but a very bad thing for a pool shop. Just about every dollar we spend at the pool shop is related to chlorine in some way, for example pool salt, algacide, new salt cell or stabiliser. It even saves on filter sand and kreepy-krawly (automatic pool vacuum) replacement parts as they wear in proportion to filter use. Indeed, this works against the Floatron—what pool shop would stock a 'product of death' to their other lines?

Ionisation is a fantastic way of maintaining a pool compared to chlorination. With energy prices rising, the energy costs of luxuries like pools need more attention. Ionisation is low on energy, low on chemicals, with less chance of algae, fewer irritants and fewer visits to the pool shop! ✻

Go to David Rowe's blog at www.rowetel.com/blog/?p=38 to see how other people have bought a Floatron in Australia. According to Australian Standards Floatrons can only be used in ponds. www.floatron.com

How it all works?

Sunlight falling on the Floatron is converted into electricity by the small photovoltaic panel. This harmless, low power current energises a specially alloyed mineral electrode below the waterline, causing the release of mineral ions into the surrounding water. Ionised water, referred to as mineralised water, naturally and efficiently controls microorganism growth in your pool.

Some contaminants in your pool such as dust, suntan lotion, body fluids, etc are not affected by minerals. An accumulation of these things will tend to cloud the water, therefore a small amount of chlorine, or any other oxidiser, is necessary to dissolve them to maintain crystal clear conditions.

Wheelie good rainwater

Perfect for renters, this DIY rainwater system can be moved to another house, writes Stuart Nesbitt.

I live in a rental property and will do so for the foreseeable future. I want to be able to collect and use rainwater to do my bit for water conservation but I don't want to fund an unrecoverable asset that only benefits the landlord's property value.

To fix this problem I've installed a mobile rainwater harvesting system that has no permanent relationship with the property or building. It's easily decommissioned and can be moved to another property.

The tanks

The system uses nine standard 240 litre council waste wheelie bins. The bins were purchased online through a supplier with surplus stock. They are new or factory seconds at half the cost of new bins. The system capacity is 2100 litres.

There are four 'feeder' bins which have been strategically positioned directly under four of the five downpipes servicing the building's roof. This was done because trenching and redirecting stormwater pipes around the building perimeter to a single tank was not possible for this project. The four downpipes drain approximately 70% of the available roof collection area. The bins are then interconnected to all the other bins with isolation valves and a 12mm standard garden hose. The five additional bins increase system capacity and are located along a side wall near the hot water service. There is space to add two more bins and increase system capacity to 2500 litres if required.

The pump

I've used a Davey RainBank packaged up as an all-in-one unit in its own weatherproof polyethylene housing and cover.

One of four 'feeder' bins positioned under downpipes, which is connected to five more wheelie bins via isolation valves and garden hose.

The pump is situated between the main feeder tank and the hot water system. The cold water supply to the hot water service has been redirected through the RainBank pump then out to the hot water service as its main cold water supply. It also has a standard ½ inch garden tap fitted which enables connection to the garden hose. This is connected to the washing machine cold water supply on laundry day. The water level sensor for the RainBank is installed in the main feeder tank.

The plumbing

The simplicity of this project starts with the existing downpipes. They are 100mm x 50mm square with an upper and lower section. The lower section was simply removed and a Leaf Eater rain head slid under the upper section. The rain head is then connected to the feeder bin placed under the downpipe using standard 90mm PVC stormwater fittings. There is no permanent connection to the building. A 50mm Leaf Eater overflow fitting with mossy trap was installed on each feeder bin. All the overflows are allowed to run on to a concrete area with stormwater drainage.

Each bin has a 15mm diameter outlet fitted 50mm above the bottom of the bin to prevent sediment flow and a 12mm isolation valve. All these outlet valves are interconnected to every other tank via a 12mm garden hose.

The main feeder tank has a 20mm diameter outlet and isolation valve with an inline filter which feeds into the RainBank pump. The RainBank pump is directly plumbed into the hot water service. The plumbing fittings to the hot water service were modified to enable the RainBank integration but can be reinstated in minutes.

Material sources

The bins were purchased online through www.justwheeliebins.com.au. The Leaf Eater rain heads were purchased from the EnviroShop in Melbourne and all the plumbing components used in this project are readily available from any large hardware store.

The packaged RainBank pump and cover was purchased through a plumbing and irrigation supply.

How does it perform?

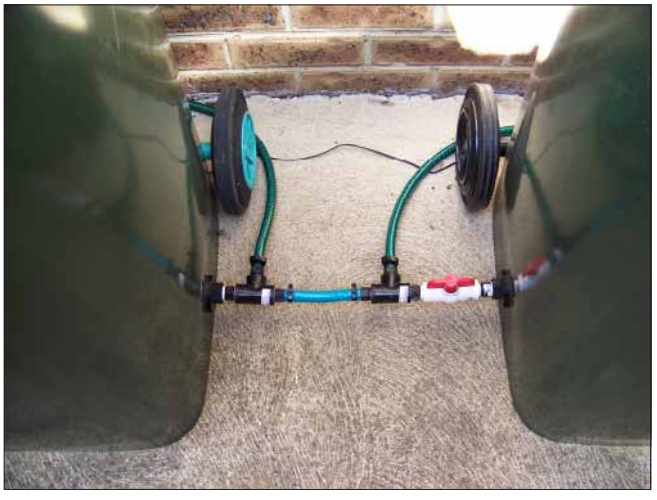
Water conservation was already a priority but since the installation of the mobile rainwater harvesting system, average daily water consumption has reduced from 70 litres to 41 litres per person. Hot water for the daily shower, bathroom, dishwashing, and a load in the washing machine each weekend is exclusively fed by stored rainwater when available. When full the system has approximately five weeks supply without rainfall. The system has overflowed on a number of occasions during the recent spring rains but ordinarily consumption is expected to closely match collection capabilities.

These five tanks provide extra storage capacity.

How much did it cost?

As the project was DIY there were no labour costs but all the materials to make it happen cost around $2300. Nearly all the materials used in the project can be transferred to another property so the investment is worthwhile. *

While it's possible to complete this sort of project without making any permanent changes to the house, it's a good idea to get your landlord's permission before starting a project like this. Plumbing of this nature should be done by a licensed plumber.



The rainwater can be sent to the washing machine and hot water service via the RainBank pump. Right: Connections and isolation valves between the tanks.

DIY cardboard solar dryer—good for Kiwis, good for all

Lindsey Roke shows how to make a simple solar dryer from recycled materials, great for preserving all that excess summer fruit.

At our family bach (seaside holiday house) we have a couple of ancient apricot trees. The only problem with these wonderful trees is that the fruit all seems to ripen and fall off at the same time. Nice as apricots are, there is a limit to how many we can eat at once. So we have a few different ways of using them: we make jam, we bottle them, we freeze them and we dehydrate them. The 300 watt electric dehydrator goes non-stop for days. In this part of New Zealand, with the high humidity, just laying them in the sun to dry doesn't work. So when I came across an article on 'proper' solar dryers I photocopied it and thought it might be a useful way to show the grandchildren the benefits of solar energy—not to mention getting more apricots dried. In reality, the grandchildren ate the apricots while the adults had fun creating the dehydrator!

This solar dehydrator appealed to me because the sloping solar collector heats a column of air which then rises through a drying chamber up the top. It looked to be just what we needed.

So, before we went to the beach for our summer holidays I hunted among my junk for a roll of duct tape, a suitable piece of glass and something to blacken my collector. I found some flat black manifold paint and a pot of tyre black.

When we are on holiday we buy our groceries from a supermarket which leaves its empty cartons out for the customers to pack their groceries into. Over a couple of shopping trips I took our supplies home in an apple box that looked to be an appropriate size for a drying chamber, and in two cartons for joining end to end to make a collector.

Top: It all starts with a couple of boxes from the supermarket. Note the collector box has been taped together. Right: Lindsey preparing the collector box with black paint. Bottom: Making the top transition.

The solar collector

We unglued one end of each of the two long, narrow cartons, then lapped one into the other and taped them together. We taped the lids back down inside the box so that most of the structure ended up with two layers of corrugated cardboard rather than one, providing strength and good insulation.

The cartons needed two coats of tyre black to get a good, solid black coating. The duct tape presented some problems, as the tyre black wouldn't stick to it so I resorted to putting an undercoat on it by spraying the tape with a dusting of the flat black manifold paint. Any other non-glossy paint of any colour would have worked as an undercoat.

We cut a slot in the top end of this pair of cartons and fashioned a bent transition duct out of more cardboard and duct tape. This has a big enough flat area on the top that we can sit the drying chamber on it without fixing it down, which makes it easier to take the sec-

Top: The kids have abandoned the project while the adults work out the next step with the collector box. Left: The apple box with the mesh ready to be pushed in. Above: The completed solar dryer, made from cardboard boxes, a single sheet of glass, chicken wire and plenty of black paint.

tions inside at night or when it rains. It also means that the partly dry fruit doesn't have to be emptied out before the chamber is shifted.

We then taped the glass to the front of the collector, leaving a gap at the bottom for the air to come in. The whole contraption was then orientated towards the sun, leaning on an old ironing board.

Drying chamber

The drying chamber was made from the apple box. I found some chicken netting and folded it into an S-shape to place inside the chamber to act as three racks. We also had some rectangles of plastic mesh gutter-guard that we used as individual lift-out trays to put on the three layers of the chicken netting.

I did restrict the hole in the top of the carton somewhat with a piece of tape. The carton's existing hand-holds also function as vents. The rate of air circulation can be adjusted by sliding the lid of the apple carton up or down to adjust the exposure of the hand-holds.

Up and running

We estimate that, when the sun is shining and the collector is orientated correctly, the solar dehydrator is theoretically collecting about the same wattage as the old electric dehydrator. Both raise the air about 15°C above ambient. While the electric dehydrator dries apricots in about 24 hours, the solar version takes about three days because the sun doesn't shine 24 hours a day. The finished product is the same from either dryer.

This project can be done fast enough so that kids don't lose interest. If leaving children to do this on their own it might be safer to substitute the glass with a plastic sheet. There is nothing particularly important about any of the dimensions. A more robust version that could be left outside permanently could be built using the same principles.

I didn't buy anything to make this contraption; at worst it would only cost a few dollars. Each load of fruit it diverts from the electric dehydrator saves about NZ$1.60 (A$1.37) worth of electricity. There are not that many solar energy projects with a pay-back under three days! ✻

Browser

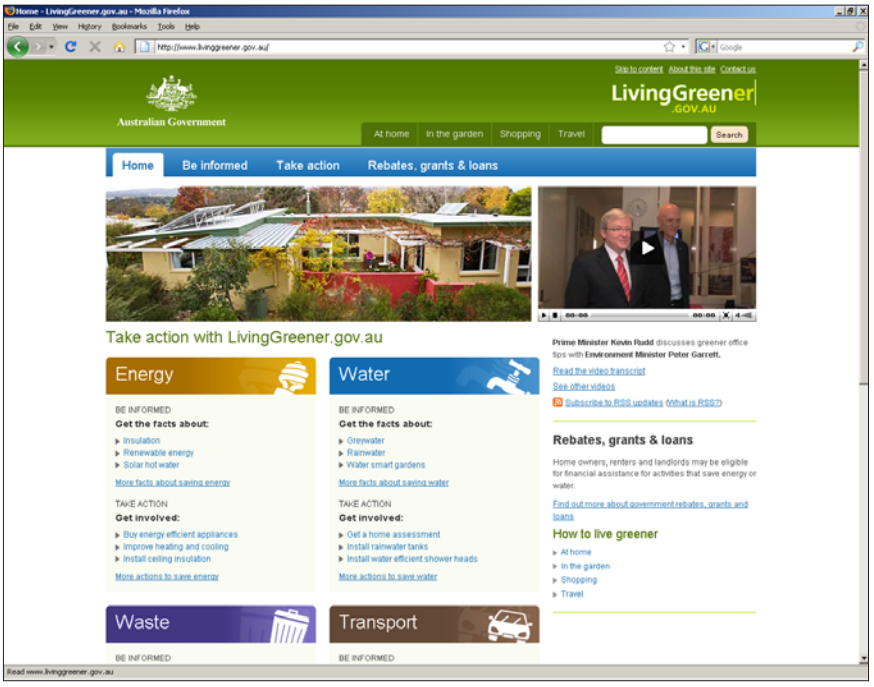
www.livinggreener.gov.au

We all know we need to reduce our environmental footprint on the planet, but finding ways to do this can be less than simple.

Living Greener is a federal government website set up to help the average person make improvements to their lifestyles to reduce their environmental impact.

The ideas and facts are loosely grouped into saving energy, saving water, reducing waste, and transport options. The site has separate sections that provide basic information on a range of ideas and subjects in each group, as well as ways to take action.

There's information on appliances and what to look for, including energy use and how to select the most efficient appliance, how to use less water, how to recycle correctly, what to do with hazardous waste, and what transport options there are, including tips on driving more efficiently, should you choose to drive.



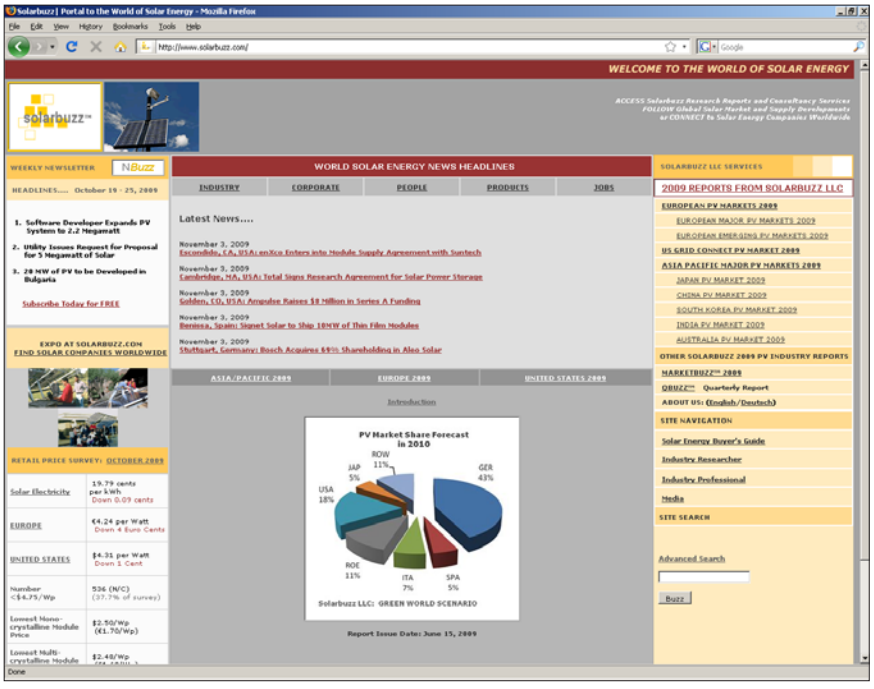
There's also rebate, grant and loan information for each area and tips for smarter everyday shopping.

Now, if only we could get the government to take notice of their own advice!

www.solarbuzz.com

The solar industry is growing at an ever increasing rate, and it can be very hard to keep up with the major developments, let alone all the minor ones.

Solarbuzz, as the name suggests, provides all the latest news on the solar and related industries.



It includes information on manufacturers and suppliers of PV systems, inverters, controllers, batteries and other associated equipment. There are extensive lists of manufacturers along with contact details and websites.

Of course, there's all the latest news about large-scale projects happening around the world, and it's enlightening to see just how much is going on. What was depressing was the complete lack of any solar projects in Australia!

You can choose to view headlines in five broad categories—industry, corporate, people, products and jobs.

Other useful resources on the site include a solar panel buyers guide, current prices of solar generated electricity and the current price in dollars per watt of PV panels in Europe and the US. There's also an email newsletter to sign up to.

All in all, a great place to check out if you're in the industry, or just interested in what the world is up to.

Self-sufficient with strawbale

Hooray for strawbale and who can argue, especially when it's so cool inside this new family home. By David Sparkes.

Three years ago, Rob and Veronica Phillips set out to build a house at minimal cost to the environment, at the same time creating a beautiful home for their young family. Nestled in the rolling countryside of Deans Marsh in southwest Victoria, this strawbale home has a look that is natural and comfortable.

"There's the ambience of it, you know?" says Rob. "You walk in and it's got the rounded and natural shaped walls. As soon as you walk into any strawbale house you get that same feeling of a cosy sort of house. And now that we've lived in it as long as we have, if I was ever going to build again, that's the only way I would build."

There are several reasons why strawbales are an outstanding option for sustainable building. First and foremost is the insulation it provides, which was the first attraction for the Phillips. Strawbale is possibly the most cost effective thermal insulation available and has a similar insulation value to fibreglass batts of the same thickness. Then there is the resource efficiency of actually making the bales; straw is a by-product that would otherwise be burnt off or left to rot, so their creation is much less resource intensive than other building materials. Strawbale buildings have great sound insulation and (contrary to what you might think) are quite fire resistant because the straw is packed so tightly and sealed by render.

They had bought the land, 24 acres backing on to 200 acres of crown bushland, ten years ago, but did not start building until some time later. To get themselves started, they built a smaller studio, partly to provide a place to stay while building the main house, but also to give Rob a chance to hone his skills in strawbale building. The strawbales, which are 450 mm thick and made from wheat straw, came from a friend in Winchelsea. Anyone who has ever taken on the task will tell you that strawbale building is not a quick process, and it took about two years before the main house was liveable.

The Phillips family including pets; all enjoying a self-sufficient life in the Otways.

Rob was also switched on to strawbale building because of his experience as a qualified solid plasterer; he had rendered strawbale walls before and this gave him added confidence that he could tackle the job. I told Rob that in every television story or article I have ever seen about strawbale building, the rendering is the bit that seems to cause

heart-stopping anxiety for the owner-builder. But Rob doesn't seem to know what the fuss is about. "It's not really hard if you do it for a living. A lot of people struggle with the rendering (but) that was an easy task for me."

It is pretty clear that Rob has a calm but dedicated approach to rendering. He doesn't believe in spraying the render onto the bales, preferring to apply it by trowel, a technique that achieves better depth and coverage. There are a number of rendering options for strawbale walls, but Rob and Veronica opted for a lime render (lime putty mixed with sand) and it has come up an absolute treat. The limestone-coloured finish looks fantastic, especially when contrasted with the green forest that surrounds the property. He applied three layers, serrating a 50mm layer on either side of the strawbales. Rob says the only glitch with the lime render is that it takes a bit longer to dry; not a huge problem.

Sustainable materials

The house was designed by Glenda Shomaly, a sustainable building designer based in Torquay. Glenda has been in the industry for 25 years and has a passion for sustainable design.

"I always loved using natural building materials," she says. "I've done quite a few mud brick houses and then I got really interested in rammed earth. And always minimal heating requirements and trying not to get houses air-conditioned."

She has designed a number of strawbale houses in the region and is an unashamed fan. "It's a really beautiful solution to sustainable housing. It has absolutely superb insulation. And the look of it is very soulful, isn't it? The thickness of the walls creates a sense of security."

Glenda designed the house to suit the size of the available bales and the recycled windows and doors that Rob and Veronica had purchased. Bringing all these dimensions together took careful planning.

A 920 watt photovoltaic system provides nearly enough electricity for the household.

"It was a real play, a jigsaw," she says. "Structurally, I think you've got to be very careful (when designing strawbale houses). I worked it to suit the bales; absolute minimum cutting. The other thing is to minimise overuse of materials. Strawbale building doesn't end up being resource efficient unless you design carefully."

Design features

The abundance of window space along the north wall means that the main living area is bathed in sun during the winter months, and when I visited the Phillips on a crisp day the room was superbly warm. During the summer months, the north-facing windows are shaded from the higher sun.

The living area has an earth floor, a mixture of clay, sand and cow manure, which has been finished with a linseed oil/turpentine mixture. It collects loads of warmth when the low winter sun enters the house through the north glazing. Earth floors are renowned for their thermal energy storage, and that collected warmth is released in the evening. The kitchen and the bathroom are separated by a mud brick wall, which collects heat from the stove and acts as another thermal energy store. Of course, when things heat up in summer, the thermal qualities of the earth floor come into play again, keeping the area cooler.

The roof is insulated by poly-wool blend batts and this, combined with the high insulation qualities of the strawbale walls, means the house has incredible insulation. Rob says they considered double-glazing for the windows, but the house is so well-insulated that they do not see how it could get much better than it is now.

The house is built around a cyprus timber frame, which sets off the white lime rendering. The cyprus was sourced from Lorne and Bambra to cut down on transport miles; Rob and Veronica tried to source all materials as locally as possible. A large portion of other materials were recycled, including doors, windows and some other timber.

A Rotaloo (composting toilet) has been installed on the hearth at the top of the stairs. This position solves a common problem with Rotaloos; getting access beneath the system.

With all the misconceptions held by mainstream society about composting toilets, it is funny to think that the Phillips kids find conventional toilets somewhat off-putting. "They've never lived in a conventional house. I mean they go and stay in their friends' house and they find the toilets offensive because if you go into a conventional house the odour stays with you. And yet, with the Rotaloo there is no odour whatsoever. It is taken away by the fan."

Water

There is no mains water on the property, so two main rainwater tanks of 7000 litres each collect run-off from the roof. This water is then pumped into an elevated tank at the top of the property, which has enough height to provide gravity-generated pressure for use in the house. There are also a couple of smaller tanks to collect extra rainwater from the roof for use in the veggie patch.

The greywater is recycled via a trench system. Water from the kitchen passes through a skimming box, which filters out the nasty oils and fats. It then joins the rest of the household greywater in a septic tank. From this tank, the water runs through a series of midi trenches that channel the water for use in the garden. Being underground, this greywater system is basically invisible other than a small manhole in the garden.

Energy use

The house is powered by a 920 watt off-grid system; this almost covers the family's needs but a generator is used sometimes.

Heating is provided by a wonderful old cast-iron bread oven in the downstairs living room, although it is not needed much because of the house's clever passive-heating design. One of the best things about this set-up is its clever use of the flue. The problem with most wood fires is the amount of heat that escapes upward and is lost outside the house. But this wood heater goes some way to correcting that problem. Whereas most flues are exposed to one room and then head straight out the roof, this fireplace has been positioned in the centre of the double-storey house. The flue extends up from the fire on the ground floor, radiating heat as it goes, coming up through the floor on the second level to do the same job in another section of the house. The flue extends from floor to ceiling in the upstairs living room, warming that room and the three bedrooms with doors facing the flue-warmed area. Rob and Veronica say that it keeps the bedrooms nice and warm at night.

The main header tank.

The walls have been rendered with a lime and sand mix up to a 50mm thick layer.

A solar hot water system was picked up secondhand and is doing the job sufficiently; keep in mind that this is a family of five. It is a Beazley tank with a capacity of 315 litres and the family makes do without a regular booster other than the wood heater.

The finished product

The term 'finished product' has to be used very carefully for the home of any owner builder; there is always something else to do. But after a tonne of work, initiative and imagination, this house is looking fantastic and can wear the 'finished' tag. ✻

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A plan for a green future

The Alternative Technology Association has produced a comprehensive list of recommendations on how to address climate change. Here's to a low carbon future.

Most *ReNew* readers would probably welcome more government assistance to do their bit for the environment. Rebates are always a good incentive, as are feed-in tariffs for grid-connected solar households. From working with its active member base, the Alternative Technology Association (ATA) has made a list of what can be done to address climate change at a government level, with a strong focus on empowering households.

The recommendations were initially prepared for the Victorian Government Climate Change Green Paper, however, a copy has been sent to all state and territory leaders.

The Green Paper outlines the state's role in complementing a national Carbon Pollution Reduction Scheme, describes how Victoria can take advantage of a low carbon economy and also proposes ways to adapt to the impacts of climate change.

The next step will be the Climate Change White Paper, a result of all the information and ideas put forward during the public consultation process. This charts the way forward for the next decade and beyond.

The ATA's submission made 16 recommendations based on research, consultation with other NGOs and, most importantly, the experience of members and supporters in working towards sustainability.

The main message is that individuals and communities need help to achieve sustainability and respond to the climate emergency. This conclusion rests on the following three themes, which are explored in separate sections of the submission.

Photo: Georgina Bittner

Can state governments support more families like this? The Packer family is leading the way when it comes to living sustainably. Household hot water is from the roof mounted solar collectors and storage tank, with a gas boost unit for the cooler months. The 1440W photovoltaic system supplies around half of the electricity needs for the family of five.

- The CPRS will not in itself deliver a safe climate. Stronger targets, further mitigation action and complementary measures will be needed to reduce emissions in line with the conclusions emerging from recent climate science.
- Communities and individuals are active and keen but need assistance to reduce emissions. This is a key role for a state government, positioned closer to the community than the federal government but with a broader and more strategic ambit than local government.
- Communities and individuals need support to develop resilience to a changing climate and economy. This requires a more integrated and sophisticated agenda than the traditional mitigation/adaptation dichotomy.

Key recommendations include:

- The final White Paper should recognise the limitations of any central policy such as the CPRS and should complement and go beyond the Federal Government's program of action.
- The Victorian Government should strongly advocate to the Federal Government the need to strengthen the CPRS to respond directly to climate science, highlighting the significant support for a strong climate response and the amount of climate-related ac-

tion currently under way at the community level in Victoria.

- Introduction of a legislated target of a 50% reduction in emissions (on 1990 levels) by 2020, in line with the latest climate science that suggests that a longer term global goal of 350ppm CO_2 or less is required to ensure a safe climate.
- A review of the existing Victorian feed-in tariff within 12 months, with a view to expanding the scheme in late 2010 or early 2011. Central to this is comparing it to other state and international schemes.
- A commitment to climate safe, zero net carbon homes by 2020.
- Significant progress towards climate safe new homes and energy efficient buildings in the next 18 months by fast tracking the introduction of 7 Star standards for new homes and renovations in Victoria, introducing minimum 40% water efficiency target for new homes by 2010 and encouraging greenhouse efficient hot water for all new homes.
- Commitment to a program to retrofit one million Victorian homes (half of Victoria's housing stock) for energy and water efficiency by 2015.
- Establishment of a Victorian community climate council or similar body which engages individuals, community groups and local councils on climate change mitigation, setting and achieving a target for emissions reductions and community resilience in adapting to climate change.

Photo: Nick Stephenson

- Introduction of mandatory minimum standards for water and energy efficiency in rental properties to ensure that those in the rental market are not disproportionately affected by energy and water price rises.
- Information, incentives and support for the building, energy and water industries' adjustment towards resilient distributed systems. Government should help these industries adjust to new markets where distributed systems work in conjunction with large and medium scale networks.
- Foster the development of innovation and a diversity of responses to the climate change adaptation challenge with a $2 million per annum community adaptation fund, offering grants up to $100,000 for specific projects designed to increase sociological, economic, ecological and cultural resilience.
- Establishment of a $1 million per annum community technology innovation fund, to supplement efforts to develop new household, neighbourhood and community scale technologies which will reduce greenhouse gas emissions and enhance resilience. ✻

The ATA submission was led by Anjali Brown with assistance from Ian Porter, Damien Moyse and Donna Luckman. For a full list of the ATA's recommendations to the Victorian Government Climate Change White Paper go to www.ata.org.au/projects-and-advocacy/ata-submissions

Sustainable bush buildings, past and present

For Brian Woodward sustainable building has been a passion for life. *Built for the Bush* celebrates his unique country home and the homes of those that came before him, writes Jacinta Cleary.

Long before the terms *oil crisis* and *climate change* became common, some bush homes in this hot and arid country were constructed with a lot of common sense. Put a modern view on these homes and they can be considered sustainable; they made use of what was available from the land around them, used recycled materials, and out of necessity relied on passive heating and cooling techniques.

Built for the Bush

These 19th century bush buildings are being explored in *Built for the Bush: the green architecture of rural Australia*. The exhibition is touring rural New South Wales with the first stop being Shear Outback in Hay, a centre dedicated to the history of sheep shearing but also home to exhibitions about country life. Hay, around eight hours drive from Sydney and five and a half hours from Melbourne, is the sort of place where consideration for the climate is essential when building.

As well as celebrating the ingenuity of builders and architects working in the bush, the exhibition explores some of the passive climate control strategies of Australia's 19th century homes and the reappearance of these traditional practices in contemporary sustainable architecture, such as Brian Woodward's home (pictured right). For 19th century rural builders the creation of simple, energy efficient homes was a matter of necessity, with limited skills, resources and materials at their disposal. Today low-impact buildings are relevant as we try to limit damage to the environment.

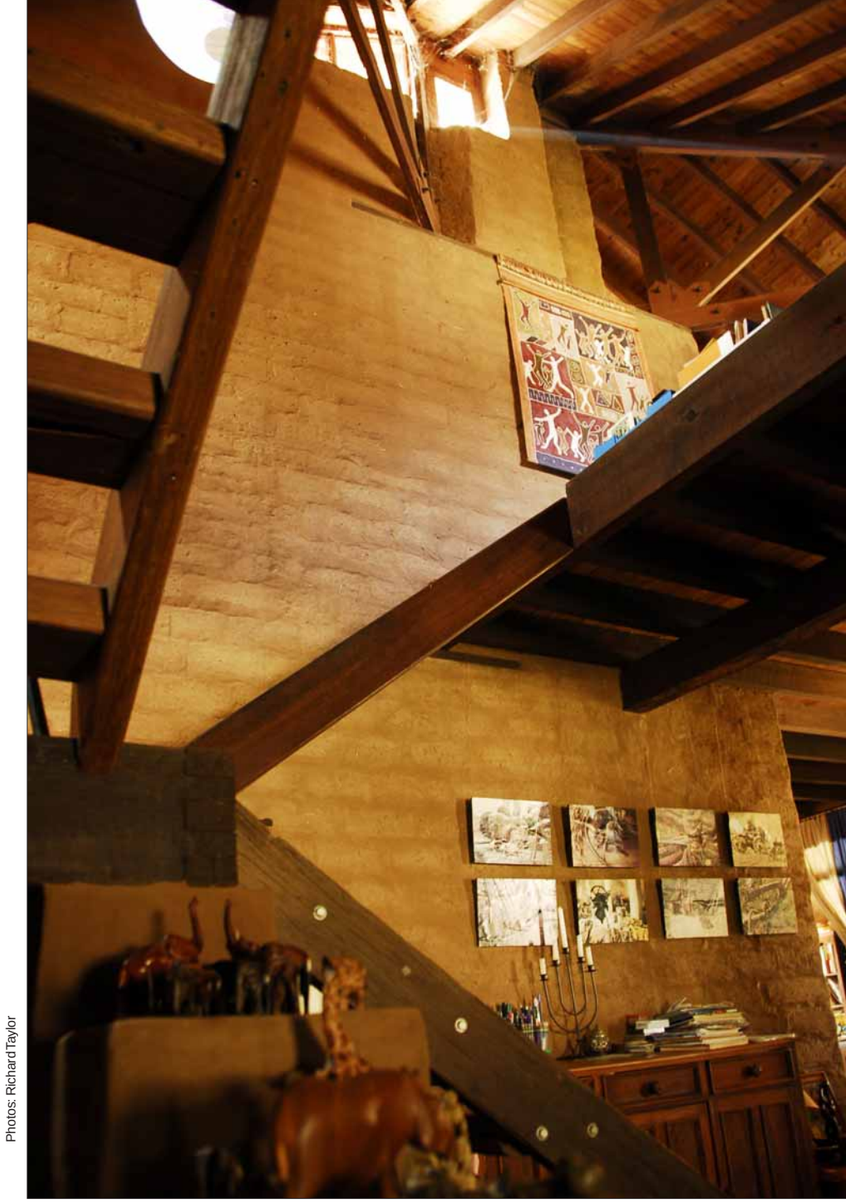
The timeline of Australian bush architecture is a fascinating one. Exhibition curator Richard Taylor describes the period around colonisation as a time when "British architecture was dominated by Georgian design, with its elegant doll's-house symmetry," but unfortunately ill-suited to the climate.

Brian Woodward falls into what Richard Taylor might classify as the 'new settler' of recent decades, a time when environmental concerns led to more sustainable buildings. "A deeper response to environmental issues occurred in the 'new settler' movement of the 1960s and 70s which, rejecting the increasing consumerism of mainstream society, headed back to the land to build communities—and houses—more in tune with the environment. The 'return to the land' movement revitalised the practice of building with natural and recycled materials and off-the-grid independence," says Richard.

As an architect and lecturer on sustainable architecture for many years, Brian Woodward set about designing and building his own self-sufficient home in the New South Wales Hunter Valley. Construction started nearly 30 years ago and to some extent is still going. Now the home has been included in the *Built for the Bush* exhibition.

Like many long-time readers of *ReNew*, Brian's interest in sustainability gained momentum during the 1973 fuel crisis. "It was an awareness of how as a society we were dependent on materials that we were squandering at such a fast rate without concern about the effect that was having on the environment."

His response was to build his own



Photos: Richard Taylor

Brian Woodward and Sally Middleton's mud brick home in the Hunter Valley; Right: smooth interiors. Below: Brian surveying a batch of mud bricks.

home out of mud brick. At the same time Brian was lecturing at the University of NSW in the rather straight-down-the-line topic of CAD (computer-aided design). He taught his passion of earth building on the side to keen students and still runs workshops on the topic.

Living on the edge of a national park around an hour and a half from Newcastle means that Brian, partner Sally and their two teenage kids chose to be as self-sufficient as possible, much like the early settlers, although they are greatly assisted by photovoltaic technology.

Off-the-grid living for this family involves a 1200W photovoltaic system with a 500Ah 24V battery bank with an upgrade to 2000Ah batteries planned soon. The inverter is a Latronics 2000W unit. In summer hot water comes from a solar hot water system designed and built by Brain and a fuel stove in winter.

Mud brick has been used where possible including the floor, which can absorb heat in winter for release later in the day. There is not a great need for artificial heating and cooling, except for some back up from the wood stove in winter. This is because the home has good passive solar design, essential to deal with the extreme temperatures of up to 40°C in summer and sometimes -7°C in winter. "The advantage of the thermal capacity of the mud bricks is that it can store energy. In winter it can store heat. The building never gets above 28°C despite the temperature outside reaching 42°C. Most of the time it's around 22°C. In winter, even without heating, it has never been below 12°C," says Brian.

The rainwater tank is corrugated iron with a 10,000 litre capacity, with back up water supply from a hand-dug well. The property also has a greywater grease trap and absorption trench and a composting toilet to keep water use down.

When Brian describes the benefits of building with earth you can understand why it was so appealing to early settlers with limited resources. "It is a material that is very easy to learn so it is available to everybody, it has wonderful sound qualities, it has fire resistance in a country that has major fire problems. It means you can build for virtually nothing. The advantages to me are unlimited.

"It doesn't take very long to learn to lay bricks pretty accurately and the walls are so thick that some inaccuracy is not a problem," says Brian.

Brian Woodward's home is designed to last a couple of centuries in a country where the average house lasts 35 years,which is relatively short compared to homes in the US and UK. Richard Taylor puts this down to borrowing housing models from overseas, not a good idea when building for a unique Australian climate. "An enormous amount of energy is consumed each time a house is built; the longer the house survives, the better the value that investment represents," says Richard. To make our homes liveable and long-lasting we need to focus on design for this climate and develop more of an Australian style. *Built for the Bush* explores what a sustainable Australian style can be. ✲

For more information about mud brick house design and Brian Woodward's workshops visit http://sites.google.com/site/earthwayssustainable

Regular readers of *ReNew* might remember Alison and Boyd's house in *ReNew 87* (*The long small house*). As it turns out, their home is a classic example of bush design and is featured in *Built for the Bush*, along with their studio (pictured). Their studio is made out of recycled materials found in Redfern, Sydney. "Every material in there, except for the bolts, were found materials. Either found in the bush here or found on the street," says Alison.

Exhibition details

Built for the Bush is presented by the Historic Houses Trust NSW. The exhibition is currently on at Shear Outback, Cnr Sturt and Cobb Highways, Hay NSW until 27 January, 2010.

Other dates for 2010:

5 February to 4 April Albury City Library Museum; 13 April to 18 July Museum of the Riverina, Wagga Wagga; mid July to mid September Temorah Historical Society; mid September to end November Pioneer Park, Griffith.

Visit the Historic Houses Trust website for full details www.hht.net.au

***ReNew* magazine is a proud supporter of *Built for the Bush*.**

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Solar panel buyers guide

Finding the right solar panel for your needs requires a lot of research. Lance Turner takes a look at the options. Tables by David Ingram.

Incentives such as feed-in tariffs and rebates mean that many more households and businesses are considering solar photovoltaics for electricity. Best of all is that this electricity source is clean and renewable.

Photovoltaic panels produce electricity directly from sunlight. They are used to power houses (on and off the mains grid), water pumps and remote communications systems, as well as in large commercial solar power installations.

In its most common form, a solar panel consists of a number of photovoltaic cells connected together. These cells are usually coated in a plastic such as ethylene vinyl acetate (EVA) and sandwiched between layers of glass and/or plastic, or sometimes plastic and metal. The collection of cells is usually surrounded by a metal or plastic frame for strength and to allow easy mounting of the panel. A junction box is often mounted on the back of the panel to allow easy electrical connection, though some panels have flying leads for connection.

Where glass is used as a covering for solar panels, it is usually low-iron glass, to allow as much light transmission as possible, thus maximising power output.

Many panels have glass on the front and a plastic, such as Tedlar, on the back to seal the panel. There are also panels designed to replace windows and other glass panels in architectural uses, and they may have glass on both sides of the cells, depending on their intended use. This means the home owner can offset some of the cost of the solar panels, as the panels themselves double as building materials. PV Solar Energy roof tiles fall into this category.

Photo (c) André Karwath, cc-by-sa

Most other solar panels are designed to be mounted on external frames, themselves mounted to a building's roof or other frame, such as a solar tracker, but there are also flexible stick-on panels that can simply be stuck to suitable roofs or structures.

The different technologies

There are three common types of solar cells: monocrystalline, polycrystalline and thin film.

Both mono and polycrystalline cells are made from wafers cut from blocks of silicon, which are then modified by a process known as 'doping'. This involves heating the cells in the presence of boron and phosphorus, which changes the structure of the silicon in such a way as to make it a semiconductor. This is the same method which is used to make integrated circuits.

Once the wafers have been doped, they then have a fine array of electrically conductive current-collecting wires applied to each side of them.

Thin film technology uses a different technique, and involves the deposition

of layers of different materials directly onto metal or glass. The most common thin-film panels are the amorphous silicon type, which are found everywhere from watches and calculators right through to large grid-connected PV arrays.

In recent years, other types of thin film materials have started to appear. These include CIGS (Copper Indium Gallium (di)Selenide) and CdTe (Cadmiun Telluride). They tend to have higher efficiencies than amorphous silicon, with CIGS cells rivalling crystalline cells for efficiency.

Flexible panels are a spinoff of thin film technology. These are manufactured on a plastic or thin metal substrate and can be rolled up or attached to curved surfaces. They are commonly used for camping and boating, but are generally quite expensive on a dollar-per-watt basis, although larger ones designed for mounting on buildings are competitive with conventional rigid panels.

Another recent development is the tubular solar panel, manufactured by Solyndra and available in Australia through Clear Solar. They look more like an evacuated tube solar hot water collector than a PV panel. The design involves coating the inside of glass tubes with thin film PV material. The resulting panel supposedly increases output and reduces wind resistance of the panels, meaning they can be mounted on a roof without penetrating the roofing material (according to the manufacturer).

As far as material use is concerned, crystalline panels use a great deal more semiconductor material than an equivalent output thin film panel. This occurs for two reasons. The first is that a lot of material is lost in the process of cutting the silicon boule or billet into slices (wafers). The cutting is done with a diamond saw or wire, which may well be thicker than the resulting wafers, so more than half of the silicon may be lost in this process. Manufacturers have been working on reducing this wastage, but it is still a considerable proportion of the total material.

The other reason for greater material use with crystalline cells is that, because they are handled as individual cells, they must be robust enough to withstand mechanical handling. So a good proportion of the cell is actually there just to provide support to the active junction. This is also an issue that manufacturers are working to improve upon, with cells slowly becoming thinner in recent years (although not by a great deal).

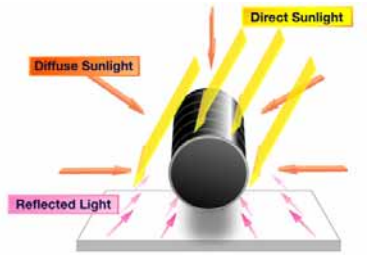
Thin film panels don't have these problems and so may use less than 1% of the semiconductor material as a crystalline panel. An example is the Kaneka thin film modules. These have an active material thickness of just 0.3 micrometres. Compared to a typical crystalline cell thickness of 100 to 200µM, this is as little as $^1/_{600}$th of the silicon, and that doesn't take into account the silicon wasted by the cutting process for crystalline cells.

There are two reasons why silicon use can be an issue. The first is the embodied energy of the silicon—it takes a lot of energy to make the highly-purified silicon used in solar panels. The second is the fact that high-grade silicon suitable for this sort of use can be in short supply due to the demand for it in both solar cells and integrated circuits, although with recent economic events, there is now a glut of manufacturing capacity which is driving panel prices down.

Indeed, prices in the US have been less than US$3 per watt for many brands for a while now. While Australia hasn't reached that level yet, there are signs that prices are indeed becoming more realistic, with panels approaching the $5 per watt mark, and some direct imports being cheaper still.

Panel ratings

There are a number of different ratings on solar panels, so let's have a look at what they are and what they mean.



The novel Solyndra panels use glass tubes lined with thin film material rather than flat sheets of glass like regular panels.

Rated (peak) power: This is the maximum sustained power output of the panel, assuming a level of insolation (strength of light falling on the panel) of one kilowatt per square metre. In general, the solar panel's rating is the rated peak power.

Nominal voltage (Vn): The system voltage that the panel is designed to be used in. A 12 volt panel is designed for a 12 volt system, but will produce voltages well above 12 volts. Some panels can be rewired to suit six or 24 volt systems. Other panels are designed for grid-interactive systems and have nominal outputs of 48 volts or even higher.

Voltage at peak power (Vp): This is the voltage measured across the panel when the panel is producing peak power.

Current at maximum power (Im): The maximum current available from the panel at peak power.

Open circuit voltage (Voc): The maximum voltage available from the panel with no load attached. This is usually around 21 volts for a 36 cell, 12 volt unit.

Short circuit current (Isc): The current obtained when the output of the panel is short circuited with an insolation level of 1000 watts per square metre at a panel temperature of 25°C.

Temperature at rated power: This is the temperature that the solar panel manufacturer rates their panels at. Most panels are rated to put out their maxi-

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Our top quality monocrystalline panels offer the same high-end efficiency and robust construction of other well-known brands whilst offering a nice cost saving. All larger 65-175W panels are fitted with a TÜV approved waterproof junction box with cable glands, and our smaller panels are fitted with a slimline junction box with silicone cable sealant. All panels are rigorously and each come complete with a manufacturer's test result. So we have no qualms about backing you with our own 20-year peace of mind warranty.

- *175W panel (ZM-9099) is IEC certified for the Solar Rebate Scheme*
- *Note: solar panel prices are reviewed regularly - see website for latest prices*

VISIT OUR WEBSITE for our updated prices

		WAS	NOW	SAVE
12V 5W	(ZM-9091)	$78.20	$59.95	$18.25
12V 10W	(ZM-9093)	$119	$94.95	$24.05
12V 20W	(ZM-9094)	$191.25	$149	$42.25
12V 65W	(ZM-9096)	$433.50	$399	$34.50
12V 80W	(ZM-9097)	$595	$475	$120
12V 120W	(ZM-9098)	$870.40	$695	$175.40
24V 175W	(ZM-9099)	$1190	$1110	$90

SOLAR PANEL MOUNTING HARDWARE

We have a range of solar panel mounting hardware that is adaptable and modular to fit most applications.

Extruded Rail 1m	HS-8702 $39.95
Extruded Rail 2m	HS-8700 $69.95
U-Type Joiner Bracket 80mm	HS-8714 $19.95
L-Type Bracket Pk 2	HS-8704 $34.95
Z-Type 28mm Bracket Pk 4	HS-8706 $79.95
Z-Type 35mm Bracket Pk 4	HS-8708 $79.95
T-Type 28mm Bracket Pk 2	HS-8710 $39.95
T-Type 35mm Bracket Pk 2	HS-8712 $39.95

LINKABLE SOLAR CHARGE CONTROLLERS

These professional grade, high-current solar charge controllers offer great flexibility to suit most solar installations. With 12, 24 or 48V system voltage, multiple units can be stacked together (up to 10 units parallel) enabling your system to expand without rendering your old charge controller useless. Featuring an LCD and front panel controls, each unit can be used as either a battery charger, load controller or diversion regulator. Connect to PC for custom settings, data logging and remote monitoring. Fully protected against reverse polarity, short circuit, high temperature and overvoltage.

- *System voltage: 12-48V*
- *Max solar voltage: 140V*
- *Max operating voltage: 68V*

45 or 60 amp models, remote sold separately:

45 Amp (MP-3726) $389
60 Amp (MP-3728) $459
Remote (MP-3729) $149

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A great book on all you need to know about solar energy and how you can use it in your home, caravan, or anywhere. Delivered as a comprehensive up-to-date and easy-reading manual. 137 Pages, soft cover.

Solar Electricity (BE-1532) $38.95

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Comprehensive coverage of photovoltaics - from the characteristics of sunlight to the detailed operation of solar cells and specific purpose photovoltaic applications. Aimed towards an engineering level understanding. 313 pages, softcover with illustrations.

Applied Photovoltaics (BE-1533) $55

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IP67 rated and TÜV certified, use with our UV stabilised cable to ensure maximum environmental protection of your solar installation.

ALL YOUR SOLAR ACCESSORIES UNDER ONE ROOF

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Male in-line	(PS-5102)
Panel mount female	(PS-5104)
Panel mount male	(PS-5106)

Was $12.95 NOW $7.50

PV Y-Leads (300mm)

2 sockets to 1 plug	(PS-5106)
2 plugs to 1 socket	(PS-5112)

Was $27.98 NOW $19.95

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*Dust, age and UV resistant, with tinned copper conductors **to minim**ise corrosion. Rated to 1000VDC.*

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***30** Amp 2.5mm² (WH-3120)*
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***55** Amp 6.0mm² (WH-3122)*
$750 per 100m roll or $8.90/m

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Designed to provide a steady amount of current over a long period and can withstand hundreds of discharge/ recharge cycles. Ideal for solar power, camping, 4WD and anywhere deep discharge and recovery is required.

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12V 38Ah (SB-1699) $199
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mum power at 25°C, which is a rather unrealistic figure given that the panel temperature under typical Australian conditions can be up to 70°C. Figure 1 shows how cell temperature affects power output for crystalline panels.

Temperature Coefficient: This is the figure that tells you at what rate a panel's output decreases with rising temperature. For instance, a panel with a temperature coefficient (of power) of -0.3%/°C means that for every degree of panel temperature above 25°C, the output decreases by 0.3%. This doesn't sound like much of a decrease until you realise that the panel might be running at 70°C. In this case, the decrease is 45 (the increase above 25°C) multiplied by 0.3, or 13.5%, a significant amount.

If you live in a hot climate then you should look for panels with as low a temperature coefficient as possible. Temperature coefficients can be specified as a change in output voltage, output current or maximum power. Sometimes only the power figure is given, sometimes all are provided (and sometimes none are!)

Current-voltage (IV) curves: These are graphs of output voltage versus current for different levels of insolation and temperature. They can tell you a lot about a panel's ability to cope with temperature increases, as well as performance on overcast days. Examples of IV curves can be seen in Figure 1.

Obviously, the most important ratings when doing calculations for a power system are the voltage and current at maximum power. A system is rarely calculated using panel wattage ratings, as this is a function of both the voltage and current. Some panels are rated at slightly higher or lower voltages than others, and this affects the amount of current available.

The open circuit voltage and short circuit current ratings are important from a safety point of view, especially the voltage rating. An array of six panels in series, while having a nominal 72 volt rating, can output over 120 volts DC—more than enough to be dangerous.

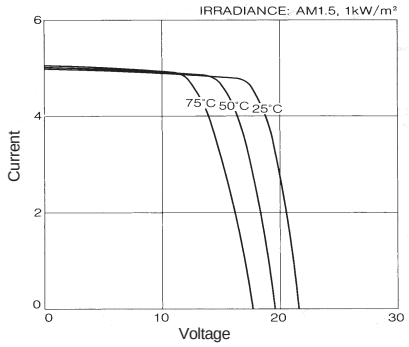


Figure 1. These IV (current-voltage) curves for a typical 80 watt polycrystalline panel show how power output is affected by temperature. You should take this into account when buying panels.

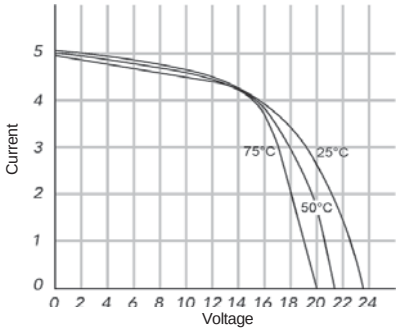


Figure 2. The IV curves for a 64 watt amorphous panel. Note how the maximum power point at the knee of the curves barely moves with increasing temperature.

Heat and shading

These are two factors that can greatly affect solar panel performance. In general, solar panel performance decreases as temperature increases, and a panel rated at 25°C will not perform as well when operating at the hotter temperatures experienced in most parts of Australia. A typical operating temperature in summer can be up to 60°C or higher.

Some companies also supply ratings for temperatures higher than 25°C, so check to see whether these are available. Also bear in mind that, generally, thin film panels perform better when hot than crystalline panels do. In many cases a thin film panel will perform as well or better than a crystalline panel which is rated at up to 10% higher wattage. For example, a thin film 65 watt panel will often perform as well as a 70 watt crystalline unit on an 'overall energy produced per year' basis.

Shading affects different panels in different ways. The reduction in performance of the crystalline panel types, even when a single cell from a panel is shaded, is quite considerable.

Thin film panels often perform somewhat better, especially panels which have bypass diodes built into each cell. Also, because thin film panels usually have cells that are long and thin, they are less likely to have individual cells fully shaded by birds and debris build-up.

However, shade falling on the panels should be eliminated if at all possible—there is not much point investing large amounts of money in power generating equipment if you don't allow it to do its job!

Embodied energy

This is the amount of energy required to produce the panel in the first place and includes all energy used to make every part of the panel, including cells, frame, cable or junction box and assembly. Some panels, especially the thin-film units, will repay their energy 'debt' within a year or two, while others, especially monocrystalline panels, take longer. However, all panels on the market will produce more energy than they use over their lifetime, if installed and used correctly.

Manufacturers are starting to provide embodied energy information on request, so we have included it in the tables accompanying this guide when available.

What to look for

It's important to buy a panel that has the correct ratings in both voltage and current, with consideration given to their performance as determined by their IV

curve. You also need to look for a few other things when buying, such as construction quality, frame type and panel shape and weight. Some panels may be more suited to your roof shape than others, especially when used on small buildings such as sheds or outdoor toilets.

Panel quality is very important. Many of the small amorphous panels manufactured in China are of variable quality—some last many years, others die a quick death—so be wary of these. However, the overall quality of Chinese panels has improved considerably in the last few years due to intense competition, so don't discount a panel just because it comes from China. Indeed, the biggest panel manufacturer in the world is based there.

Any solar panel worth buying will come with a long warranty. If the manufacturer doesn't have enough faith in their product to offer a good warranty, then why would you buy it? Most panels come with a warranty of at least five years, and some warranties are up to 25 years. We have not included any panel with less than a two-year warranty in this guide.

Warranties come in different forms. Some are just a power output warranty but don't cover things like construction quality, while others are a bit more comprehensive. Ask questions before you hand over any money.

About this buyers guide

ReNew buyers guides are intended to provide general information about the types of devices available on the Australian market. They are not intended to be a Choice magazine style testing review of each device, as we do not have the resources to test each make and model available.

ReNew does not endorse any particular device over other similar units, and the appearance of information and photos of particular products should not be seen as a promotion of that device over any other.

Another factor is whether the panels are made locally. As far as we know, there are no panels currently available that are fully made in Australia. BP solar has ceased Australian production since we last updated this guide.

Installation and rebates

The federal government rebate for PV panels recently finished and has been replaced with the Solar Credits scheme, whereby elligible PV installations receive many more RECs (renewable energy certificates) than represent the actual energy generated. This equates to a cash back similar to the previous rebates, but it also means that in order to get this benefit you must surrender your RECs (usually to the installer at the time of installation).

This scheme awards an artificially inflated number of RECs to each system, distorting the annual targets achieved under the RET (Renewable Energy Target), as the additional RECs produced will allow more carbon to be emitted from electricity generation, not less.

Fortunately, it is becoming economically viable now to ignore the scheme and buy lower cost solar panels and do much of the installation yourself. Indeed, it should be possible to do a self-installed system without RECs for a cost comparable to that of some of the more expensive commercially installed systems that requires the surrender of the RECs. Of course, a self-installed system still requires any 240 volt components to be installed and wired by a suitably qualified person.

For your system to be eligible for Solar Credits you must use panels that are certified for the scheme. A list of certified panels can be found at the Clean Energy Council website at www.cleanenergycouncil.org.au

About the table

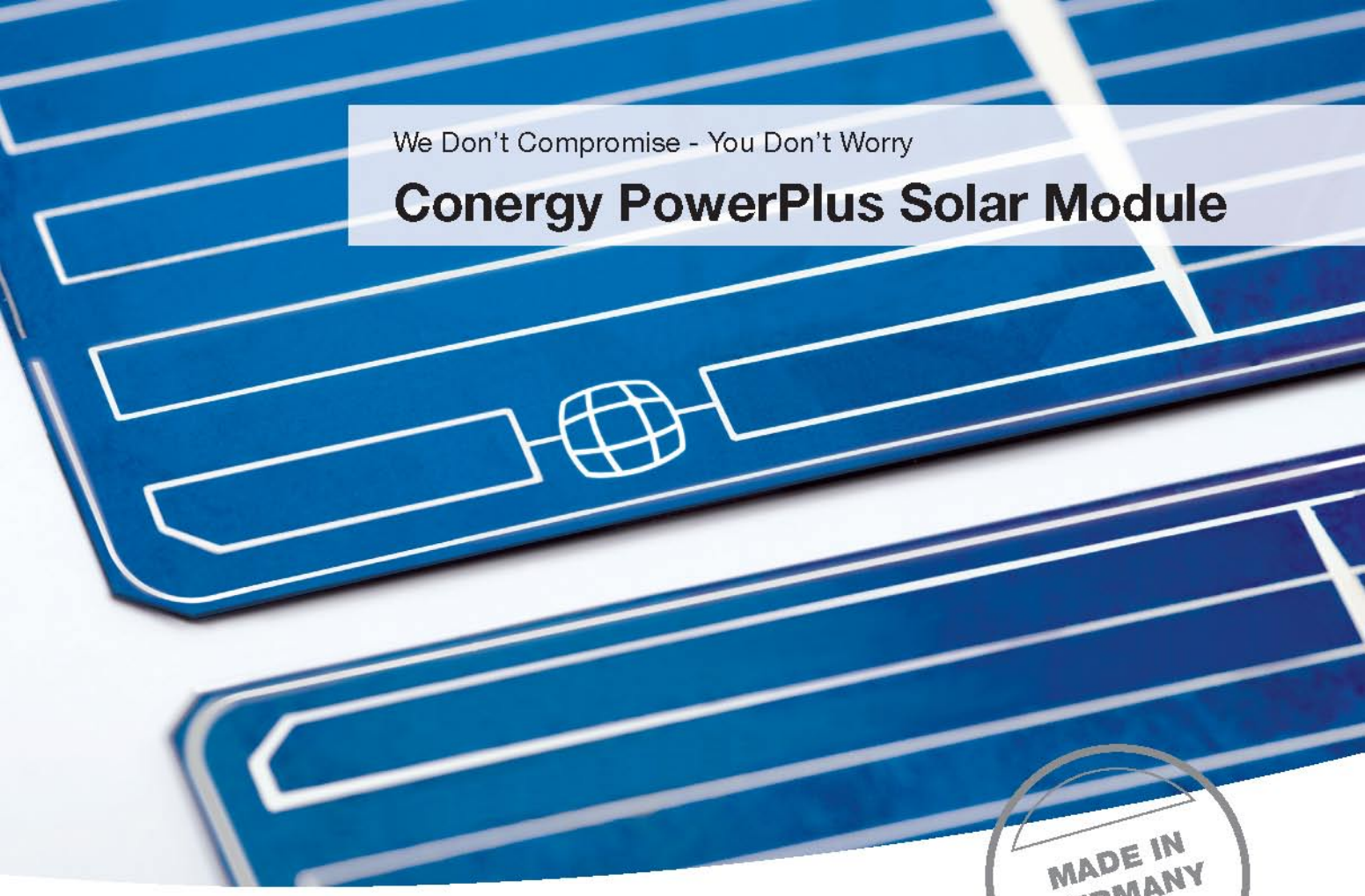
The table in this article lists all of the panels suitable for solar power systems that we were able to find. It includes all of the important information, including maximum power voltage and current (usually rated at 25°C) cell type, and panel construction and dimensions, including weight. Also included are recommended retail prices including GST and the cost of each panel in dollars per watt. However, prices should be taken with a grain of salt. Many dealers will offer panels at lower cost, so don't settle for the first price you are given—ring around! ✻

Brand (made in)	Model	Rated power (watts)	Voltage at max power	Current at max power	Cell type	Cell temp at which panel is tested	Construction	Size (L x W x T)	Weight (kg)	Warranty (years)	RRP Inc GST ($)	Cost per Watt ($)	Time to recover embodied energy (years)	Rated lifetime (years)	Comments
ASTROnergy (China) SOLCO Choice Electric ph:1800 074 007 info@solco.com.au www.solco.com.au	CHSM 5409M	80	16.4	4.88	Monocrystalline	25	Glass/Tedlar, aluminium alloy frame, anti-reflective coating	1200 x 554 x 35	10	25, 10, 3	477.72	5.98	3 years	25	Suitable for use in all on and off grid applications. Each Astronergy module has the power flash test result printed on the back laminate. This allows for better module matching and string configurations.
	CHSM 5612M	170	34.3	4.96				1580 x 808 x 45	15.5		935.00	5.50			
	CHSM 6610M	215	27.9	7.71				1652 x 994 x 45	20		POA	-			
	CHSM 6610P	215	29.6	7.96	Polycrystalline			1652 x 994 x 45	20						
	CHSM T500	120	105	1.14	Thin film			1300 x 1100 x 7	25.5				2 years		
BP Solar (Europe, China, India) BP Solar Australia ph:1800 802 762 www.bpsolar.com.au NZ: Able Solar Ltd ph:(09) 837 2211 info@ablesolar.co.nz	HX2M	2	16	0.14	Polycrystalline	25, corrected	Glass, EVA, Polyester	275 x 145 x 23	0.5	12, 2	Ask your BP Solar retailer for pricing. See website for a complete list of BP Solar distributors		2 to 4 for complete system, less for module only	25+	New warranty programme to be launched as of 1/01/2010
	HX5M 6V	5	8.4	0.54				269 x 251 x 23	0.8						
	SX305M	4.5	16.5	0.27				269 x 251 x 23	0.8						
	SX310M	10	16.8	0.59				421 x 269 x 23	1.5						
	HX10M 6V	10	8.4	1.10				421 x 269 x 23	1.6						
	SX320M	20	16.8	1.19				502 x 421 x 23	2.5						
	SX320J	20	16.8	1.19				502 x 425 x 50	3						
	BP330J	30	16.8	1.78				796 x 358 x 50	3.9						
	BP340J	40	17.3	2.31				655 x 537 x 50	5.8	25, 12, 5					
	BP350J	50	17.5	2.90				839 x 537 x 50	6						
	BP365J	65	17.6	3.69				796 x 674 x 50	6.4						
	BP380J	80	17.6	4.55				1209 x 537 x 50	7.7						
	BP3125J	125	17.4	7.20				1510 x 674 x 50	12						
	BP3170N	170	35.6	4.80				1593 x 790 x 50	15.4						
	BP3170T	170	35.6	4.80				1587 x 790 x 50	15.4						
	BP4165N	165	34.3	4.80	Monocrystalline			1593 x 790 x 50	15.4						
	BP4165T	165	34.3	4.80				1587 x 790 x 50	15.4						
	BP4165J	165	34.3	4.80				1593 x 790 x 50	15.4						
	BP4175N	175	35.4	4.94				1593 x 790 x 50	15.4						
	BP4175T	175	35.4	4.94				1587 x 790 x 50	15.4						
	BP4175J	175	35.4	4.94				1593 x 790 x 50	15.4						
	BP4180T	180	35.8	5.03				1587 x 790 x 50	15.4						
CETC SOLAR Group Corporation Clear Solar ph:1300 425 327 www.clearsolar.com.au	160WP	160	34.5	4.64	Monocrystalline	25	Glass/EVA/tempered glass	1581 x 809 x 35	16	25 years output guarantee	POA	-	-	-	-
	165WP	165	35.4	4.66					16						
	170WP	170	35.8	4.75					16						
	175WP	175	35.2	4.85					16						
	180WP	180	36.2	4.97					16						
China Sunergy (CEEG) & QSE NUE Pty Ltd ph:(03) 8796 5100 info@nuenergy.com.au www.nuenergy.com.au	CSUN 185M-190	190	36.2	5.25	Monocrystalline	25	Glass/Tedlar	1580 x 808 x 50	16	25	Prices on application.		2.5	25+	High efficiency monocrystalline solar cells.(18.5%). Certified to IEC61215 and 61730
	CSUN 290M-300	300	36.1	8.32				1956 x 990 x 50	23.8						
	SL20CE-18M	20	17.6	1.13	Monocrystalline	25	Glass/Tedlar	640 x 300 x 28	2.6	25					High efficiency monocrystalline. Certified to IEC61215 and 61730
	SL45CE-18M	45	18.9	2.39				668 x 545 x 35	4.3						
	SL50CE-18M	50	17.4	2.88				845 x 545 x 35	5.2						
	SL60CE-18M	60	18.9	3.18				845 x 545 x 35	5.2						
	SL180CE-36M	180	37.7	4.77				1580 x 808 x 40	15.0						
	SL220CE-48M	220	47.8	4.60				1600 x 1056 x 40	19.5						
	SL75CE-18P	75	17.7	4.24	Polycrystalline			895 x 668 x 35	9.0						
	SL80CE-18P	80	18.2	4.39				895 x 668 x 35	9.0						
	SL100CE-18P	100	17.5	5.71				1245 x 668 x 35	11.6						
	SL120CE-18P	120	17.5	6.86				1485 x 668 x 35	11.6						
	SL180CE-27P	180	26.2	6.85				1485 x 990 x 40	17.0						
	SL220CE-30P	220	30.1	7.30				1640 x 990 x 40	18.6						
CNPV Dongying Photovoltaic Power Co Ltd (China) CNPV Australia & NZ ph:+61 419 216 267 marketing@cnpv-power.com www.cnpv-power.com	CNPV-75M	75	17.4	4.31	Monocrystalline 36 x 125 mm cells	25, corrected	Glass/EVA/back sheet - white (black or transparent optional). Aluminium frame - silver or black	1200 x 540 x 35	7.5	25, 10, 5	438.75	5.85	<1.5 years	25+	IEC61215, IEC61730, CE
	CNPV-80M	80	17.6	4.55				1200 x 540 x 35	7.5		468.00	5.85			
	CNPV-85M	85	17.9	4.76				1200 x 540 x 35	7.5		497.25	5.85			
	CNPV-90M	90	18.3	4.92				1200 x 540 x 35	7.5		553.50	6.15			
	CNPV-95M	95	18.8	5.06				1200 x 540 x 35	7.5		584.25	6.15			
	CNPV-125M	125	17.8	7.05	Monocrystalline 36 x 156mm cells			1492 x 674 x 40	13	25, 10, 5	731.25	5.85			IEC61215, IEC61730, CE 36 x 156mm polycrystalline version also available
	CNPV-130M	130	18.0	7.20				1492 x 674 x 40	13		760.50	5.85			
	CNPV-135M	135	18.2	7.40				1492 x 674 x 40	13		789.75	5.85			
	CNPV-140M	140	18.4	7.60				1492 x 674 x 40	13		819.00	5.85			
	CNPV-145M	145	18.6	7.80				1492 x 674 x 40	13		848.25	5.85			
	CNPV-175M	170	35.8	4.75	Monocrystalline 72x 125mm cells			1581 x 809 x 40	15.5	25, 12, 10	875.50	5.15			IEC61215, IEC61730, CE IP67 TUV, UL Junction box & MC4 connector (premium FPE aluminium junction box and MC4 connector also available)
	CNPV-175M	175	36.6	4.80				1581 x 809 x 40	15.5		901.25	5.15			
	CNPV-180M	180	37.2	4.85				1581 x 809 x 40	15.5		927.00	5.15			
	CNPV-185M	185	37.8	4.90				1581 x 809 x 40	15.5		952.75	5.15			
	CNPV-190M	190	37.8	5.05				1581 x 809 x 40	15.5		1026.00	5.40			
	CNPV-195M	195	37.9	5.15				1581 x 809 x 40	15.5		1053.00	5.40			
	CNPV-210M	210	29.2	7.20	Monocrystalline 60 x 156mm cells			1650 x 992 x 46	19.5	25, 12, 10	1081.50	5.15			IEC61215, IEC61730, CE. 60 x 156mm polycrystalline version also available. IP67 TUV, UL Junction box and MC4 connector (premium FPE aluminium junction box and MC4 connector also available)
	CNPV-220M	220	29.8	7.40				1651 x 992 x 46	20.5		1133.00	5.15			
	CNPV-230M	230	30.3	7.60				1652 x 992 x 46	21.5		1184.50	5.15			
	CNPV-240M	240	30.8	7.80				1653 x 992 x 46	22.5		1296.00	5.40			
	CNPV-245M	245	30.9	7.93				1654 x 992 x 46	23.5		1323.00	5.40			
	CNPV-250M	250	40.0	8.05				1655 x 992 x 46	24.5		1350.00	5.40			
CNPV (China) MPower ph:1300 733 004 www.mpower.com.au	CNPV-185M	185	37.8	4.9	Monocrystalline	25	Glass, EVA, Tedlar	1581 x 809 x 40	15.0	25, 12, 10	984.50	5.32	2	25+	10 year workmanship and materials warranty. Dual insurance on performance warranty.
Conergy (Germany) Conergy Pty Ltd ph:1300 551 303 www.conergy.com.au	PowerPlus 170MC	170	22.97	7.47	Monocrystalline	25	EVA embedded cells, 3 bus bars, 4mm tempered solar glass, screwed sturdy aluminium frame without cavities	1335 x 986 x 46	18	25 at 80% output 12 at 92% output 5 on product (extended 10 year product warranty available on request)	POA	-	-	35+	Exclusively positive power tolerances, Huber+Suhner connection, IEC 61730 certified to 5.4kPa & IEC 61730 salt mist declaration, cardboard-free packaging.
	PowerPlus 175MC	175	23.41	7.55											
	PowerPlus 180MC	180	23.83	7.62											
	PowerPlus 185MC	185	24.18	7.69											
	PowerPlus 220M	220	29.37	7.56	Monocrystalline			1651 x 986 x 46	22						
	PowerPlus 225M	225	29.79	7.62											
	PowerPlus 230M	230	30.14	7.68											
	PowerPlus 240M	240	30.18	7.95											
	Powerplus 210P	210	28.65	7.41	Polycrystalline										
	PowerPlus 215P	215	28.8	7.54											
	PowerPlus 220P	220	29.01	7.65											
	PowerPlus 225P	225	29.23	7.74											
	PowerPlus 230P	230	29.54	7.82											

Brand (made in)	Model	Rated power (watts)	Voltage at max power	Current at max power	Cell type	Cell temp at which panel is tested	Construction	Size (L x W x T)	Weight (kg)	Warranty (years)	RRP Inc GST ($)	Cost per Watt ($)	Time to recover embodied energy (years)	Rated lifetime (years)	Comments
Conergy (Japan) Conergy Pty Ltd ph:1300 551 303 www.conergy.com.au	C 121TF	121	45	2.69	Thin Film (micromorph tandem cells)	25	Aluminium frame with stabilisation rails. Micromorph tandem cell technology, consisting of amorphous and microcrystalline silicon solar cell structure	1409 x 1009 x 46	19	25 at 80% output 10 at 90% output 5 on product	POA	-	-	25+	MC III connection, IEC 61646 ed. & IEC 61730 certified. Manufactured under ISO 9001 and CE declaration.
Conergy (China) Conergy Pty Ltd ph:1300 551 303 www.conergy.com.au	P 170M	170	35.9	4.74	Monocrystalline	25	EVA embedded cells, tempered glass, sturdy aluminium frame	1580 x 808 x 45	15	25 at 80% output 12 at 90% output 5 on product	POA	-	-	25+	IEC 61215 & IEC 61730 MC IV connection.
	P 175M	175	36	4.86											
	P 180M	180	36	5											
	P 185M	185	36.1	5.12											
Conergy (India) Conergy Pty Ltd ph:1300 551 303 www.conergy.com.au	Q 5 P	5	16.5	0.31	Polycrystalline	25	EVA embedded cells, tempered glass, anti-reflective coating, aluminium frame	300 x 185 x 22	0.7	25 at 80% output 10 at 90% output 5 on product	POA	-	-	25+	Junction box connection.
	Q 10 P	10	16.5	0.6				385 x 340 x 22	1.1						
Ekoenergy DJ Sharpe Trading ph:(03) 9598 5775 dsh63475@bigpond.net.au	SR05-170	170	35.9	4.74	Monocrystalline	45	Glass/aluminium	1580 x 808 x 45	15	25	680.00	4.00	-	-	Minimum purchase 1kW. Other sizes available.
First Solar (Germany) Conergy Pty Ltd ph:1300 551 303 www.conergy.com.au	FS 270	70	65.5	1.07	Thin Film (Cds/CdTe semiconductor)	25	Frameless laminate material with edge seal, does not require module grounding. 3.2mm heat strengthened front glass. 3.2mm tempered back glass	1200 x 600 x 6.8	12	25 at 80% output 10 at 90% output 5 on product	POA	-	-	25+	Supplied for large projects only, IEC 61646 and IEC 61730, CE Mark, Safety Class II at 1000V, Solarline 1 type connection. Certified to ISO 9001:2000 and ISO 14001:2004 quality and environmental management standards.
	FS 272	72.5	66.6	1.09											
	FS 275	75	68.2	1.1											
	FS 277	77.5	69.9	1.11											
Hyundai Heavy Industries Co Ltd Clear Solar ph:1300 425 327 www.clearsolar.com.au	HiS-S188SF	188	-	-	Monocrystalline	-	Glass/EVA/tempered glass	983 x1476 x 35	17	25 years output guarantee, 3 years for product defect	POA	-	-	-	-
Kaneka (Japan) MPower ph:1300 733 004 www.mpower.com.au	PLE-055	55	16.5	3.33	Amorphous	25	5mm glass/Tedlar/aluminium frame	960 x 990 x 40	7.7	10	501.60	9.12	1	25+	Rated at +10%/-5%. Better temperature coefficient than crystalline. Excellent shade tolerance.
	GEA-060	60	67	0.9				960 x 990 x 40	12	20	482.90	8.05			
Kaneka (Japan) Solar Shop ph:(08) 8362 9992 sa@solarshop.com.au www.solarshop.com.au	GEB	60	67	0.9	Amorphous	25	5mm glass/Tedlar/ aluminium frame	950 x 960 x 40	13.9	25	583.00	9.72	1.6	Same as for crystalline	Rated at +10%/-5%. Better temperature coefficient than crystalline. Excellent shade tolerance.
	U-EB110	110	54	2.04	Microcrystalline amorphous silicon hybrid	25		1240 x 1008 x 40	17.9	25	999.00	9.08			Rated at +10%/-5%. Better temperature coefficient than crystalline. Excellent shade tolerance.
	PLC	13	16.5	0.79	Amorphous	25		495 x 465 x 38	2.9	10	180.00	13.85			Electric fences, gates, pond pumps, automotive battery maintenance, etc.
	PLD	26	16.5	1.58	Amorphous	25		950 x 465 x 38	5.5		300.00	11.54			A good panel for telemetry and irrigation systems.
	PLE	50	16.5	3.03	Amorphous	25		952 x 920 x 38	13.5		565.00	11.30			Good for campers and boaters.
Kyocera Solar (Japan) Kyocera Solar www.kyocerasolar.com.au	KD210GH-2PU	210	26.6	7.9	Polycrystalline	25	Cells are encapsulated between tempered glass cover and an EVA pottant with back sheet	1500 x 990 x 46	18	20	POA		-	25+	Grid tie module.
	KD185GH-2PU	185	23.6	7.84				1338 x 990 x 46	16						
	KD135GH-2PU	135	17.7	7.63				1500 x 668 x 46	12.5						
	KD135SX-1PU	135	17.7	7.63				1500 x 668 x 46	12.5						Stand alone module.
	KD95SX-1P	95	17.9	5.31				1043 x 660 x 36	8.5						
	KD75SE-1P	75	17.9	4.19				940 x 744 x 36	8.5						
	KD70SX-1P	70	17.9	3.92				778 x 660 x 36	6.5						
	KD50SE-1P	50	17.9	2.8				706 x 744 x 36	6.5						
NESL Solartech Company Ltd Clear Solar ph:1300 425 327 www.clearsolar.com.au	DJ 160	160	34.5	4.64	Monocrystalline	40	Glass/EVA/tempered glass	1581 x 809 x 40	15.5	25 years output guarantee, 5 years limited warranty	POA	-	-	-	-
	DJ 165	165	35.4	4.66					15.5						
	DJ 170	170	35	4.78					15.5						
	DJ 175	175	35.8	4.89					15.5						
	DJ 180	180	36.2	4.97					15.5						
Ningbo Qixin Low Energy Developments ph:0402 266 838 chris@lowenergydevelopments.com.au www.lowenergydevelopments.com.au	80 watt	80	17.6	4.55	Monocrystalline	-	Glass/Tedlar/ aluminium frame	1186 x 545 x 35	-	-	359.00	4.49	-	-	-
Powertech (China) Jaycar Electronics ph:1800 022 888 techstore@jaycar.com.au www.jaycar.com.au	ZM-9091	5	16.8	0.3	Monocrystalline	25	Aluminium frame with tempered glass/EVA/Tedlar	295 x 255 x 23	0.8	20 years performance, 12 months construction	59.95	11.99	Variable - Depends on climate and usage	25+	NOTE: Pricing current as at 1st Dec 2009. Please check our website for most up-to-date pricing. ZM-9099 175W panel is IEC61215 and IEC61730 approved.
	ZM-9093	10	17	0.59				396 x 289 x 23	1.4		94.95	9.50			
	ZM-9094	20	17.2	1.17				639 x 294 x 23	2.4		149.00	7.45			
	ZM-9096	65	17.2	3.78				1210 x 540 x 28	8.2		399.00	6.14			
	ZM-9097	80	17.6	4.55				1200 x 540 x 35	8.2		475.00	5.94			
	ZM-9098	120	17.8	6.74				1250 x 808 x 35	12		695.00	5.79			
	ZM-9099	175	36.45	4.81				1580 x 808 x 35	14.5		1100.00	6.29			
PV Solar Tile (Australia) ph:(02) 9558 0512 info@pvsolar.com.au www.pvsolartiles.com	PVST 167	167	34	4.9	Poly	50	Powder coated aluminium, Santoprene sealing and UV resistant plastic	1600 x 870 x 15	18	Manufacturer's warranty on PV component. Frame warranty 15 years	POA	-	2-3 years	30+	Available with a range of PV brands and sizes – see web site.
	PVST 175	175	34	5.15	Mono										
	PVST 85	85	17	5				1200 x 600 x 15	9						
Sanyo (Japan) Apollo Energy (authorised distributor) ph:1300 855 484 info@apolloenergy.com.au www.apolloenergy.com.au	HIP-210NKHE5	210	41.3	5.09	HIT (Heterojunction with Intrinsic Thin-Layer) solar cells	25	Glass, EVA, Tedlar. Anodised aluminium frame	1580 x 780 x 35	15	25	1742.00	8.30	1.6 years	25+ years	This module has the best high temperature performance of any crystalline solar panel. Module efficiency 16.7%
Sanyo (Japan) Solar Shop ph:(08) 8362 9992 sa@solarshop.com.au www.solarshop.com.au	HIP-210NKHE1	210	41.3	5.09	Heterojunction with Intrinsic Thin layer Monocrystalline - Amorphous Hybrid	25	Glass, EVA, Tedlar	798 x 1570 x 35	15	25	1999.00	9.52	1.6 years	25+ years	This module has the best high temperature performance of any crystalline solar panel.

Brand (made in)	Model	Rated power (watts)	Voltage at max power	Current at max power	Cell type	Cell temp at which panel is tested	Construction	Size (L x W x T)	Weight (kg)	Warranty (years)	RRP Inc GST ($)	Cost per Watt ($)	Time to recover embodied energy (years)	Rated lifetime (years)	Comments
SCHOTT Solar (Germany) SCHOTT Australia Pty Ltd ph:(02) 8426 1607 info.australia@schott.com NZ ph:(09) 415 7200 info.newzealand@schott.com www.schottsolar.com	POLY 165	165	35.1	4.7	Polycrystalline	STC 25/ NOCT 47.1	Glass, Tedlar, aluminium frame, thermoplastic cell embedding	1620 x 810 x 50	15.5	25 years	POA	-	4.7	25+	Narrow output tolerance. Quick and easy installation. System voltage up to 1000V. Iso textured cells for greater efficiency.
	POLY170	170	35.5	4.7							1122.00	6.60			
	POLY175	175	35.9	4.87							POA	-			
	POLY 180	180	36.3	4.95							POA	-			
	POLY 220	220	29.7	7.41		STC 25/ NOCT 48		1685 X 993 X 50	23		1452.00	6.60			Suitable for ground-based arrays in tough environments. Offers good match for larger system sizes.
	POLY 280	280	39.1	7.16			Double-glass, aluminium frame, thermoplastic cell embedding	1685 x 1313 x 50	41.5	30 years	POA	-	3.7		New Product to be available 2010. Long life through double glazing.
	POLY 290	290	39.5	7.33				1685 x 1313 x 50	41.5		POA	-			
	POLY 300	300	39.7	7.55				1685 x 1313 x 50	41.5		POA	-			
	ASI-F 95	106/86	17.8/16.8	5.9/5.12	Amorphous thin-film	STC 25/ NOCT 49	Amorphous on glass, Tedlar backed, aluminium frame, heat toughened front glass	1108 x 1308 x 50	19	25 years	500.00	5.25	2.5	20+	High Energy output. Low temperature coefficient, excellent results in hot regions Shade resilient and long lifetime.
	ASITHRU-30	33/27	36	0.75	Amorphous thin-film Building Integrated PV	STC 25	Double glass with PVB foil	1000 x 600 x 11	14	10 years	430.00	15.92	2.5	20+	These products are building-integrated photovoltaics on architectural glass. ASI-Glass is available in a range of specifications, dimensions and designs. Used for external façade and overhead glazing. Limited custom sizing available, please contact us to review
	ASIOPAK-30	39.3/32.2	36	0.89				1000 x 600 x 11	14		390.00	12.11			
	ASIOPAK-1-L	35/29	68	0.43			Laminate	1028 x 629 x 17	27		POA		2.5	20+	
	ASITHRU-1-L	31/25	68	0.37				1028 x 629 x 17	27						
	ASITHRU-1-IO	31/25	68	0.37			Double glazing	1020 x 626 x 34	29						
	ASIOPAK-2-L	71/58	68	0.85			Laminate	1028 x 1205 x 17	54						
	ASITHRU-2-L	61/50	68	0.74				1028 x 1205 x 17	54						
	ASITHRU-2-IO	61/50	68	0.74			Double glazing	1020 x 1203 x 34	57						
	ASIOPAK-3-L	106/87	68	1.28			Laminate	1028 x 1782 x 17	80						
	ASITHRU-3-L	92/75	68	1.11				1028 x 1782 x 17	80						
	ASITHRU-3-IO	92/75	68	1.11			Double glazing	1020 x 1780 x 34	84						
	ASIOPAK-4-L	141/116	68	1.71			Laminate	1028 x 2358 x 17	106						
	ASITHRU-4-L	122/100	68	1.48				1028 x 2358 x 17	106						
	ASITHRU-4-IO	122/100	68	1.48			Double glazing	1020 x 2356 x 34	112						
	ASIOPAK-4x-L	140/114	72	1.59			Laminate	1205 x 2005 x 17	105						
	ASITHRU-4x-L	117/96	72	1.33				1205 x 2005 x 17	105						
	ASITHRU-4x-IO	117/96	72	1.33			Double glazing	1197 x 2003 x 34	112						
	ASI 10/12	10	16.8	0.61	Amorphous thin-film		Glass, Tedlar, aluminium frame, thermoplastic cell embedding	330 x 581	2.1	25 years					Modules for small applications
Sharp (Japan) Sharp Australia ph:1300 13 55 30 www.sharp.net.au	NTR5E3E	175	35.4	4.95	Monocrystalline	25	Tempered glass laminate, box section aluminium frame. Lead wire with MC connectors	1575 x 826 x 46	17	25	-	-	3 years	25	13.5% module efficiency. Lead wire with MC connector. PET backing sheet.
	NEQ7E3E	167	34.6	4.77	Polycrystalline			1575 x 826 x 46							-
	NUS0E3E	180	23.7	7.6				1318 x 994 x 46	-						-
	ND130T1J	130	17.4	7.48				1491 x 671 x 46	9.5						12.6% module conversion efficiency. Nominal 12 volt output. Fitted with junction box. PET backing sheet.
Sharp (Japan) SOLCO Choice Electric ph:1800 074 007 info@solco.com.au www.solco.com.au	ND-130T1J	130	17.4	7.5	Polycrystalline	25	White tempered glass, EVA resin with weatherproof film. Box section aluminium frame. Lead wire with MC3 connectors	1499 x 662 x 46	14	25, 10, 1	1177.00	9.05	3 years	25	NU-S0E3E 180 watt modules are 16V nominal which is ideal for use in grid connect systems.
	NT-R5E3E	175	35.4	4.95	Monocrystalline			1575 x 826 x 46	17	25, 10, 1	1466.75	8.38			
	NU-S0E3E	180	23.7	7.6				1318 x 994 x 46	16	25, 10, 1	1485.00	8.25			
Shurjo (India) SOLCO Choice Electric ph:1800 074 007 info@solco.com.au www.solco.com.au	SE06-J11	6	18.5	0.32	CIGS polycrystalline (Copper Indium Gallium diSelenide)	25	Tempered glass. Three layer tedlar with aluminimum inter layer. Reinforced anodised aluminium frame	228 x 596 x 22	1.7	25, 12, 5	69.15	11.53	2 years	25	CIGS modules yield more energy per rated watt than regular crystalline modules due to better performance in low light conditions.
	SE15-I15	15	18.5	0.81				406 x 596 x 22	2.7	25, 12, 5	130.43	8.70			
	SE30-J14	30	18.5	1.63				602 x 788 x 34	5.3	25, 12, 5	303.28	10.11			
	SE60-J14	60	17.9	3.38				602 x 1186 x 34	9.76	25, 12, 5	506.00	8.43			
Solarfun (China) SOLCO Choice Electric ph:1800 074 007 info@solco.com.au www.solco.com.au	SF080-18	80	17.8	4.5	Monocrystalline	25	Tempered glass, aluminium alloy frame	1200 x 537 x 35	8.5	25, 10, 3	700.00	8.75	3 years	25	The aluminium alloy frame gives Solarfun modules a great rigidity and strength.
	SF160-24	170	35.9	4.74				1580 x 808 x 45	15	25, 10, 3	1042.86	6.13			
Solarfun DJ Sharpe Trading ph:(03) 9598 5775 dsh63475@bigpond.net.au	SF170M	170	35.9	4.74	Monocrystalline	45	Glass/aluminium	1580 x 808 x 45	15	25	680.00	4.00	-	-	Minimum purchase 1kW. Other sizes available.
Solar Frontier (Japan) NENSYS New Energy Systems ph:1300 660 735 sales@nensys.com.au www.nensys.com.au	SC75-EX-B	75	40.5	1.85	CIS (copper-indium-selenium) thin film	25	Tempered glass/EVA/ weatherproof back film, anodised aluminium alloy frame, with MC4 flying leads	1235 x 641 x 35	12.4	20	548.90	7.32	0.9	TBA	Fully made in Japan in automated single-line production facilities. PV manufacturing experience since 1983. 80MW current capacity, 1GW planned capacity for 2011.
	SC80-EX-B	80	41.0	1.95							585.20	7.32			
	SC85-EX-B	85	42.5	2.00							621.50	7.31			
Solar King - China Rockby Electronics ph:(03) 9562 8559 www.rockby.com.au	SYSM10S	10	18	0.56	Monocrystalline	25	3mm tempered glass	396 x 289 x 23	-	20 years	See website	-	-	-	Check site for prices # 36994
	SYSM-20	20	17.2	1.17				645 x 295 x 25	1.9						Check site for prices # 36995
	SYSM-40	40	17.6	2.28				645 x 545 x 23	2.42						Check site for prices # 36696
	SYSM-80	80	17.6	4.55				1210 x 540 x 35	8.3						Check site for prices # 36697
	SYSM-120	120	17.6	6.82				1500 x 660 x 35	11.8						Check site for prices # 37873
	SYSM-175W	175	36	4.87				1580 x 808 x 35	14.4						Check site for prices # 37970
Solara (Germany) ARRID ph:1300 663 563 sales@arrid.com.au www.arrid.com.au	SM 40 M	12	19	0.63	Polycrystalline	25	Laminate without glass or aluminium frame. Wafers are bonded to a stainless steel backing	445 x 267 x 2	1.3	2 years marine warranty	470.00	39.17	-	10	The modules are specifically designed for marine use. Other modules are not warranted under marine conditions. The non-glass contruction of the modules allow the modules to be walked on, and the construction on stainless steel allows the module to follow deck contours (maximum 3% deflection).
	SM 60 M	18	19	0.94				620 x 250 x 2	1.65		550.00	30.56			
	SM 80 M	23	19	1.21				440 x 460 x 2	2		674.00	29.30			
	SM 120 M	34	19	1.78				590 x 460 x 2	3.1		835.00	24.56			
	SM 160 M	45	19	2.36				756 x 460 x 2	3.75		1100.00	24.44			
	SM 225 M	68	19	3.67				800 x 645 x 2	5.4		1390.00	20.44			
Solyndra Clear Solar ph:1300 425 327 www.clearsolar.com.au	SL-001-173	173	71.7	2.41	Cylindrical CIGS	85	Glass/EVA/tempered glass	182 x 108 x 0.05	31	25 year limited power warranty 5 year limited product warranty	POA	-	-	-	-

Brand (made in)	Model	Rated power (watts)	Voltage at max power	Current at max power	Cell type	Cell temp at which panel is tested	Construction	Size (L x W x T)	Weight (kg)	Warranty (years)	RRP Inc GST ($)	Cost per Watt ($)	Time to recover embodied energy (years)	Rated lifetime (years)	Comments
Sunny Energy Clear Solar ph:1300 425 327 www.clearsolar.com.au	ZDNY-170C	170	35.9	4.74	Monocrystalline silicon	85	Glass/EVA/tempered glass	1610 x 838 x122	-	25 years output guarantee, 3 years limited warranty	POA	-	-	-	-
	ZDNY-175C	175	36.2	4.84											
	ZDNY-180C	180	36.5	4.93											
	ZDNY-185C	185	36.8	5.03											
	ZDNY-188C	188	36.85	5.1											
SunOwe - China Envirogroup ph:(03) 9095 7412 info@envirogroup.com.au www.envirogroup.com.au	SF125X125-72-M170W	170W	35.7V	4.9	Monocrystalline	25	Anodised aluminium frame	1580 x 808 x 35	16	10 years @ 90% rated output, 25 years @ 80%	695.00	4.08	2.6 years approx	35 years approx	Extremely high cell and module efficiency for the cost of the modules.
SunPower (Philippines) SunPower Corporation Australia Pty Ltd ph:1800 786 769 www.sunpowercorp.com.au	SPR-210-WHT-I	210	40	5.25	Monocrystalline	25	3.2mm tempered glass	1559 x 798 x 46	15	25		0.00	1.4 to 3.8 years depending on global location.	40	Panel efficiency of 16.9%.
	SPR-225-WHT-I	225	41	5.49				1559 x 798 x 46	15						Panel efficiency of 18.1%.
	SPR-300-WHT-I	300	54.7	5.49				1559 x 1046 x 46	18.6						Panel efficiency of 18.4%.
Suntech (China) MPower ph:1300 733 004 www.mpower.com.au	STP005S/12Db	5	17.4	0.29	Monocrystalline (S) Polycrystalline	25	Glass/EVA/Tedlar	216 x 306 x 18	0.8	25, 12, 5	34.00	6.80	2	25+	High efficiency mono and poly crystalline solar cells from the world's largest solar manufacturer.
	STP010/12Kb	10						310 x 368 x 18	1.5		66.00	6.60			
	STP020S/12Cb	20	17.6	1.14				656 x 306 x 18	2.5		130.90	6.55			
	STP030S/12Lb	30	17.2	1.74				426 x 680 x 18	3.2		195.80	6.53			
	STP040/12Rb	40	17.4	2.3				537 x 665 x 30	4.0		249.00	6.23			
	STP060/12Bs	60	17.4	3.45				771 x 665 x 30	7.8		377.00	6.28			
	STP075S/12Bb	75	17.3	4.35				1195 x 541 x 30	7.8		473.00	6.31			
	STP080S/12Bb	80	17.5	4.58				1195 x 541 x 30	7.8		504.00	6.30			
	STP085S/12Bb	85	17.8	4.8				1195 x 541 x 30	7.8		535.00	6.29			
	STP135/12Tb	135	17.5	7.71				1482 x 676 x 35	12.0		847.00	6.27			
	STP175S/24Ac	175	35.9	4.87				1580 x 808 x 35	15.7		950.00	5.43			
	STP180S/24Ad	180	36	5				1580 x 808 x 35	15.7		979.00	5.44			
	STP200/18Ub	200	26.2	7.63				1482 × 992 × 35	16.8		1380.00	6.90			
	Pluto 200-Ade	200	37.9	5.28	Monocrystalline			1580 x 808 x 35	15.5		1486.00	7.43			New proprietary Gallium-F22 doping process inhibits initial light induced degradation to <1%. Pyramid texturing technology reduces light reflection and helps more sunlight enter from oblique and grazing incidences, thus allowing Pluto cells to generate more field power output than conventional solar cells.
	Pluto 205-Ade	205	38.1	5.38				1580 x 808 x 35	15.5		1522.00	7.42			
Suntech Power (China) Suntech Power Australia 82-86 Bay Street Botany NSW 2019 ph: 02) 9695 8180 sales@suntech-power.com.au www.suntech-power.com.au	PLUTO195-Ade	200	37.6	5.19	Monocrystalline - PERL (Passivated Emitter Rear Locally Diffused)	25	Glass/EVA/Tedlar	1580 x 808 x 35	15.5kg		POA	-	-	-	-
	PLUTO200-Ade	200	37.9	5.28				1580 x 808 x 35	15.5kg						
	PLUTO205-Ade	205	38.1	5.38				1580 x 808 x 35	15.5kg						
	STP005B-12/DEA	5	17.4	0.29	Monocrystalline	25	Glass/EVA/Tedlar	216 x 306 x 18	0.8	25					-
	STP020S-12/CEA	20	17.6	1.14				656 x 306 x 18	2.5						
	STP075S-12/Bb	75	17.3	4.35				1195 x 541 x 30	8						
	STP085B-12/BEA	85	17.8	4.8				1195 x 541 x 30	8						
	STP175S-24/Ad	175	35.8	4.90				1580 x 808 x 35	17.2						
	STP180S-24/Ad	180	36	5.00				1580 x 808 x 35	17.2						
	STP185S-24/Ad	185	36.4	5.09				1580 x 808 x 35	17.2						
	STP010-12/KEA	10	17.4	0.29	Polycrystalline	25	Glass/EVA/Tedlar	310 x 368 x 18	1.5	25					-
	STP065D-12/SEA	65	17.6	3.69				771 x 605 x 30	6.2						
	STP135D-12/TEA	135	17.5	7.71				1482 x 676 x 35	12.00						
	STP200-18/Ud	200	26.2	7.63				1482 x 992 x 35	16.8						
	STP210-18/Ud	210	26.4	7.95				1482 x 992 x 35	16.8						
	STP270-24/Vd	270	35.0	7.71				1956 x 992 x 50	27						
	STP280-24/Vd	280	35.2	7.95				1956 x 992 x 50	27						
	STP086Ts-A	86	72.3	1.19	Amorphous thin film	25	Glass/EVA/Tedlar (framed, unframed, or with bonded mounting rail)	1300 x 1100 x 7.5	25	25					-
TRINA Solar (China) Solar Inception ph:(07) 3166 9598 www.solarinception.com.au	DC01	175	36.2	4.85	Monocrystalline	25 Deg C	Low Iron Glass, EVA, Aluminium	1581 x 809 x 40	15.6	5 years manufacture, 10 years at 90% power output, 25 years at 80% output	582.73	3.33	-	-	-
	DC01	185	37.5	4.95				1581 x 809 x 40	15.6		616.05	3.33			
	DC05	235	29.4	7.81				1650 x 992 x 46	19.5		749.25	3.19			
Uni-Solar (USA) ARRID ph:1300 663 563 sales@arrid.com.au www.arrid.com.au	PVL-68	68	16.5	4.13	Amorphous	25	Adhesive laminate	2849 x 394 x 4	4.1	25	POA	-	1.5	40	Non glass construction, virtually unbreakable. Must be applied by Uni-Solar approved installation technician.
	PVL-136	136	33	4.13				5486 x 394 x 4	7.7			-	1.5	40	
	PVL-144	144	33	4.36				5486 x 394 x 4	7.7			-	1.5	40	
Zhejiang Sunflower Low Energy Developments ph:0402 266 838 chris@lowenergydevelopments.com.au www.lowenergydevelopments.com.au	170W	170	35.4	4.8	Monocrystalline	25	Glass/EVA/Tedlar	1580 × 808 × 35	16	-	699.00	4.11	-	-	-
	180W	180	36	5							749.00	4.16			



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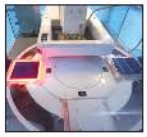



CONERGY

OUR WORLD IS FULL OF ENERGY.

Solar is scaling up!

Until recently, solar power generation plants have been small compared to coal and nuclear plants. However, solar is scaling up, with plant sizes beginning to rival other generators, writes Lance Turner.

The Andasol project, on the Guadix plateau in the province of Granada, southern Spain, is being installed in three sections, the first two of which can be seen here. Each section produces 50MW (around 150GWh per year) of electricity using arrays of parabolic troughs that track the sun. The troughs heat a heat-resistant synthetic oil as a heat exchange fluid and the heat is used to generate steam which drives a turbine. Each stage has two vast energy storage tanks which each hold 28,500 tonnes of liquid salt, so the plant can generate electricity day and night. A full thermal storage can provide power for 7.5 hours at maximum load.

Copyright Solar Millennium AG / Paul-Langrock.de

The company responsible for this project, Solar Millennium AG of Germany, is also developing solar tower generation plants. See www.solarmillennium.de for more information.

The largest photovoltaic system in the world is the 60MW Olmedilla de Alarcón project in Spain, although a 62MW installation (the 250 hectare Moura photovoltaic power station) is under construction in Portugal. Installed by Nobesol, it consists of 270,000 Siliken 235 watt crystalline photovoltaic panels.

Annual energy production is 87.5GWh and the system cost around €384 million. See www.siliken.com and www.nobesol.com for more information.

Pacific Gas & Electric are working with Brightsource Energy to install the largest solar power station in the world, at least for now. Californian law requires PG&E to source 20% of its electricity from renewable sources by 2010, which has been one of the main driving forces behind this project.

The Ivanpah Solar Power Complex, in California's Mohave Desert, will be located at Ivanpah, approximately 50 miles northwest of Needles. It will cover 1645 hectares and generate up to 440 megawatts, enough electricity to supply 140,000 homes. Brightsource will use their Luz Power Tower technology for the project. This involves thousands of sun-tracking mirrors (heliostats) that focus sunlight onto a central tower, which contains a boiler. The water therein is heated to around 550°C, producing high pressure steam that drives a standard steam turbine that turns a generator.

The complex will be built in three stages: two 110 megawatt installations, followed by the final 220 megawatts in a single installation. The first stage is scheduled to begin construction in early 2010 and to be completed by 2012. The second stage will begin construction around six months after the start of the first stage.

For more information, see www.brightsourceenergy.com

Ausra Inc, a solar thermal power generation company based in California, has been selected as the solar steam boiler supplier for the 100MW JOAN1 concentrated solar thermal power project being built in Jordan by Germany-based MENA Cleantech AG.

The project is expected to start operation by 2013 and will be the largest concentrated solar power system in the world using direct steam generation. For more info see www.ausra.com and www.mena-cleantech.de

What's happening in Oz?

There are numerous large-scale solar generation systems planned around the world. However, it seems there is not much happening here in Australia.

Solar Systems (now in receivership) had a 154MW installation planned for Victoria. It is unknown whether it will still go ahead, but looks unlikely at this stage.

Also planned was a 200MW Solar Tower power plant, to be built by EnviroMission. However, it seems that the incentives available in the US are better than those offered here (practically none) and so EnviroMission have changed their focus to Arizona. They are currently planning two 200MW Solar Tower projects, each covering around 2225 hectares. See www.enviromission.com.au.

For a country with more potential for solar generation than just about any other, almost nothing is happening. The largest solar installation in Australia is the 2MW solar thermal system at the Liddell coal-fired power station!

American power utility Southern California Edison has teamed up with eSolar to install 245MW of solar thermal power in California's Antelope Valley region.

eSolar makes modular solar thermal systems which consist of eight power towers with a boiler on top of each tower. Each eSolar module generates a nominal 46 megawatts and covers around 80 hectares. The thousands of tracking mirrors focus sunlight on the boilers to create superheated steam. The steam from each tower is collected together and used to run a steam turbine.

eSolar is also partnering with NRG Energy Inc to build a total of 500MW of solar thermal power across the southwestern US. See www.esolar.com and www.sce.com for more information.

It seems that all the largest solar power plants are happening in California. Beginning in 2010, Tessera Solar will start building two of the world's largest solar plants there.

The plants, Imperial Valley and Calico, in San Bernardino County, will produce 750MW and 850MW respectively, making them the largest solar power plants in the world.

Unlike other planned large-scale solar projects, Tessera will use the 25kW SunCatcher tracking solar dish Stirling engine, developed by Stirling Energy Systems. The total number of units is expected to be around 70,000.

For more information see www.tesserasolar.com and www.stirlingenergy.com

Solar can power the world!

Within the space of six hours, the world's deserts receive more energy than all the people in the world consume in a year. This massively wasted resource has brought about the ambitious Desertec project.

A consortium of 12 companies, including some of the world's largest, such as Siemens, Schott Solar and Deutsche Bank, plan to provide up to 17% of the EUMENA region's (Europe, the Middle East and North Africa) energy requirements by 2050. This will be done with massive installations of solar thermal systems in the deserts of northern Africa, covering a total area of around 2500km^2. While this sounds huge, it is in fact only around 0.02% of the entire MENA region.

The energy would be transmitted to central Europe by high voltage DC transmission lines, similar to the Basslink that links Tasmania and Victoria.

The project is still in the planning stages and there is some opposition to it which has raised valid concerns, such as availability of already stretched water supplies. To ease these concerns, some of the energy generated will be used for water desalination to provide water for both the power generation plants and the people of the surrounding region.

For more information or to get involved, go to www.desertec.org

A solar pump for Oesilo

Installing a solar pump near the East Timor/Indonesian border was certainly challenging for Leo Renkin, but well worth it in the end. He went to East Timor as a volunteer with the ATA International Projects Group.

Oesilo is a small town located in the northern mountainous region of the Oecusse enclave in East Timor. The recent construction of a border post and much needed border market meant that water needed to be carted from a nearby spring for it to function. Theoretically water could be pumped 900 metres to a holding tank positioned 58 metres above the spring. The holding tank could supply gravity fed water to the border posts, border market and surrounding villages. A direct drive solar pump would do the job and importantly, help save money that would otherwise be spent on purchasing and operating a fossil fuel powered pump.

The outdoor classroom where several languages are spoken.

Not so simple

To get to Oesilo one must leave East Timor, enter Indonesia then re-enter East Timor on a new visa. Clearing customs was difficult. Explaining why we had a trailer fully laden with solar pumping equipment for a job in East Timor, when we were actually entering Indonesia, was not so simple. Neither was making arrangements for the project with a local NGO partner, as Oesilo has no electricity, let alone mobile phone or internet reception.

Thankfully IPG volunteers Oliver and Patrick went on an earlier fact finding mission to Oesilo and we were able to determine the equipment required and an implementation plan. The installation of a solar pumping system would provide 12,000 litres a day to a holding tank. The tank was to be constructed by local NGO project partner Fundaceo Solenusat.

When we arrived in Oselio we set to work recruiting local workers to help with the installation. One of those eager to help us was a curious, traditional spirit man of the spring, Pak Abi, whose fingerless hands waved with enthusiasm as he spoke. We came across him one morning conversing with the frogs. Pak Abi advised us of the terms required by the spirits to ensure the project success. Dutifully, with the other workers, we respected the spirit's requests by attending a sacrificial pig ceremony and providing two exit gates from the spring for the frogs.

All workers, including the interpreter, were so enthusiastic once work got underway. The seven 130 watt solar modules to power the pump controller and Tenesol 1000 helical rotor pump were wired up and ready for action after just a few long hard days. Luckily, long-time IPG Oecusse supporter Bill Bennett would turn up with lunch inbetween overseeing other solar installations in the enclave and pitch in with a helping hand.

Training program

Training the workers in basic solar principles and maintenance procedures took place in a makeshift classroom at the site. An empty solar module box nailed to a tree served as a blackboard and plastic bags placed on the ground became classroom desks. The interpreter proved invaluable as some students preferred to learn in Indonesian where the word for water is confusingly 'air'. Others preferred the local language Baikeno where the word for water sounds remarkably like the word 'oil'. It was also important to remember the word 'solar' is the word 'diesel' in Bahasa Indonesian! I listened in amazement as the

interpreter translated questions and answers for the students who were speaking different languages. Needless to say, we were way too confused to even mention Portuguese, ironically the official language of the country.

The longer we spent in Oesilo the more we came to understand the importance of water and its availability in the development process. We often speak of energy savings provided by solar installations and compare them in monetary terms with fossil fuel powered alternatives. In Oesilo, there are no fossil fuel powered alternatives but instead an abundance of women and children carrying 10 litre water containers on their heads, sometimes up to five kilometres a day. It therefore makes more sense to compare the mind boggling amount of human energy required to carry 12,000 litres of water a distance of 900 metres with an elevation of 58 metres. We all came up with a few rubbery figures in kilojoules but decided the only way to really measure it was to do so at home. Simply take a 10 litre bucket of water on your head for a quick one kilometre walk around the block before you wash the dishes or flush the toilet. ✻

Several community groups support the ATA's projects in East Timor, including one dynamic group from NSW.

THE KANGAROO VALLEY Remexio Partnership, a friendship group that has been involved in East Timor for 10 years, wanted to provide solar lighting for 120 households in remote parts of Remexio. ATA's success with a similar solar lighting project in the village of Besilau gave the KV group confidence in the technology. The big challenge was how to fund it.

At a cost of approximately $150 per kit, the amount the KV group needed to raise was beyond their usual fundraising activities. The idea of conducting Trek for Timor was the brainchild of four Kangaroo Valley residents who had taken part in the annual Oxfam walk near Sydney.

Participants were asked to take up the challenge of walking either 14 kilometres or 50 kilometres, in teams of between two and four, and invite friends and associates to sponsor them. The idea soon took off and teams from near and far registered for the trek.

On September 19, 246 people set off on a scenic bushwalk around beautiful

Kangaroo Valley. The weather was perfect and spirits were high. About two-thirds of participants attempted the longer 50 kilometre walk, and most of them completed it including a 76-year-old man.

The lighting project captured the imaginations of participants and donors alike, and the amount raised by the trek swelled the kitty for the lighting project to over $75,000, thus reaching the required target several times over.

In early November, two representatives of KV, Greg and Sandy, joined the ATA International Projects Group to begin the installations. A decision on further 'roll-outs' will be made after assessment of the first 120 installations.

Libby Turnock

Hands up for solar: seven 130 watt solar modules power the pump in Oecussi.

See the next page for the latest on the village lighting scheme in East Timor.

Anton Vikstrom updates us on the ATA International Projects Group's progress this year.

FROM MAY to November this year ATA International Projects Group volunteers were involved in projects supplying light, power water and most importantly knowledge to the people of East Timor. Projects ranged in size and scope from large RAPS solar power systems to village lighting to training East Timorese government technicians and rural villagers. The ATA also partnered with local NGO Permatil, providing technical support for Permatil projects and sharing an office space in Dili.

The Village Lighting Scheme did not get off to the most auspicious start, with the first teaming rains of the wet season, yet it was a pleasant change from the relentless heat in downtown Dili. This year the scheme expanded to take in two new communities and another 165 installed systems. System improvements include the addition of a flexible head 1W LED and a larger solar panel. Demand for this project is strong, with requests coming from many East Timorese communities. A big thank you to Chris Adams from Friends of Aileu. Chris has volunteered in Aileu for two years and his help organising and implementing the Village Lighting Scheme has been invaluable.

The Timor-Leste Solar Power Training Project is funded by AusAID and delivered in partnership with two government departments (SEFOPE and SEPE). The aim is to assist East Timorese training providers to deliver solar power training and support students to attend training and find employment. Working with the East Timorese solar power industry, ATA staff and volunteers have developed a set of competency standards for the installation, maintenance and selection of small solar power systems. February will see the first teacher training and in July the first students will graduate from the course. Past and present ATA volunteers have made a valuable contribution to this project including Michael O'Connell, Geoff Collins, Aires de Almeida, Andrew Blair, John Kemp and Joshua Backwell.

Solar power training students with Mick Harris (far right).

ATA volunteers are looking forward to a range of new projects in East Timor and elsewhere, including transferring the lessons learnt in the Timor context to projects in Australian Indigenous communities.

The IPG would like to thank all the volunteers, equipment suppliers, sponsers and partners who made our projects possible.

Industry Supporters: Plasmatronics, Selectronics, RF Industries, MH Power, Going Solar, The Environment Shop, Saltwater Solar, Schott Solar.

Project Supporters: AusAID, Japanese Government, ILO, Kangaroo Valley Remixio Partnership, Rotary Club Balwyn, DBECT, Friends of Ainaro, Friends of Aileu, Friends of Hatu Builico, Friends of Venilale, Whitehorse Friends of Oecusse, Rotary DIK including Bill Dagg and Daryl Mills, Global Ministries, Permatil, ETWA, Felco Australia, Euan Ramsay, Methodist Ladies College, Linda Poppins and John Poppins. *

Eco-friendly materials and fire

One advocate for sustainable building techniques collected data about how earth bricks stood up on Black Saturday. Jacinta Cleary reports.

Rob Freeland had almost immediate access to Strathewen, one of the towns obliterated in the Black Saturday bushfires. His own home in Nutfield, just five kilometres away as the crow flies, was a few minutes off receiving the fire front until the wind change which saved his little town and the urban fringe beyond it of Hurstbridge and Diamond Creek.

With Rob being one of the lucky ones, he set about gathering information on how certain building materials weathered the extreme fire conditions. Rob was given permission to access the fire zone shortly after Black Saturday, surveying buildings for two days to determine which materials survived well. He used this information for a submission to the Victorian Bushfire Royal Commission.

Rob is an engineer by trade and runs his own pressed earth brick company. Needless to say his research after Black Saturday focused heavily on the performance of the environmentally-friendly earth bricks that he sells. However, Rob has years of hands-on experience with various building materials, conducting rigorous material testing and gathering data from past bushfires.

He says there has been a failure to implement recommendations over the years, from the 1939 fires, the Ash Wednesday fires in the eighties to the Canberra fires earlier this decade. "A lot of the information on fire resistant building materials has been available for at least 40 years," says Rob.

In a recent presentation to the Melbourne Branch of the Alternative Technology Association, Rob showed examples of exploded besser brick, melted glass from a glass brick, destroyed aluminium sarking and melted aluminium from a window frame, all collected from Strathewen properties after Black Saturday.

This well finished earth brick house survived the fires when the owners and a friend defended the property. Flames were reported to be two to three times the height of the surrounding forest area. The site is located on a ridge with the slope away from it on both sides. This photo indicates the quality workmanship and the sealing off of the timber where it passes through the wall, preventing embers entering the roof space.

"The clean up cleaned up a lot of things, it cleaned up a lot of evidence. We lost a lot of technical info that would have been very valuable to us," says Rob.

"That's part of an aluminium frame…anything that's aluminium went at 640 degrees—this is what takes place," he says with a piece of melted aluminium in hand.

"This is what happens to aluminium sarking," adding that any leaves that gather in the roof over the years can ignite roofing materials including aluminium foil. Current Victorian building regulations specify that roof/wall junctions are to be fully sealed, reducing the likelihood of leaves gathering in the roof space.

A melted glass brick was a reminder of what can happen to windows overall. It would have taken an extreme temperature of 1500 degrees to melt it. "When we are designing we've got to protect our window frames—good design is critical."

Standard fired bricks were substantially damaged in the Black Saturday fires according to Rob. One earth brick house had fired bricks on the upper level. The earth brick walls were still standing, however 95% of the fired bricks had delaminated, coming away from the mortar.

"A single skin brick wall can drop vertically due to no bonding. Double brick and triple brick stood up a lot better. We've been aware of this for years but still allow single skin brick-work in fire zones," says Rob.

Rob also talked about steel-framed buildings where the whole frame had distorted from the heat. The heat was so extreme that volcanic rock used for landscaping had split and the ground was burnt, exposing pipes that had been buried 600mm below the ground.

Pressed earth bricks on Black Saturday

Looking at the photos in Rob's submission to the Royal Commission it's clear that some pressed earth brick homes were substantially damaged, however the earth brick walls were still standing. Rob talks about one earth brick building that suffered due to bad design; it had big glass windows that faced the direction the fire came from, running parallel to the fire front. There were timber walls inside and the fire came straight in.

Pressed earth brick is related to mud brick with a few differences. Pressed earth bricks are consistent in quality and size, require a thinner mortar course, and up to 12 courses can be laid in a day. Mud bricks can be irregular sizes with three courses a day being the maximum that can be laid. Some consider earth bricks to be easier to use, but at the end of the day earth brick and mud brick are both made with low-embodied-energy dirt.

In the earth houses that Rob surveyed no occupants reported loss of indoor oxygen quality during the fire and all houses seemed to maintain an even indoor temperature, helping to keep people calm. So even if the house burnt down after the fire front passed, it offered vital protection when needed.

Rob's study of earth bricks burnt on Black Saturday showed minimal damage to the bricks and walls generally maintained their integrity, particularly where mortar identical to the earth bricks was used. In some cases the heat was so extreme the chemical structure of the soil was altered due to the temperature.

There are exceptions and Rob says the most important thing is to shelter from radiant heat. "There's no hard and fast rule as to which building survives on the day, a lot of it is luck."

This photo shows the effect heat had on internal earth wall surfaces. The fire penetrated the brick work by 10mm to 12mm, while destroying the second storey internal fittings and furnishing. The effect on the outer face of the earth walls was minimal. The render coatings failed and there was limited heat transfer into the brick. Several people who sheltered in earth houses reported that the external temperature was over 48°C outside prior to the fires, and 33°C inside during the fire front period. Despite the high temperatures, earth walls generally retained their structural integrity. This internal wall would require the render coating to be stripped and replaced before reuse.

Bunkers or fire rooms

Rob didn't come out in favour of fire bunkers during his presentation to the ATA Melbourne Branch. "None of the people I've spoken to who had shelters or know people who had shelters were very supportive because they couldn't get to the shelter (due to fire)."

"My recommendation is to build one room in the house with a fire retardant door to outside and a fire retardant door back in the house so they can access that room in the house as their primary shelter."

With a four-hour fire rating Rob sees earth bricks as an ideal building material for a shelter. "You've got to see how to protect the family and the most responsible way to do it. If there is a fire room in a house you can have water on, a fridge, communications. Certainly take care with your bunkers." ✻

What are the fire resistance properties of certain sustainable building materials? Carene Chong takes a look.

Strawbale

Bundle of straw tightly bound with twine or wire. Widely used in building or sediment control.

• Converting a waste material to a valuable building resource
• Straw would be burnt otherwise, producing more greenhouse gas
• High insulation—R6 to R9; 10 times the insulation of a double-cavity brick wall, thus reducing the need for heating or air conditioning.

• Though loose straw could catch fire easily, a packed straw wall is highly fire-resistant
• A properly constructed and rendered strawbale structure has a minimum two hour fire rating; some walls have passed up to four hours. The standard for a wood frame wall is one hour. Fire tests conducted in New Mexico in 1993 showed that it took a 2000°C naked flame 30 minutes to burn through an unrendered strawbale wall
• Why does it not burn easily? The strawbales are packed so tightly that oxygen needed for combustion can't enter. Further, the outside layer carbonises to form a layer of charcoal, which is a good thermal insulator.

Other properties

• Good sound insulation
• Resistant to pests because there's little nutrition for bugs in straw.

Rammed earth

Constructed by ramming a mixture of selected aggregates, including gravel, sand, silt and a small amount of clay into place between flat panels called formwork.

Sustainable properties

• Relatively low impact on environment, depending on content and degree of local material sourcing
• Generally has low embodied energy and greenhouse gas emissions, especially traditional rammed earth walls which derive soil from on-site
• Very good sound insulation.

• Rammed earth walls can carry up to a four hour fire rating, i.e. it's resistant to fire for up to four hours. This is because there are generally no flammable components in rammed earth. The fire rating will depend on the quality of the construction and the composition of the mixture used, as well as wall thickness.

• Resistant to pests/vermin because nothing in the material attracts them
• Has high thermal mass
• Durable—rammed earth buildings have been found to have survived hundreds of years.

Mud brick

Basic mud brick making involves the mixing of water to earth and pouring into moulds. The bricks are then left to dry. Some fibre or straw is often added to the mixture to improve strength and prevent cracking of the bricks.

Sustainable properties

• Essentially made of mud and earth, therefore a renewable resource
• Low embodied energy, especially basic and traditional mud bricks. However, commercially manufactured bricks can have higher embodied energy due to the use of machines in their manufacture and the need to transport them from the factory to the building site. Combustion processes and consumption of fossil fuel for production of mud bricks should be avoided to keep embodied energy to a minimum.

• Fire resistance properties similar to that of rammed earth.

• Very good sound insulation
• Very resistant to pests
• Strong, but needs protection from extreme weather and natural disasters i.e. earthquakes
• Not good insulators as they are extremely dense and lack the ability to trap air within structure.

Timbercrete

Timbercrete is a blend of cellulose, cement, sand and binders to enhance block strength and stop excessive water penetration. Its main ingredient is recycled timber and has a range of brick types including mud bricks, sandstone and cobblestone.

• Its main ingredient is recycled timber waste (cellulose), so no trees are cut down specifically to make Timbercrete
• Timbercrete greatly reduces carbon footprint by locking up carbon in its structure.

• Timbercrete has been tested to AS1530 for fire rating.

• Very durable
• Good sound insulation
• Pest/termite resistant.

Recycled concrete

Concrete made with recycled materials and aggregate.

• Recycled concrete's embodied energy is significantly lower than conventional concrete, which emits considerable amounts of greenhouse gas during production.

• Like normal concrete, recycled concrete is very fire resistant, although the fire rating will depend on the wall construction, mixture and thickness.

Other properties

• Very good thermal mass
• Durable
• Can be load bearing.

Low-cost independent remote power supply using a UPS

Jonathon Thwaites explains how he used a discarded computer uninterruptable power supply (UPS) as the basis for a small renewable energy system.

UPS systems are used to supply electricity for essential equipment such as servers and communications equipment or in offices where an unplanned shut down of computers would be costly. They generally have a small bank of batteries built into them, often lead-acid gel cells but sometimes NiCads. The batteries store energy and during a mains failure they supply power to the UPS's inverter which keeps providing the essential supply of 240 volts, 50Hz AC for any piece of equipment plugged into it. They occasionally have battery extender terminals so the UPS supply time can be extended by adding external battery banks.

The lead-acid batteries have a limited lifetime, usually less than 10 years, and the UPS system is often thrown away when the batteries finally fail. New UPS technology can make the old system obsolete or sometimes it's cheaper just to buy a new UPS than replace the batteries. The UPS inverter is often high quality and of sinewave output (cheaper units are usually modified square wave) and in no way damaged. The systems also usually come with battery chargers of varying sophistication to keep the batteries in a good state of charge. Many UPS systems are rated for only 10 minutes or so but sometimes the inverter is rated at usefully higher power output under continuous conditions.

For some time I had been thinking about using a discarded UPS to build an independent power supply system.

The UPS solar power system in the testing phase (hence the wiring spaghetti). Discarded devices like this make ideal inverters in smaller systems. The fan is a test load. The white box is the UPS, the PL20 is sitting on top of it and needs to be mounted vertically for cooling. The battery bank is shown behind with the lid of the battery box removed. It has large holes in the sides to prevent hydrogen gas build up in the box.

The UPS would supply the most expensive component of the system—the sinewave inverter—free of charge. These usually cost about $1.20 per watt of rated output. So a 1500 watt continuous rated sinewave inverter would typically cost around $2000.

The system I built uses a battery bank and UPS to create an independent 240 volt power supply system. It also uses a typical photovoltaic solar panel charging set-up, with a charge regulator (a Plasmatronics PL20) to maintain the battery charge from a number of solar panels. This makes the system independent with no need for a mains connection. It is really two very simple systems—one charging the batteries and the other using the batteries through the UPS.

The UPS

The UPS is a Holec brand unit and contains a good quality sinewave inverter which is continuously rated at 1500 watts, with a peak transient rating of

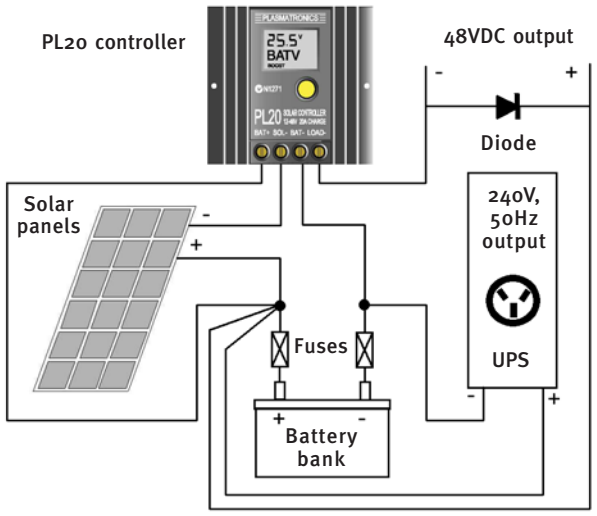
2500 watts. I picked it up from a company in Perth that services, installs and supplies UPS systems. It was in their rubbish pile so I asked the manager if I could take it. It includes:

- the battery charger (with inbuilt logic) which controls the battery bulk charging, regularly charging for short periods. It also has a float charge setting for normal charging
- settings on a dip switch panel on the back to adjust the bulk and float charge voltages, adjustment for typical mains voltage in the area and a number of other functions
- automatic low battery voltage shut down
- an RS232 connector for data logging and to use as a signal output to shut down equipment in an orderly fashion
- alarms for low battery voltage
- two UPS-powered standard power point sockets
- two filtered non-UPS-powered standard power point sockets
- several fuses to protect the UPS, battery and attached equipment.

A number of features on the UPS are not used in this system. I do not have it connected to the mains so it will not charge batteries from the mains (although the charging electronics are excellent and can be used).

I was also able to get the UPS operations manual and circuit diagrams from the owner. It is important that the manual for the UPS be read carefully and that you understand it.

The Holec UPS requires the large capacitors in the UPS to be charged relatively slowly (through a high power resistor of something like 50 ohms) when connecting to the battery bank, otherwise the batteries will dump a massive current into the capacitors for a very short time, creating voltage spikes in the UPS which are capable of destroying its internal components. Similarly the capacitors should be discharged slowly when disconnecting or shorting the output.



Wiring schematic of the UPS-based power system. The simplicity of the system is typical of smaller renewable energy systems.

Solar charging

Because the inbuilt battery charger/regulator in the UPS runs from the mains, I needed a separate solar charge regulator, so I chose the Plasmatronics PL20.

The PL20 is a complete battery charge controller capable of handling photovoltaic, wind, microhydro or other inputs. It is completely programmable, has data logging and can be connected to a PC through an RS232 cable. This little box is expensive but a very nice piece of gear and worth the money. It is designed and manufactured in Melbourne. See www.plasmatronics.com.au

The PL20 is simply controlling the charge state of the batteries independently of the UPS. This is a relatively basic use for the PL20 and many of its other control and data logging facilities can easily be implemented. Use of a PLS2 shunt adaptor would allow logging of the whole system's energy use

Panels	Eight 60W secondhand Solarex polycrystalline panels, configured as two strings of four panels in series. Nominal power 480W. Nominal output voltage 48V, unloaded 68V.
Bypass and string diodes	From old computer power supplies from kerbside collection.
Panel mounting system	Unistrut, but could use anything sensible. Steel bed frames are good.
Inverter	Holec UPS. From the rubbish heap. Sinewave inverter with 1500W continuous rating, 2500W peak transient load. Two UPS power outputs, two filtered outputs, RS232 connector for logging and system control, alarm, low battery shut-off, 48 volt battery bank configuration (internal batteries dead and removed).
Batteries	Eight secondhand 6V, 130Ah deep-cycle lead-acid, configured in series as 130Ah, 48V or 6.24kWh. Usable energy approx 33% of 6.24kWh or 2.08kWh.
Charge controller	Plasmatronics PL20
Wiring and terminal block	From kerbside collection.
Battery box, paint	From kerbside collection.

Table 1: Components of UPS-based independent power supply.

as well as the charging from PV through the PL20 to the battery bank, giving a full picture of the battery charge state.

The PLS2 allows the controller to measure charge or load currents which do not go though the controller. This allows inverter or generator currents to be included in the controller's display. The PLS2 adaptor measures the current in a current shunt and converts that measurement into a digital form. This data is then sent to the PL controller. Price of this adaptor is around $230, but if you like to know what's going on in the whole system, it's worth it.

I have not used the 48 volt load terminals of the PL20. These are the usual power outputs from a system without an inverter.

The diode is supplied with the PL20 and is used to protect the PL20. I used 15 amp fuses on the battery, on both positive and negative terminals. This allows a maximum load of approximately 750 watts. It means the load should not exceed 750 watts if you don't want the fuses to blow. It's a bit conservative as the inverter is rated at 1500 watts and the fuses could be 25 amp.

The system would be capable of running the lighting circuit in a modest hobby farm house and maybe even the refrigerator, depending on the owner's care.

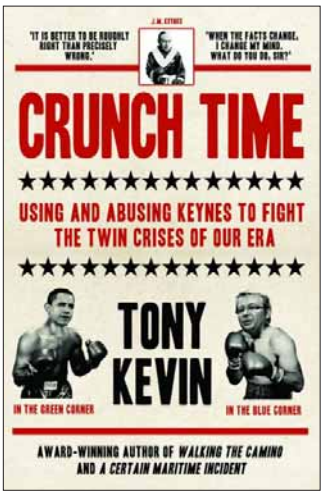
Panels: secondhand (and a very good price at that) 8 x $200	$1600
Panel mounting system: (Unistrut) could make it yourself with old bed frame and angle iron	$300
Inverter: Holec UPS. From the rubbish heap	$0
Batteries: secondhand 8 x $20 (probably a very good price I had reliable information that they were in good shape)	$320
Voltage regulator: Plasmatronics PL20	$330
Wiring and terminal block: from the rubbish heap	$0
Battery box, paint: from the rubbish heap	$0
Total	**$2,520**

Table 2: The cost of the system excluding labour and the PLS2 shunt adaptor.

Cost

The cost of the system can be seen in Table 2. As can be seen, all of the cost was for the solar panels and mounting system, the battery bank and the solar regulator.

A typical equivalent system using purchased components would be of the order of $7000, with the main saving here being for the panels ($2000), inverter ($2000) and wiring ($500). *



Crunch Time: Using and Abusing Keynes to Fight the Twin Crises of Our Era.

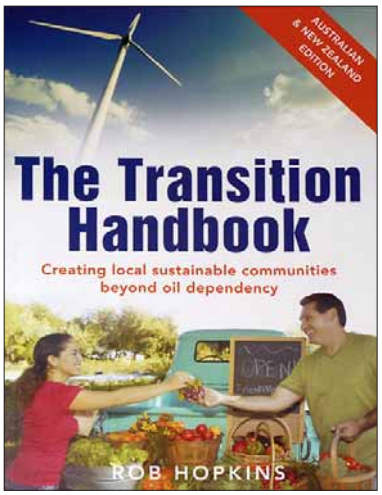
By Tony Kevin, Scribe Publications RRP $32.95

Crunch Time sees former diplomat turned author Tony Kevin turn his hand to climate change, and with the clarity of a diplomat and the bold scope of a polymath (he holds degrees in engineering, political science and economics), he seeks to tackle the broadest canvas imaginable.

Why do we persist in treating climate change as a problem somehow unrelated to the more general questions of how we manage our economy and society, when it clearly now influences and threatens both? In trying to understand this dichotomy, and how we might unravel it, Kevin channels John Maynard Keynes as his inspiration and touchstone in seeking bolder and newer solutions to climate change.

Overall, *Crunch Time* probably doesn't succeed in reaching the mark it sets for itself. The very breadth of the analysis means that some themes enter and leave without resolution, for example, why Obama had managed to deploy a 'greener' stimulus package than Rudd. But this book is an enjoyable ride and a worthy contribution to the debate around how we respond to climate change.

-Ian Porter



The Transition Handbook

By Rob Hopkins, Finch Publications RRP $34.95

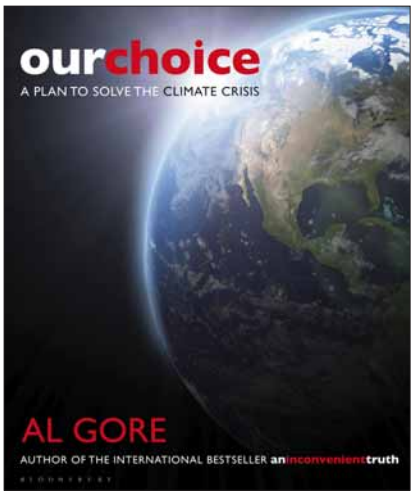
You could hardly have missed the concern regarding climate change but have you heard about peak oil? And their distinctive inter-relationship? These two problems of our time have the capability to change the way we live forever. Some might view this with doom and gloom but *The Transition Handbook* shows how this can be a positive, life-affirming opportunity to produce a better, more resilient society.

The intent is to create a society that can provide most of its needs from within the local geographical area. The book endeavours to catalyse this dream and provides techniques to enable the creation of 'Transition Towns', a movement that is gaining increasing currency all over the world.

Hopkins compares how we used to live with how we live today and, although most of these examples are written from a UK perspective, it makes for illuminating reading. He also describes visions of the world in 2030 written as newspaper articles taken from that time—a powerful tool for reinforcing the possible.

Doom and gloom are natural responses when you recognise the potential impacts of climate change; this book is about making our response look more like a party than a protest march.

-John Knox



Our Choice

By Al Gore, Bloomsbury/Allen and Unwin RRP $35.00

Al Gore's third book *Our Choice* goes further than his award-winning documentary *An Inconvenient Truth*, to profile how we can save the earth and our life on it.

His book is written in his strong personal voice with sections headed *Our sources of energy, Living systems, How we use energy, The obstacles we need to overcome*, and *Going far quickly*. It is illustrated with photographs from all over the world such as huge solar farms in Spain and California, land clearing in Indonesia and sun burnt apples in Victoria.

There are also numerous excellent colour diagrams that show us how various kinds of energy and smart grids work.

The author credits his book to "groundbreaking insights offered by the participants" and he includes Professor Tim Flannery's work on biochar. Throughout the book Gore's exhaustive research focuses on the big picture and the opportunity for humankind to "live healthier more prosperous lives" on Earth.

Our Choice could become the guide for our 'brave new world', and is essential reading for those who care about an environmentally sustainable future.

-Margaret Smith

Products

Foam from fungi!

Every now and then a product comes along that is just brilliant, and the styrofoam replacement material from Ecovative Design is one of those.

The 'foam' consists of waste materials like seed husks which are bound together using fungal mycelium (mushroom roots). There are no spores in the process, so there are no allergen concerns and there is no possibility of mushroom growth.

There are two products available—ecocradle, which is used as a replacement for moulded polystyrene foam, and greensulate, which is aimed at the domestic insulation market.

The material is resistant to mould and mildew, uses very little energy to manufacture and can simply be composted at the end of its useful life. Ecocradle can be made into any shape to suit whatever product it is protecting, just like styrofoam.

Ecocradle will be commercially available at the end of 2009, while greensulate will hit the market in 2010, although it could take a while to make it to Australia.

Manufactured by Ecovative Design, 60 Cohoes Ave, Green Island NY 12183, USA, email: sales@ecovativedesign.com, www.ecovativedesign.com

A better wallboard

Plasterboard may be the mainstay of indoor wall cladding but it has some considerable drawbacks. It is dusty when cut (the dust is a potential health hazard), it is relatively fragile and it absorbs water easily. Even the 'wet area' versions can absorb water and support mould growth.

USG Powerscape Health is a range of wallboards designed to replace both plasterboard and cement sheeting. It is stronger than cement sheet and, as it has no paper cover, sheets are easier to work and rework than either cement sheet or plasterboard. It can even be demounted during demolition and used again.

Even better, Powerscape Health is made from 95% recycled materials—85% post-industrial gypsum from power generation waste and 10% recycled cellulose. It comes pre-sealed to resist water, has a high level of sound resistance and good thermal mass, so can help stabilise temperatures inside a home.

For more information, contact Powerscape Pty Ltd, ph:1800 226 215, email: information@powerscape.com, www.powerscape.com.au

The TV that watches you

Most people watch TV, but now there's a TV that watches back.

The Sony Bravia WE5 LCD TV has a presence sensor so that it knows when you've left the room. If it senses that no-one is watching, it turns off the display, cutting energy consumption in half. The sound is left on so that you can still hear what's happening. When you re-enter the room the picture comes back on.

The TV also has other energy saving features. The 'Energy Saving Switch' allows the TV's power to be shut off without having to turn off the power point. This cuts stand-by power consumption to less than 0.0001W. So really, Sony have returned to the old idea of an off switch that really is an off switch, not a stand-by switch. It's about time someone did this!

Lastly, there is an ambient light sensor that lets the TV automatically adjust picture settings based on the room brightness, to maintain ideal screen brightness and conserve energy. A preset 'eco' setting allows viewers to watch TV with minimal energy consumption.

RRP: $2199 for the 40" model and $2499 for the 46" unit.

For more information contact Sony Australia on ph:1300 137 669 or go to www.sony.com.au

Serious LED bulbs

There are so many LED bulbs on the market, it's hard to know what to buy. Unfortunately, while they are improving, many bulbs still have poor thermal management and so run hotter than they should, resulting in reduced light output and shorter lifespan.

The EvoLux bulbs from EarthLED combine a Cree LED module (Cree make the most efficient power LEDs available) with a heatsink/fan assembly, so the LEDs run nice and cool. This is housed in a funky (we can't really say it's pretty) LED bulb case, along with a 90 to 277 volt AC universal voltage driver, so the bulbs can be used anywhere in the world.

What makes the EvoLux really stand out though is that, unlike most LED bulbs, it puts out as much light as a 75 watt incandescent: 1075 lumens for the cool white and 1000 lumens for the warm white. And it does this while using a maximum of 13 watts. CRI (colour rendering index) of the bulbs is 75 and 80 for the cool and warm white respectively.

The EvoLux is available in a standard and short version, in both ES27 and BC22 bases, so it will fit most light sockets found in Australia. It isn't dimmable, although EarthLED do have some dimmable lower powered LED bulbs.

The ATA is testing these bulbs and so far they have proven to be excellent, with almost inaudible fans and high light output.

RRP: US$49.99 for either type, plus $20 postage.

Available directly from EarthLED, ph:+1 877 855 1625, email: earthledsales@earthled.com, www.earthled.com

Bricks made of coal waste

Fly ash is the main waste product of burning coal for electricity generation. It is a huge problem as far as disposal is concerned, having to be stored at the bottom of large ponds as it becomes easily airborne. A number of environmental disasters have occurred in the US when ponds have ruptured, such as in Kingston, Tennessee, in December 2008.

Vecor has a range of bricks, pavers and tiles that are made almost entirely from fly ash. The bricks are lighter and far better insulating than regular bricks and take a lot less energy to manufacture. Even better, Vecor claim that they can even process old fly ash that's been stored under water, so they are able to eliminate a huge environmental problem by turning it into useful products.

For more information contact Vecor Australia, ph:(07) 3122 2233 or go to www.vecor.com.au

Salt of the Earth

Some of the highly refined salt we normally consume might be better used to clean the floor. However, reading the ingredients on a bottle of Pink Lake natural salt is a bit like reading a box of multi-vitamins, with minerals such as calcium, magnesium and potassium to name a few.

We're not suggesting upping your salt intake, but if you're looking for a sustainably sourced salt then this could be it. Jane and Neil Seymour from biodynamic farm Mount Zero Olives, collaborated with the Barengi Gadjin Land Council (representing the traditional owners) to resume harvesting the salt at Dimboola's Pink Lake. What transpired was a project that involved many levels of the community and resumption of a harvest carried out by indigenous communities for years.

The lake is fed from a natural spring and the pink colour is from the beta carotene in the lake. All harvesting is done by hand and within days there's no sign of any disturbance to the lake. Best of all it's a renewable a crop, and the hotter it gets, the more salt there is—perfect for the arid Wimmera Mallee.

RRP: Pink Lake Salt Fine 300g: $8, Pink Lake Salt Coarse 300g: $8, Pink Lake salt mill 250g: $16.

Available from www.mountzeroolives.com

Products

High fire protection double glazing

After the February 2009 bushfires, Victoria and the ACT adopted a new bushfire construction standard, AS3959-2009, which sets out the minimum construction requirements for each level of defined bushfire hazard.

Miglas has just released a range of double glazed windows and doors that have been tested to BAL-40 standard, the second highest rating, meaning they can withstand a heat flux of up to 40kW/m^2 without the need for external screening.

The windows and doors use Viridian's new PyroGuard 40TM insulated glass unit to achieve the rating. According to the manufacturer, even at a radiation level of 40kW/m^2, only 3% of the radiant energy makes it through the window and into the home.

RRP: according to application

For more information, contact Miglas, ph:(03) 9728 3999, email: contact@miglas.com.au, www.miglas.com.au

Undies can be green too

A lot of underwear is made from synthetic materials like polyester. While they are durable, they don't breathe well and are not very environmentally friendly.

Mitch Dowd, makers of a range of undies, recently released their Green range. They have replaced regular cotton with organic cotton and polyester with bamboo fibre. Further, Mitch Dowd have minimised all dyeing, finishing, dyes and auxiliaries across the Green range and has prohibited the use of formaldehyde, heavy metals, and any harmful or hazardous substances in the processing of the materials, meeting the requirements of the Global Organic Textiles Standard.

The undies come in a range of styles and colours. They are available from Myer, David Jones and Harris Scarfe stores, as well as from DFO stores.

For more information, contact Mitch Dowd, ph:1800 671 319 or go to www.mitchdowd.com.au

Clay bricks without firing

Traditional clay bricks are vitrified, which means they are fired to a high temperature in a kiln. This uses a huge amount of energy, so the embodied energy of the bricks used in an average house can be considerable.

The Geo Brick is a range of bricks made from clays from the Victorian goldfields, along with a stabiliser. Instead of firing, the bricks are pressed, stacked and air dried, resulting in a range of bricks with light pastel earthy colours without the use of added oxides.

According to Geo Brick, their bricks can reduce greenhouse gas production of brickmaking by between 50% and 90% (depending on the amount of stabiliser used), or up to six tonnes of CO_2 per average house lot of 10,000 bricks. Also, because they have a high thermal mass, they can be used inside as well as out to make indoor temperatures more stable.

There are four models of Geo Brick: GeoBrick 4, 8, 12 and 16. The bricks are water resistant of course, and the Geo Brick 16 is rated for use near the sea as it is also salt resistant. Geo Bricks have been compression tested to 27MPa.

Geo Brick's goal is to produce Australia's first ever commercially produced carbon neutral brick in 2010.

RRP: similar to regular bricks.

For more information contact Geo Brick, ph:1300 855 098, email: info@geobrick.com.au, www.geobrick.com.au

Don't let that water get away

For a dry country, Australia wastes an awful lot of stormwater. While rainwater tanks have become more popular, many homes have downpipes in the wrong place, so you either have to run large above ground pipes or install a wet pipe system, which has its own issues.

The Barloch Downpipe Loch is a simple device that fits in your downpipe and allows you to divert rainwater from the downpipe to where you actually need it. It has two small and one large diameter outlets, so you can divert water to multiple areas simultaneously, such as the garden, the rainwater tank and even to top up the pool. Should the volume of water be too great for the outlets, there is an inbuilt overflow, so any excess goes to the stormwater system.

For bushfire prone areas there's also the Bushfire Loch, which allows you to shut off your downpipes completely so that gutters can be filled with water for fire protection. It has a hose connection point built in, making filling gutters easy.

The Barloch Lochs are made from injection moulded ABS (the same plastic used for computers and TVs) and is UV resistant. They come with a three year warranty.

RRP: $35 for the Downpipe Loch and $75 for the Bushfire Loch.

For more information, or to buy online, contact Barloch, email: info@barloch.com, www.barloch.com. Also available at Mitre 10 and Reece plumbing stores.

Take it from the top!

Water tanks are great but they have one drawback—the water comes from the bottom of the tank, which is where all the dirt, debris, sludge and bacteria build-up occurs. This can make for less than clean and healthy water from your tank, and debris can block toilet and washing machine valves, as well as clogging up water filters.

The Waterboy is a simple device that consists of a flexible hose fitted inside the tank to the water outlet. The other end of the hose is fixed to a float, so you are always drawing water from the top of the tank water.

The entire unit is made from non-toxic materials, including food-grade polyethylene, stainless steel and EVA (ethylene vinyl acetate).

The Waterboy is available to suit various tank types and water outlets from 20 to 50mm in diameter.

RRP: $179.

Available from Crystal Clear Water, email: sales@crystalclearwater.com.au, www.crystalclearwater.com.au/waterboy

Use the right bins!

There's no doubt that when it comes to recycling, Australians have a way to go before they get it right. Many people make the mistake of placing the wrong materials in the wrong bins, which makes recycling the materials that much more difficult. In extreme cases of contamination, entire loads of recyclables can be dumped instead of recycled.

The Planet Earth Cleaning Company was finding this to be a huge problem in the premises they were cleaning and so decided to come up with a simple system that anyone should be able to use. It consists of four coloured bins, one for each of the types of waste: organics for composting, mixed recyclables, paper and cardboard, and everything else (for landfill).

The bins are made from corrugated plastic and use 70% less plastic than regular bins. There are several sizes of bin, including 30 and 60 litre large bins and 7 and 12 litre paper bins for under your desk. There's also a tiny one litre 'landfill only' bin for your desk. Bins are shipped flat for easy transport and are simple to assemble.

RRP: from $3.95 for the 1 litre bin to $18.95 for the 60 litre bin.

Available from The Planet Earth Cleaning Company, ph:1300 669 441, email: sales@theplanetearth.com.au, www.theplanetearth.com.au

The national picture

Now that global pressures are driving us toward adoption of a deeply flawed and weak emissions trading scheme, it is useful to consider its implications for Australia, writes Alan Pears.

THE SUBTLE dimensions of the proposed Carbon Pollution Reduction Scheme are becoming more visible. Liable Parties can buy 100% of their permits from offshore, while exports of Australian permits are banned. Indeed, export of permits will only be allowed after a change in the legislation, which is likely to be difficult to achieve.

At the same time, the government is lobbying hard for the Clean Development Mechanism (CDM) to be extended to include avoided destruction of forests in developing countries (but, notably, not in developed countries such as Australia, where it might make things difficult for loggers of old-growth forest). This is likely to deliver large numbers of very cheap permits—and potentially undermine the credibility of the CDM mechanism, while reducing government revenue from permit sales and allowing Australian emissions to continue to rise.

This means Australia's permit price will be driven by the lowest-priced CDM permits. Indeed, some Liable Parties may be able to buy very cheap CDM permits through private deals. So Australia will have the lowest carbon price in the world. This scenario contrasts with Treasury's estimates of future Australian carbon prices, which suggest our permit price will be well above the global values estimated in the 2007 IPCC report. That IPCC study also showed that driving innovation could significantly reduce the price of emission permits.

Is Treasury over-estimating future permit prices? If so, it is feeding the frenzied lobbying for special treatment.

The distortions created by transitional allocation of free permits, as well as inadequate recognition of additional voluntary abatement through retirement of permits, will drive emission abating investment and businesses off-shore in an abatement leakage. It's odd that the government is very concerned about the risk of emission leakage (emission-intensive industries moving offshore with their emissions), while it shows no concern for abatement leakage, which involves the loss of the industries we need to build a low carbon economy.

It's even stranger that none of these 'at risk' emission-intensive industries have moved offshore as a result of the increase in the value of the Australian dollar relative to the international price benchmark US dollar. Yet, as pointed out in a recent *Crikey* article, this has had a much bigger impact on their bottom lines than any likely carbon price. In any case, if our most emission intensive industry, aluminium smelting, moved offshore, it would most likely move to a low emission electricity generation source, so the world's emissions would decline. And Victorians would save on the existing massive subsidies.

The transition arrangements could also be damaging. For example, a low emission product (say a HDPE or PET drink container) will pay its full carbon cost, while high emission containers such as glass and aluminium get 94.5% of their permits for free. So low emission products could actually suffer bigger price increases than their high emission competitors. Just the signal we don't need! We need compensating incentives for adversely affected low emission goods and services. Or regulations that protect their market shares.

Challenging the 'energy efficiency' sceptics

One reason why modelling the cost of emission abatement in Australia shows higher costs than elsewhere is that our economic modellers generally apply conservative estimates of energy efficiency improvement potential and rates of innovation. Traditional economists and policy makers believe that businesses are, on the whole, as energy efficient as it makes economic sense to be. So logically it follows that there is little potential for cost-effective energy efficiency improvement. Australian industry has actively reinforced this view. And, in any case, many economists suggest the 'rebound effect' will mean that any savings will simply be absorbed by growth in energy consumption for other things!

Recent developments in a number of areas have challenged these views. First, we are beginning to see results from the first serious Australian industry energy efficiency programs. At a state level, both New South Wales and Victoria now require high energy (and water) consuming businesses to carry out audits, submit action plans and implement measures with better than a three year payback period. Nationally, the Energy Efficiency Opportunities (EEO) program requires all companies using more than 0.5 petajoules of energy (several million dollar annual bills) to carry out detailed assessments and publicly report on measures up to four year payback, as well as reporting on their responses to these opportunities.

The Victorian scheme in its initial

form identified annual abatement of over a million tonnes at payback periods averaging under two years. EEO, based on the first round of reports, has identified over $650 million of annual savings and 6.5 million tonnes of abatement with less than a four year payback. Over two-thirds of these savings have payback periods of two years or less: that's equivalent to an interest rate on an investment of over 50% annually. How could businesses afford to ignore such fantastic returns?

These results are just a beginning: as skills, knowledge and data management improve, much larger savings will be found. Even so, the savings already identified will go some way towards offsetting the cost of buying emission permits. The reality is that Australian industry is not very skilled at identifying or capturing energy efficiency potential. Lean staffing, lack of measurement, monitoring and diagnostic systems, short-termism that leads to rejection of worthwhile investments, and low priority have all taken their toll.

A key problem has been the dogma associated with energy market reform: it was going to deliver ever-lower energy prices, so why would anyone bother to save energy? Unfortunately, industrial energy prices have increased by around 30% since the National Electricity Market began. So, many businesses have made investment decisions that favoured energy waste, believing that lower prices would offset this cost. These decisions are already costing them more, even before the enormous costs of additional power generation and transmission and emission permit costs are factored in. Whoops.

Rebounds, amplifications and flow-ons

As far as the so-called rebound effect is concerned, it is a classic example of an element of truth being used as an excuse not to do something. The idea is that, if you save energy, you will have more money left in your pocket. You may use this to do more of the activity on which you have saved (because it is relatively cheaper), or to spend on other things that consume energy.

There are a few problems with this. Firstly, the amount of money most people save on energy efficiency is a small proportion of the total cost of a delivered service: even for an average car, fuel cost is less than a third of total costs, so spending all the financial savings from saving fuel on driving more would reduce the overall fuel savings, but only partly offset them. Indeed, for a services business, saving energy might reduce total input costs by half a percent, not really enough to allow them to waste much more energy.

Underlying this issue is the reality that, instead of using emotive and biased terms like 'rebound effect' we need to describe it in more neutral terms as a 'flow-on' effect. We could choose to (or be required to) invest the financial savings from energy efficiency in saving more energy: this would be an 'amplification' effect. For example, if someone is happy with the savings from buying one energy efficient lamp, they may use the savings to buy more—and save more. Whether we get a rebound or an amplification of energy savings depends on how we spend the money saved. Individual choice and institutional change can drive us towards amplifying the savings. ✻

A glossary of renewable energy

All those technical terms can make renewable energy systems difficult for many people to understand. This glossary aims to cover all of the most commonly used terms, as well as a few of the more specific terms.

A

Alternating Current (AC): Electrical *current* that continually reverses direction. The frequency at which it reverses is measured in cycles-per-second, or *Hertz* (Hz). The magnitude of the current itself is measured in *amps* (A). Mains electricity is AC electricity.

Alternator: A device for producing *AC electricity*. Usually driven by a motor, but can also be driven by other means, including water and wind power.

Ammeter: An electrical or electronic device used to measure *current* flowing in a circuit.

Amorphous silicon: A non-crystalline form of *silicon* used to make *photovoltaic panels.*

Ampere (Amp): The unit of measurement of electrical *current*. Symbol is A or I.

Ampere-hour, Amp-hour (AH): A measurement of electrical *current* over time. One amp-hour is equivalent to one *amp* of current flowing for one hour.

Anode: The positive *electrode* in a *battery*, *diode* or other electrical device.

Anemometer: A device used to measure wind speed.

Axial flow turbine: a turbine in which the flow of water is in the same direction as the axis of the turbine.

B

Battery: A device, made up of a collection of *cells*, used for storing *electricity*. Can be either *rechargeable* or non-rechargeable. Batteries types include *flooded cell*, *sealed*, and *dry cell*. Battery chemistries include lead-acid, nickel-metal-hydride (NiMH), nickel-cadmium (NiCad) and Lithium.

Battery charger: A device used to charge a *battery* by converting (usually) mains voltage *AC* to a *DC* voltage suitable for the battery. Chargers often incorporate some form of *regulator* to prevent overcharging and damage to the battery. Available in both *switchmode* and *ferro-magnetic* types.

Betz Limit: The maximum power (theoretically) that can be captured by a wind turbine from the wind. Equal to 59.3 percent of the wind energy.

Blade: The part of a turbine that water or air reacts against to cause the turbine to spin. Sometimes incorrectly refered to as the propeller. Most electricity-producing wind turbines will have two or three blades, whereas water-pumping wind turbines will usually have up to 20 or more.

C

Cathode: The negative *electrode* in a *battery*, *diode* or other electrical device.

Capacitor: An electronic component used for the temporary storage of *electricity*, as well for removing unwanted *noise* in circuits. A capacitor will block *DC* but will pass *AC*. New high capacity types called ultracapacitors are now being used as battery replacements in hybrid vehicles and small renewable energy systems.

Cell: The most basic, self-contained unit that contains the appropriate materials, such as *plates* and *electrolyte*, to produce *electricity*.

CIGS (or CIS): Copper indium [gallium] selenide. A type of semiconducting material used to make high efficiency thin film *photovoltaic cells*.

Circuit breaker: An electrical device used to interrupt an electrical supply in the event of excess *current* flow. Can be either magnetically or thermally activated, or a combination of both. Can be manually or automatically reset.

Conductor: A material used to transfer, or conduct, *electricity*, often in the form of wires.

Cold cathode fluorescent lamp (CCFL): A type of compact fluorescent lamp that uses a tube that does not contain heating elements at each end. CCFLs can take several minutes to warm up, but their tubes can be much smaller than a regular CFL.

Compact fluorescent lamp (CFL): A form of *fluorescent lighting* that has its tube 'folded' into a "U" or other more compact shape, so as to reduce the space required for the tube.

Conduit: A pipe or elongated box used to house and protect electrical cables.

Converter: An electronic device that converts *electricity* from one *DC* voltage level to another.

Cross-flow turbine: A turbine where the flow of water is at right angles to the axis of rotation of the turbine.

Current: The rate at which electricity flows in a *conductor.* Analogous to the volume of water flowing through a pipe. Measured in *Amperes*, or Amps.

D

Darrius Rotor: A form of *vertical-axis wind turbine* that uses thin *blades*.

Direct Current (DC): Electrical *current* that flows in one direction only, although it may vary in magnitude. Batteries produce DC electricity.

Diode: A *semi-conductor* device that allows *current* to flow in one direction, while blocking it in the other. Also see *Light emitting diode*.

Dry cell battery: A *battery* that uses a solid paste for an *electrolyte*. Common usage refers to small cylindrical 'torch' *cells*. Not usually rechargeable.

E

Earth: Refers to physically connecting a part of an electrical system to the ground, done as a safety measure, by means of a conductor embedded in suitable soil.

Earth-leakage Circuit Breaker (ELCB): A device used to prevent electrical shock hazards in mains voltage power systems, including *independant power systems*. Also known as residual current devices (RCDs).

Electric vehicle: A vehicle that uses rechargeable batteries and an electric motor and controller for motive power instead of an internal combustion engine. Slowly becoming more common as manufacturers look for low emission vehicle solutions.

Electricity: The movement of electrons (a subatomic particle), produced by a *voltage*, through a *conductor*.

Electrode: An electrically *conductive* material, forming part of an electrical device, often used to lead current into or out of a liquid or gas. In a battery, the electrodes are also known as *plates.*

Electrolysis: A chemical reaction caused by the passage of *electricity* from one *electrode* to another.

Electrolyte: The connecting medium, often a fluid, that allows electrolysis to occur. All common batteries contain an electrolyte, such as the sulphuric acid used in *lead-acid batteries*.

Energy: Power consumed multiplied by the duration of use. For example, 500 *watts* used for four hours is 2000 *watt-hours*. Also commonly expressed as kilowatt-hours, where one kilowatt-hour is 1000 watt-hours.

Equalising charge: Charging of a lead acid battery so that the electrolyte starts to bubble. This ensures that the electrolyte is the same density throughout each cell and that all cells reach a fully charged state.

F

Float charge: A way of charging a battery by varying the charging *current*, so that its terminal *voltage* (the voltage measured directly across its terminals) 'floats' at a specific voltage level.

Flooded cell battery: A form of *rechargeable battery* where the *plates* are completely immersed in a liquid *electrolyte.* The starter battery in most cars is of the flooded-cell type. Flooded cell batteries are the most commonly used type for independant and remote area power supplies.

Fluorescent light: A form of lighting that uses long thin tubes of glass which contain mercury vapour and various phosphor powders (chemicals based

on phosphorus) to produce white light. See also *Compact fluorescent lamp*.

Furling: A method of preventing damage to *horizontal-axis wind turbines* by automatically turning them out of the wind using a spring-loaded tail or other device.

Fuse: An electrical device used to interrupt an electrical supply in the event of excess current flow. Often consists of a wire, encased in a glass tube for safety, that melts when excess current flows through it.

G

Gell-cell battery: A form of *lead-acid battery* where the *electrolyte* is in the form of a gell or paste. Usually used for mobile installations and when batteries will be subject to high levels of shock or vibration.

Generator: A mechanical device used to produce *DC electricity*. Power is produced by coils of wire passing through magnetic fields inside the generator. See also *Alternator.* Most *alternating current* generating sets are also refered to as *generators*.

Gigawatt (GW): A measurement of *power* equal to a thousand million *watts*.

Gigawatt-hour (GWHr): A measurement of energy. One gigawatt-hour is equal to one *gigawatt* being used for a period of one hour, or one *megawatt* being used for 1000 hours.

H

Halogen lamp: A special type of *incandescant* globe made of quartz glass and a tungsten filament, enabling it to run at a much higher temperature than a conventional incandescant globe. Efficiency is better than a normal incandescant, but not as good as a *fluorescent* light. Most commonly found in downlights. Sometimes called a dichroic lamp, in reference to the reflector coating used on some halogen reflector lamps, that allows heat (infra-red) to exit the rear of the lamp while visible light is reflected forward.

Head: The vertical distance that water will fall from the inlet of the collection pipe to the water turbine in a hydro power system. Only the vertical component is measured, not the entire length of pipe.

Hertz (Hz): Unit of measurement for frequency, equal to cycles per second—*see AC (Alternating Current).* Common household mains power is normally 50Hz, or 50 cycles per second.

Horizontal-axis wind turbine: The most common form of *wind turbine*, consisting of two or three (but up to six or more in some designs) airfoil-style *blades* attached to a central hub which drives a *generator*. The axis, or main shaft of the machine is horizontal, or parallel to the earth's surface.

I

Incandescant globe: One of the most common forms of light globe in the home, usually consisting of a glass globe inside which is a wire filament that glows when *electricity* is passed through it. They are the least efficient of all electrical lighting systems, and certain types are now being phased out in numerous countries, including Australia.

Independant power supply system: A power generation system that is independant of the mains grid.

Insolation: The level of intensity of energy from the sun that strikes the earth. Usually given as watts per square metre (W/m²). A common level in Australia in summer is about 1000W/m².

Insulation: A material used to prevent the flow of electricity. Normally used on electrical wires to prevent electric shock. Typical materials used include plastics such as *PVC* and polypropylene, as well as ceramics and minerals such as mica.

Insulation: A material used to prevent the flow of heat into or out of a building. Often consists of 'batts' placed in the ceilings and walls, but can also be metal foil or 'loose fill' materials, such as recycled paper fluff.

Inverter: An electronic device used to convert *DC electricity* into *AC*, usually with an increase in *voltage*. Inverters can have either a *sine wave* or *modified square wave* output. The two main types are stand-alone inverters, which are designed to act as a replacement for mains power, and grid-interactive inverters, which feed energy from various power sources such as solar panels back into the grid. Some inverters can perform both functions.

J

Junction box: An insulating box, usually made from plastics such as *PVC*, used to protect the connection point of two or more cables.

K

Kilowatt (KW): A measurement of power equal to one thousand *watts*.

Kilowatt-hour (KWHr): A measurement of *energy*. One kilowatt-hour is equal to one *kilowatt* being used for a period of one hour.

L

Lead-acid battery: A type of *battery* that consists of *plates* made of lead and lead-oxide, surrounded by a sulphuric acid *electrolyte*. The most common type of battery used in *RAPS* systems.

Light emitting diode (LED): A semiconductor device which produces light of a single or very narrow band of colours, or white light at various colour temperatures. LEDs are used for indicator lights as well as for domestic and commercial lighting. Readily available in red, green, blue, yellow and amber, as well as cool, neutral and warm whites. High quality LEDs have a very long rated life, as much as 100,000 hours. LEDs are set to become the most common source of artificial lighting in the next few years.

Lithium battery: A type of *rechargeable battery* that uses lithium metal or metal compounds. Characterised by high storage densities and long cycle life. Commonly found in portable electronic devices, power tools, and increasingly in *electric vehicles*.

Load: The collective appliances and other devices connected to a power source. When used with a *shunt regulator,* a load is often used to absorb any excess power being generated.

M

Megawatt (MW): A measurement of power equal to one million *watts*.

Megawatt-hour (MWHr): A measurement of power with respect to time (energy). One megawatt-hour is equal to one *megawatt* being used for a period of one hour, or one *kilowatt* being used for 1000 hours.

Metres-per-second (m/s): A speed measurement system, often used to measure wind speed. 1m/s equals 2.2 miles per hour or 3.6 km/h.

Micro-hydro system: A domestic-scale generation system that uses water to produce *electricity*. Types of *water turbine* include *Pelton*, Turgo, *Crossflow*, Overshot and Undershot *waterwheels*.

Modified-square-wave: A type of waveform produced by some stand-alone *inverters*. Looks like this: ⎍⎍⎍⎍. This type of waveform is not as suitable for some appliances as a *sine wave*. Some inverters produce a multi-step waveform that manufacturers tend to call modified sine-wave. These are not true sinewave inverters.

Monocrystalline solar cell: A form of solar cell made from a thin slice of a single large crystal of *silicon*. Monocrystalline cells have the highest embodied energy of all the solar cell types.

Multimeter: A type of meter used for testing electrical circuits. A multimeter can usually measure voltage, current and resistance, and some can also measure frequency, capacitance, inductance and other parameters.

N

Nacelle: That part of a *wind generator* that houses the *generator*, gearbox etc at the top of the tower.

Nickel-cadmium battery (nicad): A form of rechargable battery, having higher *storage densities* than that of lead-acid batteries, that use a mixture of nickel hydroxide and nickel oxide for the *anode* and cadmium metal for the *cathode*. The *electrolyte* is potassium hydroxide. Very common in small rechargeable appliances, but rarely found in *independant power systems* due to their high initial cost.

Nickel-metal-hydride battery (NiMH): A form of rechargable battery, similar to a nicad, but being made with more benign materials, so without the toxicity of cadmium. Very common in small rechargeable appliances.

Noise: Unwanted electrical signals produced by electric motors and other machines that can cause circuits and appliances to malfunction. Often caused by cheap inverters without adequate filtering.

O

Ohm: The unit of measurement of electrical *resistance*. Symbol is Ω. A resistance of one ohm will allow one *amp* of *current* to pass through it at a *voltage drop* of one *volt*.

Ohm's Law: A simple mathematical formula that allows either *voltage*, *current* or *resistance* to be calculated when the other two values are known. The formula is: V = I x R, where V is the voltage, I is the current, and R is the resistance.

P

Pelton wheel: A *water turbine* in which specially shaped buckets attached to the periphery of a wheel are struck by a jet of water from a narrow nozzle. Only suitable for high head (high pressure) systems.

Photovoltaic effect: The effect that causes a volt-

age to be developed across the junction of two different materials when they are exposed to light.

Photovoltaic cells: Flat cells made from various photovoltaic materials such as silicon, copper-indium-gallium-selenide (CIGS) and Cadmium Telluride (CdTe). Multiple photovoltaic cells are manufactured into large arrays to form photovoltaic panels, usually just called solar panels or PVs.

Pitch: Loosely defined as the angle of the blades of a wind or water turbine with respect to the flow of the wind or water.

Plates: The *electrodes* in a battery. Usually take the form of flat metal plates, but may be many shapes, including cylindrical. The plates usually participate in the chemical reaction of a battery, but sometimes just provide a surface for the migration of electrons through the *electrolyte*.

Polycrystalline silicon: *Silicon* used to manufacture *photovoltaic panels* which is made up of multiple crystals clumped together to form a solid mass. Manufactured by casting molten silicon into ingots.

Power: The rate of doing work. Expressed as watts (W). For example, a *generator* rated at 800 watts can provide that amount of power continuously.

PVC (Poly-vinyl chloride): A plastic used as an insulator on electrical cables, as well as for *conduits*. Contains toxic chemicals such as plasticisers. Unplasticised PVC (U-PVC) is less hazardous as it doesn't contain plasticisers such as phthalates which are often considered carcinogenic, but it does still require toxic chlorine compounds to make.

R

Rechargeable battery: A type of *battery* that uses a reversible chemical reaction to produce *electricity*, allowing it to be reused many times. The chemical reaction is reversed by forcing *electricity* through the battery in the opposite direction to normal discharge.

Regulator: A device used to limit the *current* and *voltage* in a renewable energy system, normally to allow the correct charging of *batteries* from power sources such as *solar panels* and *wind generators*. Also refers to a type of electronic component used in electronic circuits to provide regulated voltage to voltage sensitive devices.

RAPS (Remote Area Power Supply): A power generation system used to provide electricity to remote and rural homes, usually generating power from *renewable* sources such as *solar panels* and *wind generators*, as well as non-renewable sources such as petrol-powered generators. A RAPS is a form of *independant power supply system*.

Renewable energy: Energy that is produced from a renewable source, such as sunlight, flows of wind or water, or sustainably grown plants.

Residual Current Device (RCD): See *earth-leakage circuit breaker.*

Resistance: A material's ability to restrict the flow of electrical *current* through itself. Measured in *Ohms*.

Resistor: An electronic component used to restrict the flow of *current* in a circuit. Sometimes used specifically to produce heat, such as in a heating element. Often used with LEDs to control the current through them to a safe level.

Rotor: that part of a *wind turbine* that consists of the *blades* attached to the hub.

S

Savonius rotor: A type of *vertical axis wind turbine* that uses half-drum shaped '*blades*' to catch the wind and turn a shaft. Generally a low speed turbine with high torque, usually used for water pumping but sometimes for *electricity* generation.

Sealed lead-acid battery: A form of *lead-acid battery* where the *electrolyte* is immobilised, by either being contained in an absorbent fibre separator or gell between the batteries *plates*. The battery is sealed so that no electrolyte can escape, and thus can be used in any position, even inverted with some models.

Semi-conductor: A material that only partially conducts *electricity*. Neither an insulator nor a true conductor. *Transistors* and other electronic devices are made from semi-conducting materials and are often called semi-conductors.

Shunt: A low-value *resistance*, connected in *series* with a *conductor*, that allows measurements of *currents* flowing in the conductor by measurement of *voltage* across the shunt. Often used with devices such as *inverters* to allow monitoring of the energy used.

Sine wave: A sinusoidal-shaped electrical waveform. Mains power is a sine wave, as is the power produced by some inverters. The shape of a sinusoidal wave looks like this: ∿. The sine wave is the most ideal form of electricity for running more sensitive appliances, such as radios, TVs, computers and the like.

Solar cell: A single *photovoltaic* device, usually made of *silicon*, that converts light into electricity.

Solar panel: A device used to convert light from the sun directly into *DC electricity* by using the *photovoltaic effect*. Usually made of multiple *solar cells* bonded between glass and a backing material. Also called a *photovoltaic* panel.

Solar power: *Electricity* generated by conversion of sunlight, either directly through the use of *photovoltaic panels*, or indirectly through *solar-thermal* processes.

Solar Thermal: A form of power generation using sunlight to heat water or other fluid that is then used to drive a motor or turbine, or to use the heated water directly, such as in a solar hot water system.

Storage density: The capacity of a battery, in *amp-hours,* compared to its weight or volume. Measured in *watt-hours* per kilogram or *watt-hours* per litre.

Surge: An unexpected flow of excessive *current*, usually caused by excessive *voltage*, that can damage appliances and other electrical equipment.

Surge: An excessive amount of power drawn by an appliance when it is first switched on. Inverters usually have a surge rating, which is the maximum surge current or power they can produce for a short period.

Switchmode: A form of converting one form of electricity to another by rapidly switching it on and off and feeding it through a *transformer* to effect a *voltage* change. Many power supplies are switchmode devices and are typically more efficient, smaller and lighter than older style ferro-magnetic supplies.

T

Tip-speed ratio: The ratio of *blade* tip speed to wind speed for a *wind turbine*.

Transistor: A *semi-conductor* device used to switch or otherwise control the flow of *electricity*.

Transformer: A device consisting of two or more insulated coils of wire wound around a magnetic material such as iron, used to convert one *AC voltage* to another or to electrically isolate individual circuits.

Turbulence: Airflow that varies in speed and direction rapidly and violently that can cause damage to *wind turbines*. Often caused by objects such as trees or buildings.

V

Vertical-axis wind turbine: A *wind turbine* with the axis or main shaft mounted vertically, or perpendicular to the earth's surface. This type of turbine does not have to be turned to face the wind—it always does. Types include Savonius and Darrius.

Voltage: Unit of measurement for the electrical 'pressure' of *electricity*. Measured in volts (V).

Voltage drop: The *voltage* lost along a length of wire or *conductor* due to the *resistance* of that conductor. This also applies to *resistors*. The voltage drop is calculated by using *Ohm's Law*.

Voltmeter: An electrical or electronic device used to measure *voltage*.

W

Water turbine: A device that converts the motion of the flow of water into rotational motion. Often used to drive *generators* or pumps. See *micro-hydro system*.

Waterwheel: A simple water turbine, often consisting of a series of paddles or boards attached to a central wheel or hub, that is connected to a *generator* to produce *electricity* or a pump to move water.

Watt (W): A measurement of power, commonly used to define the rate at which an appliance consumes energy.

Watt-hour (WHr): A measurement of power with respect to time (energy). One watt-hour is equal to one *watt* being used for a period of one hour.

Wind farm: A group of *wind generators* that usually feeds power into the mains grid.

Wind generator: A mechanical device used to produce *electricity* from the wind. Typically a form of *wind turbine* connected to a *generator*. *

Wind turbine: A device that converts the motion of the wind into rotational motion. Often used to drive *generators* or pumps. *

***** Wind generator, wind turbine and windmill are commonly used interchangeably to describe complete wind-powered electricity generating machines.

Y

Yaw: The orientation of a *horizontal-axis wind turbine*.

Z

Zener diode: A *diode* often used for *voltage* regulation or protection of other components.

Q&A

240 volt DC systems

I've been experimenting with 240 volt DC for a while now and found that most things will run on DC with no modification as long as it hasn't got a transformer or an induction motor. As most new equipment now has a switchmode power supply, transformers are fast becoming obsolete, which only leaves the fridge and washing machine. Haier has released an inverter fridge which I'm guessing will run on DC.

Maybe the time has come for a 240 volt DC solar power system and to ditch the inverter and all the losses and problems they cause?

Warrick Smith

240 volt DC systems have existed for many years, I remember going on a school camp over 30 years ago and they had a 240 volt DC system for lighting. I also know of several people who were running 240 volt DC systems, and there was a company in SA that made inverters for use on 240 volt systems that had no transformers, making them very efficient.

There's no way to know if the Haier fridge will run on DC (unless you are an electronics tech or talk to the manufacturer). The main compressor will use a variable inverter system that will probably run from DC but the circulation fans (if it has them, many fridges do) may be AC fans.

But the other thing to remember with DC is that switches, relays and circuit breakers need to be rated to handle DC currents. AC waveforms pass through the zero voltage and zero current flow points 100 times a second, so any arcs caused as a switch or relay opens are quickly extinguished. This isn't the case with DC and arcs can be considerable. For a switch designed to work on AC, the arcing can quickly cause damage and would certainly void the warranty.

Lance Turner

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Home heating needed?

We are in the process of building our new home. The house has a 7.8 star rating on paper (FirstRate) and has extra improvements not registered on the program (like edge of slab insulation) and air-tightness tested by a blower door test.

When does a house not need heating? Eight stars, nine stars, ten? Does it really have to be ten or do people not notice it when it is eight or nine, for example?

Chris Matthews

There is no definite answer to this question. It depends on your personal preferences and what you regard as an acceptable temperature. Owners of some of the best sustainable homes say they never or almost never have to use additional heating. However I suspect they put up with temperatures which are lower than what the average person will.

If sufficient thermal modelling were done on your house I suspect projections could be done for average minimum and maximum temperatures. I don't know FirstRate well enough to know if it can produce this information. Ask the person who has done the rating and make your own guess on the minimum temperature you would be comfortable with.

Mick Harris

A dead solar pergola

A few years back we bought one of those veranda roofs that opens and closes—it was very expensive. We selected a solar battery so as to reduce our electricity carbon emissions.

But imagine our frustration when we called the company to seek a replacement only to be told that while they still sell the unit they no longer replace these solar batteries and could not recommend anyone who did.

Why would anyone be so dumb to even consider buying such a unit now?

Ange Kenos
Melbourne VIC

That's very slack that the company isn't offering backup service, especially if they are still selling solar installed systems, but some companies are just like that, they just want to sell the product, get paid and not have to think about it again.

The battery should be a simple replacement, it will be a standard size and chemistry. I assume it is the actual battery and not something else in the solar system? What the company calls a 'solar battery' will most likely consist of a small solar panel that charges a sealed lead-acid or nicad/NiMH battery in a box. There will also be a small charge controller in there (possibly). It's usually the battery that dies after a few years, but could be another component.

What you need is either someone skilled in electronic work (you need an electronics technician, not an electrician) or a solar installer who is willing to look at the unit.

However, in the scheme of things, something like that doesn't use much energy as they don't operate very often or for very long, so the simplest solution might be powering it from the mains. Being a solar device, the motors are probably 12 volt DC units or similar, so they will need to be driven by a power supply (transformer). I can't give specifics as I have never seen the system, but connecting it to AC is probably the best bet.

Lance Turner

The best car option

I was wondering whether you could provide some advice regarding cars.

After living for several years without a car, I am moving to Western Australia with my family. Much as Perth's public transport system has improved in recent years, it is still a car focused city and we think that we'll have to buy one. The question is, which one?

I was initially attracted to the Prius for obvious reasons. However, we have discounted it for two reasons. Firstly, there is limited space across the back

seat for baby/children's seats. Secondly, we will be doing a lot of country travel and not much inner city driving. The benefits of the hybrid appear to be gained through highly efficient fuel usage and low emissions at low speeds in busy, stop-start, city traffic. Those benefits don't seem to accrue with suburban and country driving. We were also advised that the battery/electronics of the Prius are a not insignificant negative in looking at the total environmental impact.

We next looked at the Peugot 308, which is a diesel with very high levels of fuel efficiency. I was concerned with diesel's particulate emissions but have been advised that these are now very low due to improved technologies. We have also been advised that given the amount of country driving that we are likely to do, the Peugot was likely to provide a better environmental outcome overall than the Prius, also taking into account the battery/electronic issues.

But I then thought about the issues of transporting a European car to Australia and I wondered whether a less efficient car but locally produced car, such as a Holden Astra, which I am told is also quite fuel efficient, might provide a better result.

I also wondered whether a secondhand car might provide a better environmental outcome—reduce, reuse, recycle etc. In short, what factors are most important in attempting to evaluate the environmental impact of a car over its life cycle.

Henry Jackson

For your sort of use I would probably go with the diesel Peugot, they have come a long way in the last few years. They are pretty good with their particulate emissions now, except when under heavy load. Even the latest diesels will blow some smoke when pushed hard, I've seen current model Mercedes and Peugots producing smoke when going up the hills around my area. But overall, it seems they are the best option as far as greenhouse gas emissions are concerned and the fuel companies have been cleaning up their diesel fuels in recent years by reducing the sulphur content.

You're right about the hybrids having the greatest gains in stop-start driving, although even on country cycle driving they are still very good, better than the average petrol vehicle, probably because there are still plenty of times when you have to accellerate, such as passing and hill climbing.

Being that all imported cars come over on ships, the fuel used to transport them would be relatively small compared to what they use in their lifetime. Bear in mind that many Australian' cars are just rebadged imports anyway. I'm not sure about the Astra, but I expect it has a lot of imported components. I seem to recall it had a lot in common with a recent model Opel (the older Astras were rebadged Nissans).

Certainly, a secondhand car is a good option, but really, whether it's you or someone else who buys it, there are only so many secondhand cars to go around, so in real terms it doesn't make much difference. If you buy new, someone else would most likely buy the secondhand car you were going to buy, and vice versa.

Anyway, that's my thoughts on the subject, but the automobile chamber of commerce or similar organisations may have more information.

Lance Turner

A whirlybird generator?

I have been curious to find out if there are any kind of generators that could be connected to a "whirly bird" on my roof. The thing keeps turning all year round so it would be perfect for creating low current/voltage charge for batteries, or maybe geared effectively to get more power from it. Any suggestions on who may supply this kind of equipment or know of anyone doing a similar thing?

Peter Sharpe
Tamworth NSW

Unfortunately a whirly bird type ventillaor turns because it has no load on it. Any sort of load, such as a generator, would stall it. The actual swept area of the rotor is quite small and they collect very little energy. You might be able to get 100 or so milliwatts out of it sometimes but it wouldn't be much more than that and that amount of power is of little use really.

Gearing doesn't increase the amount of energy available, in fact it will reduce it. Gearing only serves to match the speed of a rotor to the required speed of a generator, it can't increase the power available (you can't make power from nothing).

ATA has been looking at the viability of wind turbines in urban areas and they simply are not realistic in most cases, so you are much better off looking at a solar array. You will get a much greater amount of energy produced for the money spent, especially now that panel prices are falling and are set to fall quite a bit more in the next year or so. See the solar panel buyers guide in this issue for more information and panel pricing.

Lance Turner

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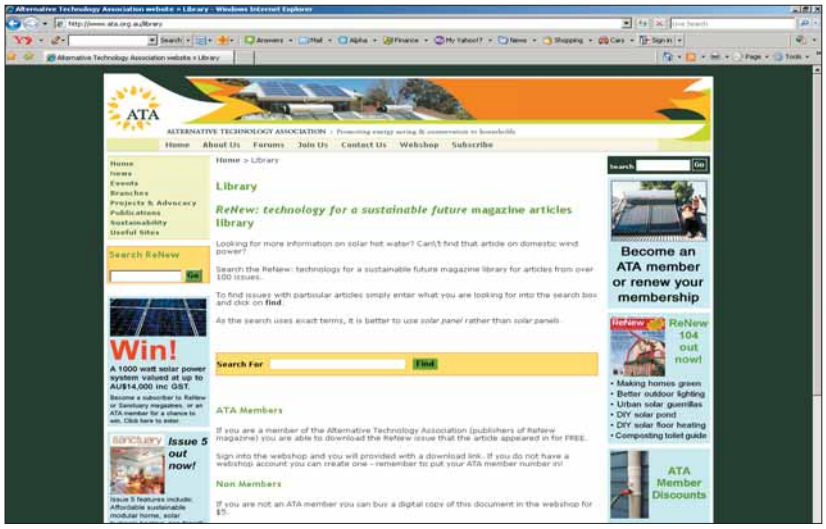

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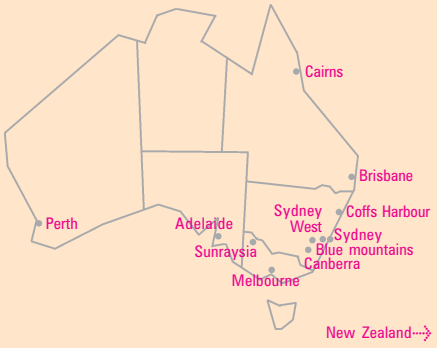

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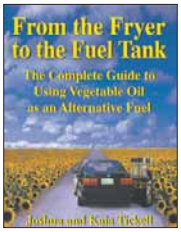
Musician Xavier Rudd's symphony in straw bale, Houses with advanced solar hydronic heating systems, Green bathroom renovations, Beautiful rammed earth homes, plus eight stunning sustainable homes from across Australia.

Issue 6

Cool treatments for a hot house, chemical-free pools, 10 tips for sustainable design, solar air-conditioning, taming the sun, plus beautiful sustainable homes from across Australia.



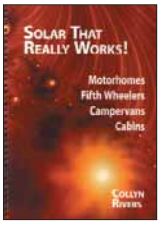
From the Fryer to the Fuel Tank

Author: Joshua Tickell

Price: $34.95 plus $8 postage

Paperback, 160pp

A great book that shows the reader how to make a clean-burning renewable fuel from waste vegetable oil. Includes detailed instructions on making and using the fuel in a standard diesel vehicle. *Item code: FFTFT*



Solar That Really Works!

Price: $42.50 plus $8 postage, 82pp

Whether for motor homes, fifth wheelers, caravans or cabins, solar energy is silent, clean and increasingly affordable. This book is a down-to-earth guide to getting it right the first time.

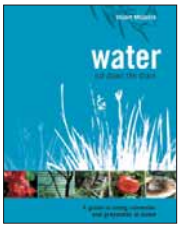
Item code: STRW

Water Not Down the Drain: A guide to using rainwater and greywater at home

Author: Stuart McQuire

Price: $29.95 plus $8 postage

A comprehensive guide to sustainable water use around the home. Consult this book before you install rainwater tanks or a greywater system, or even if you just want to reduce your daily water use. *Item code: WNDD*

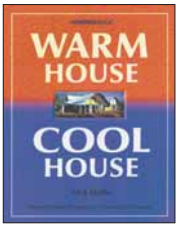


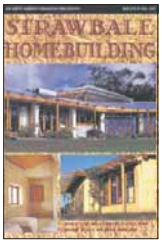
Warm House, Cool House

Author: Nick Hollo

Price: $33.00 plus $8 postage, Paperback, 172pp

An easy-to-read introduction to the principles of energy-efficient housing design. Covers a broad range of topics and contains an abundance of drawings, plans and photographs. *Item code: WHCH*



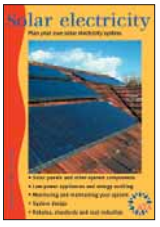


Strawbale Homebuilding

Price: $19.95 plus $8 postage, Paperback, 156 pp

This book details practical strawbale building practices you can use to build anything from a small cabin in the bush to a mansion in the city. A great book that details many homes that have been built around Australia.

Item Code: SBH



ATA Booklets series: Solar Electricity

Price: $10 each plus $2.50 postage

Covers all the basics you need to know when designing a solar power system. Includes panel types, batteries, controllers, inverters and many other aspects of solar energy systems.

ATA Booklets series: Solar Hot Water

Price: $10 each plus $2.50 postage

Solar hot water is possibly the best way to get started with renewable energy. This booklet outlines all of the different system types and which one will best suit your needs.

ATA Booklets series: Wind Power

Price: $10 each plus $2.50 postage

In this booklet you will find all the information you need to get an understanding of wind-powered electrical and water pumping systems, how to size and install them correctly, how to look after them, safety requirements and a great deal of other information.

Your Home Technical Manual

Price: $49.50 (sorry, no member discount on this item) plus $8 postage

Gives you the information you need to design and build a more comfortable home that is less expensive to run while being more environmentally friendly.

Contains over 60 fact sheets on sustainable solutions for designing and building your home. *Item code: YHTM*

Renewables on CD ROM

ReNewROM

Price: $65 plus $2.50 postage

The second CD ROM of the series, covering issues 41 to 70 of *Soft Technology* and *ReNew* back issues, many of which are no longer available. This disk is fully searchable with 30 complete magazine issues in PDF format, so it can be used on PCs, Macs and Linux boxes. *Item code: RENEWROM*

ReNewROM II

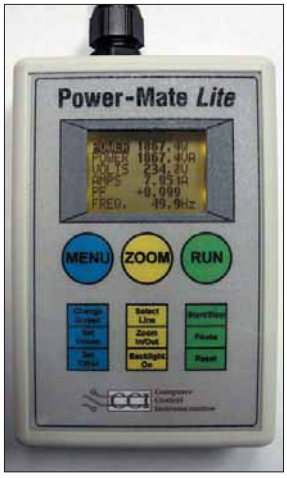
Price: $65 plus $2.50 postage

The third CD ROM in the series, and covers issues 71 to 89 of *ReNew* back issues, many of which are no longer available. This disk is fully searchable with 19 complete magazine issues in PDF format, so it can be used on PCs, Macs and Linux boxes. *Item code: RENEWROM2*

ReNewROM III

Price: $45 plus $2.50 postage. The fourth CD ROM in the series, and covers issues 90 to 99 of *ReNew* back issues, many of which are no longer available. This disk is fully searchable with 10 complete magazine issues in PDF format, so it can be used on PCs, Macs and Linux boxes. *Item code: RENEWROM3*

Kits, LEDs and energy-efficient devices



Power-Mate Lite energy meter

Price: $119.95

This new meter features a new multi line backlit LCD display, intuitive three-button operation, simplified menus and non-volatile memory, so the meter resumes after a power interruption without loss of data. As well as instantaneous power it displays energy used and the cost per hour, quarter and year, greenhouse gas production and some more technical figures such as power-factor, frequency and VA (volt-amperes). The meter also has preset measurement period timer choices of 1, 8, 12, and 24 hours and 2, 5, 7, 14, and 28 days. Even better, unwanted display screens can be suppressed from view.

Item code: POWERMATE-LITE

Non-contact thermometer

Price: $102.50

This non-contact infrared thermometer can measure from -50 to 650 deg C, making it ideal for measuring the surface temperature of your solar panels or checking for thermal leaks in your home.

The unit features dual laser targeting to help get an accurate temperature reading and backlight so the temperature can be read in low light conditions. The thermometer also has adjustable emissivity from 0.10 to 1.00 so the unit can be adjusted to more accurately measure the temperature of the surface.

It is supplied with a holster and battery. See our webshop for specifications. *Item code: THERMO_INFRARED_ED72*

Digital lux meter

Price: $51.65

A handy digital light meter which will measure light in three ranges, from 0.1 to 50,000 lux. The photo detector is wired on a curly cord, allowing the user to take light measurements at the optimum position. A sensor cover is included.

This meter is ideal for measuring light levels when replacing incandescant lamps with more energy-efficient alternatives, or for checking light levels on solar panels etc.

Item code: METER_LUX_50K

LED Replacement Bulb: cool white and warm white

Price: $33.50

This LED lamp has been designed as a direct drop-in replacement for MR16 halogen lamps. Its 5W power rating ensures a high level of brightness that is the equivalent to a 20W halogen MR16 lamp. Also, unlike the halogen equivalent that generates high levels of heat, these LED type MR16 lamps generate very little heat and are therefore safer. The body is made of aluminium for good heat dissipation, to keep the LEDs running as cool as possible.

Power consumption is around 5 watts at 12 volts, either AC or DC, so can be plugged straight into most halogen sockets without changing the transformer.

Typical applications include kitchen/bathroom lighting, entertainment lighting, architectural lighting, landscape lighting, bollards, security and garden lighting, and interior commercial lighting.

Note: some electronic transformers may cause flickering due to this lamp drawing insufficient power to load the transformer adequately.

Available in cool, neutral and warm white, in 38 and 60 degree beam angles. *Item code: LEDHAL_5WMR16_XXYYCLR where XX is CW (cool white), NW (neutral white) or WW (warm white) and YY is the beam angle (38 or 60)*

Power-Mate energy meter

Price: 10 amp version is $295; 10 amp heavy duty version is $345 and the 15 amp version is $405

If you are looking for a professional and robust device for energy auditing or use on the workshop floor, then the Power-mate is the meter to use!

It consists of a hand-held meter which can be connected to the appliance it is measuring via a simple piggyback plug and socket set. The meter features an LED display for easy reading and high visibility at all times.

The meter can tell you a variety of measurements including: power in watts, voltage and current, with minimum, maximum and instantaneous readings. The meter can also tell you the cost of running the appliance, how much energy the appliance used in kilowatt-hours and how many kilograms of greenhouse gas emissions it produced, all in hourly, yearly, quarterly and accumulated figures. There are three versions available: the 10 amp, the 10 amp heavy duty, and the 15 amp unit (which has 15 amp plugs with the large earth pin). *Item code: POWERMATE-10A/10AHD/15A*

We also have a Power-Mate for hire (for ATA members only) for $30 a week including express post to you.

Low-cost energy meter

Price: $69.95

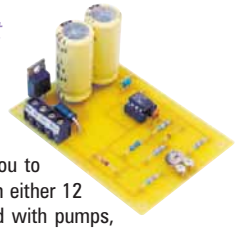
Our new Power Usage Meter is an Australian-approved version of the Killawatt EZ, a very popular meter in the US. The meter will display total kilowatt-hours, voltage, watts, current, frequency, volt-amps, power factor, elapsed time, utility rate (energy cost per kilowatt-hour) and accumulated energy cost. It will also project costs, in dollars and cents, for an hour, day, week, month or year. The unit has memory backup so you can move it from place to place without losing the settings and recorded information.

Rated accuracy is ±2%. **However, this meter is not very accurate below 10 watts due to the resolution of the internal circuitry.**

Item code: POWERUSAGEMETER

ATA members now receive a flat 15% discount on ATA products, except for booklets and where noted. Ask for your discount when you order! Postage is a flat rate of $8, regardless of the number of items, or $2.50 for booklets/magazines/CD ROMs.

6 amp maximiser kit



Price: $45

Our popular mini-maximiser kit will handle pumps up to 6 amps. The kit allows you to build the unit for use on either 12 or 24 volts. When used with pumps, the maximiser can provide up to 40% more pumping per day.

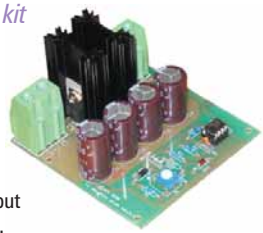
Note: not suitable for battery charging use!

Item code: MAXIMISER_6AMP_KIT

Giant LED Sale!

We are having a sale of all our Luxeon and superflux LEDs. To grab a LED bargain, see our webshop at http://shop.ata.org.au. Note that LEDs are available as webshop purchases only!

12 amp maximiser kit



Price: $70

This device allows you to drive pumps and other motor-driven devices directly from a solar panel or panels, without the need for batteries.

When used with pumps, the 12 amp maximiser can provide up to 40% more pumping per day.

Note: This kit is not designed for use as a battery charger, and must only be used with solar panels and motors/pumps.

Maximum current: 12 amps.

Item code: MAXIMISER_12AMP_KIT

Dynamo multiband radio

Price: $59.95

Housed in a sturdy rubber and plastic casing, this radio is great for any outdoor activity that requires a heavy duty radio which will withstand a lot of punishment. Features include FM, MW, LW and SW bands and an alarm. It can be self-powered by dynamo operation or two AA batteries.

Item code: RADIO_DYNAMO_SW

Simple 1 amp rectifier kit

Price $6

This very simple kit allows you to build a rectifier for use with polarised LED halogen lamps or for polarity protection of electronic equipment. Uses four Schottky diodes to reduce voltage drop and includes a 1 amp fuse.

Item code: SIMRECTKIT_1A

30 amp speed controller kit

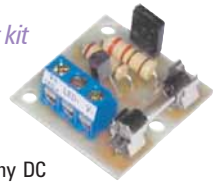
Price: $49.95

This controller allows you to vary the speed of 12 or 24 volt DC motors from 0 to 100%. It is also ideal for controlling loads such as incandescent/halogen lamps and heating elements. It is ideal for use on small electric vehicle projects, such as electrically assisted bikes and go-carts.

We have tested it to over 30 amps without problems.

Item code: SPEEDCONKIT

Constant current circuit kit



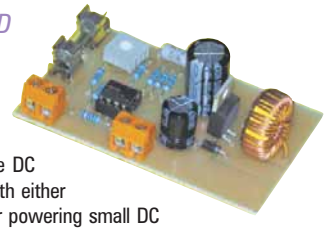
Price: $9

This short form kit allows you to build a simple constant current circuit for driving LEDs from almost any DC voltage. It is available in four sizes, 20mA, 50mA (for the Superflux LEDs), 300mA (for the 1 watt Luxeon LEDs) and 650mA (for the 5 watt Luxeon LEDs).

Please specify which current rating you need when ordering.

Item code: SIMCCKIT_XXX where XXX is the current rating in mA (020, 050, 300 or 650)

Switchmode LED driver kit



Price: $30

This kit allows you to build a simple switchmode DC to DC converter with either voltage limiting (for powering small DC appliances from up to 30 volts DC) or current limiting (for driving LEDs directly from up to 30 volts DC). The voltage or current is fully adjustable, allowing the one design to be used for a huge number of appliances or LED types, including the 1 watt and 5 watt Luxeon LEDs. Efficiency is typically over 70% on most input voltages.

Kit includes circuit board, all components and instructions. No case is provided.

Item code: SWITCHMODEKIT

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Too good to throw out

From crate to carroter

Tim Nelson built a planter box out of a discarded pallet.

WE HAVE many pots on our rooftop patio but none are wide enough or deep enough to produce edibles other than herbs and the odd tomato. One thing that does abound in our neighbourhood is discarded materials from the local market. A broken, splintered crate destined for landfill inspired me one Sunday afternoon and I quickly set about creating a planter box in time for the spring planting.

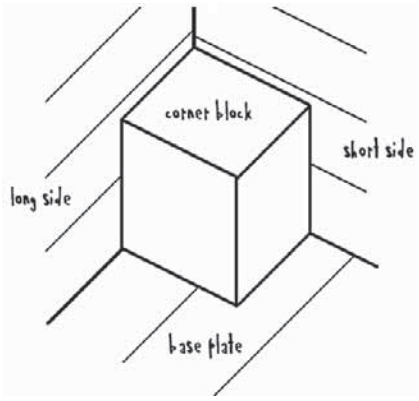
First the pallet needs to be deconstructed. A trusty hammer and jemmy bar are all you need but try to keep the slats in as good a condition as possible. An easy way to decide the size of the planter box is to leave the length of the box as the original length of the pallet, making its width half the original length. The reason for this is it makes measuring and cutting simple, as you are only ever halving the length of the slats. Constructing the side plates was simply a matter of nailing (or screwing) the long horizontal slats onto three vertical supports for the long sides and two supports on the short sides.

Construction of the base is exactly the same but you need to make the base plate roughly 40mm (four times the slat thickness) wider than the short sides. The reason for this is that when the sides and base come together, the vertical sides need to sit on the base for support, rather than being suspended next to it. If the short sides and base plate are the same width then this will not be possible.

Use four of the cube-like blocks that previously separated the pallet's top and bottom (there should be nine of these) as corner blocks to which the base plate and then the side plates can be successively attached (see illustration). For these joints I used 80mm galvanised wood screws.

Once the base and sides are hanging together use some galvanised right angle brackets closer to the top of the planter box for added strength. Basically I continued to reinforce it until it was rigid enough not to wobble.

With the box constructed, about eighty 10mm holes were drilled through the base plate for drainage. After this the entire interior of the box was given two coats of non-toxic, bitumised, waterproofing agent in an attempt to minimise water absorption into the timber. Black pond plastic was also used to provide an extra barrier between the moist soil and soft timber but remember to punch some holes along the bottom for drainage! Any left over blocks of wood from the corners of the crate made perfect stands under each corner to ensure air flow and adequate drainage.



Now our planter box was ready for soil. It was really important, however, to consider the water efficiency of our planter box. Our rooftop bears the full brunt of all weather, making summer a particularly challenging time for our plants. We decided to install some very basic subsurface irrigation to help reduce evaporation and encourage root growth, thereby increasing our veggies' chance of survival.

The subsurface system basically comprises two sets of piping with holes drilled in every 10 or so centimetres. The piping is laid about 10 centimetres down into the soil and a right-angle join allows the tops to poke out above the soil level. We can then bucket our greywater directly into the piping and let it slow release from there. The greywater going subsurface into our veggie box is cold water collected before the shower becomes hot, so it doesn't carry nasty contaminants that are normally not recommended for use on veggies. Two little caps help prevent evaporation from the pipes' openings as well as reducing pipe colonisation by moisture-loving creatures.

With some chicken manure, homemade worm castings, organic soil and plenty of mulch, our planter box is beginning to take off. While some of the more long-term veggies will take a bit longer to establish, we are already finding it hard to keep up with the amount of lettuce we are producing. *

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